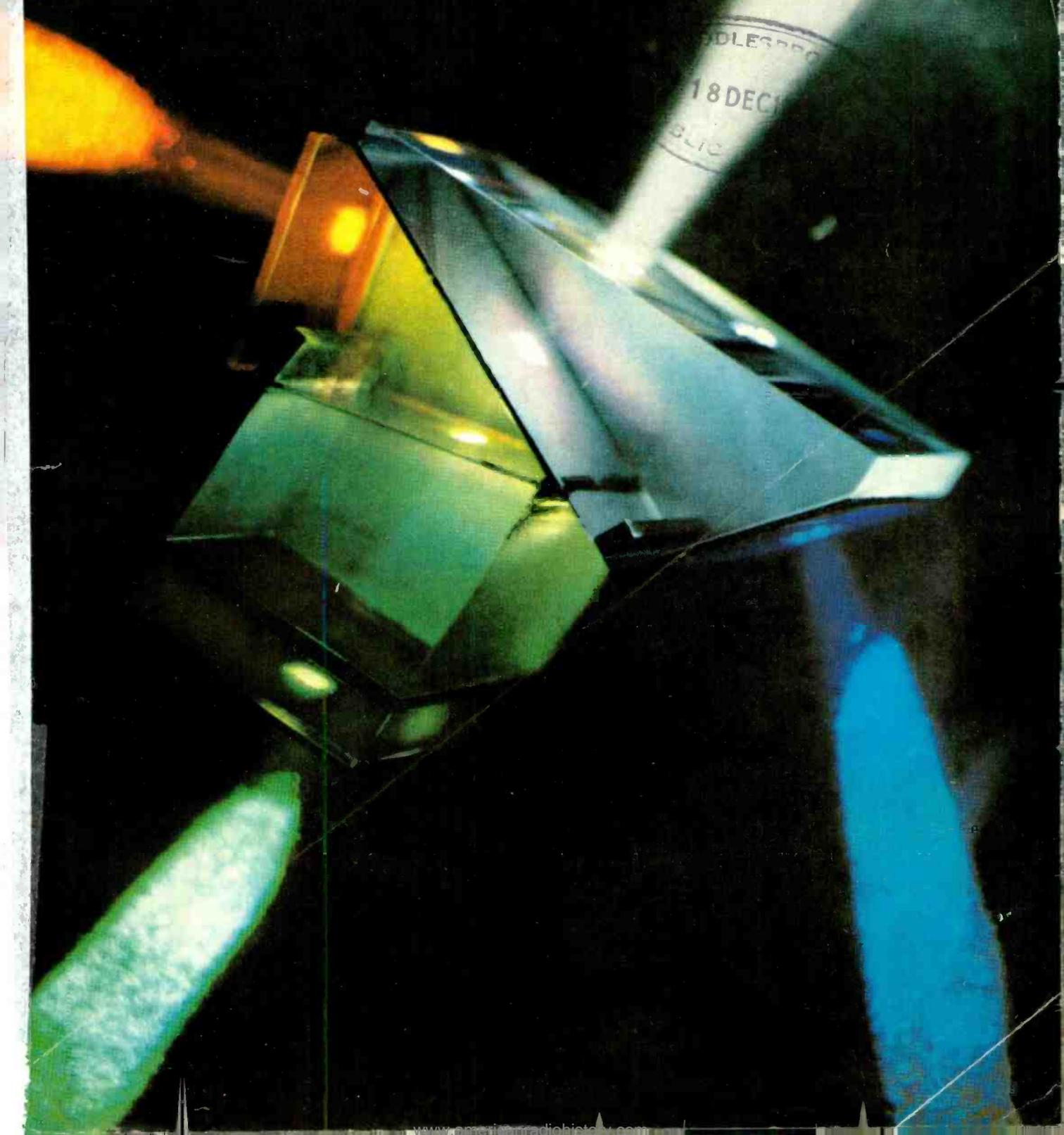


COLOUR TELEVISION IN THE U.K.

JANUARY 1968
Three Shillings

Wireless World

ELECTRONICS • TELEVISION • RADIO • AUDIO



RELAYS

ex stock in 7 days

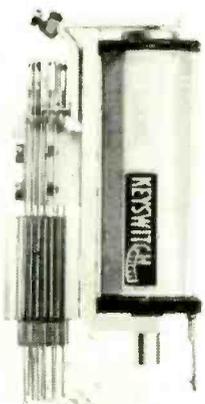
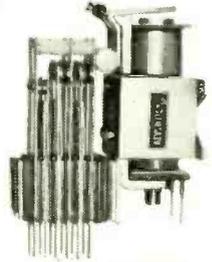
*C.S.A. APPROVED IN CANADA AND GREAT BRITAIN

| | | | |
|--|--|--|---|
| <p>*MK</p>  <ul style="list-style-type: none"> ★ 3 pole 7.5 amp ★ 5 million ops. min. ★ 12/4 each per 1000 Single pole 9/7 each per 1000 | <p>*MM Contactor</p>  <ul style="list-style-type: none"> ★ 2 pole 15 amps ★ .5 million operations minimum ★ 17/8 each per 1000 | <p>MHP Plug-in relay</p>  <ul style="list-style-type: none"> ★ 4 pole, 1 amp ★ 100 million operations ★ 13/- each per 1000 SOLDER TERMS <p>2 pole 8/- each per 1000</p> | <p>1051</p>  <ul style="list-style-type: none"> ★ Snap action microswitch relay ★ 7.5 amp, 1 million operations Also available in plug-in version ★ 7/5 each per 1000 |
| <ul style="list-style-type: none"> ★ 2 pole 5 amp ★ 5 million ops. min. ★ 14/8 each per 1000 | <p>*MKP Plug-in relay</p>  | <p>*MK103</p> <ul style="list-style-type: none"> ★ Single pole 3 amp ★ 1 million operations minimum ★ 5/11 each per 1000  | <p>MK403P NEW Plug-in relay</p>  <ul style="list-style-type: none"> ★ 4 pole 3 amp ★ 5 million operations minimum ★ 29/- each per 1000 SOLDER TERMS ★ 21/9 each per 1000 |

RELAYS

made to measure

APPROVALS: C.E.G.B. No. 131 & 92 · B.R. POST OFFICE KRL · U.K.A.E.A.

| | | | | |
|--|---|--|---|--|
| <p>P.O. 3000 RELAY</p> <ul style="list-style-type: none"> ★ Manufactured to full G.P.O. specification, also to Industrial Standards ★ Contacts up to 30 amp  | <p>P33 PLUG-IN RELAY</p>  <ul style="list-style-type: none"> ★ Plug-in version to BPO 3000 relay, made to measure for Industrial Applications ★ Contact ratings up to 10A/750V ★ Positive-lock retaining clip ★ 30 million operations minimum | <p>P.O. 600 RELAY</p> <ul style="list-style-type: none"> ★ Compact version of BPO 3000 relay ★ Contacts up to 10A ★ Sensitivities down to 30mW ★ Up to 18 contact springs  | <p>COMPONENT BOARD P304</p>  <ul style="list-style-type: none"> ★ Plug-in component board unit for low cost, easy chassis fabrication ★ 15/- each per 500 FROM STOCK | <p>CONTACTOR K700 RELAY</p> <ul style="list-style-type: none"> ★ High-current/high-voltage 3000-type relay ★ Contact up to 30A240V a.c. ★ Sensitivities down to 45mW ★ PTFE armature bar/lifting rods  |
|--|---|--|---|--|

KEYSWITCH RELAYS

KEYSWITCH RELAYS LIMITED

120/132 Cricklewood Lane · London · NW2 · Tel: 01-452 3344
Telex: 262754

WW-001 FOR FURTHER DETAILS

Wireless World

ELECTRONICS, TELEVISION, RADIO, AUDIO

JANUARY 1968

- 619 A Genuine Reject ?
620 Radio Signals from the Heart of Matter *by D. A. Tong*
625 R.F. Measurements and Standards
626 B.B.C. Colour Service
628 The PAL Colour TV System *by S. C. Ryder-Smith*
634 Emitter-coupled, Emitter-timed Multivibrators *by G. B. Clayton*
641 Semiconductor Type Numbering *by T. D. Towers*
645 The Design of a Class D Circuit *by K. C. Johnson*
651 Sub-surface Propagation

SHORT ITEMS

- 624 A Logical Bassoon
638 P.O. Receiving Station Refurbished
638 Changes in Maritime Radio Regulations
644 Units and their Abbreviations
655 Letter from America

REGULAR FEATURES

- | | |
|--------------------------------------|---|
| 619 Editorial Comment | 654 Books Received |
| 638 World of Wireless | 654 H.F. Predictions |
| 640 Personalities | 656 World of Amateur Radio |
| 650 Letters to the Editor | 657 January Meetings |
| 652 News from Industry | 658 New Products |
| 653 1968 Conferences and Exhibitions | 664 Real and Imaginary <i>by "Vector"</i> |

PUBLISHED MONTHLY (3rd Monday of preceding month). Telephone: 01-928 3333 (70 lines). Telegrams/Telex: Wlworld Iliffeprs 25137 London. Cables: "Ethaworld, London, S.E.1." Annual Subscriptions: Home; £2 6s 0d. Overseas; £2 15s 0d. Canada and U.S.A.; \$8.00. Second-Class mail privileges authorised at New York N.Y. BRANCH OFFICES: BIRMINGHAM: 401, Lynton House, Walsall Road, 22b. Telephone: Birchfields 4838. BRISTOL: 11 Marsh Street, 1. Telephone: Bristol 21491/2. COVENTRY: 8-10, Corporation Street. Telephone: Coventry 25210. GLASGOW: 123, Hope Street, C.2. Telephone: Central 1265-6. MANCHESTER: 260, Deansgate, 3. Telephone: Blackfriars 4412. NEW YORK OFFICE U.S.A.: 300 East 42nd Street, New York 10017. Telephone: 867-3900

Editor-in-chief:
W. T. COCKING, F.I.E.E.

Editor:
H. W. BARNARD

Technical Editor:
T. E. IVALL

Editorial:
B. S. CRANK
F. MILLS

Drawing Office:
H. J. COOKE

Production:
D. R. BRAY

Advertisements:
G. BENTON ROWELL
(Manager)
J. R. EYTON-JONES

Iliffe Technical Publications Ltd.,
Managing Director: Kenneth Tett
Editorial Director: George H.
Mansell
Dorset House, Stamford Street,
London, S.E.1

Subscribers are requested to
notify a change of address four
weeks in advance and to return
wrapper bearing previous ad-
dress

© Iliffe Technical Publications
Ltd., 1968. Permission in writing
from the Editor must first be
obtained before letterpress or
illustrations are reproduced from
this journal. Brief extracts or
comments are allowed provided
acknowledgement to the journal
is given.

VOLUME 73 No. 13
PRICE: 3s.

FIFTY-SEVENTH YEAR
OF PUBLICATION

Wireless World

ELECTRONICS, TELEVISION, RADIO, AUDIO

A Genuine Reject?

WHILE the article by T. D. Towers in this issue on transistor type numbers should assist readers in identifying a particular device and tracking down the manufacturers, one is tempted to ask how much faith can be placed in a type number? Large users of semiconductors buy direct from the manufacturers and can have every confidence in the devices they receive. The situation is rather different, however, for the home constructor who requires only a couple of AC107s. It has become apparent that unscrupulous dealers are stamping reject transistors with well-known type numbers and selling them as genuine items. Type numbers have also been altered when a particular device is in short supply; an example of this would be to remove the D from OC81D. Restamped devices often do not resemble the transistors they replace, electrically or mechanically or both. It is a well-known fact that many transistors will operate, to the detriment of the circuit, under conditions for which they were not intended, thereby facilitating the deception. The deceit is not limited to individual sales of semiconductors; complete equipments and sometimes kits are being marketed that use reject semiconductors, although no mention is made of this in the literature.

The home constructor would blame his own workmanship, lack of knowledge or the circuit he was making when it failed to operate satisfactorily rather than suspect that the semiconductors were not what they claimed to be. We do not deprecate the use of reject transistors; we only object when they masquerade as "on spec" devices.

How can the home constructor recognize these devices? The deception is not easily detected although the print used on restamped devices is usually large and untidy or the new markings are sometimes placed on a plastic sleeve slipped over the transistor. Genuine transistors nearly always carry the manufacturer's name or emblem and usually also a batch number—re-marks have neither of these. Another point to watch for is the case and lead-out configuration; sometimes the re-marks are not even in the correct encapsulation. Because the range using the old European coding "OC" is probably the most common and best known as far as the home constructor is concerned it is these devices that appear to be most often misrepresented.

Our advice is, deal only with a reputable supplier, return any devices that are not what they are claimed to be and beware of the isolated term "guaranteed." Guaranteed for what?

By Numbers

ANOTHER aspect of numbering is raised by a correspondent whose letter is published in this issue. He pleads for a common identification or part-numbering system for components. Instead of each user of a component giving his own part-number to it—depending upon the particular piece of equipment in which it is to be used—there should be, the writer suggests, a British Standard part number that all could use. If this were done it would certainly simplify the specification of components but it would, of course, mean that every variant of the physical and electrical specification of a particular resistor, capacitor, or what have you, would have to bear a different number. Only those most closely concerned with the supply of components will fully appreciate the difficulties experienced in the present jungle, but is the correspondent's suggestion practicable? Perhaps the introduction of i.c.s provides a golden opportunity for starting such a scheme.

VOL 73 NO 13

JANUARY

1968

WIRELESS WORLD, JANUARY 1968

619

Radio Signals from the Heart of Matter

An old circuit—the superregenerative receiver—put to a new use in analysis of materials by nuclear quadrupole resonance spectrometry

By D. A. TONG, B.Sc., Ph.D.

Only too often research into atomic scale phenomena involves large and costly electronic apparatus. Presented here is a technique that can provide useful information about the actual electron distribution within a molecule but which only costs a few pounds to set up. The article should provide enough information to enable the interested electronics experimenter or student to experience for himself the thrill of picking up radio signals from the very heart of matter, the atomic nucleus.

THE superregenerative receiver¹ was widely used by radio amateurs in the early days of v.h.f. because it combines very high sensitivity with great simplicity. Later on as v.h.f. techniques advanced, its disadvantages, i.e., poor selectivity, poor frequency stability and radiation of interference, resulted in its virtual elimination as a serious rival to the superheterodyne receiver for communications work. Since the early 1950s, however, the superregenerative detector has embarked on a new career in a totally different field, that of the branch of nuclear magnetic resonance (n.m.r.) spectrometry known as nuclear quadrupole resonance (n.q.r.)² spectrometry. Later in this article we will describe simple circuitry with which it is possible to detect n.q.r. in suitable solids, but first it will be useful to discuss briefly the physical basis of the phenomenon itself.

THEORY OF N.Q.R.

A spinning atomic nucleus has a magnetic moment which is colinear with the axis of spin, and therefore can be regard-



Dr. David Tong, who is 26, graduated in chemistry at Leeds University and received his Ph.D. for research into chemical applications of N.Q.R. He has been a research fellow at the University of Warwick and has recently joined the staff in the Department of Chemistry, University of Glasgow. Dr. Tong has developed an improved superregenerative N.Q.R. spectrometer which is to be produced by Decca Radar Ltd. to which he is a consultant.

ed as a minute spinning bar magnet. Because of its sub-microscopic size, however, the motion of such a magnet in a magnetic field can only be described adequately by means of quantum mechanics, and, in fact, differs somewhat from that of a spinning magnet of ordinary size.

When an ordinary bar magnet is placed in a magnetic field, it tends to take up a position of minimum potential energy; that is, with its magnetic moment aligned along the field direction as shown in Fig. 1(a). Any small displacement from this position makes the magnet oscillate as shown in (b), until its potential energy has been dissipated by friction, when it again comes to rest. If, instead of being stationary, the magnet is continually spinning about an axis coincident with its magnetic moment (c), it still tends to align along the field (shown by H_0), except that any displacement now results in a precession about the field direction (d), instead of a vibration. The behaviour is entirely analogous to that of a spinning gyroscope in the earth's gravitational field, and the angular frequency of the precession is proportional to both the magnetic moment, M , and the applied field strength, H_0 . Fig. 1 (e) is a vector diagram representation of the precession.

When, on the other hand, one considers the motion of a spinning magnet of nuclear dimensions in a magnetic field, one finds that, unlike the classical magnet, it can never align itself completely along the field, to do so would be to violate the Heisenberg Uncertainty Principle. In fact, the angle that the spin axis makes with the field is restricted to one of a limited number of "allowed" values and the spin axis therefore precesses continually about the field direction.

In practice one is not concerned with the nucleus of a single atom but usually with specimens containing extremely large numbers of atoms. Under such conditions the individual nuclear magnetic moment of one atom cannot be observed and one can only detect the resultant of all the microscopic moments. Not surprisingly, perhaps, this resultant, or "macroscopic", magnetic moment behaves in many ways as if it belonged to a spinning bar magnet as shown in Fig. 1. In particular, it tends to align itself completely along the direction of an applied magnetic field. Then, if the spin-system is suddenly disturbed by suitably applying energy to the sample, the macroscopic moment temporarily begins to precess around the field direction at some particular angle and at a frequency, the "Larmor" frequency, which depends on the nuclear magnetic moment and the applied field strength.

The method usually adopted for transferring energy to the sample is to introduce a second magnetic field at right-angles to the first, but one which is oscillating at a radio

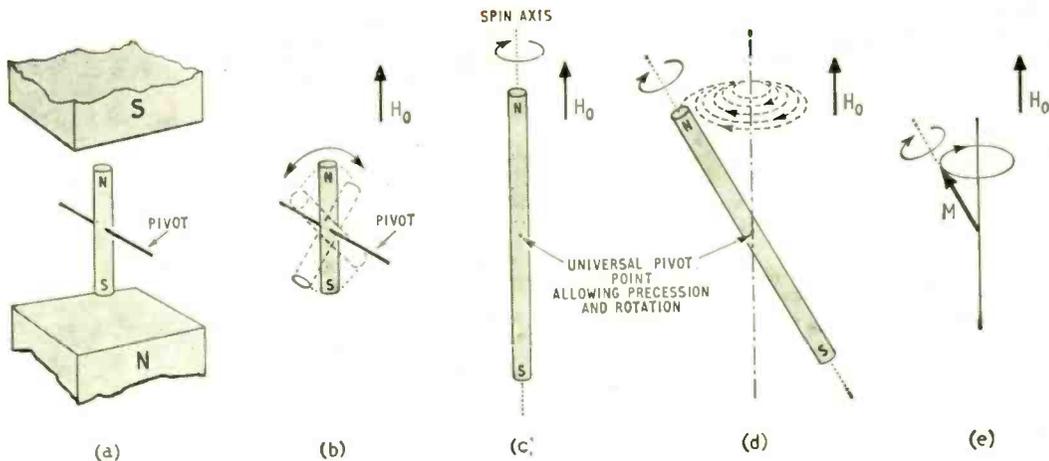


Fig. 1. (a) Equilibrium position of a bar magnet in a uniform magnetic field. (b) shows the oscillations of the bar magnet about the equilibrium position resulting from a small displacement therefrom. Assuming the bar magnet is spinning about its long axis, (c) shows it in its equilibrium position in the uniform magnetic field. (d) shows the precession about H_0 which results from displacing the spinning magnet from its equilibrium position. In a real system the precession dies away as shown as the potential energy of the displaced magnet is dissipated. Finally (e) shows in vector form the precessing magnet in the absence of frictional forces; M represents the magnetic moment of the magnet.

frequency. Such a field is equivalent to two separate fields rotating in opposite directions, and if the rotation frequency is much different from the Larmor frequency, neither has any appreciable effect on the spin system. In contrast, when the two frequencies are identical the effect is considerable, because, no matter how the macroscopic moment precesses, the resultant of the steady field, H_0 , and the component of the oscillating field which rotates in the same direction as the precession, H_1 , will always act so as to pull it away from the H_0 direction. The system is then said to be in resonance, and energy is absorbed from the rotating field. This effect is shown in Fig. 2. In the case of the hydrogen nucleus, for example, the Larmor frequency is 42.577 MHz in a field of 1.0 tesla (10,000 gauss), and is therefore well within the radio-frequency range. All other nuclei have lower frequencies than this.

So far we have only discussed the phenomenon of n.m.r., but it is now only a small step to extend the discussion to explain n.q.r. (Fig. 3). Atomic nuclei with the property of spin fall into two groups according to whether the distribution of their positive charge is spherical or non-spherical. Nuclei in the latter category, in addition to having a magnetic moment also possess an electric quadrupole moment. Such a moment is equivalent to two electric dipoles placed back-to-back, and if a quadrupolar nucleus is present in a non-uniform electric field, it experiences a torque and will tend to align itself with its quadrupole moment (which is co-linear with the axis of spin and the magnetic moment) along the direction of maximum electric field gradient (e.f.g.). Moreover, as the nucleus is spinning, precession at certain "allowed" angles will again occur, but in this case it will be about the e.f.g. direction.

Notice, however, that such precession still involves a precessing magnetic moment and the resultant of a large number of such moments can still couple with a rotating magnetic field. In short, in n.q.r. the interaction energy, and hence the resonance frequency, is determined by an electrostatic field gradient acting on the nuclear quadrupole moment, whereas in n.m.r. the important interaction is that of the nuclear magnetic moment with an external magnetic field. Both effects can be detected by interaction between the macroscopic magnetic moment and a rotating magnetic field.

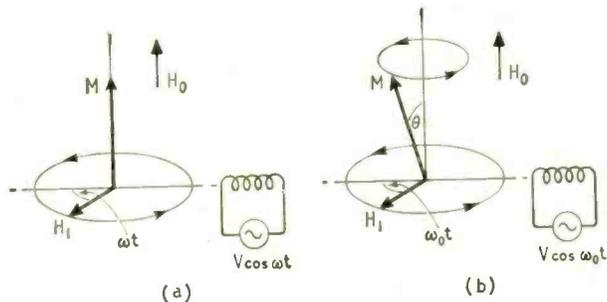


Fig. 2. Interaction of the macroscopic nuclear magnetic moment M with a steady magnetic field H_0 and a rotating magnetic field H_1 . (a) When the frequency of rotation ω is different from the Larmor frequency ω_0 , M remains aligned along H_0 and is unaffected by H_1 . (b) When H_1 rotates at ω_0 , M experiences a force which pulls it away from the H_0 direction, about which it precesses.

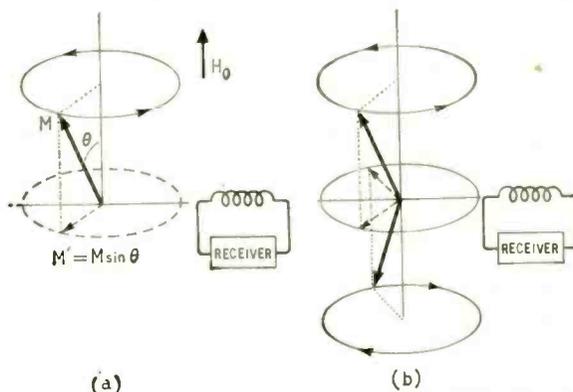


Fig. 3. (a) In the case of n.m.r., the component M' of M rotating in a plane perpendicular to the steady field direction induces an alternating voltage in the sample coil. (b) The case of n.q.r. in powdered samples is similar, except that H_0 is not present and M , which is now the resultant of a large number of macroscopic moments each precessing about a different direction, is accompanied by an equal and opposite moment rotating in the opposite direction.

The main difference between the two techniques in practice is that a large external magnetic field must be applied to the sample to detect n.m.r., and by varying the field strength the resonance frequency can be brought into a suitable range. The e.f.g. necessary for n.q.r., on the other hand, is already present in most crystalline solids and the resonance frequencies are fixed. The e.f.g. arises from the detailed electron distribution within chemical bonds, and since the n.q.r. frequency depends directly on the e.f.g. important information about these distributions can be obtained. Typical n.q.r. frequencies range from as low as 5 MHz right up to several thousand, depending on the properties of the particular nucleus and the type of compound.

THE SUPERREGENERATIVE DETECTOR

Having looked at the magnetic resonance phenomenon, we can now return to what is probably more familiar ground and see where the superregenerative receiver enters the picture. We have mentioned that to excite a resonance it is necessary to place the sample of material in a coil which is supplied with r.f. current. This can be done very conveniently by making the coil part of the tank circuit of an oscillator. The system can then be easily tuned over the necessary wide frequency range. If the level of oscillation is arranged to be critically dependent on the tank circuit Q , as in the so-called marginal oscillator, the sudden absorption of energy by the sample as the oscillator passes through the resonance frequency causes a drop in r.f. level and provides a means of detecting the resonance. Such oscillators, many of them very simple, are widely used for studying n.m.r. For n.q.r., however, considerably greater values of H_1 are required, and this is where the superregenerative oscillator (s.r.o.) comes into its own, for even when a superregenerative receiver is adjusted for maximum sensitivity, the average r.f. level may be several volts. In fact, it behaves also as a low-power transmitter—as anyone knows who has tried to operate two such receivers within half a mile of each other.

The s.r.o. can successfully combine high sensitivity with high r.f. levels because it is sensitive only during a very short interval between pulses, and at this point in the quench cycle the valve anode current, and hence the generated shot-noise, is low. During the bursts of r.f. oscillation, however, large peak voltages can be attained without affecting the detection process. There is, though, one important difference between a s.r.o. used for n.q.r. and one used as a communications receiver. In the last-mentioned case the circuit is adjusted to operate in a com-

pletely incoherent condition because then the gain of the circuit is a maximum, whereas a certain degree of coherence is essential for resonance excitation.

The term "incoherent" refers to the random phase relationships which exist between successive bursts of oscillation when each one builds up from noise voltages only, i.e., when each burst is completely damped before the next pulse starts to build up. When the r.f. output of such an oscillator is monitored on a receiver one finds that there is no definite oscillation frequency present but only a band of noise spread over several hundred kHz. Such a signal is useless for exciting nuclear resonances because negligible power is present in the relatively narrow width (a few kHz) of the resonance line. The situation changes, however, if the oscillations are less severely damped between pulses, because then the starting phase of each pulse is determined partly by the tail of the previous pulse and partly by noise. In other words the coherence is increased. The effect on the monitor receiver is to cause discrete frequencies to appear, and since the oscillator is pulsed, they are spaced at integral multiples of the quench frequency on either side of the oscillator's fundamental frequency.

The available power is now concentrated into narrow frequency bands and many of them are sufficiently strong to excite a resonance in a sample of material placed in the s.r.o. tank coil. Such resonances are then simultaneously detected by the circuit because the precessing macroscopic magnetic moment induces an r.f. voltage in the coil, and this voltage provides an input signal for the s.r.o., now acting in its role as a receiver (Fig. 3). The operation might be crudely pictured as that of a radar system: the s.r.o. sends out a pulse which excites the spin-system in the sample, making it ring like a high-Q tuned circuit, and the ringing signal is then picked up as the "response."

In practice, the "ringing" time, or to use its correct name, the "spin-phase relaxation time", is of the order of milliseconds and is considerably longer than typical quench periods (10 to 100 microseconds). This is why the nuclei "see" the r.f. waveform as its Fourier components (or sidebands) rather than as individual

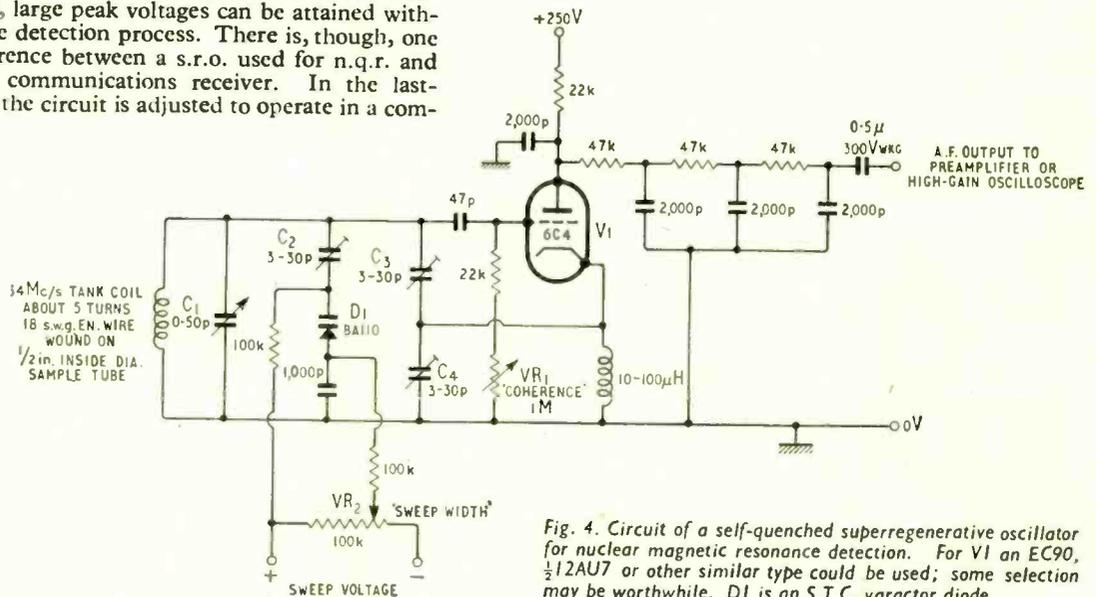


Fig. 4. Circuit of a self-quenched superregenerative oscillator for nuclear magnetic resonance detection. For $V1$ an EC90, $\frac{1}{2}$ 12AU7 or other similar type could be used; some selection may be worthwhile. $D1$ is an S.T.C. varactor diode.

bursts of oscillation, as it appears on a wide-bandwidth oscilloscope.

SUITABLE APPARATUS

A very simple circuit which has been widely used to detect n.q.r. in the 15 to 50 MHz range is shown in Fig. 4. The circuit is a self-quenched Colpitts oscillator, the quench frequency and coherence depending on the grid time-constant, which can be varied by VR₁. It is also self-detecting because when a signal is present the quench rate increases slightly, and this results in an increased voltage drop across the anode load resistor. After filtering out the quench frequency components the audio output signal is amplified in a conventional low-noise preamplifier, such as that of Fig. 5.

A suitable setting for VR₁ can be arrived at by monitoring the r.f. output on a receiver, the correct adjustment being half-way between that giving a very sharp series of sidebands and that which results in a broad band of noise. Since the gain of the detector depends on the coherence, VR₁ can also be adjusted by observing the noise level at the output of the preamplifier. In this case the correct setting is somewhere between the ones giving maximum and minimum noise amplitudes.

In order to observe a resonance line directly, some method is required of repetitively sweeping the oscillator frequency back and forth over a range of up to several hundred kHz, while simultaneously observing the output on an oscilloscope. Many oscilloscopes have a terminal which allows a connection to be made to the timebase output, and if this is the case, it is only necessary to connect this output in such a way as to always reverse-bias the variable capacitance diode D1. Care must be taken, however, not to exceed the maximum rated reverse voltage for the diode (30V for the BA110), or to drive it into forward conduction. The depth of modulation can be adjusted by both VR₂ and C₂. If a sweep output is not available from the oscilloscope, a sinusoidal sweep can be obtained from a mains transformer giving say 20V output, together with a suitable battery connected so that the diode is never forward-biased. Finally, if an oscilloscope is not available, it is still possible to detect a resonance by listening to the output on a pair of headphones or a loudspeaker.

The construction of the circuit should follow good v.h.f. wiring practice, keeping all r.f.-carrying wires as short and direct as possible. Beehive trimmers are suitable for C₂, C₃ and C₄, but a good quality tuning capacitor is essential for C₁, together with a good slow-motion drive. Since the resonances to be detected are likely to be only two or three times larger than the noise level at first, careful tuning is required, and the

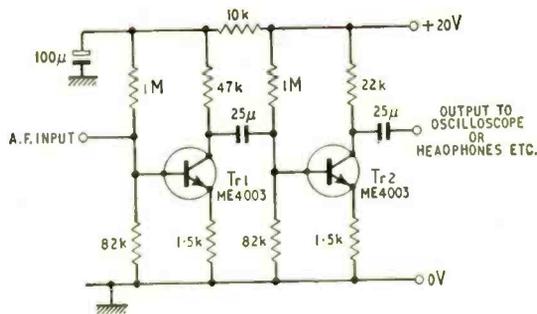


Fig. 5. A suitable audio frequency preamplifier for use with the Fig. 4 circuit.

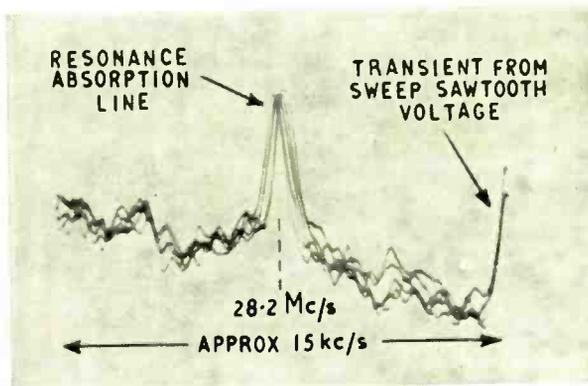
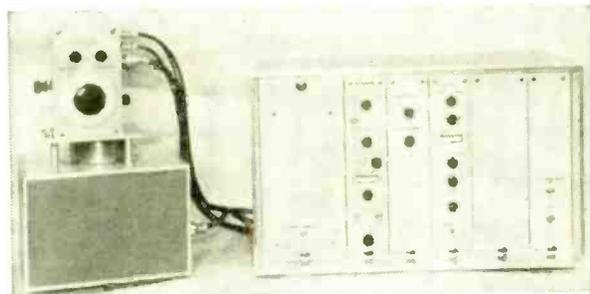


Fig. 6. Photographically recorded c.r.o. trace showing the ³⁵Cl n.q.r. line in potassium chlorate at room temperature, obtained with a circuit similar to that of Fig. 4. The position of the centre of the resonance line was slightly different on each of the five sweeps recorded because of jitter on the sawtooth generator used for the frequency sweep. Slightly higher signal-to-noise ratios can be expected for ³⁵Cl in para-dichlorobenzene.

h.t. supply should be well smoothed to eliminate hum. The r.f. choke in the cathode circuit is a rather critical component and if the oscillator exhibits dead-spots, i.e., ranges over which oscillations cease, it is likely that the particular choke has a series resonance in the range. The solution is to try a different choke.

A suitable substance which at room temperature gives a strong signal at about 34.27 MHz and another weaker one at 27.01 MHz is para-dichlorobenzene. The signals are due to the n.q.r. of the ³⁵Cl and ³⁷Cl nuclei, respectively, and the two frequencies are in the ratio of 1.2688 to 1, which is the ratio of the quadrupole moments of the two nuclei. In nature, the two isotopes occur with relative abundances of approximately three to one and this accounts for the different intensities of the two resonance lines. To observe the stronger, ³⁵Cl, line the oscillator should be set to sweep around the 34 MHz region by monitoring on a receiver, or by temporarily injecting a signal at 34.27 MHz into the s.r.o. from a signal generator. Careful tuning of C₁ should then enable the resonance signal to be seen (or heard). Final adjustments to C₃, C₄ and VR₁ should then be made in order to obtain best signal-to-noise ratios. With the para-dichlorobenzene sample contained in a glass tube of half-inch internal diameter and packed tightly to a depth of about one inch, a signal-to-noise ratio of at least ten should be attainable with a good oscillator valve. It is important to have as much sample material as possible within the coil volume and therefore the sample tube should have thin walls



Decca prototype n.q.r. spectrometer. (An automatic frequency marker unit is missing from this particular example and would normally occupy the blank panel space.)

and the coil should be wound tightly on the sample tube itself.

Because of the sidebands present in the oscillator power spectrum, several responses are seen for each true resonance line, and for serious work some way of eliminating all but the fundamental is required. Usually this requires the use of the slightly more complicated externally-quenched s.r.o., but the methods used generally rely on the fact that if the quench frequency is altered, only the fundamental response will be unmoved. Unfortunately, with the self-quenched circuit the coherence, and hence the gain, varies as the quench rate is altered (using VR_1), but the effect should still be observable.

Sometimes the circuit will display apparent resonances which are in fact not due to the sample. These may be recognized by removing the sample, when of course a true n.q.r. signal would disappear. A neater method, however, is to place a small magnet near to the sample, whereat any n.q.r. line will be broadened so much that it will be effectively erased. This effect arises because of the interaction between the individual nuclear magnetic moments and the field, which results in a splitting of the resonance line into several components. The extent of the splitting is dependent on the orientation of the magnetic field with respect to the internal reference axes of the crystal and, in a powdered sample with its random distribution of angles, the effect is to broaden the line. Any line which does not show this behaviour cannot be attributed to n.q.r.

Another effect which can be easily demonstrated is that of temperature. If the sample is heated, the resulting expansion causes small changes in the internal electron distributions of individual molecules and leads to a change in the n.q.r. frequency. If the sample is subject to a non-uniform temperature, caused, for example, by body heat during handling, or by a nearby soldering iron, different parts of the sample have different resonance

frequencies and the line is broadened. It is always advisable, for this reason, to wait five or ten minutes after handling the sample before trying to detect a resonance. Since the n.q.r. frequency depends only on the nuclear quadrupole moment, a constant of nature, and the e.f.g., a property of the particular chemical compound, it has been suggested that n.q.r. be used as a thermometer³. Such a thermometer would be useful in situations where frequent calibration is impossible, e.g., remote weather stations or space probes. A suitable sample in such applications is potassium chlorate, whose ³⁵Cl resonance is at 28.2133 MHz at 0°C. Its advantage lies in its low natural line-width of about 500 Hz, which means that more accurate frequency measurements are possible, and in its fairly large temperature coefficient of about -4.8 kHz per degree.

Other nuclei whose n.q.r. frequencies fall in the frequency range of the circuit of Fig. 4 are ⁶⁹Ga, ⁷¹Ga, ⁶³Cu, ⁶⁵Cu, and ⁵⁹Co. Cobalt and gallium compounds are not readily available but a suitable copper compound is cupric oxide. This shows two broad resonance lines at 25.955 MHz and 24.028 MHz, at 28°C, corresponding to the ⁶³Cu and ⁶⁵Cu nuclei respectively. Finally, to give the reader an idea of the results to expect with the apparatus described, a photograph of the ³⁵Cl n.q.r. line in potassium chlorate at room temperature is shown in Fig. 6.

In conclusion the writer would like to point out that apparatus basically identical to that described above is being used in laboratories throughout the world for serious research in n.q.r.

REFERENCES

1. "Superregenerative Receivers," by J. R. Whitehead. Cambridge University Press, Cambridge (1950).
2. H. G. Dehmelt. *American Journal of Physics*, 22, 110 (1954).
3. J. Vanier. *Metrologia*, 1, 135 (1965).

A Logical Bassoon

THE bassoon is notorious for the difficulty of its fingering (the pattern of raised and lowered fingers necessary to produce a particular note), and certain orchestral passages such as in Stravinsky's *Rite of Spring*, can daunt the most accomplished player. Dr. G. S. Brindley, F.R.S., a physiologist at Cambridge University, has attempted to ease the player's task by designing a new type of bassoon which uses electronic logic circuits to simplify the fingering. He gave a demonstration of the new instrument, which is based on a German bassoon, at a meeting of the British Acoustical Society held at the B.B.C. Research Department on 5th December.

Acoustically the Brindley bassoon is similar to a conventional instrument except that the acoustic column, constructed from Sapele wood, is of rectangular cross-section instead of circular. The player's fingers operate a set of keys incorporating micro-switches, and the on-off signals from these are fed to diode-transistor logic circuits which control solenoids powered from a 24 V supply. The solenoids raise and lower pads over the holes in the acoustic column. The logic circuits are arranged to separate the "holing" (patterns of open and closed holes) from the fingering, so that for each note it has become possible to choose the holing that is best acoustically and the fingering that is best for facility. (It would

be possible to use a fingering system as for the piano.) First the microswitch signals are fed into "recognition" logic circuits—a series of AND gates—where each pattern of raised and lowered fingers causes a particular "note output" terminal to be activated. The signals from these terminals then pass into "programming" logic, comprising a series of OR gates, the outputs of which directly operate the holing solenoids. All the electronic circuitry, except the solenoid power supply, is mounted on the outside of the acoustic column.

Another helpful innovation in the bassoon is a 15-W electric heater, which is used not only to get rid of condensation but to tune the instrument. When being played the bassoon stands on the floor between the player's legs and causes no obstruction to his line of sight. Ordinary bassoon reeds are used. The timbre has a slight suggestion of saxophone quality.

Also at the B.A.S. meeting H. D. Harwood (B.B.C. Research Department) described and demonstrated a new B.B.C. monitoring loudspeaker which is outstanding in both its freedom from colouration and its repeatability of frequency characteristic. This has been achieved mainly by the use of a new cone material, a type of sheet polystyrene called Bextrene, which is shaped by a vacuum forming technique.

R.F. Measurements and Standards

SINCE July the British Calibration Service has been in operation and is seeking to establish centres of expertise in r.f. measurements on a larger scale than has been possible hitherto. An indication of the interest in r.f. measurements and standards, which until recently suffered from lack of official support and recognition, was provided by the attendance of about 150 at a conference on the subject held at the National Physical Laboratory from November 14th to 16th. Organized by the Institution of Electronic and Radio Engineers in collaboration with the Institution of Electrical Engineers, the conference was formally opened by Sir Leonard Atkinson, president-elect of the I.E.R.E., and a total of 18 papers was presented.

There is nothing comparable in this country to the strong central facility in the United States at the Radio Standards Laboratory of the National Bureau of Standards, although a new Division of Electrical Science has recently been formed at the National Physical Laboratory and one of its first tasks will be to establish a laboratory for r.f. measurements. Close co-operation with other European countries is also desirable and it might be a sensible plan to arrange some division of the work between countries if we are to attempt to reach the same standards of accuracy as the N.B.S. over the whole field of measurement.

COMPARISON WITH ABROAD

At the conference a review of the present position in measurement capability presented the state of the art in the U.K. in comparison with the range of standards developed in Europe and the United States. The fields covered in the range 100 kHz to 3 GHz were frequency, power, impedance and reflection co-efficient, current and voltage, attenuation, noise, field strength and power density. It was clear that further effort was required in several fields to match the best of foreign standards but at least one speaker made the point that small teams in this country had achieved results in their selected areas quite as good as those, for example, of the N.B.S. The Electrical Inspection Directorate of the Ministry of Technology, has played a leading part in improving our r.f. standards and measuring procedures and standards of impedance, power, attenuation and bridge and reflectometer methods were described. Developments are in progress to extend the accuracy of impedance standardization to 0.1% over the range 200 MHz to 3 GHz and with a new piston attenuator it is hoped to achieve an accuracy of ± 0.01 dB in 100 dB. The present accuracy of power measurement is $\pm 1\%$ between 2 and 80 mW but a new form of dry load calorimeter is under construction. This makes use of a sensitive thermal converter of the multi-junction type developed by Wilkins at N.P.L. to detect the temperature rise in the metal-film load resistor. The frequency range is from audio frequencies to about 5 GHz and the expected accuracy is $\pm 0.2\%$ for powers of 40 mW to 4 W.

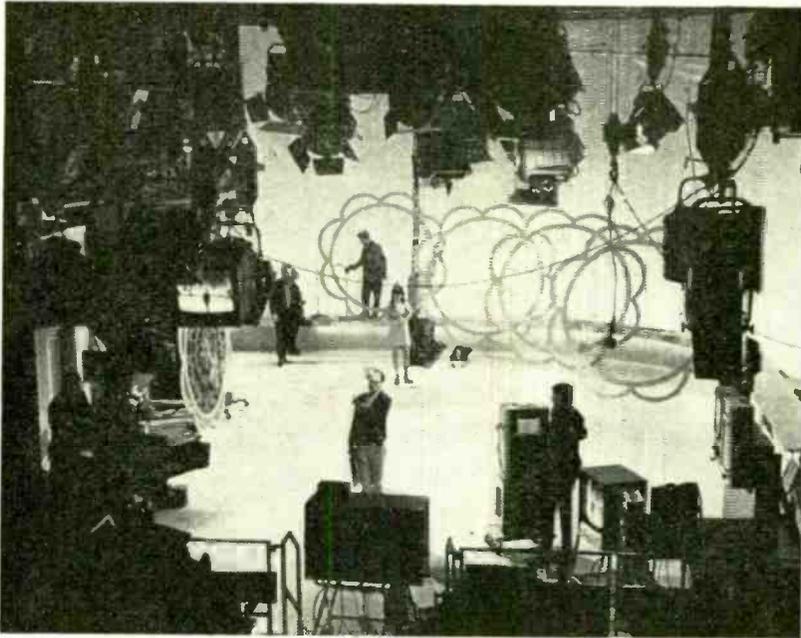
Another approach to power measurement was described by Marconi Instruments in developing a range of commercial power meters extending from 100 mW to 1 kW. Unlike the E.I.D. instrument the thermo-element is here incorporated in the r.f. circuit, the heater of the junction forming part of the connection to the load resistor. By adopting a thin-film form of construction for the heater and by changing from co-axial to slab-line

geometry the insertion of the thermal element can be arranged without causing appreciable discontinuity. The e.m.f. generated by the thermo-junction is very nearly proportional to the (current)² passing to the load resistor and is read on a millivoltmeter calibrated directly in total incident power to an accuracy of $\pm 5\%$.

Thin films form the load resistors in both the E.I.D. and Marconi instruments: they also find application at the other end of the system in the source resistor of the thermal noise standard developed by Ferranti. The resistor, an alumina tube coated with pyrolytic carbon, is maintained at a temperature of 1,000°C in a vacuum enclosure. It is matched to a 50 Ω coaxial line at the operating temperature. There are indications that the present temperature co-efficient of resistance, amounting to several parts in 10,000, can be reduced and this will enable the standard to be used over a range of temperature, indicated by a platinum/rhodium thermo-couple, without appreciable mis-match. These sources have been examined on the noise comparator designed by the Services Valve Test Laboratory and the mean value at 300 MHz agrees closely with two different types of noise diode, giving confidence that an absolute accuracy of ± 0.1 dB has been achieved. Comparison with other sources suggests that this holds up to 1 GHz.

The measurement of attenuation is central to many r.f. procedures and several papers described methods for the comparison of attenuators. The arrangement favoured by both Marconi Instruments and E.I.D. was parallel i.f. substitution with the standard attenuator operating at a fixed frequency, usually 30 or 60 MHz. This method imposes severe requirements on the linearity of the first mixer stage and in the E.I.D. equipment the thermionic diode used is linear to better than 0.01 dB over the range -7 to -107 dBm, from a frequency of 108 MHz to more than 1 GHz. The sensitivity and stability of the equipment enables a change of 0.001 dB to be detected under good signal-to-noise conditions. The Post Office Research Station has also under development equipment which it is hoped will enable insertion gain and loss to be measured to an accuracy of ± 0.01 dB in 60 dB at frequencies in the range 0-50 MHz, the accuracy falling progressively to ± 2 dB at frequencies of 1-2 GHz (see p. 599, December issue).

An interesting paper from the University of Southampton described the problems arising in measurements on very small thin-film and monolithic circuit components, in the frequency range 100-1,000 MHz. For thin films it is permissible to scale-up the measurement and the resistance and capacitance per unit area are obtained from test pieces evaporated in concentric form which then provide convenient terminations for the coaxial lines of the admittance/impedance measuring equipment. For monolithic components the measurement must be conducted in situ and it is necessary to reduce the dimensions of the standard 50 Ω coaxial lines to an area of about 0.01 \times 0.01 inch while remaining well shielded from each other. The transition is made by the use of a micro-stripline formed by laying a gold ribbon between two layers of dielectric sheet and clamping between thick brass plates. The connection to the chip is made by a gold wire or by extending the gold ribbon but a significant reduction in the residual inductance of about 1 nH can be achieved by making the final link in the form of a uniline.

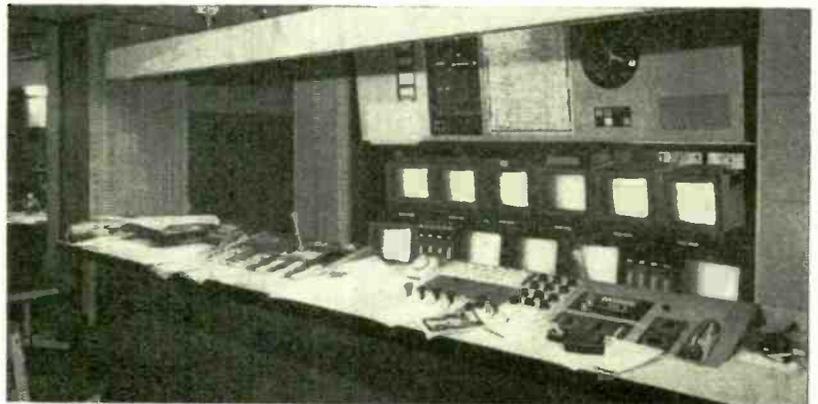


A view from the audience seating in colour studio 8 at the B.B.C. Television Centre during a rehearsal.



Sound controller's position with tape and disc backing facilities, in the sound control room associated with one of the two colour studios.

The vision and lighting control room studio one. It is equipped with what is called a "Q-file" lighting control, made by Thorn, by means of which up to 100 lighting combinations and levels can be pre-set and brought into operation sequentially.



B.B.C. COLOUR SERVICE

FOR the past ten months or so the B.B.C. has been gradually installing colour equipment at the Television Centre, in West London, so that when its colour service was officially inaugurated on December 2nd two production studios, a continuity studio and two mobile control rooms were fully operational. As a result, up to 25 hours of the 30 or so hours of programmes on BBC-2 each week are now in colour.

Each of the two production studios is equipped with four Marconi Mk. VII four-tube cameras and the continuity studio with three Peto-Scott three-tube Philips plumbicon cameras. Peto-Scott cameras are also used in the mobile control rooms. A third production studio, which will be brought into service in the Spring, will have four E.M.I. four-tube cameras. The new studio, which is at Alexandra Palace, is being equipped with three Marconi cameras and will be brought into service in colour in January; until then the news will be in monochrome.

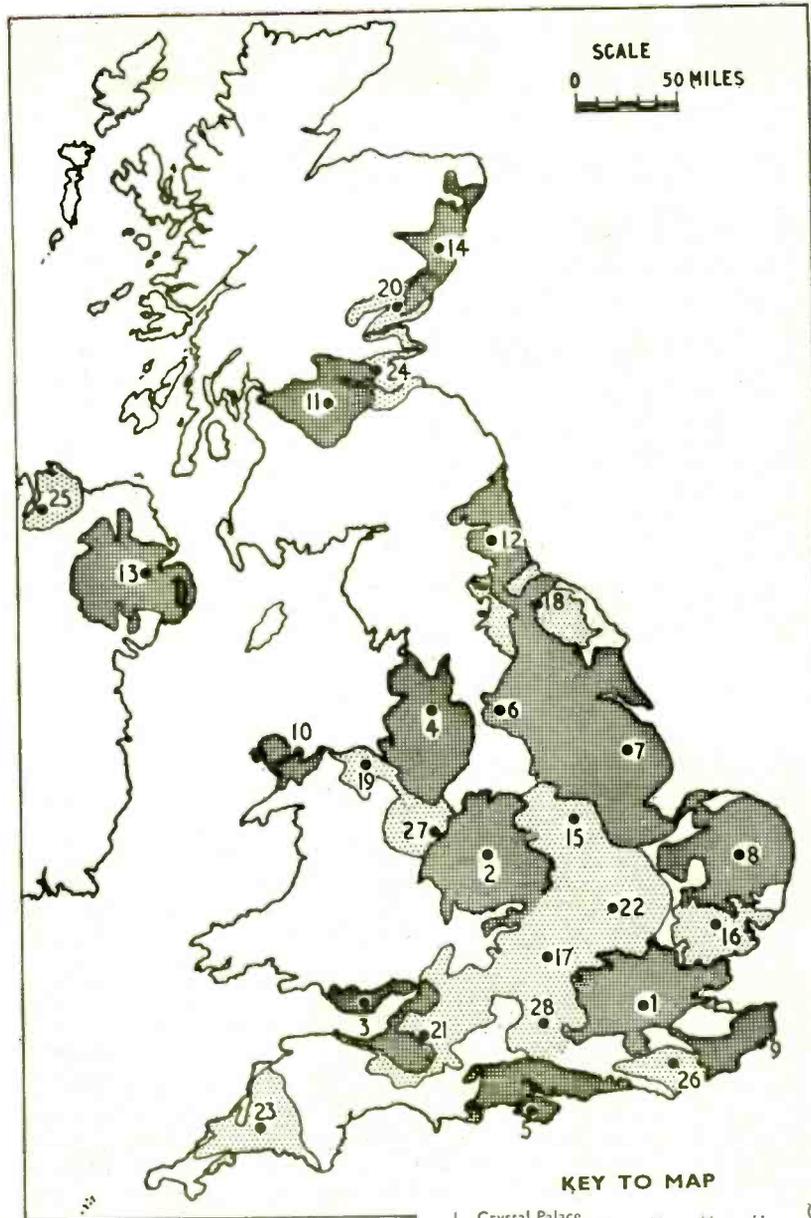
All the cameras are equipped with zoom lenses and not fixed-focus lenses in a turret. The main reason for this being that it is extremely difficult to maintain in a matched condition the colour characteristics of different lenses. Cameras have to be warmed up for two hours before line-up can

be undertaken and the line-up itself takes a further hour and a half. Care is necessary to keep the colour temperature of the lighting constant. Colour studios are operating on a level of 1615 lux (150 ft. candles). To provide the extra and more evenly distributed illumination necessary for colour the B.B.C. has developed a dual-purpose lantern one end of which produces a spot source and the other a soft-light.

Cameras are, of course, only part—albeit a crucial part—of the colour installation. The backing-up facilities already in use at the Television Centre include four Ampex 2000 videotape colour recorders (a further two will be installed early in the new year); one mobile Ampex 2000 (a second is planned for next Spring); and one R.C.A. TR70 vision tape recorder for news at Alexandra Palace where a Pye 16mm telecine unit using a four-tube camera will also be brought into service in January. Telecine equipment at the Television Centre includes four 16mm and five 35mm Cintel twin-lens units and a further three will be added in the Spring. Then, of course, one must not forget the field store convertor, developed by Rainger for the conversion of American 60-field colour signals to 50 fields and vice-versa (described in our October 1967 issue). There is also a SECAM/PAL transcoder.

The PAL system: next page

Service areas of the 14 stations which transmitted colour television on the opening of the service on December 2nd are shown with a line tint. The other stations shown are scheduled to be in operation by early 1969, in fact the first six (Nos. 15-20) are expected to be ready for use in 1968. The key to the stations gives in parentheses the channels for BBC-2



KEY TO MAP

| | | | | | |
|----|------------------|----|----|----|------|
| 1 | Crystal Palace | .. | .. | .. | (33) |
| 2 | Sutton Coldfield | .. | .. | .. | (40) |
| 3 | Wenvoe | .. | .. | .. | (51) |
| 4 | Winter Hill | .. | .. | .. | (62) |
| 5 | Rowridge | .. | .. | .. | (24) |
| 6 | Emley Moor | .. | .. | .. | (51) |
| 7 | Belmont | .. | .. | .. | (28) |
| 8 | Tacolneston | .. | .. | .. | (55) |
| 9 | Dover | .. | .. | .. | (56) |
| 10 | Llandona | .. | .. | .. | (63) |
| 11 | Black Hill | .. | .. | .. | (46) |
| 12 | Pontop Pike | .. | .. | .. | (64) |
| 13 | Divis | .. | .. | .. | (27) |
| 14 | Durris | .. | .. | .. | (28) |
| 15 | Waltham | .. | .. | .. | (64) |
| 16 | Sudbury | .. | .. | .. | (44) |
| 17 | Oxford | .. | .. | .. | (63) |
| 18 | Bilsdale | .. | .. | .. | (26) |
| 19 | Moel-y-Parc | .. | .. | .. | (45) |
| 20 | Balcalk | .. | .. | .. | (64) |
| 21 | Mendip Forest | .. | .. | .. | (27) |
| 22 | Sandy Heath | .. | .. | .. | (28) |
| 23 | Caradon Hill | .. | .. | .. | (27) |
| 24 | Craigkelly | .. | .. | .. | (55) |
| 25 | Londonderry | .. | .. | .. | (52) |
| 26 | Heathfield | .. | .. | .. | — |
| 27 | Staffordshire | .. | .. | .. | (45) |
| 28 | North Hampshire | .. | .. | .. | (45) |

General view of the control desk and monitors, only two of which are for colour, in the production control room of studio 8.



THE PAL COLOUR TV SYSTEM

A simplified explanation of how it works

By S. C. RYDER-SMITH, B.Sc.

A TELEVISION set giving a black-and-white picture is a fairly complex piece of equipment. With colour the complexities obviously multiply, and a host of fresh terminology is introduced into the subject. What follows is an attempt to explain, in fairly simple terms, how the PAL system operates. The explanation offered goes no further than outlining the background theory, and building on this to the point where a PAL receiver block diagram can be understood.

The first question to be considered is: how can we set about analysing the colour content of any scene, and then reproduce the scene so that the full range of colours is preserved? Fortunately, the solution to this problem has already been discovered in colour photography, and is fairly familiar. A colour may be analysed into its red, green and blue components, and then reconstructed by adding red, green and blue light in the same proportions as discovered in the original. This is illustrated in the simple colour television system shown in Fig. 1.

In this system three television cameras view a scene simultaneously. One, by looking through a red filter, transmits the red component only, the next, with a green filter, the green component only, and the last with a blue filter, the blue component only. Each camera output drives a cathode ray tube monitor. The monitor receiving the "red" camera output has a red filter in front of it, and therefore gives a red image, which is focused by a lens on to a viewing screen. The monitors receiving the "green" and "blue" outputs similarly give green and blue images on the viewing screen, and so the original scene is reconstructed in full colour.

The major difficulty with this scheme is the impossibility of aligning the three separate colour-component pictures, red, green and blue, as each is taken from a slightly different viewpoint. The answer, at the camera end, is to use a single camera lens system, and, with suitable mirrors and filters behind the lens, separate out the red, green and blue parts of the image, and project each on to a separate camera tube. (See front cover.)



S. C. Ryder-Smith graduated from Queen Mary College, University of London, with a degree in Electrical Engineering in 1956. After initial training as a graduate apprentice with S.T.C. he joined the staff of their transistor division applications laboratory. Here, besides general circuit design work, he made a special study of voltage breakdown in transistors, and published various works on this subject. He now heads the market developments group in the S.T.C. component marketing division.

At the receiver end of the chain, there is also the problem of aligning the three separate colour pictures, and presenting them on a single screen. This may be overcome by depositing three different phosphors, in some pre-determined pattern, on the screen of a c.r.t. which is equipped with three separate electron guns. One phosphor emits red light when excited, another green, and the last blue. It is arranged that the three electron beams coming from the guns scan together under the influence of a single set of scan coils, but that the beam from one gun can excite only the red phosphor, the beam from the next gun only the green, and the beam from the last gun only the blue. The way in which this is achieved in the shadow-mask tube has been described in detail in the March 1967 *Wireless World* but a diagram from this article is repeated here as Fig. 2 to show the basic principle. A tube of this sort is capable of producing three superimposed pictures, one red, one green and one blue, in which the strengths of the red, green or blue components can be independently varied by changing the grid voltages on the appropriate electron guns.

A more practical form of the colour system shown in Fig. 1 can now be devised. This is shown in Fig. 3.

The system arrived at in Fig. 3 would make an excellent basis for a colour service, if it weren't for two drawbacks. In the first place, three separate transmission paths are needed, and hence three times the bandwidth. Secondly, any normal black-and-white receiver could receive only one of these colour signals, and would get a picture with grossly distorted tonal values (equivalent to looking at a scene through a strong red, green or blue filter).

The problem, then, is to find a way of transmitting the *R* (red), *G* (green) and *B* (blue) information in such a way that a black-and-white set, with no modifications, will display a good picture with no tonal distortion. In addition, the total bandwidth used for the transmission must be no greater than that allocated for normal black and white, and yet a colour receiver must be able to recover from this signal the *R*, *G* and *B* information.

The way in which the *R*, *G* and *B* signals are coded to form a single combined signal for transmission is ingenious. First, a new signal, *Y*, is formed, by adding portions of the *R*, *G* and *B* signals:

$$Y = 0.30R + 0.59G + 0.11B$$

In this equation, it is assumed that a maximum red output is represented by $R=1$, and a zero red output by $R=0$. A similar assumption is made for *G* and *B*.

By adding together the red, green and blue picture signals in this way, what results is a signal representing the black-and-white view of the scene. A normal monochrome set can therefore receive the *Y* signal and reproduce the correct black-and-white picture. The reason why only 0.11 of the blue signal is used, whereas 0.59 of the green is used, is a matter of human physiology. The human eye is much less sensitive to blue than to green. A bright green appears to the human eye lighter

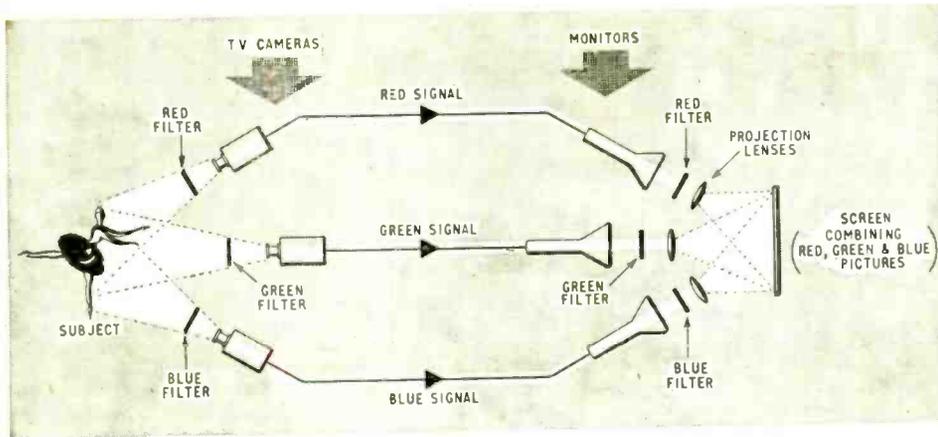


Fig. 1. Simple colour television system.

than a bright blue. Therefore, when a brilliant green is being televised, $G=1$, $R=B=0$, and $Y=0.59$ (a light grey). When a brilliant blue is being televised, $B=1$, $R=G=0$, and $Y=0.11$ (a darker grey). Producing Y according to the equation given above therefore results in a black-and-white picture with a tonal range acceptable to the human eye.

So far, the encoding described has merely reduced the colour signals to a black-and-white signal. How does a colour set separate out the original R , G and B signals?

First, for the sake of compatibility with black-and-white sets, it has been necessary to produce the Y signal. Further independent signals must now be provided so that a colour set can use them in conjunction with the Y signal to produce the original R , G and B information. There are, in fact, two additional signals:

$$(R - Y) \text{ and } (B - Y)$$

and these are called colour-difference signals because, as can be seen, they result from *subtracting* the Y signal from colour component signals.

Adding the Y signal to the two colour difference signals gives

$$(R - Y) + Y = R$$

$$(B - Y) + Y = B$$

Therefore a colour receiver can use the incoming Y , $(R - Y)$ and $(B - Y)$ signals to produce the original R and B signals. There is still the problem of obtaining the G signal in the receiver. This can be done by making use of the following mathematical relationship.

$$0.30(R - Y) + 0.59(G - Y) + 0.11(B - Y)$$

$$= 0.30R + 0.59G - 0.11B$$

$$- 0.30Y - 0.59Y - 0.11Y$$

$$= 0.30R + 0.59G + 0.11B$$

$$- Y(0.30 + 0.59 + 0.11)$$

$$= 0.30R + 0.59G + 0.11B - Y$$

$$\text{But } Y = 0.30R + 0.59G + 0.11B$$

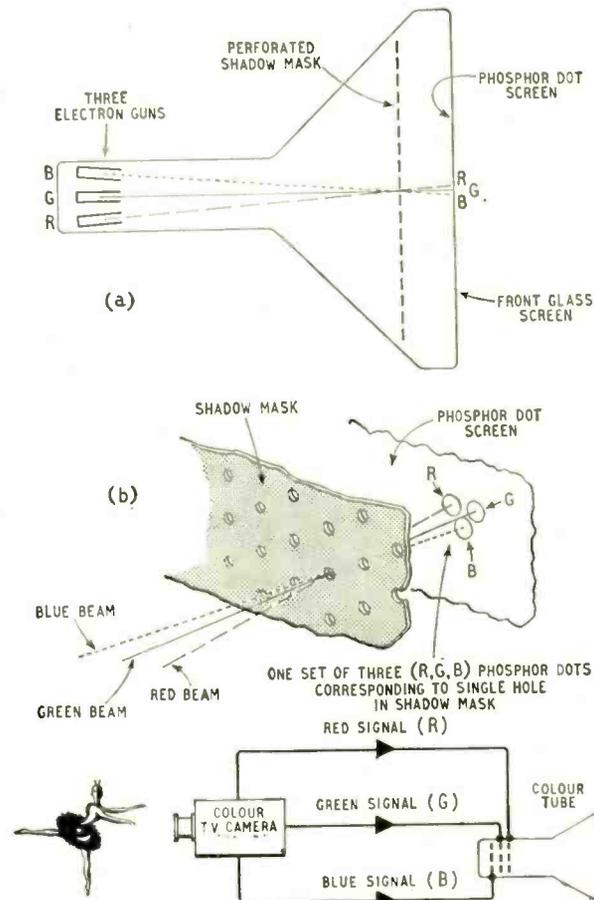
$$\therefore 0.30(R - Y) + 0.59(G - Y) + 0.11(B - Y) = 0$$

It follows from this that

$$-(G - Y) = \frac{0.30}{0.59}(R - Y) + \frac{0.11}{0.59}(B - Y)$$

In other words, if the two incoming colour difference signals $(R - Y)$ and $(B - Y)$ are added together in the correct proportion, and the sign of the resulting signal is changed, a signal equal to $(G - Y)$ can be produced.

A simplified schematic of the decoding in the receiver is shown in Fig. 4.



(Below) Fig. 2. Principle of shadow mask c.r.t.: (a) beams converging on mask and diverging on to screen; (b) close-up of mask and screen.

Fig. 3. More practical form of Fig. 1 system.

Note that the final comparison between the colour difference signals and Y is achieved by feeding a negative-going voltage proportional to Y (indicated as $-Y$) to the cathodes of all three electron guns, while voltages proportional to the colour difference signals are fed to the grids of the appropriate guns. The beam current in any gun is determined by the difference between the cathode and grid voltages. Thus, in the red gun the beam

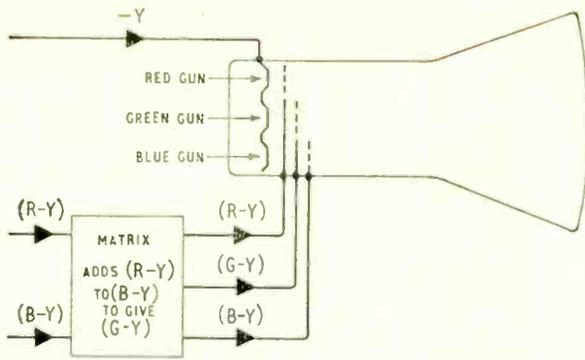
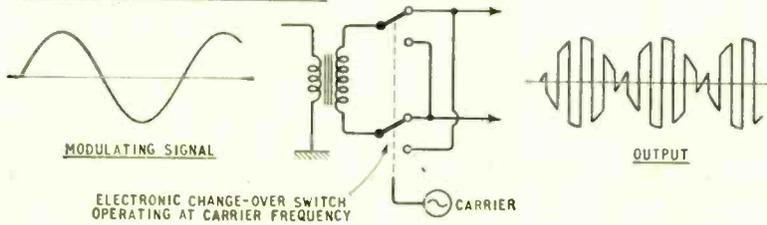


Fig. 4. Decoding in the colour receiver.

SUPPRESSED CARRIER MODULATION



NORMAL AMPLITUDE MODULATED SIGNAL

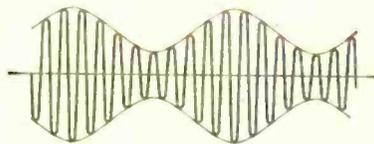


Fig. 5. Suppressed carrier modulation compared with a.m.

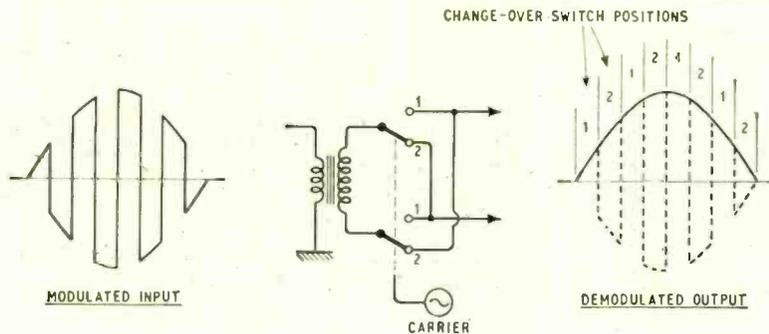


Fig. 6. Suppressed carrier demodulation in the receiver.

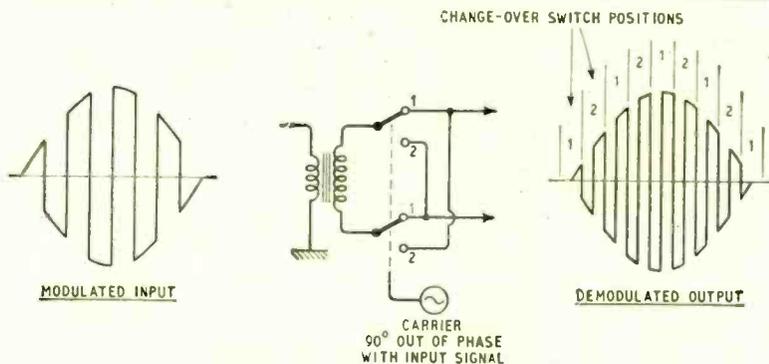


Fig. 7. Demodulator oscillator 90° out of phase.

current and hence the amount of excitation of the red phosphor, is proportional to:—

$$(R - Y) - (-Y) = R$$

Similarly, for the green and blue guns:

$$(G - Y) - (-Y) = G$$

$$(B - Y) - (-Y) = B$$

The same effect could be produced by adding the colour difference signals to the Y signal before reaching the colour tube.

It has already been noted that the Y signal gives a good black-and-white representation of the scene being televised. What do the colour difference signals represent? First, assume that a scene containing no colour—only black, white, and the intermediate greys—is being televised. Pure white may simply be defined as having equal quantities of red, green and blue. Therefore $R = G = B = n$, where $n = 1$ for full white, intermediate values for greys, and zero for black.

$$Y = 0.30n + 0.59n + 0.11n = n$$

The colour difference signals become

$$R - Y = n - n = 0$$

$$G - Y = n - n = 0$$

$$B - Y = n - n = 0$$

Therefore, when a black and white picture is being transmitted, Y continues to have a value representing the tonal value, or luminance of the scene, but the colour difference signals disappear. The colour difference signals only have a value once colour is introduced into the scene. It becomes obvious therefore, that the function of the colour difference signals is simply to provide information as to the colour of a scene, while the brilliance, or luminance, of the scene is conveyed in the Y signal. For this reason, the Y signal is called the luminance signal and the $(R - Y)$, $(G - Y)$, $(B - Y)$ signals are called the chrominance signals.

Experiment has shown that while the human eye is sensitive to detail arising from differences in luminosity, it is relatively insensitive to details arising from colour changes only. A benefit of this is that while the Y signal must be transmitted at full bandwidth to get good definition, the chrominance signals can be transmitted with a considerably reduced bandwidth.

The remaining problem in constructing a practical colour television system is how to transmit the $(R - Y)$ and $(B - Y)$ signals without (a) increasing the overall bandwidth of the system, and (b) interfering significantly with the operation of a normal black-and-white set displaying the picture due to the Y signal.

The methods described so far are common to all colour systems. Where

N.T.S.C., PAL, and SECAM differ in the methods adopted in transmitting the $(R - Y)$ and $(B - Y)$ signals.

Most of the credit for making colour television possible must go to the developers of the N.T.S.C. system. PAL is basically N.T.S.C. with modifications based on the now extensive experience of the problems and operation of N.T.S.C. in the U.S.A.

N.T.S.C. TRANSMISSION SYSTEM

The basic problem has been outlined above: How to transmit the $(R - Y)$ and $(B - Y)$ signals in addition to the Y signal without increasing the transmission bandwidth, or interfering unduly with the reception of the Y signal by a normal black-and-white receiver. The problem is complicated by the fact that the $(R - Y)$ and $(B - Y)$ signals can have either a positive or a negative value. Normal methods of modulation deal only in magnitude and not with sign.

The solution adopted in N.T.S.C. has been to use suppressed carrier modulation. A simple way of looking at this type of modulation is to assume that the modulating waveform is chopped by the carrier. The waveforms resulting from this operation are shown in Fig. 5. For comparison, a normal a.m. signal is also shown.

Note that when the modulating signal is zero, with suppressed carrier modulation the output is also zero. With amplitude modulation, on the other hand, a zero modulating signal is represented by a carrier of constant amplitude. Demodulating an amplitude modulated signal is simple: a normal diode detector will do the job. With suppressed carrier modulation, however, demodulation is a major difficulty. The method normally employed is to make use of a second electronic change-over switch operated in exact synchronism with the modulating switch. The demodulation process is illustrated in Fig. 6.

For this sort of demodulation to work successfully, there must exist within the receiver an oscillator which is not only precisely locked in frequency to the carrier oscillator at the transmitter, but is also closely in phase with the transmitter oscillator. Fig. 7 shows what happens when the demodulating oscillator is 90° out of phase with the incoming signals.

In this case, when the high frequency elements of the output are filtered out, the net output is zero.

Although there is obviously a drawback in the fact that the local oscillator in the receiver must be phase as well as frequency locked to the carrier oscillator in the transmitter, advantage can be taken of this phase sensitivity. It has been shown that if the carrier modulating the signal is 90° out of the phase with the receiver oscillator, then demodulation produces zero output (after filtering the high frequency components). Take the case where the modulated signal and the local demodulating oscillator are exactly in phase, and a correctly demodulated output is being obtained. If a second signal is added to the original modulated signal, having an identical carrier frequency but being 90° out of phase, then this second signal will not produce any changes in the demodulated output, just because it is 90° out of phase. However, if a second demodulator is used, driven from the same local carrier oscillator, but with a 90° phase change introduced, then this demodulator will produce an output

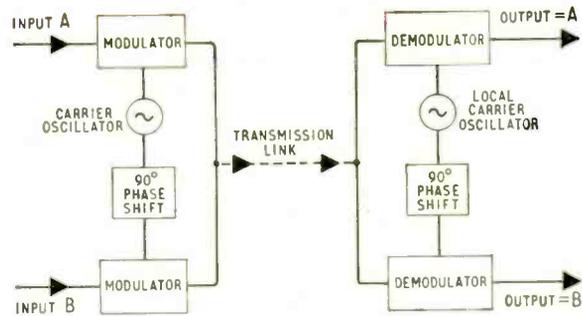


Fig. 8. Technique for conveying two independent sets of information.

from the second signal, and the original signal will give a zero output. This is illustrated in Fig. 8.

Thus it is possible for a single signal to carry two independent channels of information.

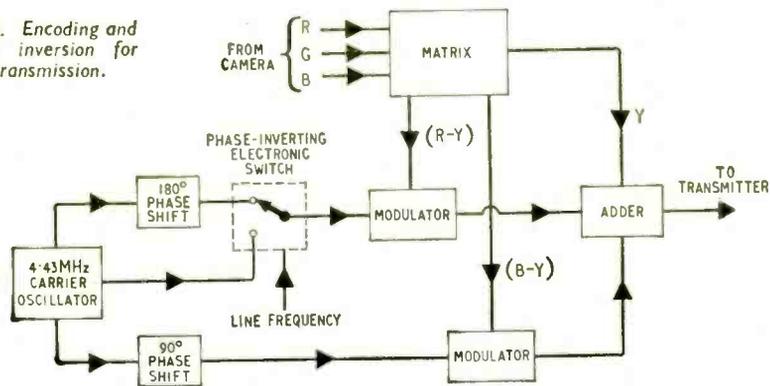
In the N.T.S.C. colour system advantage is taken of this by using a single suppressed carrier modulated signal to convey both the $(R - Y)$ and $(B - Y)$ information. The carrier frequency selected is in the region of 4.4MHz. The Y signal is, of course, transmitted in the normal amplitude modulation mode used for black-and-white transmissions. The suppressed carrier chrominance signal, centred on 4.4MHz, and containing both the $(R - Y)$ and $(B - Y)$ signals, is then added to the Y waveform, and treated as normal video information.

Although this method neatly solves the problem of transmitted $(R - Y)$ and $(B - Y)$ information with no increase in the overall bandwidth, two questions immediately spring to mind. Surely the chrominance signal will appear on the screen as normal high frequency video? Secondly, will high frequency video arising from the picture content be interpreted as chrominance information, and affect the colour? In other words, the luminance, or Y , signal can interfere with the chrominance signals $(R - Y)$ and $(B - Y)$ and vice-versa.

This cross coupling does in fact occur. But by a careful choice of chrominance carrier frequency—in PAL it is 4.43361875MHz—the effects can be minimised. The chrominance signal produces a fine and unobtrusive pattern of dots across the screen, and fine detail in the picture content can produce a small distortion in the colour. However, both of these effects are small.

There still remains the problem of ensuring that the local carrier oscillator in the receiver is in frequency and phase lock with the transmitted carrier. This is done by

Fig. 9. Encoding and phase inversion for PAL transmission.



choosing a part of the transmitted waveform where video information is not present—i.e., during the sync pulse and fly-back period, and transmitting a short burst of carrier. A gate in the receiver separates this from the rest of the video wave-form, and feeds it to the local oscillator to synchronize it.

Although there are, of course, a number of sophistications to the N.T.S.C. system not described here, the main outline of the method has been covered.

PAL

The major shortcoming of the N.T.S.C. system has proved to be its sensitivity to phase errors in the chrominance channel. Fairly exact phase relationships must be kept if proper separation between the $(R - Y)$ and $(B - Y)$ channels is to be achieved. Once phase errors do occur, then false $(R - Y)$ and $(B - Y)$ information is given, and colour reproduction deteriorates. A particularly sensitive area for phase errors to occur is, of course, the transmission path between the transmitter and receiver. N.T.S.C. receivers must therefore be equipped with a "hue" control to correct for these phase errors, and under adverse conditions fairly frequent adjustments to this control are necessary.

The purpose of PAL is to take the N.T.S.C. system, and modify it to make it less sensitive to phase errors in the chrominance channel. This is done by inverting the carrier phase of the $(R - Y)$ signal on alternate lines. This is why the system is called PAL—Phase Alternation Line. Fig. 9 shows how the phase inversion is obtained at the transmitter by an electronic switch. In the receiver,

a corresponding switch is operated on alternate lines, which restores the $(R - Y)$ signal to its correct phase. The consequence of this phase alternation is that any phase error which occurs during one line is balanced by an equal phase error in the opposite sense in the following line. (Originally, of course, the phase error is always in the same sense on each line. But alternate lines are phase reversed in the receiver to correct the phase alternation of the $(R - Y)$ signal. The phase error is therefore also inverted on alternate lines, and the average phase error is reduced to approaching zero).

It is of course necessary for the receiver to identify what line is being transmitted—one with $(R - Y)$ normal or phase inverted. This is done by phase inverting the burst of colour carrier on alternate lines in synchronism with the phase inversion of the $(R - Y)$ signal.

In PAL, phase errors in one line are balanced by equal and opposite phase errors in the following line. In a simple PAL receiver, PAL-S, averaging of these errors is left to the human eye. Where the errors are small, this can be quite satisfactory. However, large errors lead to a coarse line structure, sometimes referred to as the Hanover blind effect. A more satisfactory solution is to perform the averaging electronically. This is done in a PAL-D receiver by means of a delay line which delays the chrominance signal for the exact duration of one line. Each line of chrominance information, as well as being directly fed to the c.r.t., is also fed into the delay line, and added to the following line, where the phase errors cancel.

The block diagram of a complete PAL-D receiver is shown in Fig. 12. This looks at first rather terrifying.

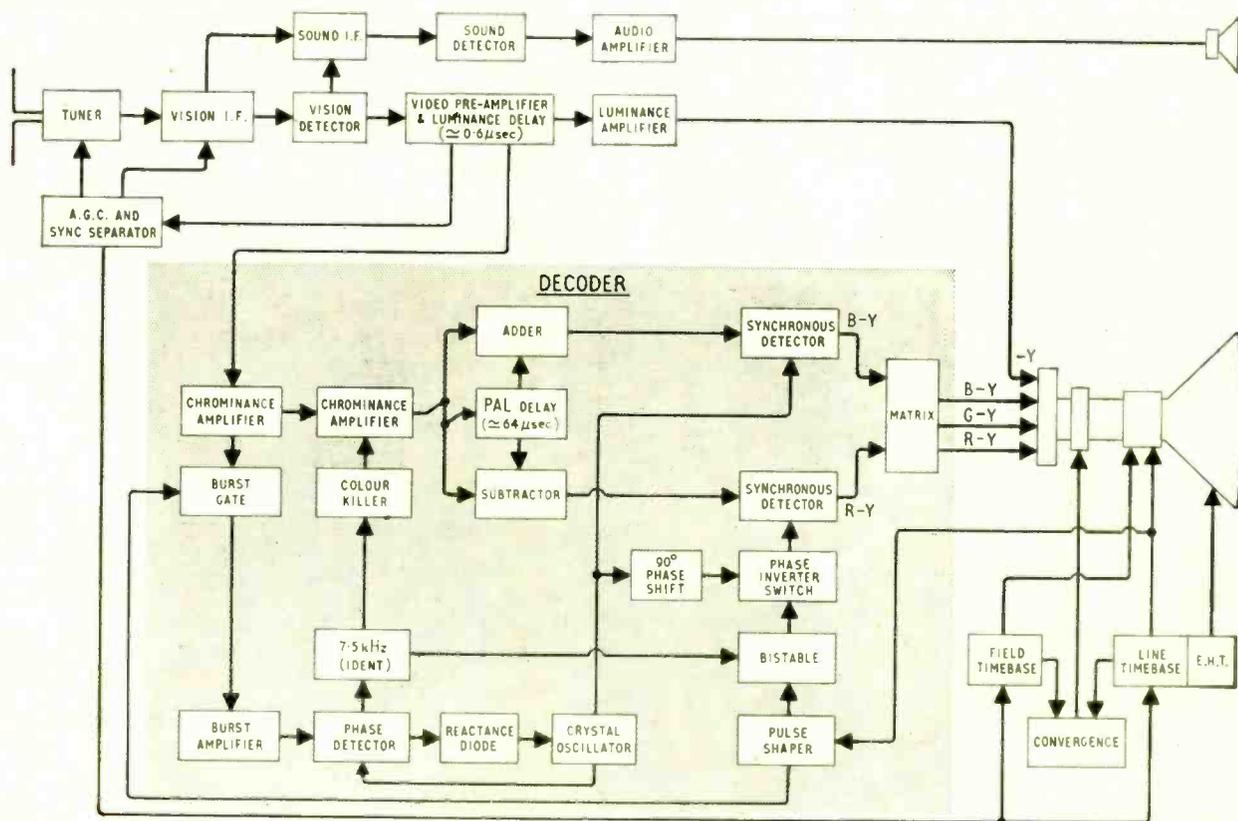


Fig. 10. Schematic of PAL-D colour receiver.

Taken bit by bit, and in the right order, however, it turns out to be relatively harmless.

The signal from the aerial is fed into a normal tuner, identical with the tuner used in a black-and-white set. The output of the tuner, at i.f., is fed to the vision i.f. amplifier, from which it goes into the vision detector. The sound signal is picked off from the vision i.f. amplifier, or alternatively, the vision detector, and goes through a normal sound channel to the loudspeaker.

The video output from the vision detector is fed through a video pre amplifier, a delay line giving a delay of approximately $0.6\mu\text{s}$ and the luminance amplifier (basically a normal video output stage). The output signal consists of the luminance signal Y , plus the unwanted, but unavoidable, encoded chrominance information. This output is fed to the cathodes of the three c.r.t. guns. The delay circuit of $0.6\mu\text{s}$ is not the main PAL delay line. Its function is to compensate for the short delay which the chrominance signals undergo in passing through the decoding circuits.

Before going through the $0.6\mu\text{s}$ delay line, the video signal is also fed to two other circuits. The first is the a.g.c. sync separator. This circuit provides (a) the required sync pulses, which are taken to the line and frame timebases, and (b) an a.g.c. signal which is used to control the gains of the tuner and vision i.f. amplifier. The second circuit to receive the video signal is the chrominance amplifier. Here, that part of the video signal which contains the chrominance information is filtered out and amplified prior to demodulation.

PHASE LOCKING SYSTEM

At this point it is as well to leave the direct chrominance signal path, and follow the parts of the circuit used to provide a correct phase locked carrier for the chrominance demodulation. The burst gate is connected to the output of the first chrominance amplifier. This gate is opened for a short period during the start of each line scan by a signal derived from the line timebase. The colour burst, transmitted to phase lock the local oscillator of the receiver, occurs during the period when the burst gate is open. The burst amplifier therefore receives the colour burst, but no other part of the video waveform. The output of the burst amplifier is compared in phase with the output of the local oscillator, which is crystal controlled.

It will be remembered that the phase of the colour burst alternates from line to line, and that the phase of the colour burst on any one line provides information on whether the $(R - Y)$ signal has its normal phase, or is phase inverted. In fact it is arranged that the colour burst phase changes back and forth by 90° . On one line it leads the required local oscillator phase by 45° , and on the following line it lags the required phase by 45° . The output of the phase detector is, therefore, a signal varying positive and negative at half line frequency. It is arranged that the circuit containing a reactance (variable capacitance) diode used to control the phase of the crystal oscillator is much too slow to follow the line to line variations in the output of the phase detector. Instead, it takes up a mean position, which is, of course, the required phase.

Meanwhile, the 7.5kHz (half line frequency) signal at the phase detector is used for two purposes. A bistable circuit is driven from the output of the line oscillator and changes state at the start of each line. Its output is used to phase invert the drive to the $(R - Y)$ demodulator on each alternate line, in order, to correct for the phase inversion given to the $(R - Y)$ signal on alternate

lines at the transmitter. However, it is obviously necessary to phase invert the $(R - Y)$ demodulator drive on the same lines as which the $(R - Y)$ signal is phase inverted. Information on which lines have the phase inverted $(R - Y)$ signal is contained, as already explained, in the phase of the colour burst. As the alternation in phase of the colour burst from line to line gives rise to the 7.5kHz signal at the phase detector, this 7.5kHz signal can be used to identify the line with $(R - Y)$ phase inverted. For this reason, this signal is referred to as the "ident" signal. It is fed to the bistable which is constrained to operate in phase with the ident signal. In this way, the phase inversion of the drive to the $(R - Y)$ demodulator is made to occur always on the alternate lines on which the $(R - Y)$ signal is phase inverted.

A second function of the ident signal is this. When a black-and-white picture only is being transmitted, it is important that no luminance information gets through the chrominance channel. If it did, parts of the picture where fine detail were present might appear coloured, and this is obviously very undesirable in a black-and-white transmission. This problem is solved quite simply. When a black-and-white picture is being transmitted, no colour bursts are included in the video waveform. The 7.5kHz signal therefore does not appear at the phase detector. In its absence, the colour killer circuit comes into operation, and turns the second chrominance amplifier off. It follows that when the colour bursts are absent, no information at all can get through the chrominance channel.

Let us return now to the chrominance signal at the output of the chrominance amplifier. This is fed into the PAL delay line, and also into a circuit which adds it to the output of the delay line, and another which subtracts the output of the delay line. Remembering that the output of the delay line represents information from the preceding line, in which the $(R - Y)$ information will have an opposite phase, the result of adding and subtracting adjacent lines of information can readily be calculated.

If the signal emerging from the delay line is $\pm(R - Y) + (B - Y)$ then the signal coming from the chrominance amplifier output, representing the following line of information, will be

$$\mp(R - Y) + (B - Y)$$

Adding these two lines gives

$$\pm(R - Y) \mp(R - Y) + 2(B - Y) = 2(B - Y)$$

Subtracting gives

$$\pm(R - Y) \pm(R - Y) + (B - Y) - (B - Y) = \pm 2(R - Y)$$

This part of the circuit, the delay line, adder and subtractor, therefore carries out two functions: it provides the phase error correction by averaging between succeeding lines, which is a basic feature of PAL, and it also separates the $(R - Y)$ and $(B - Y)$ signals. Both signals are fed into synchronous detectors (these are the demodulators described earlier). The $(B - Y)$ demodulator is driven direct from the phase locked crystal oscillator. The $(R - Y)$ demodulator derives its drive from the crystal oscillator, after it has first passed through (a) a 90° phase shift circuit, and (b) the phase inverter switch described above.

The two demodulators produce at their outputs the original $(B - Y)$ and $(R - Y)$ signals. These then go to a matrix where they are added in the correct proportions to produce the $(G - Y)$ signal. Finally, all the colour difference signals are taken to the grids of the appropriate guns in the shadow-mask colour cathode-ray tube.

Emitter-coupled, Emitter-timed Multivibrators

1: Astable Circuits

ASTABLE and monostable multivibrators are well known and widely used pulse circuits. The astable multivibrator switches repetitively between two quasi-stable states generating a series of rectangular pulses. The monostable circuit has one stable state in which it remains until a suitable trigger pulse is applied, causing it to switch rapidly to a quasi-stable state, in which it remains for a period of time, before returning to its original state; thereby generating a single rectangular pulse for each trigger pulse. The characteristics of these circuits that are normally considered to be of importance are: stability of pulse amplitude and width with respect to changes in supply voltages, temperature, spread in transistor parameters and switching time between states.

The most common forms of the multivibrator circuits are the collector base coupled versions shown in Figs 1 and 2, in which the timing function is performed in the base circuit. The transistors are normally saturated in order to stabilize pulse amplitude against changes in transistor parameters, but the pulse amplitude is still dependent on supply voltage and pulse durations are affected by changes in temperature. The less well known emitter-coupled, emitter-timed forms of the circuits possess definite advantages in that the timing operation is performed in the emitter circuit resulting in a pulse

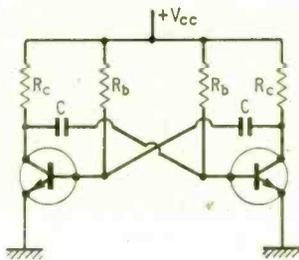


Fig. 2. (right) A conventional-base coupled monostable multivibrator.

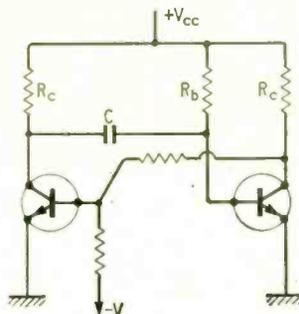


Fig. 3. (left) Basic emitter coupled, emitter timed, multivibrator.

Fig. 1. (left) A conventional collector-base coupled astable multivibrator.

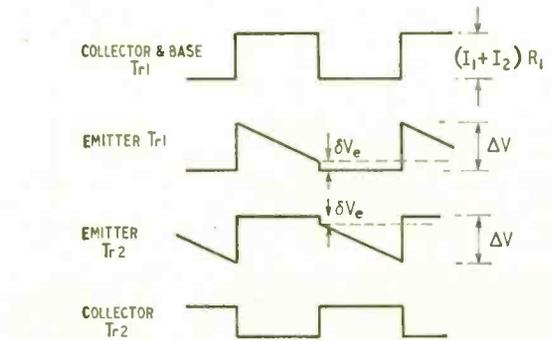
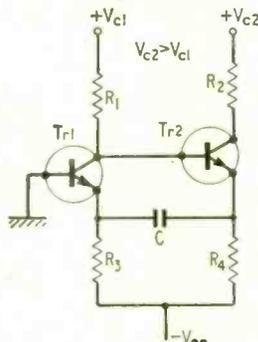


Fig. 4. Waveforms of an emitter timed multivibrator.

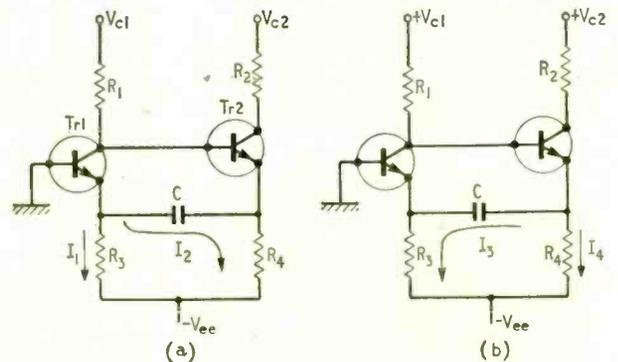
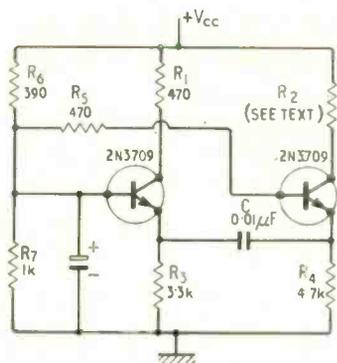


Fig. 5. Equivalent circuit of Fig. 4. (a) Tr1 on—Tr2 off; (b) Tr2 on—Tr1 off.

duration which is far less dependent on transistor parameters and, therefore, on temperature variations. In addition the pulse duration and amplitude can be made less dependent on power supply variations and the minimum switching times for a particular transistor type can be realized. Also a square waveform can be produced and the circuits have a completely "free" collector.

The circuit of an emitter-timed astable multivibrator is given in Fig. 3 and its idealised waveforms in Fig. 4. The circuit loop between the emitter of Tr1—collector Tr1—base Tr2—emitter Tr2 and the emitter of Tr1 is regenerative, so that both transistors conduct together only during the rapid switching between states. As Tr1 switches on the potential at its collector, and at the base of Tr2, falls rapidly causing Tr2 to cut off. The emitter current of Tr1 is then made up of two components (Fig. 5a), I_1 flows through R_3 and I_2 charges capacitor C causing the potential at the emitter of Tr2 to fall. After a time t_1 , Tr2 comes into conduction again and a regenerative action takes place causing the emitter

Fig. 6. Practical emitter timed astable requiring only a single power supply.



emitter of Tr1 to run down for a period t_2 . Then Tr1 comes into conduction again and the cycle repeats.

An approximate analysis of the circuit may be carried out if it is assumed that the negative step at the collector of Tr1 is small compared with the negative supply, the charging currents will then be taken as being constant during the timing periods. The effect of leakage currents will be ignored for silicon transistors.

The negative step at the base of Tr2 is $\alpha_{cb}(I_1 + I_2)R_1$ which is approximately equal to $(I_1 + I_2)R_1$ since $\alpha_{cb} \approx$ to unity.

Capacitor C must charge by an amount:

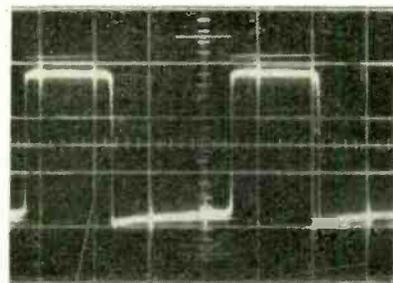
$$\Delta V = (I_1 + I_2)R_1 - (\delta V_e + V_{be2}) \quad \dots \quad (1)$$

Where δV_e is the step at the emitter of Tr2 and V_{be2} is the difference between the base emitter voltage of Tr2 when switching occurs and the base emitter voltage when the current I_1 is flowing.

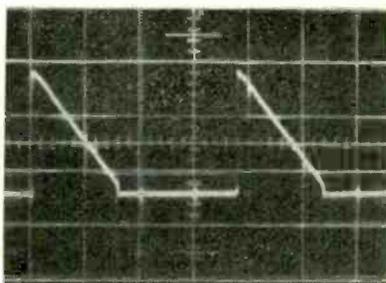
$$\text{Current } I_3 \approx I_1 = \frac{V_{cc} - V_{be1}}{R_3} \quad \dots \quad (2)$$

Continued on page 636

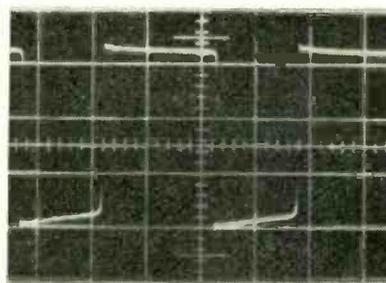
of Tr2 to be driven suddenly positive. This change is communicated by capacitor C to the emitter of Tr1, cutting it off. The emitter current of Tr2 is then also made up of two components (Fig. 5b), I_1 through R_1 and I_3 charging capacitor C and causing the potential at the



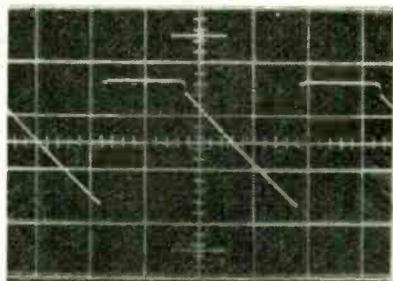
(a) 0.5 V/cm. 2 μ s/cm.



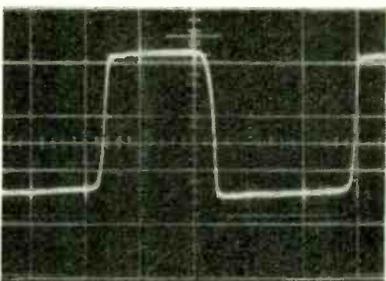
(b) 0.5 V/cm. 2 μ s/cm.



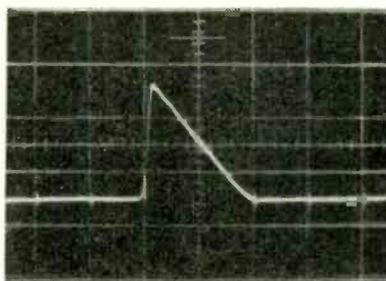
(c) 0.5 V/cm. 2 μ s/cm.



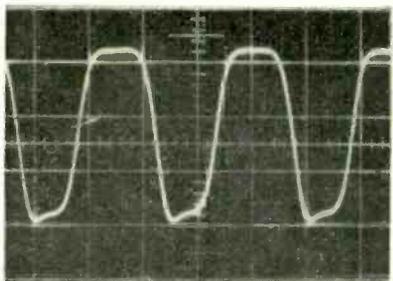
(d) 0.5 V/cm. 2 μ s/cm.



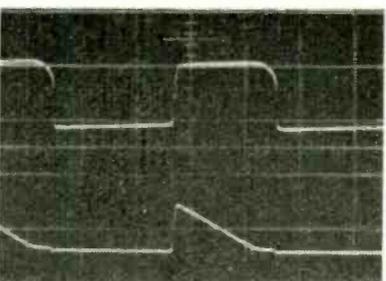
(e) 0.5 V/cm. 0.2 μ s/cm.



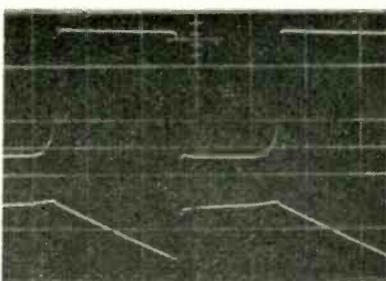
(f) 0.5 V/cm. 0.2 μ s/cm.



(g) 0.5 V/cm. 0.05 μ s/cm.



(h) 1 V/cm. 2 μ s/cm.



(i) 1 V/cm. 2 μ s/cm.

Fig. 7. Waveforms present in the circuit of Fig. 6. (a) taken at the collector of Tr1; (b) emitter Tr1; (c) the collector at Tr2; (d) emitter of Tr2; all taken with R_3 at 220 Ω . The slope at the top and bottom of the waveforms is due to the charging currents not remaining constant. (e) Waveform at the emitter and (f) at the collector of Tr1 where the timing capacitor = 1,000 pF. (g) Collector of Tr2 when the timing capacitor is reduced to 100 pF, the smallest rise time for a particular transistor type is realized. (h) Upper collector and lower emitter of Tr1 (i) Tr2 when the timing capacitor = 0.01 μ F and $R_3 = 470 \Omega$. The effect of allowing Tr2 to saturate can be clearly observed.

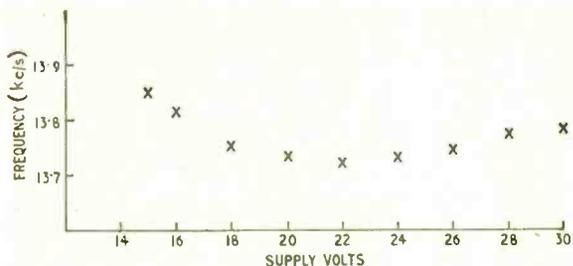


Fig. 8. Variation of frequency plotted against supply voltage for the circuit shown in Fig. 6 with $C=0.1 \mu F$, $R_2=470 \Omega$.

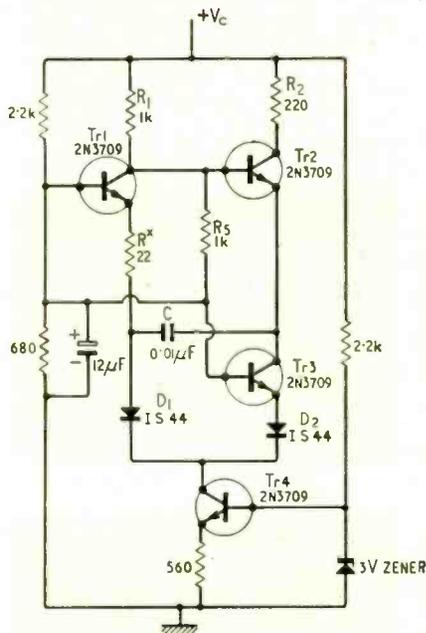


Fig. 9. Improved astable multivibrator.

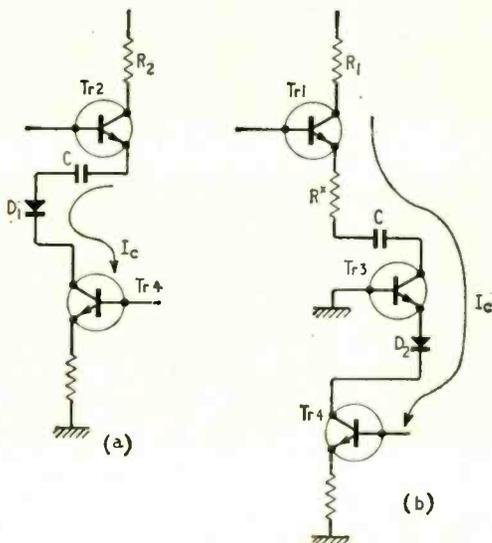


Fig. 10. Showing charging paths in the circuit of Fig. 9: (a) Tr2 on—Tr1 off; (b) Tr1 on—Tr2 off.

$$\text{and } I_1 \approx I_2 = \frac{V_{c1} + V_{ee} - V_{be2}}{R_1} \dots \dots (3)$$

$$\text{The time period } t_1 \approx \frac{\Delta VC}{I_2} \approx \frac{(I_1 + I_2)}{I_2} R_1 C$$

$$t_2 \approx \frac{\Delta VC}{I_3} \approx \frac{(I_1 + I_2)}{I_1} R_1 C$$

The term $(\delta V + \delta V_{be2})$ is neglected. Substituting for I_1 and I_2 gives:

$$t_1 \approx \left[1 + \frac{R_4}{R_3} \frac{1}{1 + \frac{V_{c1}}{V_{ee} - V_{be1}}} \right] CR_1$$

$$t_2 \approx \left[1 + \frac{R_3}{R_4} \left(1 + \frac{V_{c1}}{V_{ee} - V_{be1}} \right) \right] CR_1$$

V_{be1} is assumed equal to V_{be2} .

If the currents I_1 and I_2 are made equal, $t_1 = t_2$, and the frequency is approximately equal to $1/(4CR_1)$.

Both timing periods are seen to depend on the ratio $V_{c1}/(V_{ee} - V_{be1})$ which indicates the possibility of obtaining a multivibrator with very good frequency stability against changes in supply voltage. Increasing the supply voltages, with this ratio held constant, causes an increase in the charging currents, but it also causes the same fractional increase in the voltage step through which the capacitor has to charge. The constancy of the ratio can be assured by using only one power supply and a resistive divider (R_3, R_4). The need for the second positive supply may be removed by including the resistor R_5 ; the circuit is shown in Fig. 6.

In the above equations we can now replace V_{c1} by:

$$V_c' = V_{cc} \frac{R_5}{R_1 + R_5} \text{ and } R_1 \text{ by } R_1' = \frac{R_1 R_5}{R_1 + R_5}$$

An emitter-coupled emitter-timed multivibrator is required, operating frequency around 100 kc/s and a mark-space ratio not far from unity. The design procedure is as follows. Using $f = 1/(4CR_1')$, if C is made $0.01 \mu F$ then R_1' must be 250Ω .

But $R_1' = R_1 R_5 / (R_1 + R_5)$ so we make $R_1 = R_5 = 470 \Omega$.

With a nominal supply voltage of 20 V the resistive divider was chosen to give an effective emitter supply of -15 V. This makes $V_c' = 2.5 V$. The approximate values of the charging currents are determined from equations (2) and (3). $R_3 = 3.3 k\Omega$. $R_4 = 4.7 k\Omega$ makes $I_1 \approx I_2 = 3.5 mA$. The value of R_2 determines the amplitude of the signal at the collector of Tr2. Two different values were tried, 220 Ω and 470 Ω . It was found that the 470 Ω resistor caused Tr2 to saturate. The transistors employed were inexpensive plastic encapsulated general purpose silicon planar type made by Texas Instruments.

Fig. 7 shows the oscillographs taken from the circuit of Fig. 6 and demonstrates clearly the effects of altering the values of R_2 and the timing capacitor.

The frequency dependence of the circuit on supply voltage was measured with $R_2 = 220 \Omega$ and $R_5 = 470 \Omega$. In the former case a supply change from 15 to 25 V caused the frequency to change from 132 to 124 kc/s, whilst in the latter case a change from 15 to 30 V caused a much smaller change in frequency from 126 to 123 kc/s. The frequency dependence of the saturating circuit was also measured with a timing capacitor of $0.1 \mu F$. The results are indicated graphically in Fig. 8. A change of

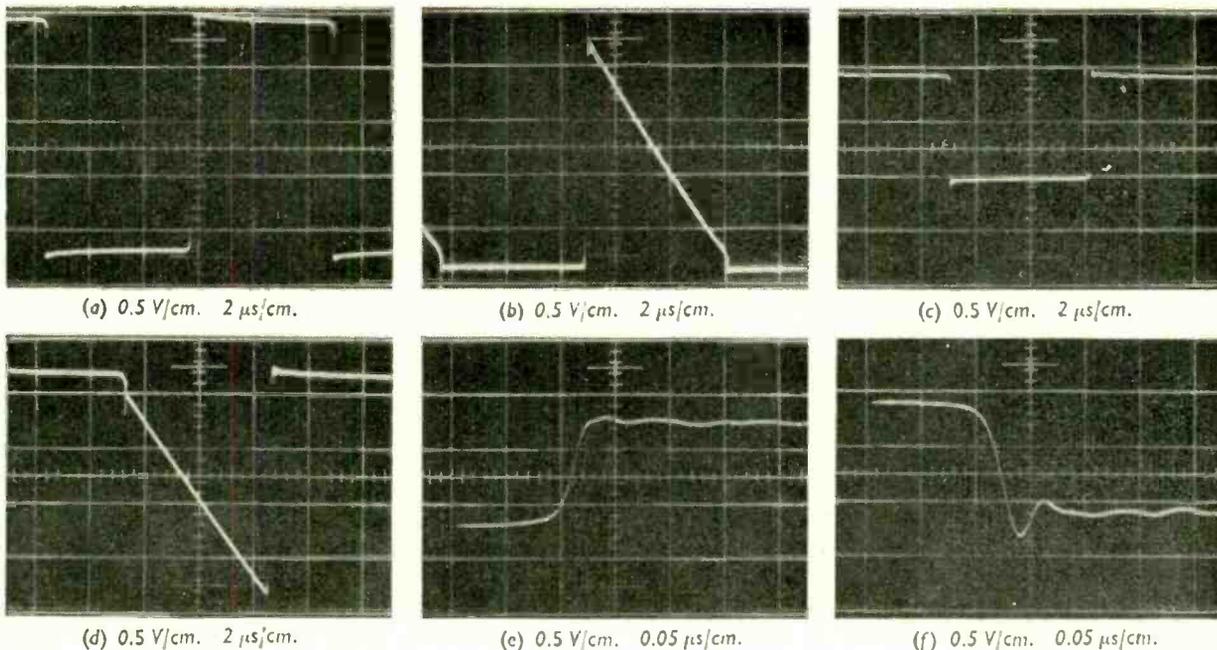


Fig. 11. Oscillograms taken in the circuit of Fig. 9. (a) collector Tr1; (b) emitter Tr1; (c) collector Tr2; (d) emitter Tr2. It can be seen that the mark-space ratio is very close to unity and the top and bottom of the waveforms are flatter than those of the circuit of Fig. 3. (e) The rise time and (f) the fall time of the waveforms at the collector of Tr2 showing the rapid switching time.

supply from 15 to 30 V changed the frequency by less than 1% overall. The difference in behaviour between the saturating and the non-saturating circuits are considered to be largely due to the terms δV_e and V_{be2} as these alter with changes in charging currents. However, these changes are smaller when Tr2 is allowed to saturate.

A modified circuit was designed which has the rapid switching and sharply defined waveforms associated with non-saturating operation but whose frequency stability against changes in power supply voltage is superior to the saturating circuit discussed above. The mark space ratio of the waveforms is very close to unity and the pulse height varies little with changes in supply voltage. The circuit is shown in Fig. 9; the emitter resistors are replaced by Tr4 which acts as a constant current source. Diodes D1, D2 and transistor Tr3 cause the whole of this current to charge capacitor C during the timing periods.

Assume that a regenerative action has just resulted in Tr1 being driven into cut off. The constant current supplied by Tr4 charges capacitor C, the charging path being through Tr2 and D1 (Fig. 10a). D2 and the emitter base junction of Tr3 are reverse biased. The potential at the emitter of Tr1 falls at a uniform rate, and, after a period of time t_2 , Tr1 comes into conduction and a regenerative action switches off Tr2. The forward bias across the emitter base junction of Tr1 and the voltage drop across R^* , prevents D1 from conducting and the constant current charges C through Tr1, Tr3 and D2 (Fig. 10b). The emitter of Tr2 falls at the same uniform rate at which the emitter of Tr1 fell (assuming the α_{cb} of transistor Tr3 is close to unity), for a time t_1 until Tr2 comes into conduction again and the regenerative action switches off Tr1 repeating the cycle. If we neglect the step in the emitter voltage of Tr2, δV_e and the small term δV_{be2} (eq. 1) capacitor C has to charge through a voltage $\Delta V = I_c R_1'$. Where I_c is the constant current

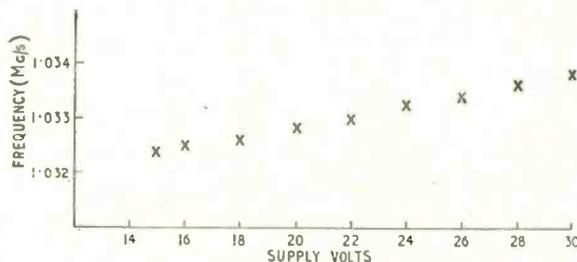


Fig. 12. Variation of frequency with supply voltage for the circuit of Fig. 9. $C = 1,000$ pF.

supplied by Tr4, R_1' is the effective collector load resistance of Tr1. The rate of charging is the same in both

cases $\frac{I_c}{C}$ V/sec.

$$\text{so: } t_1 = t_2 = \frac{\Delta V \cdot C}{I_c} = C \cdot R'$$

The frequency of oscillation, $f = 1/(2C \cdot R')$. The performance of the modified multivibrator is illustrated by the oscillograms of Fig. 11. The frequency dependence on the supply voltage was measured, a change of supply from 15 to 30 V caused a change of frequency of 0.5%. With a timing capacitor of 1000 pF stability was good and is illustrated in Fig. 12. A change in supply from 15 to 30 V altered the frequency by 0.14% and the pulse height, at the collector of Tr2, by less than 10%.

(Next month: monostable circuits)

REFERENCES

1. Mullard Technical Communications. July '61.
2. Mullard Technical Communications. April '62.

WORLD OF WIRELESS

Post Office Receiving Station Refurbished

THE TRANSITION from Nissen huts and manually operated equipment to brick buildings and automatically tuned radio receivers is now complete at the G.P.O. high-frequency (4 to 27 MHz) radio receiving station at Bearley in Warwick. The new installations cost about £0.5M. This station will combine efficient and reliable reception of long-distance radiotelephone and radiotelegraph communications with the maximum possible economy. Although much of the future transoceanic signal traffic will be carried by submarine cables and Earth satellites, h.f. radio can still play a useful role in world communications in lightly loaded routes for communicating with ships and for auxiliary and standby purposes alongside cable and satellite systems.

An outstanding feature of Bearley is the frequency generating equipment which controls the accuracy of the receiver synthesizers. It consists of three 100 kHz crystal controlled oscillators sunk into 30 feet deep boreholes where the temperature remains within about 0.5°C of 10°C without any artificial control. The accuracy of this master frequency can be maintained to within one part in ten million, with adjustment at about yearly intervals, or, if required, to 1 in 10⁸ with adjustments about once a month. This central master frequency source provides, by synthesis, the extremely accurate beat oscillator frequencies. The majority of the 60 receivers at this station are solid-state i.s.b. types suitable for the reception of telephony or multi-channel telegraphy and were designed by Plessey Electronics Group to a Post

Office specification. The PVR 800, as it is called, is a quadruple superheterodyne receiver capable of remote control for tuning either to any one of the six predetermined frequencies or by fully synthesized control selecting any one of the 200,000 discrete channels available (in increments of 125 Hz). Because of the accuracy of the synthesized frequencies the receiver can carry out an automatic carrier search process for, and identify, a wanted carrier signal. When the wanted transmission is found, the receiver can automatically maintain correct tuning, providing the transmitter frequency variations do not exceed internationally agreed limits.

The original aerial system has been retained more or less unchanged. A ring of rhombics (70ft high), efficient over the important band of frequencies above 8 MHz, combines global coverage with facilities for special aerial diversity reception. Diversity operation is necessary to achieve efficient reception of telegraph transmissions. In this case, two similar aeriels spaced several wavelengths apart feed two separate receivers whose outputs are combined. This method of space-diversity reception (compared with single aerial reception) is said to be equivalent to increasing the power of the distant transmitter by upwards of 30 times. All rhombics at Bearley are bi-directional, each rhombic end being terminated at the internal aerial distribution board, where, by means of a wideband passive hybrid network, it can serve up to four receivers simultaneously.

New Earth Satellite Station in Australia

WITH work well up to schedule, the new Earth station being built at Moree, in northwest New South Wales, by the Australian Overseas Telecommunications Commission, is expected to be in service by the beginning of the year. The total cost of the project is more than \$A4 million. It is the eighth space communications establishment built or in the planning stage in Australia. The Moree satellite communications station will be employed to link Australia into the Intelsat II satellite system, providing commercial communications and television transmission and reception with North America and major points in the Pacific. Countries which will be served will include the U.S., Canada, Japan, the Philippines, Hong Kong and other countries of Eastern Asia. It will supplement the \$A250 million broad band coaxial cable system which Australia and other Commonwealth partners have built across the Pacific and Atlantic Oceans. The new station will send and receive signals via the Intelsat satellite positioned directly over Fiji. Intelsat II was launched

from Cape Kennedy for the International Satellite Consortium of which Australia is a foundation.

A high degree of accuracy was required in siting the structure of the Moree Earth station. It had to run precisely due north and south. Margin for error was only 0.000008% or 10ft in 23,000 miles. The station has been built on a 257-acre site and it includes a 90ft parabolic antenna weighing 200 tons, mounted on a four-storey operations building. Australia's other space communications establishments are at Cooby Creek, Queensland, three stations near Canberra, in the Australian Capital Territory, two stations associated with the Woomera Rocket Range installations, and two in Western Australia, at Muchea and Carnarvon. NASA is reported to be considering establishment of a further station in the Canberra area, but no official announcement has yet been made about this project. Altogether more than \$A100 million has been spent in Australia on these projects in the past six years.

Changes in Maritime Radio Regulations

SUBSTANTIAL amendments have been made to those parts of the 1959 Radio Regulations and Additional Radio Regulations which apply to the maritime mobile service. This is a result of the World Administrative Radio Conference which was convened in Geneva on the 18th September by the International Telecommunication Union and which completed its work on 3rd November with the signing of the Final Acts. These will come into force on the 1st April 1969. The amendments have been determined substantially by the fact that since the last revision of the regulations in 1959, there has been a significant drop in the number of passenger ships owing to the growth of air travel, and a notable increase in the number of cargo ships. There has also been a rapid expansion in fishing fleets and other craft.

Thus requirements for radiotelephone and radiotelegraph channels have increased considerably.

Among the decisions of the Conference are the following: the gradual introduction up to 1st January 1982 of s.s.b. radiotelephony in the bands allocated to the maritime service between 1605 and 4000 kHz; the gradual introduction up to 1st January 1978 of s.s.b. radiotelephony in the bands between 4 and 23 MHz; allocation of frequencies for narrow-band direct printing telegraph systems (teleprinters) and data transmission systems; assignment of frequencies for the transmission of oceanographic data; and in general measures to increase safety at sea (signal code, watch on distress signals, etc.), including conditions governing the use of emergency position-indicating radio beacons.

Subscription Television

IT APPEARS from American press reports that a decision authorizing subscription television on a regular basis has been delayed for yet another year by Congress. Ever since the Zenith Radio Corporation first demonstrated the technical feasibility of this form of television viewing twenty years ago there has been controversy. The Federal Communications Commission is faced with the problem of putting pay television into operation while providing adequate protection for existing commercial stations who, with theatre owners, strongly oppose such a system, which they say, would ruin "free" television and the theatre. At the same time the F.C.C. has to consider the right of the public to choose a system where they were willing to pay for programmes uninterrupted by commercials.

Here in Great Britain a subscription television system has been operating experimentally in London and Sheffield by Pay-TV and during the past year the programmes have included feature films which were screened six months after general release. An indication of the prospects for subscription television in this country is expected soon from the Postmaster-General.

Communications Experiments

THE THIRD in a series of five applications technology satellites, ATS-C, was launched from Cape Kennedy on 3rd November. Among the nine experiments carried on board is one concerned with communications. This will be conducted using two microwave repeaters (receiver/transmitter) which constitute the spacecraft's s.h.f. communications sub-system. Both repeaters operate in three modes, the first two (multiple access and frequency translation) are used in a microwave communications test, and the third mode, wide-band data, is used for transmitting television pictures from the spacecraft's spin scan cloud cover camera to the ground. The basic objective of operating the repeaters in the first mode is to evaluate the s.s.b. technique for multiple access communications. This technique is a promising approach to the development of a multiple access system where two or more ground stations use the spacecraft simultaneously, since it affords a maximum number of voice channels in the minimum bandwidth of the overcrowded radio frequencies. The repeaters are operated in the third mode for evaluating a high quality f.m. system for relaying wideband data such as colour television, digital and facsimile signals. The f.m. system used for these tests is a refinement of those installed in the Telstar and Syncom communications satellites.

Sophisticated Surplus

A NEW generation of surplus electronic equipment is now becoming generally available on the open market as computer after computer ends its days at the breaker's yard. For instance, at the recent R.S.G.B. exhibition one could buy a bank of 26 unused thermionic digital indicators neatly mounted on a paxolin printed circuit strip and marked with all power supply voltages for the princely sum of 10s (less than the cost of one of the indicators). Clearly there are many bargains about provided the reader is prepared to search for them and separate the wheat from the chaff. Some boards are coated with a thin layer of epoxy resin rendering it extremely difficult, though not impossible, to salvage any usable components. A range of boards, ex I.B.M. computers, do not suffer from this defect and in many cases are usable more or less as they stand for the original purpose they were intended. These boards contain gates, bistables, differential amplifiers, etc., and cost in the region of a couple of shillings each. One example contained four two-input NAND gates that operated quite happily from a 6-V

supply; such boards should prove very useful to schools and colleges. Buying these items is something of a lucky dip and a good deal of time must be spent in tracing out individual circuits to discover what one actually has. The I.B.M. boards may be obtained from Patrick & Kinnie or L.S.T. Components.

Information Services provided by the I.E.E. in the fields of physics, electrotechnology, and control are known collectively as INSPEC. Exploitation and development of this facility is to be assisted by a grant from the Office for Scientific and Technical Information, and by collaboration with the Institute of Electrical and Electronics Engineers, and the American Institute of Physics. The object of this expansion programme in 1968 is to extend the present service (limited to publication of *Science Abstracts* and *Current Papers*) to include a service of selective dissemination of information S.D.I. The above facilities will be changed to a computer-based service, and the present publications will be produced by computer methods from the January issues in 1969. From the same date S.D.I. will come into operation, and magnetic tapes containing data concerning all literature processed by INSPEC will be available.

The possibility of a nationally recognized qualification and title for technician engineers was discussed by 31 engineering institutions and societies and members of the Council of Engineering Institutions on the 1st December. The result was that those organizations who are outside the C.E.I. would group into like interests, and each group prepare and submit recommendations for a joint meeting with C.E.I. in February next.

ANNOUNCEMENTS

Ten weekly lectures on studio audio control equipment begin at the Northern Polytechnic, Holloway, London N.7, on January 11th. The fee is 21s and application forms can be obtained from the Head of Department of Electronic and Communications Engineering.

A series of 12 weekly lectures on piezo-electric devices and their applications will be held at Southall College of Technology, Beaconsfield Road, Southall, Middx., commencing January 17th. The course fee is 6 gn.

A course of six lectures on u.h.f./s.h.f. techniques will be held at Norwood Technical College, Knight's Hill, London, S.E.27, commencing 20th February. The lectures will take place each Tuesday evening. Fee is 15s.

Mr. E. W. Weaver, Director of the London Telecommunications Region of the G.P.O., formally opened London's first p.c.m. telephone link (between Sunbury, Middlesex and Central London) on November 27th.

A new company, **Electronic Brokers Ltd.**, has been formed to collect and offer prompt payment for electronic equipment and components at present lying unused in many British companies. The head office of this company is at 8 Broadfields Avenue, Edgware, Middx.

A series of one-week courses on vacuum technology will be held during 1968 at Edward High Vacuum Ltd., Manor Royal, Crawley, Sussex. Details are available from the Customer Training Officer.

AEI-Thorn Semiconductors, Lincoln, are providing a mask-making service for industrial, academic and research establishments. Sample masks within ten days are offered. Plates of up to two-inches square can have a registration to within 40 μ in.

Film strips and slide sets produced by Mullard will now be distributed by Educational Systems Ltd., ESL House, Imperial Drive, North Harrow, Middlesex. (Tel: 01-868 4400.)

PERSONALITIES

R. I. Walker has been appointed chief engineer of the Semiconductor Division of the Ferranti Electronics Department at Gem Mill, Oldham, Lancs. Mr. Walker, who has been with the company for seven years, occupying the position of deputy chief engineer, was formerly with the Services Electronics Research Laboratory, at Baldock, where he was responsible in the late 1950s for much of the early development work on silicon mesa transistors. Ferranti also announce the appointment of **Alan Williamson** as product marketing manager, discrete components, and **Brian Down** as product marketing manager, integrated circuits. Mr. Williamson has been with the company for seven years latterly as senior field sales support engineer, and Mr. Down, who was formerly in the application group of the Ferranti Semiconductor Division, has rejoined the company after two years with Texas Instruments.

John S. Walker, M.Sc., F.I.E.E., who recently joined De La Rue Instruments Ltd., as managing director, has for the past 10 years been with Texa Instruments Ltd. where he was latterly manager of the Research and Development Department. From 1949 to 1953 Mr. Walker was at Manchester University where he took a course in physics, which



J. S. Walker

he followed by an M.Sc. course in electrical engineering in 1952/53. He then spent two years with Standard Telephones and Cables. In 1955 Mr. Walker joined International Computers and Tabulators and then the British Tabulating Machine Co. before going to Texas Instruments. Mr. Walker is a member of the I.E.E. Panels on Semiconductor Devices and Integrated Circuits.

G. H. Stearman, B.Sc.(Eng.), M.I.E.E., for the past ten years lecturer at the Col-

lege of Aeronautics, Cranfield, where he specialized in electronics and digital techniques, has joined Feedback Ltd., of Crowborough, Sussex, as development department manager. He obtained his degree at Brighton Technical College and was with Cable & Wireless Ltd., for



G. H. Stearman

two years before joining Southern Instruments Ltd. in 1951 where he stayed for six years. In 1964 Mr. Stearman was seconded for a year to the National Aeronautical Laboratory at Bangalore.

D. G. Smee, M.B.E., A.M.I.E.E., commercial director of the Marconi Company since 1965, has been appointed chairman of the board of directors of Elliott-Automation Microelectronics Ltd., which forms part of the Elliott-Automation group of companies recently acquired by English Electric (parent company of Marconi). In this new position he will be responsible for coordinating the activities of Marconi and E.A.M. in the field of microelectronics. Mr. Smee, who is 50, joined the Marconi Company in 1933, working at the Research Laboratories until the outbreak of war in 1939, when he joined the Royal Signals. He returned to Marconi in 1946, and in 1950 became assistant commercial manager. Six years later he was appointed manager of the Company's Broadcasting Division.

D. H. Roberts, B.Sc., M.I.E.E., F.Inst.P., for some time head of solid-state research at Plessey's Allen Clark Research Centre at Caswell, Northants, has become general manager of the company's Semiconductor Division at Swindon in succession to **Brigadier J. D. Haig** who is appointed general manager of overseas plant operations. Mr. Roberts joined the Plessey laboratories at Caswell in 1953 after graduating in physics at Manchester University. Also transferred from Caswell to the Swindon

production team are: **W. Holt, B.Sc., A.R.C.S.**, aged 34, who joined Plessey in 1961 from Marconi's Research Laboratories, and has been chief development engineer at the Allen Clark Research Centre; **R. C. Foss, B.Sc., Ph.D., M.I.E.E.**, aged 31, principal engineer, integrated circuit development, at the Centre, who joined Plessey in 1964 from E.M.I. Electronics; and **M. J. G. Gay, A.M.I.E.E.**, aged 30, who joined Plessey from the Mullard Thin Film Unit in 1964 and has been in charge of circuit techniques research at the Caswell Research Centre.

S. N. Ray, M.Sc., B.Sc.(Eng.), M.I.E.E., F.Inst.P., acting head of the Department of Electrical and Electronic Engineering, Borough Polytechnic, London, for the past year, has retired. Born in Calcutta in 1902, Mr. Ray came to this country after receiving his M.Sc. degree from Calcutta University in 1925 and continued his studies for his B.Sc. (London) and the Diploma of Faraday House. For 11 years he was in the radio industry and joined the staff at the Polytechnic in 1939. He was senior lecturer in radio engineering until he was appointed principal lecturer in applied electronics in 1961. He has been acting head of the Department of Electrical and Electronic Engineering since **V. Pereira-Mendoza, M.Sc.Tech., F.I.E.E.**, became principal in 1966. The new head of the Department is **Kenneth W. E. Gravett, M.Sc.(Eng.), M.I.E.E., A.M.I.E.E.**, who has been senior lecturer in electrical measurements at



K. W. E. Gravett

the Brighton College of Technology. After graduating at King's College, University of London (where he also obtained his master's degree), he served an apprenticeship with the British Thomson-Houston Company at Rugby. He subsequently held appointments at the Post Office Research Station and on the staff of the Battersea College of Technology.

Semiconductor Type Numbering

Some guidelines through the chaos of type code numbers that face you nowadays

By T. D. TOWERS,*

M.B.E., M.A., C.Eng.

THERE is a lovely old proverb that runs: "Who buys has need of a hundred eyes." How true this is when you set out to select a transistor or a diode nowadays from the host of different kinds of type numbers used, either from one of several "standard" systems in operation, or from the non-standard systems used by individual manufacturers. In Great Britain you can come across transistors or diodes of almost any nationality. If you are going to find your way confidently among them, you have to know something of the basic numbering systems used, and these are discussed individually below.

JEDEC system.—Probably the oldest standard numbering system in current common use is the American "JEDEC."† In this, the Electronic Industries Association (E.I.A.), in the United States, registers devices from specifications put up by manufacturers. It uses a numbering system in which the first numeral shows how many diode junctions the device has, with a "1" for a diode, a "2" for a triode transistor and a "3" for a tetrode. After this initial numeral comes an "N," and then the number in serial order under which the device was registered with the authority. As an example, the "2N914" is the 914th triode transistor registered.

By the end of 1967, both 1N (diode) and 2N (triode) numbers registered had passed the 5,000 mark.

Any manufacturer, provided he meets the specification as registered by the original manufacturer with E.I.A., can supply devices to JEDEC numbers. The full details of any individual registered device can be obtained from E.I.A., 2001 Eye St., N.W., Washington, D.C., 20006. Unfortunately, they do not publish an easily available comprehensive authoritative list of JEDEC devices and their characteristics.

PRO ELECTRON system.—Although the JEDEC standard numbering has come into fairly common use in Europe, there is a European standard system, known as "PRO ELECTRON," which is also widely used here in parallel with JEDEC. The organizing authority is the Association Internationale PRO ELECTRON, of 10, Avenue Hamoir, Brussels.

As with the JEDEC system, the manufacturer registers with PRO ELECTRON a device he has developed. Any other manufacturer can then supply devices marked with the same registered number, provided his version also meets the electrical and mechanical specification registered with PRO ELECTRON.

The PRO ELECTRON system has one big advantage over JEDEC. All you can tell from a JEDEC number is whether the device is a diode, triode, etc., and some indication of the time of registration, since low numbers mean the device was registered years ago. With PRO ELECTRON, the letters and numbers used are much more significant.

The PRO ELECTRON type number always has five places: either two letters and three numerals (as in BC107) or three letters and two numerals (as in BCY72). The first letter indicates the bulk semiconductor material used: A=germanium; B=silicon; C=gallium arsenide; and R=compound photo-conductive material.

The second letter indicates the circuit type of the device: A=signal diode, non-power; B=variable capacitance diode; C=transistor, l.f., non-power; D=transistor, l.f., power; E=tunnel diode; F=transistor, h.f., non-power; G=multiple device; H=field probe; K=Hall generator; L=transistor, h.f., power; M=Hall modulator or multiplier; P=radiation sensitive device (photo-diode, photo-transistor or photo-conductive device); Q=radiation generating device; R=specialized breakdown device; S=transistor, switching, non-power; T=controlling and switching device with breakdown characteristics, power (s.c.r. or thyristor, etc.); U=transistor, switching, power; X=multiple diode; Y=rectifier, power; and Z=Zener diode (voltage reference or regulator).

The final three places of the PRO ELECTRON five-place registration number give an indication of the general area of use and a serial number. Where three numerals are used (e.g., BC107) this indicates a device for "entertainment" or "consumer" use; i.e., for radio or television receivers, audio amplifiers, tape recorders, etc. The three numbers run from 100 to 999. Where a letter and two numerals are in the last three places (e.g., BCY72), this indicates a device for use in industrial and professional equipment. The letters (which bear no significance) in this case start from Z back through Y, X, etc. The accompanying serial numbers run from 10 to 99 only.

Sub-classifications are permitted in certain devices such as Zener diodes, power diodes and thyristors (s.c.r.s) in the PRO ELECTRON system. These are indicated by further codings added after a hyphen at the end of the five-place basic number according to a significant system.

For Zeners, the code addition gives information on the nominal voltage and its tolerance. The tolerance appears first as a single letter: A=1%; B=2%; C=5%; D=10%; and E=15%. The nominal voltage follows as a numeral plus the letter V in the position of the decimal point where necessary. Thus BZY88-C9V1 represents a silicon Zener for industrial use, with registration number Y88, tolerance 5% and nominal voltage 9.1 V.

For rectifiers and thyristors, the additional PRO ELECTRON code numbers signify the repetitive peak reverse voltage in volts. Thus BYX36-100 indicates a silicon rectifier for industrial use with registration number X36 and a 100-V rating, while the BTY99-100 represents a silicon thyristor for industrial use with registration number Y99 and a 100-V rating. With

† Joint Electronic Device Engineering Council.

* Newmarket Transistors Ltd.

power rectifiers and thyristors, the cathode is normally connected to the stud mounting. Where the anode is connected to the stud ("reverse polarity"), a final letter R is added. By this a BTY99-100R signifies a reverse-polarity BTY99-100.

Recently supplementary codings have arisen for ordinary transistors, too. You may come across the well-known BC108 in versions coded BC108A, B and C. The final letter suffix in this case denotes a narrow-spread selection of current gain within the wider spread limits of the basic BC108 device.

Old European coding system.—The PRO ELECTRON system has become widely accepted in Europe during the 1960s, and is often referred to as the "new" European system. It has replaced the old European system under which semiconductors were indicated by an initial "O" (standing for zero heater volts in the then existing valve coding). After the initial O came a letter in the coding with A=diode, C=triode, etc., and a registration number. Many readers will remember with nostalgia such codings as the OC71 transistor and the OA81diode. Devices are still being marketed under this old system, but it is to be expected that they will ultimately disappear.

Japanese system.—Japanese transistors appearing for sale and in equipment in Britain over the last decade have faced engineers with a new set of numbers according to a standard widely used in Japan. The first two symbols of the code are "2S" for triode transistor, and the third gives an indication of the general characteristics of the transistor according to the following code: A=p-n-p, r.f.; B=p-n-p, a.f.; C=n-p-n, r.f.; and D=n-p-n, a.f. As an illustration, the 2SA49 is a p-n-p, r.f. transistor with registration number 49.

"Services" standard systems.—On the British market, the user will occasionally come across devices bearing type numbers according to some Government standard.

The commonest of these are the "CV" types, where the type designation consists of the letters CV followed by a four- (and recently five-) digit number. In the future this is likely to be supplemented by a separate British Standard (BS9000) series arising out of the work of the celebrated Burghard Committee.

The British Post Office, too, has in the past issued its own series of semiconductor specifications and users may come across these in a self-evident numbering series, PO1, PO2, etc.

The only other Government numbering system the

ordinary user is likely to meet is the American "Mil. Spec." series corresponding to the British "CV" system. Under this coding, devices are normally specified as the corresponding commercial JEDEC number with the prefix "JAN" added; e.g., JAN 2N3093 is the Mil. Spec. version of the 2N3093. This is the current procedure, but Mil. Spec. devices may also be found coded under the previous system, where the prefix indicated the branch of the services sponsoring the device. The single JAN prefix now used replaces the separate prefixes USA, USAF and USN formerly used. The "Mil. Spec." jargon name for these devices arose because they were related to a specification document numbered Mil-S-19500, where the individual devices were distinguished by a suffix number; for example, the 2N914 has the designation Mil-S-19500/373 in its military version.

House Codes.—Most manufacturers sell semiconductor devices under their own special series of "house" numbers, as well as under numbers according to one of the standard systems. Some of these house codes have woven themselves firmly into the structure of the British market, and it will be long before they disappear.

Some guide to the transistor house codings is given in Table I, which shows the more common initial letters used by semiconductor manufacturers in the U.K. Diode house codes tend to be much more numerous and less distinctive than transistor codes and are not therefore included.

Apart from the house numbers put out in published data, semiconductor manufacturers sell a considerable portion of their output under special or "private" house numbers. Little guidance can be given on this to the general user, but, if he comes across a device the characteristics of which he cannot trace, he can always write to the manufacturer (whose name should appear on the device along with the type number).

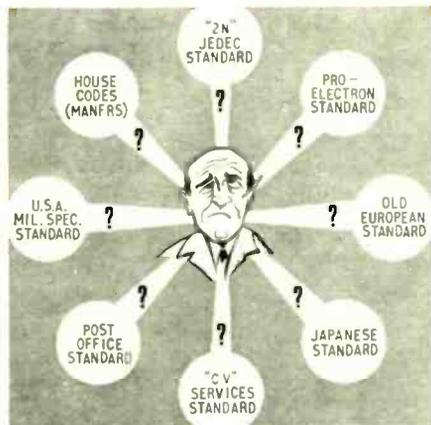
A final mystifying feature of transistor numbers is that large users frequently lay down their own "in-house" specifications with their own code numbers, and manufacturers mark the devices they supply with these "in-house" numbers. When you come across one of these, it is, I fear, not easy to find out details of its specification.

INFORMATION ON SEMICONDUCTOR DEVICE TYPES

Having discussed the many different methods of coding a semiconductor device which may be met with in practice, the reader can be forgiven if he thinks: "That is all very well, but where can I go to find out the characteristics of any particular device?" In the case of a device in a standard numbering system such as JEDEC or PRO ELECTRON, he could write direct to the registration authority, but this can be a long and expensive procedure. The ordinary engineer-in-the-street usually turns to one of the commercial publications described below.

The most complete current commercial tabulations of data on semiconductor device types are published by Derivation and Tabulation Associates, Inc., of 32 Lincoln Avenue, Orange, New Jersey, 17050, U.S.A. Three of their publications circulate world wide among semiconductor users.

Transistor D.A.T.A. Book.—This is a characteristics tabulation for virtually every transistor (about 13,000 types at the time of writing) commercially available in the world. It is completely revised biennially in Spring and Autumn, with separate updating supplements in



Pity the poor engineer faced with the chaos of semiconductor device numbers in many different systems.

Summer and Winter. The annual subscription is currently \$30.50 in the U.K. It does not include obsolete transistors, but there is a separate publication for these.

Discontinued Transistor Yearbook and Replacement D.A.T.A. Book.—This is an annual edition issued each Summer and is a compilation of all discontinued types since 1956. Each edition costs \$15.25 in the U.K. Diodes are covered by a third publication.

Semiconductor Diode and SCR D.A.T.A. Book.—This covers virtually every type of available diodes and already runs to some 66,000 entries. It is issued in complete revisions in Spring and Autumn and the annual subscription is \$39.50 in the U.K. These three "D.A.T.A." books give sufficiently detailed tabulation of characteristics for most uses of the devices, and in addition give mechanical outlines. For the user of many semiconductor types, they have become almost "bibles." But they are expensive, and less ambitious students have to turn to more modest publications.

Iliffe's Radio Valve Data.—This data tabulation (covering transistors and diodes as well as thermionic valves) is the successor to the well-known *Wireless World* Valve Data Manual and still costs only a modest 9s 6d. Even so, it is probably the best easily available data tabulation for British semiconductor devices, and it has the useful feature of being brought up-to-date regularly.

Avo's International Transistor Data Manual.—This transistor tabulation, issued by Avo Ltd. for use with their commercial transistor tester, is also marketed separately at 45s. It, too, is a most useful general data tabulation, with many features not commonly found. For example, it contains listings of CV and Russian transistors.

Other commercial tabulations.—There are a number of other commercial listings of transistors published, but they are generally less useful than those described above, either because they tend to go out of date or are aimed primarily at a non-British market. For completeness, however, some of the more easily available are listed below:

- (i) "Techpress" Transistor Specifications and Substitution Handbook, 1967, by Techpress Inc., Brownsburg, Indiana 46112.
- (ii) Transistor Specifications Manual, by Foulsham-Sams Technical Books, W. Foulsham and Co., Ltd., Slough, Bucks.
- (iii) "Datadex" Transistor Reference Book by M. W.

TABLE I
INITIALS OF TRANSISTOR HOUSE CODES IN COMMON USE BY MANUFACTURERS IN THE U.K.

| | |
|--------------------------------|--|
| C, CP | SGS-Fairchild |
| DT | Lucas Semiconductors |
| FI, FK, FM, } FSP, FT, FV } | SGS-Fairchild |
| GET | Mullard-G.E.C. (Assoc. Semiconductors) |
| GM | Texas Instruments |
| HT | Emihus |
| M | Motorola |
| NKT | Newmarket Transistors |
| P | SGS-Fairchild |
| PEP | A. E.I. Semiconductors |
| V | Newmarket Transistors |
| SE | SGS-Fairchild |
| TI, TM | Texas Instruments |
| TK | S.T.C. |
| ZDT, ZT, ZTX | Ferranti Semiconductors |
| ZG, ZS | Texas Instruments |

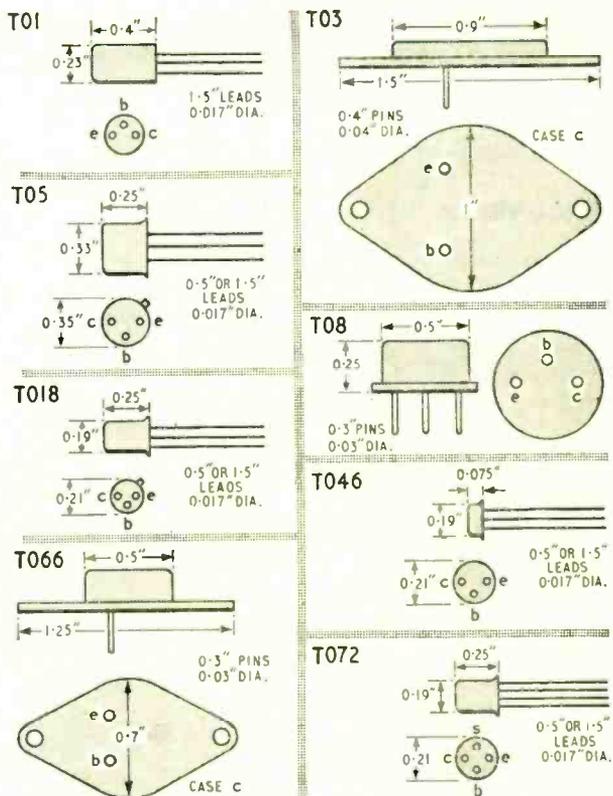


Fig. 1. Simplified mechanical details of the more common standard JEDEC "TO" transistor outlines (Typical dimensions only).

Lads Publishing Co., Philadelphia, P.A.
(iv) British Transistor Directory, by E. N. Bradley, Norman Price (Publishers) Ltd., London.
(v) Guide Mondiale des Transistors, by Société des Editions Radio, 9 rue Jacob, 75, Paris, 6.

In all this, it should not be overlooked that if you write to any semiconductor manufacturer he will be pleased to send you information on his devices.

INFORMATION ON SEMICONDUCTOR OUTLINES

In the early days of transistors, fifteen years ago, manufacturers invented their own device shapes and lead configurations, but of recent years there has been considerable standardization.

JEDEC outlines.—As in device numbering, the E.I.A. in the U.S.A. led the way in outlines. It registered the dimensions of certain preferred cases or encapsulations for semiconductor devices under "TO" (transistor) and "DO" (diode) outline standard numbers. Full details of the outlines so registered can be found in the JEDEC publication 12E, "Registered Outlines and Gauges for Semiconductor Devices." You can also find the JEDEC outlines at the end of the D.A.T.A. publications described earlier.

Some of the registered JEDEC outlines have virtually dropped out of use with time, but certain "standard" ones have been adopted by most manufacturers. In transistors, the commoner outlines in use are TO1, TO3, TO5, TO8, TO18, TO46, TO66, and TO72. Simplified drawings of these are given in Fig. 1.

VASCA outlines.—Over here some moves towards outline standardization have been made. A "Record of Semiconductor Outlines" from the Electronic Valve and Semiconductor Manufacturers' Association, Mappin House, 156/162 Oxford Street, London, W.1, gives details of the VASCA system, in which outlines are registered under an "SO" (semiconductor outline) number related to the American "TO" JEDEC numbers. VASCA also registers semiconductor lead configurations under an "SB" (semiconductor base) series.

I.E.C. outlines.—A separate standard numbering system for registered outlines has been developed by the International Electrotechnical Commission (I.E.C.), 1 Rue de Varembe, Geneva, Switzerland, and issued in their Publication 191-2, "Mechanical Standardization of Semiconductor Devices." Both this and the VASCA publication relate their standard outline numbers to JEDEC and to other standards.

CV outlines.—In the numbering of semiconductor outlines, you may come across the British Government CV system which typifies various outlines according to an appendix number to a semiconductor code popularly known as K1007. Thus probably the commonest encapsulation for silicon small-signal transistors appears as K1007/A1-D14, as well as JEDEC TO18, I.E.C. 2-106, and VASCA SO12A.

CONCLUSION

Although we have examined most of the multifarious type and outline coding systems used by manufacturers, it would seem at long last standardization is beginning to take hold. The bulk of semiconductor devices used in the British market in the future are likely to be coded on either the PRO ELECTRON or the JEDEC numbering systems (with a few house codes sprinkled around), and outlines will generally be described by the JEDEC "TO" system.

Units and their Abbreviations

READERS may have noticed that we have been gradually introducing the hertz (Hz) as the name for the unit of frequency in place of c/s over the past few months. Much was said in support of both of these names in the course of an argument in our correspondence columns early in 1967, but there is no question that the hertz is now being widely adopted and is here to stay. *Wireless World* therefore intends to standardize on Hz, together with its multiples, kHz, MHz, GHz and THz.

Since the hertz is an internationally recommended name for one of the derived SI (Système Internationale) units,* this seems an appropriate time for *W.W.* to standardize on SI units generally. In practice this means that there are no changes to the most common electrical units and their symbols (V, A, Ω, W, C, J, F, H, etc.). Since, however, SI is really a development of the m.k.s. (metre-kilogramme-second) system and therefore brings in metric units for length and mass in place of British measures, some of the other SI units appropriate to electronics and communications may be rather unfamiliar. A selection of these is listed (right) with comments. With frequency it has only been necessary to change the *name* of the unit—its value has not been affected. The SI unit names in the table, however, represent units of different size from the older-established units, and so one has to use conversion factors to change the older units into SI units or vice versa.

Although the basic unit of length in the SI system is the metre, it would obviously be impracticable, at the present juncture, to abandon the British inch, foot, yard and other units of length completely. These will still be widely used in physical dimensions, for example chassis and cabinet sizes. We shall therefore adopt a policy of introducing the metric units of length gradually,

* See B.S. 3763: 1964 "The International System (SI) Units." Also "Changing to the Metric System" (N.P.L. booklet), H.M.S.O. 3s 6d. The basic SI units are the metre (m), kilogramme (kg), second (s), ampere (A), degree Kelvin (°K), and candela (cd). Supplementary units are the radian (rad) and the steradian (sr). All other units are derived from these, and the system is coherent in that any SI unit results from products and/or quotients of other SI units.

| Quantity | Unit and Abbreviation | Remarks† |
|--|---|--|
| Short wavelengths (as in light) | micron (μm) | Replacing angstrom unit (Å) |
| Force (as in transducers) | newton (N) | = kg m/s ² . Replacing pound-force (lbf), poundal (pdl), dyne (dyn). |
| Pressure (e.g. acoustics, transducers) | newton per square metre (N/m ²) | Replacing lbf/in ² , dyn/cm ² , inH ₂ O, mmHg, torr, bar, atm. etc. |
| Magnetic flux | weber (Wb) | = V s. Replacing lines, Maxwell. |
| Magnetic flux density | tesla (T) | = Wb/m ² . Replacing gauss, lines/cm ² , Maxwells/cm ² . |
| Magnetic field strength | ampere per metre (A/m) | Replacing oersted. |
| Illumination (e.g. television, opto-electronics) | lux (lx) | = lm/m ² . Replacing foot-candle, lumen per square foot (lm/ft ²). |
| Luminance | candela per square metre (cd/m ²) | Replacing foot-lambert, cd/ft ² , cd/in ² . |

† Conversion factors between SI and other units are given in the N.P.L. booklet "Changing to the Metric System"

in some cases using them alone, in others printing them alongside the British units. A similar method of gradual introduction will be adopted with other physical quantities for which the present, non-SI, units are widely used and familiar to our readers.

OUR COVER

THE theme of colour television is portrayed by the dichroic prismatic separation system employed in the Philips three-Plumbicon camera. Several of these cameras, which are marketed in the United Kingdom by Peto Scott, are being used by the B.B.C. for its colour service which opened on December 2nd.

2: THE DESIGN OF A CIRCUIT

By K. C. JOHNSON, M.A.

THE first article in this series considered the advantages and disadvantages of the class D principle of operation for power amplifiers in general and for transistor audio circuits in particular. The conclusion formed was that the class D principle does not lead to any overwhelming advantages and that such circuits are not likely to displace the conventional class B type on any large scale. Nevertheless, they do have considerable intrinsic interest and readers may like to see a circuit that the author has developed which attempts to exploit as many of the special features of the class D principle as possible. This circuit uses the simple feedback form of modulator for generating the switching wave form, despite its comparatively poor distortion characteristics, since any improvement requires unjustifiable extra complexity. The last two stages work in class D; three might have been so employed to give a lower standing current in exchange for a lower maximum output amplitude and lower efficiency at the larger output levels. The top-cut filter at the output is a simple choke, although some small improvement in performance could be gained by using a more complicated network.

OUTPUT STAGE DESIGN

The circuit diagram of the complete amplifier appears in Fig. 4. It will be seen that the two final transistors Tr6 and Tr7 are employed as switches to provide a powerful square-wave voltage source from which current is drawn through an audio band filter to the loudspeaker; essentially as shown in Fig. 2 last month. The diodes D2 and D3 are included because the relatively low frequency current required for the loudspeaker in such an arrangement will often be flowing "backwards" with respect to the voltage being generated by the switching action and this backwards current is carried by these diodes. It cannot be carried by the transistors unless they are made to meet severe "symmetrical" ratings in addition to the other difficult requirements, since the currents involved are substantially equal to the peak currents that the devices must be able to carry in the forward direction. Notice that this reverse current is carrying power back from the reactive components in the filter network to the power supply, and that it is directly because of this returning of unwanted power that the class D system is potentially so highly efficient.

The two transistors thus work in conjunction with the diodes opposite to them, as is indicated in the drawing; when large amplitudes are being handled only one such pair is switching the real current at any one time while the other carries little or nothing. Because the variations in the audio signal are comparatively slow it is possible to connect the centre-tapped inductor L_1 as shown on the diagram without any significant effect on the basic switching action. When, however, real transistors are

being switched at a speed approaching the limit of their capabilities it will always in practice be found difficult to ensure that a perfect "break-before-make" action is obtained, and this inductor helps to prevent any serious build-up of unwanted current due to this transient overlap of transistor conduction. In this circuit the strapping of the bases of the drive stage, Tr4 and Tr5, ensures that such overlaps will never be very serious, but the extra inductor costs little and enables the transistors to be switched that tiny bit faster with better standing current. The detailed design of this stage, and indeed of the whole circuit depends on the characteristics of the transistors selected for the positions Tr6 and Tr7. As has been said already this choice is difficult; if it were not so, a complementary pair of devices would be employed and several advantages realized, but at present it is difficult to find a single adequate type and hence an arrangement of the form familiar in conventional circuits is used, where only the drivers Tr4 and Tr5 need be complementary. Accordingly a single transistor type serves for both positions, so that reasonable matching is easily achieved. The device chosen is the Fairchild BC119, this allows a maximum current of 1 A, with guaranteed saturation to 1.5 V when the base drive is 100 mA, it has a cut-off frequency of at least 40 Mc/s and a maximum voltage, at any allowable current level, of 30 V without avalanche breakdown. It is an n-p-n silicon planar epitaxial transistor in a TO5 case.

The use of this device, to within its ratings, fixes the power supply voltage at a maximum value of 30 V. If, as proposed last month, the modulation level is restricted to 60% of the ultimate value on account of the sideband distortion effects, then the available output amplitude at the loudspeaker cannot possibly be guaranteed to exceed ± 7.5 V because of the allowances that must be made for ohmic losses in both the transistors and the filter network. If, moreover, the current is also held within the allowable limit then the maximum useful value will be about ± 0.8 A after taking into account the ripple in the filter. Therefore, the maximum output power that can be guaranteed is 3 W average into a loudspeaker system that has been adjusted to present a load of exactly 9.5Ω . Into a speaker of different impedance the power limit will be lowered, since either the voltage or the current will be unable to reach its full value.

Needless to say any pair of transistors of this type will almost certainly be found to function perfectly well at twice this current and at larger voltages as well, so that more power will in fact be obtainable, but there can be no guarantee of this and neither the manufacturers nor the author can be blamed if devices fail. In a conventional circuit these same transistors can be used up to 60 V where they are always cut off before voltages above 30 are applied. Since the full 1 A current can also be used the power limit for a pair in class B working

is about 14 W into a load of 28 Ω ; over four times more than with class D! For this output to be maintained for any length of time heat-sinks are mandatory, but this presents no real difficulty, while the very high frequency cut-off allows a large factor of feedback to be applied without any serious stabilization problem.

The diodes for the positions of D2 and D3 must be able to carry the same peak voltages and currents as the power transistors and here the selection of a suitable type is even more difficult since the forward voltage drop must be small to avoid unnecessary turning on of the opposite transistor⁵ and the switching speed has to be fast. The Fairchild type EB 383 can stand the reverse voltage, but the published limit values of stored charge and capacitance are barely adequate while the forward characteristic is not specified at all for currents exceeding 50 mA. To be able to guarantee the performance of the circuit a more exotic diode type ought have been employed; unfortunately none are readily available. However, the specimens of EB 383 that the author tested have proved to be entirely satisfactory. The diodes for use with these transistors should really be able to carry a forward current of 1 A at less than 1.5 V, a capacitance of not more than 10 pF and a charge-storage characteristic equivalent to a time of perhaps 10 ns.

The driver stage, comprising Tr4 and Tr5, requires a pair of complementary devices each capable of delivering a peak current of 100 mA or more to the final transistors, with approximately matched speed and saturation characteristics. Notice that in this form of circuit the drive current is not delivered unless the load demands it, and that the final transistors are not turned on at all unless the output current exceeds perhaps 25 mA in the appropriate direction (due to the low value used for the resistors R_{18} and R_{19}). This low value for the base resistors also ensures that the final transistors are switched off rapidly when required. The driver transistors must be able to stand the full supply voltage without breakdown and have adequate speed, but the current levels

are so much lower that the selection of suitable types is comparatively easy. From the Fairchild range type BC 125 will serve in n-p-n position while BC 126 is the matching p-n-p device. Both these types are TO5 size but are encapsulated in plastic. The bases of the drive transistors are connected directly together since there is no critical adjustment of cross-over current needed and a bit of "slack" is indeed desirable to reduce the effects of both the top and bottom devices being turned on at the same time.

The centre-tap of the inductor L_1 provides a symmetrical output for the switching stage and it is from here that the "bootstrap" capacitor C_8 , the feedback network R_9 , and the main filter inductor L_2 are all driven. The value of L_2 is chosen to be 250 μ H and represents a compromise between the need to keep down the ripple current at the switching frequency, which causes inefficiency and reduces the available output current, and the requirement that the high audio frequencies must not be restricted. Clearly a more complicated filter network with a sharper cut-off could have been used, but the design of such an arrangement would involve nothing new and, moreover, it is rather doubtful whether the improvement would justify the trouble. Remember that these inductors must be able to carry the full loudspeaker current without magnetic saturation effects being significant, while the resistance of the windings is a major contribution to inefficiency at high power levels and must be kept low. Thus these components must inevitably be comparatively expensive and bulky.

Fig. 5 shows how both of the inductors L_1 and L_2 can be made as a single unit using two pieces of standard ferrite aerial rod for the magnetic circuit. If the reader can obtain properly designed ferrite "pot" cores then a conventional winding for each inductor can of course be used, but remember that an adequate air-gap is essential and that the capacitance between the ends of L_2 must be kept particularly small to avoid high frequencies reaching the loudspeaker leads.

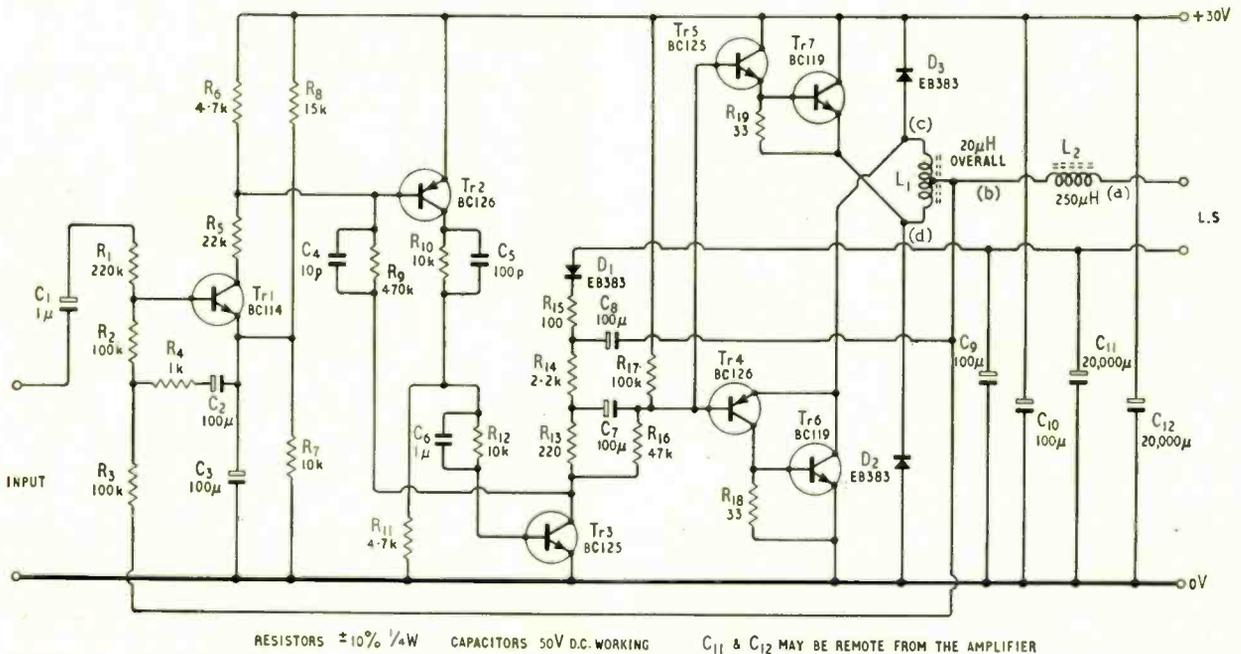


Fig. 4. The circuit diagram of the amplifier.

To construct the coils wind a layer of thin insulating tape round two pieces of ferrite rod 0.3 inches in diameter and 1.5 inches long. L_2 is made up of 50 complete figure-of-eight turns of 32 s.w.g. enamel covered copper wire, care being taken to ensure tight packing at the cross-over point. L_1 consists of 10+10 turns wound in a single layer, round both rods, using the same wire. The assembly is completed by winding with a layer of insulating tape to hold the turns in place. Using this form of construction the measured values of the coils were: $L_1=5.6 \mu\text{H}$. 0.16Ω (each half). $L_2=250 \mu\text{H}$. 0.8Ω . The 50 or so complete turns required are not difficult to wind by hand and form an inductor with a not too inefficient arrangement of copper, ferrite and air-gap which has a very low capacitance and doesn't require a specially made core assembly. Notice that the mutual inductance of the two coils wound in this way is comparatively negligible so that there is no question of having to connect L_1 , the proper way round, and also that no exact balance between the two halves is necessary.

The loudspeaker is connected directly to this inductor while the d.c. blocking capacitors, C_0 and C_{11} , in parallel are between the loudspeaker and the power supply. This is a transposition of the arrangement shown in Fig. 2 last month, but there is of course no difference in the method of operation. The change is made partly to avoid the appearance of signal voltages on components which will inevitably be large, but mainly so that the "bootstrap" circuit can draw its current from these capacitors and so get it for "half price." This rather surprising possibility comes from the fact that the voltage on C_0 remains substantially constant at about half the supply voltage and that the switching circuit maintains this value by an efficient transformation action. If a current averaging 10 mA is drawn from C_0 , then a current of this magnitude will flow in the inductor L_2 , but the transistors Tr5 and Tr7 will carry this current, on average, for only half the time, so that the steady drain at the power supply is only 5 mA or thereabouts instead of 10. A further power saving in the "bootstrap" action is obtained by using a diode D1, rather than the usual resistor, to draw the current for charging the capacitor C_0 . This becomes possible in the class D circuit since the regular switching action ensures that this capacitor is fully recharged every cycle of the carrier frequency. The capacitor C_0 is, therefore, maintained at almost half the voltage of the power supply, when the circuit is in operation, and provides a source of extra voltage to ensure that Tr5 is adequately saturated when Tr3 is cut off, in the usual way.

It will be noticed that C_0 and C_{11} are shown to be connected in parallel on the circuit diagram and also that C_{10} and C_{12} are similarly arranged. This is done simply to emphasize the point that return capacitors for the fast switching currents must be mounted within one inch or two of the transistors to reduce radiation. It will not be practical to mount the whole of the large capacitor that is required at this position. Accordingly it is suggested that a relatively small part of the capacitance (even $100 \mu\text{F}$ is only 0.5% of the total) should be mounted close to the transistors while the remainder may perhaps be a few feet away as convenient. It will be seen that these capacitors are not connected as a bridge, but that C_{10} and C_{12} are across the whole voltage while the half-way rail is only bypassed downwards. This is done to reduce the effect on the signal of ripple on the supply due to the use of a simple cheap rectification circuit. If a good smooth power source is available then the capacitors can be used more economically if C_{12}

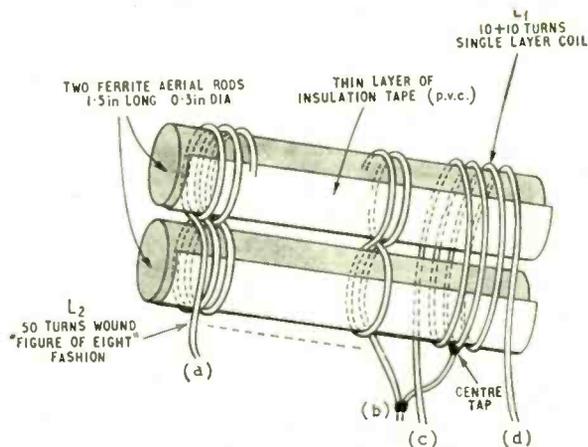


Fig. 5. Showing how to wind the inductors.

has its negative end transferred to the half-way rail, smaller values will then serve for the same low frequency performance. With this circuit the switching action may start appreciably sooner after switching on if the capacitors are connected as a bridge, but this is not a very important consideration for most applications.

INTERMEDIATE STAGES

The two stages comprising Tr2 and Tr3 together form the hysteresis circuit shown in Fig. 3 last month. Complementary transistors are used in these positions but the requirements are not as severe as for the more powerful stages, except that Tr3 has to be able to carry a slightly greater peak voltage due to the "bootstrap" circuit arrangement. The current level is so very much lower that the same types can be used as in the driver stage without any worry about the ratings being exceeded.

It has already been described how the capacitor C_8 carries a "bootstrap" voltage generated from the switching square-wave by the action of the diode D1. The resistor R_{15} is included solely to limit the diode current to a safe value during transients; note that R_{14} , below it, is the main load resistor for Tr3. The drive voltage developed by this resistor is transmitted to Tr4 and Tr5 through the capacitor C_7 , and the a.c. coupling action of this capacitor ensures that the drive is substantially balanced in the two directions. Thus both Tr4 and Tr5 receive adequate currents to make certain that they saturate properly and that the minimum voltage is dropped in the final transistors so as to give both high efficiency and to avoid the generation of second and other even harmonics that would result from unbalance in the action. Once the proper operation of the circuit is established the few microamps carried by R_{16} and R_{17} become negligible in comparison with the base currents that the driver stage receives through C_7 . These resistors must be included, however to ensure that there is a sufficient amount of d.c. coupling between these stages to give a satisfactory "self starter" action. If at any time the circuit is not self-oscillating, there is a feedback action which automatically brings the various voltages towards their correct values, since with these resistors in circuit there is a d.c. coupling at every stage round the loop. If, for example, the voltage on the capacitor C_{11} is too low, then this feedback cuts off Tr1, so that Tr2 and

Tr3 are also cut off. R_{17} causes Tr5 to conduct, and the voltage across C_{11} is made to increase. Conversely, if C_{11} has too high a voltage it is "pulled down" by both Tr3 and Tr4. This action may be expected to take a few seconds whenever the amplifier is turned on. As it comes to an end the trigger circuit, Tr2 and Tr3, will switch, and when this happens a relatively large current flows through C_7 so that a powerful action occurs and the correct voltages for the proper working of the amplifier are set up within a few milliseconds.

The coupling from the collector of Tr2 to the base of Tr3 is designed to transmit switching edges as effectively as possible. When Tr2 is turned on the small capacitor C_5 injects a "shot" of charge into the base of Tr3 so that it comes on very quickly. When turning off is required, the relatively large capacitor C_6 is available to provide a reverse bias equal to the maximum permitted base-emitter voltage and the comparatively low value of R_{11} allows a considerable reverse current to flow, so that again the action is very rapid. R_{10} fixes the steady base current in the on condition while R_{12} is used to set the voltage on C_6 . The changes of mark-space ratio that are an essential feature of the action cause small variations in the voltage on the capacitor C_6 , but these have no serious effect on the working.

The reverse coupling through R_9 and C_1 causes the required trigger effect by contributing a positive feedback current to the base of Tr2. Again there is a small capacitor to deliver a "shot" of charge to the base, it works both ways this time, and a resistor to give a d.c. action. It will be noticed that this feedback is taken directly from the collector of Tr3 whereas the resistor R_{13} is included in series with the capacitor C_7 which transmits the main current to the output stages. This resistor serves two purposes. First, it evens out the quantity of current sent to Tr4 as C_7 discharges and its voltages gets less during loud low notes when the mark-space ratio may differ from 50:50 by a considerable amount for a comparatively long time. Secondly, it ensures that each action of the trigger circuit is irrevocably started before any significant slackening of the drive to the output stages is allowed to occur.

THE INPUT STAGE

It will be remembered that in the simple feedback modulation arrangement, which was explained last month (Fig. 3) and which is used in this amplifier, the first part of the circuit serves to integrate the error of the system. Notice that this error signal is not small, as in most ordinary feedback systems, since the output from which the feedback is taken is the full size switching square wave without any smoothing from the filter choke L_{22} . It is an essential feature of this system that the low frequency components in this error are kept small by the operation of the circuit. They cannot, however, be made to be exactly zero in this simple arrangement, as will be seen in the final article, and it is this finite error which causes most of the distortion in this form of amplifier.

In Fig. 4 the error is obtained as a current resulting from unbalance in the negative feedback network formed by R_{11} , R_3 , R_4 and R_5 , and it is made to flow into the base of transistor Tr1. The integration action comes from the familiar Miller effect, using the capacitance between collector and base within the transistor itself together with the voltage swing developed at the lower end of R_5 . No extra capacitance is added to ensure that the contribution to this voltage from the resistor R_5 is made as large as possible in comparison with the swing at the

base of Tr2. This is because the latter will contain a component due to the positive feedback current from R_9 and perhaps also some non-linearity which will both introduce inaccuracy into the integration action and hence possible extra distortion at the output. Observe that the value of R_5 can be altered if an adjustment of the carrier frequency of the finished circuit is required for any reason. The current in Tr1 thus essentially slides smoothly up and down, with the integration of the error, between limits at which it causes the trigger pair, formed by Tr2 and Tr3, to switch by overcoming the positive feedback current from R_9 .

The level of current chosen for Tr1 is a compromise between the requirement that the transistor must carry enough to accommodate the necessary swing without serious non-linearity at the emitter, and the need for it to still have sufficient collector voltage, even when R_5 is made relatively large, for saturation to be avoided and for the collector-base capacitance to be reasonably constant. The choice of R_5 determines this current, since this resistor must develop the right voltage to keep Tr2 near its switching point, the average value in this circuit is made to be about $120\mu\text{A}$. A transistor type must thus be used which has a good performance at low levels of operation, for this the Fairchild BC 114 is very suitable. It has a typical current gain of over 200 at this current as well as both low noise and adequate ratings for voltage and speed. This device again is packaged in plastic but is of the small TO 18 size.

The emitter of this stage is held at almost half the supply voltage by the resistor chain R_7 and R_8 , while C_3 provides a bypass path to the negative rail. Since the feedback through R_3 and R_4 is fully effective at very low frequencies, due to the inclusion of C_1 and C_{23} , this arrangement automatically holds the average voltage at the output of the final switching pair at the centre of the available range. This also means that the mark-space ratio of the switching square wave is made to have an average value of 50:50. Ordinary tolerance resistors will normally serve adequately for the positions R_7 and R_8 , but their values may be adjusted if more exact fixing of the average level is needed.

The use of a split attenuator for the feedback, with C_2 at its centre returned direct to the emitter, allows Tr1 to draw an appreciable amount of steady base current without upsetting this d.c. action, while at the same time it permits a high value of gain to be obtained in the audio band where C_2 has a low impedance and the attenuator has its full effect. The feedback then sets the overall voltage gain at a value which in this circuit is about 45 times. The input impedance is determined directly by the resistor R_{11} , since the base of Tr1 is a "virtual earth," and the value chosen, $220\text{k}\Omega$, is a compromise between the gain obtained in the amplifier and the distortions introduced by the inaccuracies in the feedback action due to the current and the voltage swing at the base of Tr1.

FEEDBACK ERRORS

An estimate of the magnitude of these inaccuracies can be obtained by considering the working conditions of the first transistor. Its mean collector current is around $120\mu\text{A}$ and the variations necessary to give switching of the trigger arrangement will be perhaps $\pm 20\mu\text{A}$. Thus the voltage swing at the base-emitter junction needed by the mutual conductance, will be roughly $\pm 10\text{mV}$, while the base current changes required by the current gain will typically be $\pm 0.1\mu\text{A}$. Now these two effects are essentially similar, and as the impedance of

the feedback network as seen by the base is about 100 k Ω , assuming a high impedance at the amplifier input terminals, the current swing is just equivalent to a further ± 10 mV so that the two effects can be combined as a single effective voltage of ± 20 mV at the base. However, we can if we wish consider this voltage as if it were an extra unwanted input added to the normal input, and its effective value is then ± 64 mV as we must allow for the action of R_1 and R_2 . The waveform of this voltage corresponds to the integral of the error of the overall feedback loop, by virtue of its derivation. That is to say that it is approximately triangular in shape with the peaks at the well defined constant levels quoted above but with the sloping parts changing with the input waveform. But since the error of the modulation system we are using is known from the theory to be given next month, its integral is also known. Each component of the error will be multiplied at the output by the factor $1-j(2/\pi)(f_c/f_E)(64/300)$ where j and the frequency ratio are the direct result of the integration, f_c being the carrier frequency and f_E the frequency of the error component under consideration; $2/\pi$ is a constant and the $64/300$ is a measure of the magnitude of this effect compared with the input required to give a fully modulated square wave at the output. It will be noticed that this distortion effect appears to be most serious at low frequencies, but as we shall see next month this is just where the basic modulation distortion is least, so that the results are not necessarily so catastrophic as they seem.

A further inaccuracy in the action of the feedback arises from the fact that when the trigger circuit, Tr2 Tr3, switches there is a small step in the voltage at the base of Tr2, apart from the quick kick due to the action of C_4 . This causes a corresponding step in the current through Tr1, due to the action of the integration capacitance in holding a constant voltage at the collector. It has already been pointed out that the use of a relatively large resistor for R_3 reduces this effect, but even with this circuit the voltage step will be perhaps 200 mV, so that the current will jump about ± 5 μ A. This means that in addition to its smooth integration current change the transistor is carrying a further ± 5 μ A of current swing which follows the square wave switching action. In exactly the same way as before this can be represented as an additional signal at the input terminals, and its effective value is then ± 16 mV. There is no integration involved here and the effect is to increase not only all the distortion components by a uniform factor of $1+16/300$ but the main signal as well, so that there is no practical effect on the distortion at all. The ratio $16/300$ comes from the effective amplitude at the input due to this effect and the input required to fully modulate the square wave as before.

Notice that both these imperfections only introduce distortion in proportion to that which has already been generated by the failing of the basic modulation process itself. If this could be reduced these effects could become less important. Clearly, however, the design of this stage could be altered fairly easily so as to reduce them directly at the expense either of a loss of overall amplifier gain or a need for additional transistors. In this circuit the gain and economy have been preferred to the relatively small advantage that would result from their reduction. It is interesting to observe that it is the second of these two effects, the one that increases the gain by a more or less constant factor, that governs the success of the feedback in eliminating the distortions caused by errors in the edge timings and the amplitude of the square wave at the output. The factor $16/300$

indeed also represents the amount to which these effects are reduced by the feedback action. An apparently dramatic improvement might perhaps be gained here by the simple addition of a resistor of about 3 M Ω directly between the collectors of Tr2 and Tr1. This could be adjusted so as to exactly compensate the effect of the voltage step, but the author has not investigated this.

CONSTRUCTION AND TESTING

In constructing this circuit it must not be forgotten that switching edges of duration shorter than 1 μ s are essential in its working, so that the layout must be neat and compact with no signal leads more than an inch or so in length. All the components, except the two large capacitors, can easily be mounted on a plastic board about 4in \times 3in, and there are no special heat sink arrangements required for the final transistors. The power supply must be able to provide about 300 mA maximum current at 30 V, usual input and loudspeaker arrangements being made.

When switched on a circuit of this type should begin to function within a few seconds, but a brief pause must be expected as the voltages on the capacitors are brought to the correct values and then a faint "tick" will be heard as the self-oscillation commences. When switching on for the first time it may save needless expense if resistors of about 100 Ω are put in series with both the loudspeaker and the power supply. This form of circuit is not worse than class B in this respect, indeed it is rather better, but these resistors may prevent serious damage to the expensive semiconductors in the event of faulty components or wiring errors. With them included in the circuit low amplitude signals should be reproduced reasonably well and the various voltages and currents may be checked before they are removed.

If the circuit is not functioning correctly then a fault has to be found, and as the reader may be perhaps unfamiliar with this type of circuit some guidance will be given. If the circuit is not oscillating then each stage round the loop must have its d.c. state examined until a point is found where the output is not as would be expected (bearing in mind the present d.c. input conditions (regardless of the a.c. input)). When this is done the fault is usually found quickly and correct functioning obtained. If on the other hand, the circuit is already oscillating then there is little difficulty in finding a break in the signal path in the usual way.

The circuit as shown in Fig. 4 has more than enough sensitivity to give a good output when driven directly from a normal crystal pickup or microphone, but there is, of course, no objection to the use of any of the usual forms of pre-amplifier if more gain or tone control facilities are required. As explained already, no claims for outstanding quality of reproduction can be made for this circuit, but it is hoped that some contributions have been made towards the exploration of the possibilities. To obtain more bass response simply increase the value of all the electrolytic capacitors; but for almost any other improvement, more power, less distortion, more gain or higher efficiency, it will almost certainly be necessary to find a superior type of transistor for the final stage and modify the design along lines that have been suggested.

Next month's article will discuss in more detail just what the errors introduced by pulse width modulation are, and how they could in principle be reduced.

REFERENCE

- Letters to the Editor, M. D. Salmain, *Wireless World*, June 1965.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Burghard Committee and Common Standards for Components

WITH great enthusiasm many are engaged in preparing or awaiting the publication of the new British Standards for electronic parts in the B.S.9000 series—the common standards recommended by the Burghard Committee. Common standards they may be in some respects but they will be lacking in one important detail—a common system of identification or part numbering.

Very soon now tens of part makers will be busy allocating their own identification numbers and sales codes to all the many styles, values, tolerances, wattages, etc., covered by the new specifications: and early next year a hundred companies intending to use these parts will be busy preparing their schedules of part numbers for use by their drawing offices for purchasing or stock control purposes. And then later, each parts manufacturer will need to prepare a cross reference list showing the equivalence between his many customers' part numbers and his own.

The Services, too, will be allocating their N.A.T.O. stock numbers to the items they intend to purchase.

What a waste of national effort! What an opportunity missed—to have a British Standard part number that all could use.

Time is slipping by and it is now too late to grasp this nettle in the first specifications to be published: but there are more to come. Can nothing be done?

E. P. STANTON

(Quality Control Manager)

Plessey Components Group, Swindon

“Honour to whom Honour”

E. AISBERG, Director of our Paris contemporary *Electronique Industrielle*, has written commenting on the origin of the term “class D” given by K. C. Johnson in his article last month. He writes:—

L'auteur attribue l'invention de ce montage et l'appellation “classe D” à P. J. Baxandall. Celui-ci a en effet consacré aux amplificateurs classe D un article dans *Proceedings I.E.E.* en 1959.

Cependant, l'amplificateur classe D a été inventé par l'ingénieur français Roger Charbonnier, à l'époque directeur de “Rochar Electronique”. La brevet correspondant a été déposé au nom de cette maison le 6 janvier 1954. Et la première description a paru sous la signature de J. P. OEHMICHEN dans le numéro 1 (mars-avril 1955) de notre Revue *Electronique Industrielle*.

J'ai tenu à préciser ce petit point d'histoire afin de rendre à César ce qui lui est dû.

Buy British

I SUPPOSE that most of your readers will agree with your editorial in the December number of your journal, but I must say that I think that the industry must bear part of the blame for the situation. I will not use your space to recount, in detail, my attempts to get data or

products out of British firms. It may be some consolation to Mr. Thompson that I would not rate the chances of a small buyer of getting an answer as better than one in five. On the other hand, my only letter to an American firm was answered by return, and the goods were despatched on receipt of my firm order and cheque.

I would be only too happy to buy British i.c.s if I knew that they were available. So far, I can recall seeing only American i.c.s offered on the retail market, and I have had some of them. I expect to buy more i.c.s, but, on their past performance, I am reluctant to spend time and money on fruitless enquiries to British firms. It therefore seems that my choice is between buying foreign, and buying nothing. While I should prefer to “Buy British,” I have no intention of going without these fascinating devices. Will any British firm, perhaps by the appropriate advertisement, giving price and channels of availability, in your journal, prove me wrong?

J. B. G. PARKER (G3SOL)

London, E.6.

I DOUBT very much if “any” young engineer, as you suggest in your December Editorial, would be allowed to buy American at will, if only because of import duty. Certainly this is not so in my establishment. We buy American usually when the item is not made here, or when the American article is obviously superior—one might add, there is often little difference in the price, and delivery has so far been good.

You may be interested to know that a British instrument advertised in *W.W.* at the end of 1966, and ordered by me near the beginning of this year, had still not been delivered at the end of November when I cancelled it as it was not yet in production!

British makers seem to think they get a raw deal—perhaps some of them do. Undoubtedly, however, there are a number who get what they deserve. And if certain foreign firms can do incomparably better, as they can in some fields, we have no right to play the hurt, misunderstood British routine. If British makers can produce, the profession will gladly buy.

“ENGINEER”

Bailey Amplifier Mod.

I HAVE received one or two queries regarding the cut-off frequency of the treble filter in the pre-amplifier circuit I described in the December 1966 issue. I have looked into this and have discovered that the capacitors used were about 50% greater in capacitance than their marked value. In order to obtain the correct performance this means that all the capacitors should be updated by 50% in the treble filter. The new values will therefore be 0.015 and 0.0075 μ F or as near as possible. The large tolerance on capacitors had been overlooked in this instance so it is important that capacitors of at least 10% tolerance should be used. If a slightly lower cut-off frequency is desired there is no reason why the values cannot be increased to 0.02 and 0.01 μ F, there being more convenient values to obtain.

ARTHUR R. BAILEY

Sub-surface Propagation

Some points from an I.E.E./I.E.R.E. conference on m.f., l.f. and v.l.f. radio

IT has been known from the early days of radio that in round-the-world transmission the energy is confined between the earth and the ionosphere, thus overcoming the diffraction losses round the curve of the earth. On v.l.f. the height of the lower boundary of the ionosphere is no longer large compared with the wavelength and the ray method of studying the propagation characteristics, so useful at h.f., is only practicable for use at short distances. For long distances it is necessary to treat the region between the earth and the ionosphere as a waveguide and to study the propagation in terms of mode theory.

In a survey paper at the recent I.E.E./I.E.R.E. conference on propagation J. R. Wait, himself a leading expert in this field, referred to the fundamental researches of K. G. Budden giving the full wave treatment of the modes, including the effects of the curvature and of the magnetic field of the earth. He treated the problem in a severely mathematical way that many engineers must find difficult to appreciate, but the basic results emerging from this study are proving most valuable as a means of interpreting v.l.f. field-strength measurements in terms of possible electron distributions in the D region of the ionosphere.

GEOLOGICAL WAVEGUIDE

A further interesting development of the waveguide concept is the proposed application to long-distance propagation in sub-surface geological strata. It is suggested that at depths of several miles there may exist extensive strata of very low conductivity between regions of much greater conductivity, constituting a waveguide with very low attenuation. While much has been written on the theoretical side, based on highly idealised models, and communication has been established over several miles, the technical and economic problems are immense and considerable doubt has been expressed about finding strata of sufficiently low conductivity of the required extent in the desired places.

There is evidence that such communication between subterranean points may sometimes be achieved by the "up-over-and-down" mode whereby energy from the transmitter travels up to the surface, escaping into the air and travelling, possibly with the help of the ionosphere, along the surface of the earth, some of it then being refracted into the earth to the receiving point below.

The attenuation of radio waves through sea water is very great, but it decreases with decreasing frequency and the use of v.l.f. for submarine communication is being actively pursued. The rigid mathematical theory is exceedingly difficult, but simple physical principles show that contact between a base above ground and submarines anywhere on the earth can be achieved by using v.l.f. The wave travelling over the earth is vertically polarised and is refracted vertically downwards and is receivable on a suitably oriented horizontal dipole on a submarine that is sufficiently near to the surface.

It follows similarly that communication between submarines, too far apart for direct propagation through the

water, must be by an "up-over-and-down" mode with the implied limitation in depth below the surface, and that using electric dipoles they should be horizontal and end-on to one another. Very little practical information is available, but the theoretical analysis makes reference to magnetic dipoles even though the available size of a loop regarded as a single turn would be very inefficient compared with an electric dipole at these frequencies.

For communication purposes the use of v.l.f. is inevitably restricted by the limited bandwidth available, but the advent of extremely accurate reference clocks and frequency-stabilized v.l.f. transmissions has prompted their use for time signals and navigational aids with a world-wide coverage. The latter application depends for its success upon the high stability of the D region of the ionosphere as a reflector of v.l.f. waves, the height of reflection by day being nearly constant at about 70 km and changing at sunset in a well-predictable way to about 85 km at night and back again at sunrise.

This stability in relation to a phase-comparison navigational aid is much greater than for the corresponding use of the E and F layers at higher frequencies, but much work is still needed to take account of sudden phase anomalies due to ionospheric disturbances, especially in the polar regions. A suggestion has been made for the automatic suppression of errors due to diurnal and seasonal variations in the ionosphere by working at two frequencies symmetrically displaced about 12 kHz.

In his opening address at the conference on m.f., l.f. and v.l.f. propagation, J. A. Ratcliffe deplored, as a scientist, the very limited use that had been made of v.l.f. transmissions for the study of the lowest regions of the ionosphere during the period when ionospheric sounding at high frequencies had been developed for the study of the E and F layers and the prediction of the propagation characteristics of high-frequency communication. In this he was perhaps over-modest in view of the work of the team that he directed for so many years at the Cavendish Laboratory using the transmissions from Rugby GBR.

SCIENTIFIC RESEARCH

It was notable that the recent conference was mainly concerned with the use of v.l.f., not as a means of communication but as a tool for scientific research. The advent of rockets and satellites has given an immense impetus with the possibility of receiving signals in the ionosphere from terrestrial v.l.f. transmitters and of transmitting v.l.f. signals to earth. The study of the wave forms of atmospheric lightning flashes is greatly advancing our knowledge of the earth-ionosphere waveguide and of resonance effects at e.l.f. The associated phenomenon of whistlers with their large frequency dispersion in the audio band has been explained in terms of the magneto-ionic theory of propagation in the ionosphere, but the observations made in the ionosphere have revealed that the v.l.f. ionograms are as complicated as those being obtained by sounding at h.f. from the original satellite Alouette I which is now in its sixth year of operation.

NEWS FROM INDUSTRY

'ELECTRONIC CAM'—THE BEST OF BOTH WORLDS?

FILM offers television companies a medium by which programme material can be interchanged between countries without regard to line standards or the colour system in use. Producing a film using motion picture methods is an expensive and time-consuming process and it has long been considered desirable to devise a system for exposing film using television multi-camera techniques. The film camera is not "interested" in whether black and white or colour stock is being used and does not suffer from the degradation in picture quality associated with telecine machines. The basic idea of marrying a television camera to a film camera to enable the scene to be monitored remotely is not a new one, this latest system "Electronic Cam" was devised by Arnold and Richter of Munich and has been developed by engineers from Rediffusion Television Ltd. over the past two years.

Basically the system consists of the marriage of an Arriflex 35mm camera and a plumbicon camera tube; light from the scene is reflected by a mirrored segment on the shutter to the plumbicon during the film pull-down period. The output of the plumbicon drives a small television monitor that acts as the camera view-finder and also drives other monitors throughout the studio. In the complete installation three such cameras are employed, the film motor of each

camera being controlled remotely by means of switches on a central production control console. Four monitors are employed on this console, one for each camera and, in addition, one for the camera that has been selected. Switching, or cutting, between cameras can be carried out in about one-third of a second, this being the time taken for the camera mechanism to reach operating speed or, if desired, all cameras can be left running, only one being used for the "take," allowing instantaneous "cutting" between cameras but wasting large amounts of film stock. Rehearsals can be carried out without film in the cameras and in this case footage counters on the control console make it possible to predict the amount of film required in each camera for the actual take, eliminating wastage. Identification and synchronizing marks are recorded on both the film and the magnetic tape used for the sound track indicating which camera it came from and facilitating the assembly of the film and sound track. In a pilot production film, taken to assess the performance of the system, a fifteen minute film was made in approximately one hour on the studio floor. The film was divided into three sections, each being filmed as a continuous take, the director cutting between cameras as required, achieving a film utilization ratio of 1.52:1.

CODE OF PRACTICE FOR AERIAL INSTALLATION

WITH the advent of colour television the question of aerial installation has become of greater importance and it is felt strongly both by the Radio and Television Retailers Association (R.T.R.A.) and the Radio and Electronic Component Manufacturers Federation (R.C.E.M.F.) that high standards will have to be adhered to. To this end a code of practice for aerial installation has been agreed by the two bodies and in future all members of the R.T.R.A. will be expected

to conform to these standards. Any serious departure from them may result in disciplinary action being taken by the Association. It is also suggested that any member that does not erect his own aerials should forward a copy of the code to the company concerned in order that an undertaking may be given that installations will be made in accordance with the code. Copies of the code are available free from the R.T.R.A., 19-21 Conway St., London, W.1.

NUCLEONIC INSTRUMENT FIRM EXPANDS

THE largest company in the nucleonics field in Europe will be formed as a result of a major rationalization of the nuclear instrument industry in the U.K. Nuclear Enterprises of Edinburgh, founded as recently as 1956, has taken over the nucleonics interests of E.M.I. at both Hayes, Middlesex and Wells, Somerset, as the first stage in a triple acquisition. Nuclear Enterprises is also, subject to necessary consents, acquiring Isotope Developments Ltd. and the

Baldwin Instrument Company, both members of the Elliott-Automation Group situated near Aldermaston. The Nuclear Enterprises range of radiation detectors and instruments will be supplemented with medical, physics, and data handling equipment from E.M.I., low cost laboratory and medical instrumentation from I.D.L. and industrial nucleonics instrumentation for gauging, analysis and process control from Baldwin Instruments.

Cable and Wireless Ltd. have placed contracts with Submarine Cables Ltd. (an A.E.I. company) for a deep sea submarine telephone cable that will provide a maximum of 640 telephone circuits between Canada and Bermuda. The project, which is known as CANBER, requires 800 nautical miles of cable, 81 submersible repeaters and five submersible equalizers worth a total of £3.5M. The cable will be jointly owned by the Canadian Overseas Telecommunications Corporation and Cable & Wireless Ltd. Some of the new materials needed for fabricating the cable will come from Canadian sources. CANBER is due to be laid in 1969 by the 8,960-ton cable ship *Mercury* from the Cable and Wireless fleet. CANBER will land in Canada in the vicinity of Mill Village, Nova Scotia, permitting connections with the Canadian satellite earth stations.

The information services of the Government of Hong Kong have announced that steps are being taken to prevent manufacturers wrongly describing radio receivers by incorporating into them **non-functioning transistors**. In talks with the manufacturers the Colony's Commerce and Industry Department found that the manufacturers were opposed to this practice and that the dummy transistors had been included at the request of overseas buyers! As from January 1st the Commerce and Industry Department will institute checks to determine whether any local transistor receiver factory is incorporating non-functioning transistors and legal action will be considered against any that are continuing with the practice.

Orders for four harbour radar systems worth a total of £128,000 to be installed at Montreal, Brisbane, Rostock (East Germany), and Wallasey (Cheshire), have been received by Decca Radar Ltd. The installation for the port of Montreal is to be completed in two phases. The first of these consist of installing a two-channel radar and two 16-inch displays that will provide a traffic control service. In the second phase the radar coverage will be increased by a remote scanner, controlled by a u.h.f. link relaying its information back to the control room via a microwave system. The other three systems will not have the remote scanner and differ from the Montreal system only in aerial and display sizes.

The G.P.O. has placed an order with **Standard Telephones and Cables Ltd.**, for a 6GHz microwave system to link the Post Office tower in London with Norwich. The equipment, type RL6D, will provide six broad-band radio channels between London and Stoke Holy Cross (Norwich), with repeater stations at Kelvedon Hatch and Sibleys in Essex and at Wickhambrook and Mendlesham in Suffolk. The RL6D provides a 10-W power output; the aerials used will be of the cassegrain type for single or bipolar operation.

1968 CONFERENCES AND EXHIBITIONS

| | | |
|--|-------------------------|---------------------------------|
| LONDON Mar. 11-14 Physics Exhibition | Alexandra Palace | |
| Apr. 8 & 9 Thick Film Technology | Imperial College | |
| Apr. 18-21 Audio Festival & Fair | Hotel Russell | |
| Apr. 22-24 Interference Problems and Microwave Systems | I.E.E., Savoy Pl. | Communications |
| May 13-18 Instruments, Electronics and Automation Exhibition | Olympia | |
| May 20-31 Communication-Satellite Earth Stations | Royal Lancaster Hotel | |
| July 29-Aug. 2 Ships' Gear International Exhibition | Olympia | |
| Sept. 9-12 Elementary Particles | Queen Mary College, E.1 | |
| Sept. 9-13 International Television Conference | I.E.E., Savoy Pl. | |
| Sept. 20-Oct. 2 Tropospheric Wave Propagation | I.E.E., Savoy Pl. | |
| Oct. 2-5 R.S.G.B. Radio Communications Exhibition | R.H.S. New Hall | |
| BELFAST Apr. 1-3 Heavy Particle Collisions | Queen's University | |
| BRIGHTON Oct. 8-10 National Electronics Packaging Conference & Exhibition | Hotel Metropole | |
| BRISTOL Jan. 2-4 Integrated Circuits Symposium and Exhibition | The University | |
| Mar. 27-29 Thermodynamics and Fluid Mechanics | The University | |
| CARDIFF Apr. 18 & 19 Audio-Visual Aids Conference and Exhibition | Cathays Park | |
| CRANFIELD Mar. 25-28 Aerospace Instrumentation Symposium | College of Aeronautics | |
| DURHAM Apr. 2 & 3 Semimetals and Narrow Gap Semiconductors | The University | |
| EDINBURGH Aug. 5-10 I.F.I.P. Data Processing Congress & Exhibition | The University | |
| FARNBOROUGH Sept. 16-22 Electronics and Air Show | R.A.E. | |
| GLASGOW Mar. 8-16 NORBEX—North British Engineering Exhibition | Kelvin Hall | |
| HARROW Mar. 12-14 Public Address Show | King's Head Hotel | |
| HARWELL May 9 & 10 Low Energy Electron Diffraction | | A.E.R.E. |
| LOUGHBOROUGH Apr. 16-19 Modular Education for Industry | | University of Technology |
| MANCHESTER Jan. 3-6 Solid State Physics Conference | | Inst. of Science and Technology |
| Sept. 24-28 Electronics, Instruments, Control and Exhibition | | Belle Vue Components |
| Nov. 4-6 Electronic Instruments Exhibition | | Hotel Piccadilly |
| NOTTINGHAM Sept. 11-13 Physical Aspects of Noise in Electronic Devices | | The University |
| PAISLEY Apr. 17-19 Automation Techniques in Industry | | College of Technology |
| SOUTHAMPTON Jan. 9 & 10 Materials for Acoustic & Vibration Damping | | The University |
| Apr. 22-24 Nucleation, Growth and Structure of Thin Films | | The University |
| SWANSEA July 15-18 Electrical Contact Phenomena | | University College |
| TEDDINGTON Jan. 17 & 18 Holography—Recent Advances and Applications | | National Physical Lab. |
| OVERSEAS (Jan. to May) Jan. 16-18 Symposium on Reliability | | Boston |
| Jan. 26 & 27 Colour Television Conference | | Detroit |
| Feb. 14-16 Solid-state Circuits | | Philadelphia |
| Feb. 28-Mar. 1 Scintillation & Semiconductor Counter Symposium | | Washington |
| Mar. 7-12 Festival du Son | | Paris |
| Mar. 21-23 Microwave Power | | Boston |
| Apr. 1-6 Components Exhibition & Colloquium also Electroacoustic Exhibition | | Paris |
| Apr. 9-11 Telemetry Conference | | Houston |
| Apr. 16-18 Turbulence of Fluids and Plasmas | | New York |
| Apr. 22-24 Frequency Control Symposium | | Atlantic City |
| May 8-10 Electronic Components Conference | | Washington |
| May 14-17 Quantum Electronics Conference | | Miami |

BOOKS RECEIVED

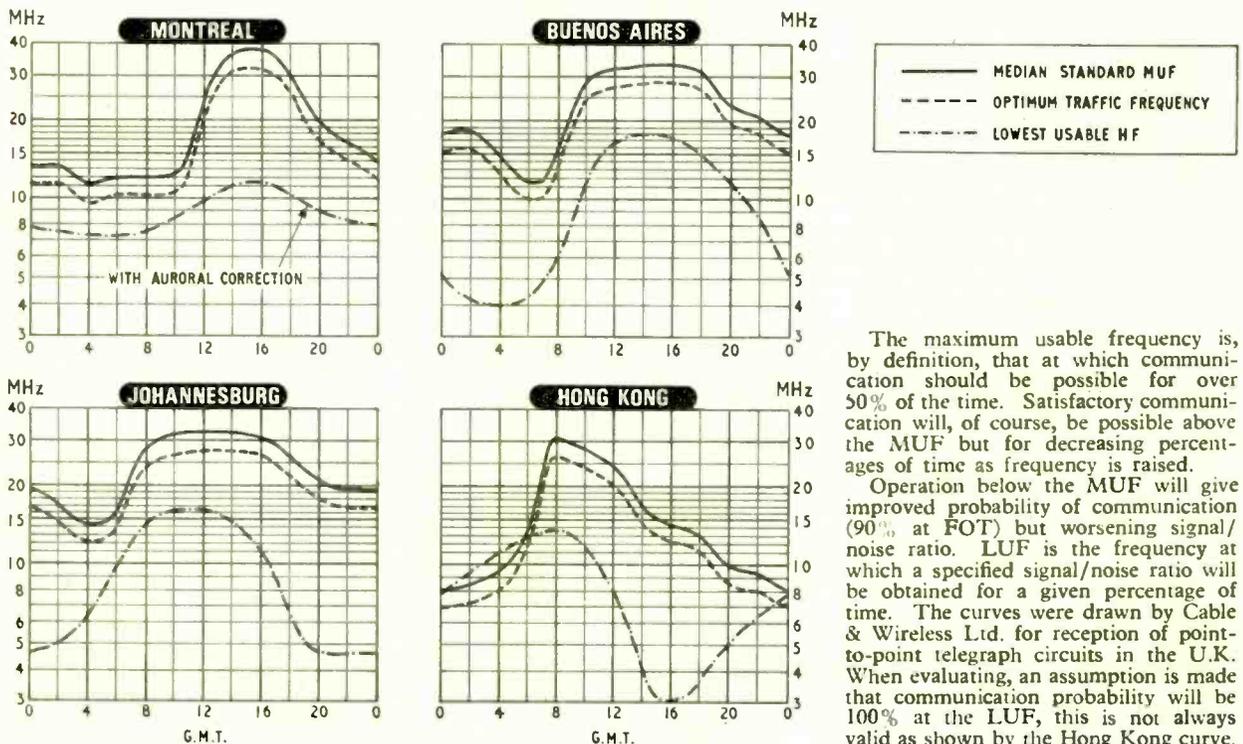
Microwave Valves by C. H. Dix and W. H. Aldous, presents an account of the basic physical processes and the operation of microwave valves. Although only the essential mathematics is included the book is intended for readers with H.N.C. or a degree. The approach to the subject begins with a description of the the motion of electrons and the properties of the various types of r.f. circuits and transmission lines that are used in the devices. Although microwave triodes are discussed, the emphasis is on beam devices both linear and crossed field, and in describing these the space-charge wave approach is used. Further chapters cover the formation and focusing of electron beams, the noise properties of microwave devices, construction and applications. Pp. 269. Price 55s. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1.

The Practical Aerial Handbook, by Gordon J. King. The introductory chapters provide a grounding in the principles of radio propagation and aerial design. Different types of aerial are discussed and guidance is given on choosing the best aerial system for a particular need together with practical installation information. The remainder of the book covers methods of combining signals received by separate aerial systems; methods of supplying several receivers from one aerial; improving reception using aerial booster amplifiers; shared aerial systems as used in blocks of flats, etc.; and combating interference. Appendices give information on aerials for colour television, aerials for stereo radio; the distant reception of v.h.f. and u.h.f. signals. Pp. 224. Price 35s. Odhams Books Ltd., 40 Long Acre, London, W.C.2.

Introduction to Vector Analysis by W. D. Day. Suitable for self-tuition, because of the numerous worked examples and graded exercises, this book presents the theory of vector analysis in a form suitable for the electronics engineer. Starting from basic definitions and notation, the concept of scalar and vector products of two vectors, triple products, differentiation, line and surface integral is established. The differential equations of electron motion in uniform magnetic and electric fields at right angles are considered in some detail. The scalar point, scalar potential, divergence, curl, cartesian, cylindrical and spherical co-ordinates are all examined. The remaining chapters are devoted to more general vector fields in particular to the time varying electromagnetic field governed by Maxwell's equations. Pp. 260. Price 42s. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1.

Techniques of Pulse-Code Modulation in Communication Networks by G. C. Hartley, P. Mornet, F. Ralph and D. J. Tarran. This book, from the I.E.E. Monograph series, is published at an opportune moment with the recent opening of London's first p.c.m. link. After the introduction and an historical review, the principles of p.c.m. are outlined and such topics as time sampling, signal reconstruction, quantization, companding, etc., are discussed in some detail. The remainder of the work is devoted to the application of p.c.m. communication principles, basic system elements and factors affecting system design, a glossary of terms is also included. Pp. 110. Price 30s. Cambridge University Press, Bentley House, 200 Euston Road, London, N.W.1.

H. F. PREDICTIONS — JANUARY



The maximum usable frequency is, by definition, that at which communication should be possible for over 50% of the time. Satisfactory communication will, of course, be possible above the MUF but for decreasing percentages of time as frequency is raised.

Operation below the MUF will give improved probability of communication (90% at FOT) but worsening signal/noise ratio. LUF is the frequency at which a specified signal/noise ratio will be obtained for a given percentage of time. The curves were drawn by Cable & Wireless Ltd. for reception of point-to-point telegraph circuits in the U.K. When evaluating, an assumption is made that communication probability will be 100% at the LUF, this is not always valid as shown by the Hong Kong curve.

LETTER FROM AMERICA

SOME controversy has been caused among electronics engineers over here during the past few months by S.I.As. What are S.I.As.? Well, they are basically very small stub antennas which have built-in transistors to give extra gain. They are usually $1/25$ th wavelength and the inventor, Edwin Turner, of the Air Force Avionics Laboratory in Dayton, Ohio, claims that S.I.As could be built into TV sets and "would out perform aeriels many times the size." However, there are doubters. Harry Greenberg, chief electronic engineer of Channelmaster Corporation, says categorically, "In our opinion, they would not perform as well as ordinary rabbit ears aeriels, let alone replace roof-top aeriels." It is well known that the smaller the aerial length, the lower the signal strength received. Hence, the signal-to-noise ratio tends to get worse as the pick-up aerial gets shorter. However, this is offset to some extent by the fact that atmospheric noise is very high at high frequencies and so the signal-to-noise ratio is less dependent on the aerial or receiver. So a smaller aerial will not necessarily mean a small signal-to-noise ratio although the signal itself will be less. In *Time* magazine Turner states, "We have in effect substituted a short aerial carrying a large current for a long aerial carrying a small current." He went on to say, "A S.I.A. at $1/16$ th wavelength instead of $1/4$ is about equal in signal-to-noise ratio to a dipole aerial or tunable rabbit ears, even at $1/25$ th the noise characteristic is comparable with a dipole when mismatches in the dipole were considered." Turner claims that S.I.As provide a wide impedance match and quotes ratios of up to 50 to 1. In one version the transistor d.c. current is controlled to move the optimum bandwidth matching range. Considerable work in this field has been carried out by Hans Meinke at the Munich Technical University and a circuit was published in *Electronics* last July. But so far from silencing the critics, it provoked more opposition. One, Wilfred Carson, said, "It was obvious that one stage was about to break into oscillation and so the stage gain would be abnormally high." At the Canadian International Electronics Conference Dr. Flachenecker said "from v.l.f. up to 30 MHz S.I.As show field strength sensitivities nearly equal to the external noise-field

strength if the aerial height is around 1 metre." So the debate continues.

THE FIRST commercial colour television receiver was introduced back in 1954 by R.C.A. This was a 15-in model costing about \$1,000. Some 10,000 sets were sold that year, but by January 1967, the total number of colour sets in the U.S.A. had soared to 9,750,000. Early in 1967 experts forecast total sales of colour sets at six million and at the end of October the sales had reached 4,086,521 for colour, compared with 4,394,857 for monochrome. At a recent E.I.A.* merchandising seminar, a speaker caused a stir of interest when he said his firm was already campaigning for that second colour TV in every home. Support for this expression of "Gracious Living" came from R.C.A., who are now pioneering a low cost 14-in portable. Says the Sales President, "In pioneering the new 14-in diagonal screen size, we are counting heavily on a second set market for colour that will appear much sooner than it did in black-and-white TV. The colour set viewer who is spoiled by colour in the living room won't accept a monochrome substitute in the den or bedroom." (I could add from experience—neither will the children!) How about prices? Well, they range from about \$199 for a portable to around \$500 for a console with a 23-in screen. Tube sizes are a little confusing as some manufacturers use diagonal measurements while others stick to the tube face area. Philco have just released a large screen portable (267 sq in) at \$299.95. They ask, "Why should the least expensive large screen colour set cost a working man a month's pay?" Why indeed! This price is certainly very reasonable but it is possible that some of the Japanese imports will be cheaper still. The modern colour sets are very easy to operate but ingenious devices are fitted to some models to ensure accurate tuning. For instance, Motorola uses an automatically switched indicator lamp to show "on the nose" tuning and Westinghouse sets have a tuning bar. When this bar is depressed vertical black bars appear on the screen and the trick is to turn the fine tuning control until only one bar is seen. The circuit is quite complicated and it employs two multivibra-

tors with a gating valve and variable relay. Incidentally, some Motorola models use transistors throughout but most other designers prefer hybrid circuits. At the moment, integrated circuits are widely used for audio stages or i.f. sections, etc. They are also employed in f.m. tuners, receivers and amplifiers—R.C.A. even has an i.c. pre-amplifier built in a pickup cartridge. Westinghouse has just released a single i.c. audio amplifier which can replace nearly all the components in low power record players or tape recorders. The input is high impedance so a ceramic pickup can be used and the output is rated at 1 W for 5% distortion.

AMPEREX HAVE an interesting i.c. called a "Bifet" which consists of a mosfet coupled to a transistor emitter-follower plus biasing resistors all housed in a normal three-lead TO-18 can. Input impedance is very high, being of the order of 10^{12} . Noise is exceptionally low—the total voltage measuring less than 25 microvolts! This is comparable with the best valve amplifiers and so the "Bifet" will be particularly useful for low-level microphone pre-amplifiers, photo-cell head amplifiers, etc.

NEW TRANSISTOR devices are appearing almost every day but one of the most interesting is called a "Pitran" transducer. This is a silicon planar transistor that has the emitter-base junction mechanically coupled to a tiny diaphragm located at the top of the can. When a pressure is applied to the diaphragm a large reversible change is produced in the transistor characteristics. Sensitivity is quoted as 4 V per gramme point force and linearity is said to be better than 1%.

THE VIETNAM WAR has given a tremendous impetus to electronic research and development—particularly in the communications field. Probably one of the most bizarre inventions concerns enemy—or rather *people*—detection. It consists of a pump that pipes in air to a colony of bedbugs. The presence of human beings causes the bugs to become agitated so modulating a r.f. field to give audible or visual indication. Sensitivity is said to be very high but it is not stated whether the bugs discriminate between Viet Cong and Americans!

G. W. TILLET.

* Electronic Industries Association.

WORLD OF AMATEUR RADIO

World-wide Network of Amateur Radio Beacons?

PROPOSALS for the establishment of a world-wide network of amateur radio beacon transmitters to operate on frequencies in the amateur 21- and 28-MHz bands have been put forward by a scientific ionospheric observation group within the German national amateur radio society. The group, which has 100 regular observers, is continuing work done in Germany during the International Geophysical Year (I.G.Y.) and in the subsequent International Quiet Sun Years (I.Q.S.Y.), and its proposals visualize the setting up of one beacon in each of the five continents to operate in the 21-MHz band and at least two beacons in each continent to operate in the 28-MHz band. Each beacon will use a main and a secondary frequency, the main frequency being common to all beacons in a particular band. Secondary frequencies will be spaced in an arrangement of channels of 2.5-kHz wide below the main frequency. The secondary frequency assigned to a particular station will be transmitted when the main frequency is not being used.

Transmissions on the main frequency will be arranged in accordance with a time-shared world-wide schedule, which will enable radio amateurs and scientific institutes to monitor automatically, or by means of pen-recorders, etc., the actual world-wide propagation conditions on the band concerned. Transmissions on the secondary frequencies will supplement observations on the main frequency and will allow permanent checks on conditions for a certain general path direction and provide a means to monitor the effect of sudden solar events, and of band openings, which cannot be covered by the main frequency transmissions because of time sharing.

It is also hoped to provide a similar world service on a frequency in the 50-MHz (six-metre) band but unfortunately this band is not generally available to amateurs in Europe and Asia. Special facilities, however, are visualized for this scientific project. The proposals for a world-wide network of amateur radio beacon transmitters are to be submitted to the International Amateur Radio Union for consideration by the 75 national societies that form the Union.

European Fox Hunting Championships.—Teams from the Soviet Union, Yugoslavia and Hungary were respectively placed 1st, 2nd and 3rd in the 80-metre section of the European Fox Hunting Championships held recently in Czechoslovakia. The individual winner (a Russian) located the four hidden transmitters ("foxes") in 49 mins 6 secs and the time of the winning team was 118 mins 26 secs. The 2-metre section was won by a team from Hungary with teams from Bulgaria and the Soviet Union in the 2nd and 3rd places. The time of the winning team was 89 mins 53 secs (locating six "foxes") and the individual winner (another Russian) located three hidden transmitters in 37 mins 30 secs.

R.N.A.R.S. Code Proficiency Transmissions.—Morse code proficiency transmissions arranged by the Royal Naval Amateur Radio Society, now take place on the first Tuesday of each month at speeds of 15, 20, 25, 30 and 35 words per minute. Transmissions commence at 20.00 G.M.T. on 3,520 kHz and perfect (100%) copy at a particular speed is required to qualify for the appropriate Code Certificate. Completed logs, together with five 3d stamps, should be sent to R.N.A.R.S., 27, Oxted Rise, Oadby, Leicester.

QSL Cards for R.A.F.A.R.S. Members.—Cards depicting six Royal Air Force aircraft spanning 25 years of R.A.F. history are now available to the 450 members of the Royal Air Force Amateur Radio Society, to confirm contacts.

Slow-Scan Television.—The United States Federal Communications Commission has recently proposed that slow-scan television shall be authorized in certain parts of the amateur high-frequency bands, namely, 3.8-3.9, 7.2-7.25, 14.2-14.275 and 21.25-21.35 MHz as well as in the telephony bands at 10, 6 and 2 metres. The bandwidth will be that of a normal single sideband signal, nominally 3 kHz. It is not yet known whether similar proposals have been put forward by any licensing authority in Europe or Asia. Slow-scan television (although permitted in the United Kingdom for those holding an amateur television licence) has not, so far, attracted a great deal of interest.

Nigerian Award.—The 5N2 Award is available to any radio amateur or short-wave listener who can produce evidence of having worked or heard five Nigerian amateur stations (5N2 calls) on two or more amateur bands. (For example, four stations can be worked or heard on 21 MHz and one on 28 MHz.) The Award will be issued in three classes: telephony (including single sideband), telegraphy and mixed. Applications, together with a certified copy of the log (or QSL cards in the case of short-wave listeners) and accompanied by five international reply coupons should be sent to the Awards Manager, N.A.R.S., P.O. Box 2873, Lagos, Nigeria.

Amateur Radio in India.—New rules for amateur radio licences, drafted by the Indian Department of Communications, came into force on September 1st, 1967. They permit the issue of licences to young people aged 14 years and upwards. For some reason, which the Amateur Radio Society of India has not been able to discover, no new licences have been issued in India since the beginning of 1967 when the membership of the society was around 350.

Simulated Emergency Test.—In late January during a simulated emergency test, organized by the American Radio Relay League, the opportunity will present itself for all United States radio amateurs to take part in a nation-wide demonstration of amateur radio public-service facilities. The emergency test will take place during the weekend January 27th-28th, and will include all Amateur Radio Public Service Corps members in local and national exercises for the Red Cross, Civil Defence and similar organizations.

Championship of France.—The annual contests organized by the French national amateur society (R.E.F.), to decide the champions of France for 1968, will be held on January 27th/28th (telegraphy) and February 24th/25th (telephony). Both contests will commence at 14.00 on the Saturday and finish at 21.00 on the Sunday.

Monaco Amateurs to join I.A.R.U.—The Association des Radios Amateurs de Monaco is seeking membership in the International Amateur Radio Union. Formed in 1953, the Association now has 18 licensed transmitting members—the total number of licensed stations in the Principality. Licences are issued to visitors to Monaco who submit proof of being bona fide licensed amateurs in their own country.

V.H.F. Licences in Germany.—Call signs in a new series, DC6 followed by two letters, are now being issued to German amateurs who wish to operate on frequencies above 144 MHz. Holders of these calls have passed a technical examination but not a Morse code test. In the United Kingdom call signs in the series G8 followed by three letters are issued to amateurs who wish to operate on frequencies above 420 MHz.

JOHN CLARRICOATS, G6CL.

JANUARY MEETINGS

Tickets are required for some meetings: readers are advised, therefore, to communicate with the society concerned

LONDON

2nd. I.E.E.—Colloquium on "The economical collection of meteorological data" at 2.30 at Savoy Pl., W.C.2.

4th. I.E.E.—Hunter Memorial Lecture "Changing patterns in communications" by J. H. H. Merriman at 5.30 at Savoy Pl., W.C.2.

5th. I.E.E.—"The practical use of radar and d.f. techniques in locating earth satellites" by Dr. H. G. Hopkins and W. A. S. Murray at 5.30 at Savoy Pl., W.C.2.

8th. I.E.E.—Discussion on "Logarithmically periodic aerials" at 5.30 at Savoy Pl., W.C.2.

8th. I.E.E.—Discussion on "Domain originated functional integrated circuits (DOFICS)" at 5.30 at Savoy Pl., W.C.2.

9th. I.E.E.—Discussion on "Electrical signals for data acquisition and transmission—what form should they take?" at 5.30 at Savoy Pl., W.C.2.

10th. I.E.E.—"Some aspects of electrostatic loudspeakers" by Prof. J. Merhaut at 6.0 at 8-9 Bedford Sq., W.C.1.

10th. S.E.R.T.—"Digital voltmeters" by J. R. Pearce at 7.0 at London School of Hygiene & Tropical Medicine, Keppel St., W.C.1.

11th. Inst. of Electronics—"Modern semiconductor devices" by D. F. Dunster at 6.45 at the School of Hygiene and Tropical Medicine, Keppel St., W.C.1.

16th. I.E.E. & I.P.P.S.—Colloquium on "MOST devices" at 2.30 at Savoy Pl., W.C.2.

17th. Inst. Navigation—"Sub-surface navigation" by Dr. W. P. Williams at 2.15 at the Royal Inst. of Naval Architects, 10 Upper Belgrave St., S.W.1.

17th. I.E.E.—"Colour television receiver design" by B. J. Rogers at 5.30 at Savoy Pl., W.C.2.

18th. R.T.S.—"London schools television service" by W. Kemp and P. W. Lines at 7.0 at the I.T.A., 70 Brompton Rd., S.W.3.

22nd. I.E.E.—Colloquium on "Microwave integrated circuits" and "Microwave solid state sources" at 10 a.m. at Savoy Pl., W.C.2.

22nd. I.E.E.—Discussion on "Microwave electrostatic wattmeter" at 5.30 at Savoy Pl., W.C.2.

24th. I.E.E.—"Studio colour equipment" by G. Parker at 6.0 at 8-9 Bedford Sq., W.C.1.

26th. R.T.S.—"Television aids to film production" at 7.0 at the I.T.A., 70 Brompton Rd., S.W.3.

29th. I.E.E. & I.E.R.E.—Discussion on "Diathermy" at 5.30 at Savoy Pl., W.C.2.

31st. R.S.G.B.—"The development of a u.h.f. television service" by R. C. Hills at 6.30 at the I.E.E., Savoy Pl., W.C.2.

ABERDEEN

10th. I.E.E.—"The engineer and the law" by H. B. Morton at 7.30 at Robert Gordon's Institute of Technology.

BIRMINGHAM

24th. R.T.S.—"The transmission of colour television signals over Post Office links" by E. Howorth at 7.0 at the Medical Institute, Harborne Rd., Edgbaston.

29th. I.E.E. & I.P.O.E.E.—"Design considerations in microwave links" by G. Wanless and E. Jamieson at 6.0 at M.E.B., Summer Lane.

BOURNEMOUTH

31st. I.E.R.E.—"Some circuit aspects of M.O.S. transistors" by N. E. Broadberry and L. N. M. Edward at 7.30 at the College of Technology.

BRISTOL

16th. S. Inst. Tech.—"Instrumentation in medicine" by D. H. Follett at 7.30 at the Dept. of Physics, the University.

18th. I.E.R.E., I.E.E. & R.Ae.S.—"Concord" by H. Hill at 7.0 at the University.

25th. I.E.E.—"The best method of educating engineers—full time or sandwich?" by D. M. Dummer and P. L. Arlett at 6.0 at the Technical College.

CARDIFF

10th. R.T.S.—"The philosophy of colour camera design" by C. B. B. Wood at 7.30 at the Angel Hotel.

24th. I.E.R.E.—"The development of satellite communications" by J. K. S. Jowett at 6.30 at the Welsh College of Advanced Technology.

DUNDEE

11th. I.E.E.—"The engineer and the law" by H. B. Morton at 7.0 at Robert Gordon's Institute of Technology.

EDINBURGH

10th. I.E.R.E.—"Microwave and optical communication systems of high traffic capacity" by R. W. White at 7.0 at the Dept. of Natural Philosophy, the University.

GLASGOW

11th. I.E.R.E.—"Microwave and optical communication systems of high traffic capacity" by R. W. White at 6.0 at the University of Strathclyde.

HAMBLE

17th. I.E.E. & R.Ae.S.—"Telecommunications in aviation" by W. P. Nicol at 8.0 at the College of Air Training.

HUDDERSFIELD

30th. I.E.E.—"The role of the systems engineer" by Dr. Wilson at the College of Technology.

HULL

25th. I.E.E.—"The engineer and the law" by H. B. Morton at 6.30 at Y.E.B. Offices.

ISLE OF WIGHT

26th. I.E.E.—"The work of the Engineering Institutions Training Board" at 6.30 at the Technical College.

LEEDS

23rd. I.E.E.—"The future use of solid-state devices in the microwave field" by Dr. J. E. Carroll at 6.30 at the University.

LIVERPOOL

8th. I.E.E.—"Electromagnetic levitation" by H. R. Bolton at 6.30 at the University.

17th. I.E.R.E.—"Manufacturing aspects of the shadowmask tube" by P. T. Funnell at 7.0 at the Regional College of Technology, Byrom St.

22nd. I.E.E.—"Jodrell Bank radio telescope" by R. Lascelles at 6.30 at the University.

MALVERN

22nd. I.E.E.—"Electronic telephone exchange" by L. R. F. Harris at 7.30 at the Abbey Hotel.

MANCHESTER

22nd. I.E.E.—Faraday Lecture "Medical electronics" by Dr. D. W. Hill at 7.30 at the Free Trade Hall.

23rd. I.E.E.—Faraday Lecture "Medical Electronics" by Dr. D. W. Hill at 2.30 (Schools) and 7.30 at the Free Trade Hall.

31st. I.E.E. Grads.—"Superconductivity" by Dr. A. C. Rose-Innes at 7.0 at U.M.I.S.T.

MIDDLESBROUGH

11th. I.E.E. & S. Inst. Tech.—"System reliability and safety assessment" by G. Hensley at 6.30 at the Cleveland Scientific Inst.

NEWCASTLE-UPON-TYNE

10th. I.E.R.E.—"Some applications of electronics to oceanographic sensors" by A. M. East at 6.0 at the Inst. of Mining and Mechanical Engrs., Westgate Rd.

15th. I.E.E.—"Microelectronics" by Dr. S. S. Forte at 6.30 at Rutherford College of Technology.

NOTTINGHAM

16th. I.E.E.—Faraday Lecture "Medical electronics" by Dr. D. W. Hill at 7.15 at the Albert Hall.

OXFORD

10th. I.E.E.—"The future of the Institution of Electrical Engineers" by Dr. G. F. Gainsborough at 7.0 at S.E.B., 37 George St.

PLYMOUTH

3rd. R.T.S.—"Graphics in television" by Don Baker at 7.30 at the Studios of Westward Television Ltd.

PORTSMOUTH

17th. I.E.E.—"The problems of digital s.s.b. systems" by R. T. A. Standford at 6.30 at the College of Technology.

24th. I.E.E.—"Project control—critical path analysis" by E. H. Harry at 6.30 at the College of Technology.

READING

11th. I.E.R.E.—"Parametric amplifiers" by Prof. D. P. Howson at 7.30 at the J. J. Thomson Physical Lab., the University.

RUGBY

3rd. I.E.E.—"Fabrication uses of the electron beam" by H. N. G. King at 6.15 at the College of Engineering Technology.

10th. I.E.E. & I.P.P.S.—"Atomic measurement of time" by Dr. L. Essen at 6.30 at the Col. of Advanced Technology.

SOUTHAMPTON

16th. I.E.R.E.—"Microwave ultrasonics" by Dr. R. W. B. Stephens at 6.30 in the Lanchester Theatre, the University.

23rd. I.E.E.—"The introduction of direct digital control" by Dr. V. Latham at 6.30 at the Lanchester Theatre, the University.

STEVENAGE

15th. I.E.E.—"Post Office Tower" by D. G. Jones at 7.0 at the College of Further Education.

WOLVERHAMPTON

31st. I.E.R.E.—"The use of a computer to control an industrial process" by D. G. Leak at 7.15 at the College of Technology, Wulfruna St.

NEW PRODUCTS

Stereo Tape Deck

A COMPACT stereo tape deck offering off-tape monitoring, sound-on-sound, sound-with-sound, echo and duet effects, is available from Ampex Great Britain Ltd. Smaller than previous models in the Ampex line, the model 753 measures 15½ in wide × 13 in deep × 6½ in high. This deck has three heads—record, playback and erase—permitting precise monitoring and sound-on-sound recording and playback, eliminating the possibility of crosstalk often found on models with a single record/playback head. As with all Ampex open reel audio recorders, the magnetic heads are of the deep-gap design. Sound mixing features of Model 753 make it possible to mix narration with music tracks, add sound and musical effects to home-produced programmes, and to conduct language pronunciation studies. The sound-on-sound facility permits that while listening to recorded material, new material may be recorded on the same sound track without erasing the original material. With sound-with-sound, recorded material on one track can be played and new material recorded on the second track permitting playback in stereo. Off-tape monitoring permits material to be played back as it is recorded, allowing instant adjustment for best recording fidelity. By switching a control knob to an "echo" position material may be recorded with echo effect. With "duet effect," material being recorded on one track may also be recorded on the second track, but with slight delay, achieving a special



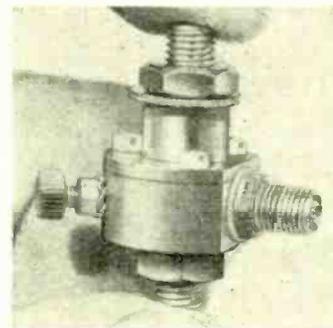
depth of stereo sound on playback. This is said to be especially useful in recording and playing back musical soloists. Model 753 has pre-amplifiers and offers a unique line-jack that permits the recorder to be connected to any type amplifier with consistent performance. It also features twin vu-meters, all solid-state electronics, automatic shut-off, and dual capstan drive, which reduces flutter and wow to a minimum. Overall record/reproduce frequency response measured at the pre-amplifier output is ± 3 dB at 40 Hz—15 kHz at 7½ i.p.s. and ± 4 dB at 50 Hz—7.5 kHz at 3½ i.p.s. Signal-to-noise ratio from peak record level to broad band noise at the pre-amp output is 46 dB (unweighted) at 7½ i.p.s. and 43 dB (unweighted) at 3½ i.p.s. The deck model weighs 23 pounds. The price is 79 gns. Ampex Great Britain Ltd., Acre Road, Reading, Berks.

WW 301 for further details

GUNN DIODE OSCILLATOR

THE oscillators in the CL8 series by Mullard are intended primarily for experimental purposes and for performance assessment in microwave systems. They can also be used in speed checking equipment and bench-top microwave demonstration systems for schools and colleges. Each oscillator has a gallium arsenide device fitted in a small cavity which can be mechanically tuned over 1 GHz. Self-contained, a typical continuous output of 5 mW can be obtained with a supply of 7 V d.c. There are four oscillators, the CL8 360, 370, 380 and 390, covering the range 8 to 12 GHz. Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

WW 302 for further details



Operational Amplifier

FLEXIBILITY of the Westinghouse WC306 operational amplifier (dual in-line package) is indicated by the fact that (a) a choice of inputs is available, a high impedance 300 kΩ pair of differential inputs and a low impedance 3 kΩ pair, (b) outputs are, a differential pair of output terminals as well as the regular single-ended output, and (c) bandwidths can be selected up to the 30 MHz unity gain of this device, using the low input impedance terminals; 40 dB of gain can be achieved at 10 MHz. Most of this amplifier's 1,100 to 4,400 open loop gain can be used without exceeding 0.2% distortion. Only sufficient feedback to maintain d.c. operating point stability is necessary. With a worst case situation of 5 kΩ source impedance, and a 150 kHz bandwidth the noise is only 12 μV r.m.s. In many low-frequency instrumentation applications where noise is serious, lower source impedances and restricted bandpass will substantially lower this figure. Common mode rejection (83 dB) retained at high frequencies, low thermal drift (5 μV/°C) and an output voltage swing of ± 7 V are additional features of this op-amp. Applications

include high-frequency video amplifier for driving push-pull loads such as c.r.t. deflection plates, servo motors and speaker coils. The differential outputs could also be used for driving balanced transmission lines. It can also be used as a high-fidelity pre-amplifier for audio work. Westinghouse Electric Corporation, Molecular Electronics Division, Box 7377, Elkridge, Md. 21227.

WW 303 for further details

Coaxial Attenuator

A Kay Electric (U.S.A.) in-line attenuator, the Series 110 has a frequency range of d.c. to 4 GHz attenuated over 132 dB in 1 dB steps. It employs a segmented intrinsic cavity switch assembly. A simple slide switch operation controls individual steps of 1, 2, 3, 6, 10, 20, 30, 30 dB. The overall accuracy is 2% up to a maximum of 1 dB at 1 GHz and 5% up to a maximum of 5 dB at 4 GHz. The U.K. agents are Wessex Electronics Ltd., Royal London Buildings, Baldwin Street, Bristol, 1.

WW 304 for further details

TRACKING FILTER

IN order to reject harmonic and rattling distortion from the control accelerometer signal of an electro-magnetic vibration system, Derritron have introduced the solid-state tracking filter TF1. This provides precise tracking at high sweep rates. Automatic bandwidth switching between five crystal filters (3, 10, 30, 100 or 300 Hz bandwidth) may be selected by three separate programmes derived from the compressor functions of the Derritron vibrator control oscillator, VCO1, with which the TF1 is specifically designed to operate. A band reject output is available in addition to bandpass and d.c. analogue outputs. The tuning signal can be derived from any audio oscillator provided the amplitude variation does not exceed 40 dB. It is primarily designed for use in sine, random, sine-random and swept-random vibration testing or for precise analysis and measurement of audio signals. Derritron Electronic Vibrators Ltd., Sedlescombe Road North, St. Leonards-on-Sea, Sussex.

WW 305 for further details

Silver Bearing Solders

SOLDERING of silver-coated glass and ceramic surfaces and silver-plated components presents difficulties when using conventional tin/lead solders. Enthoven Solders Ltd. have produced a range of silver-bearing solders for such work, since the solubility of silver in tin is said to be greatly reduced by using a solder alloy already bearing a specific silver content. This does not affect the inherent solderability of the tin-rich alloys. The melting ranges of the silver bearing solders lie within the normal soft solder range. Enthoven Solders Ltd., Dominion Buildings, South Place, London, E.C.2.

WW 306 for further details

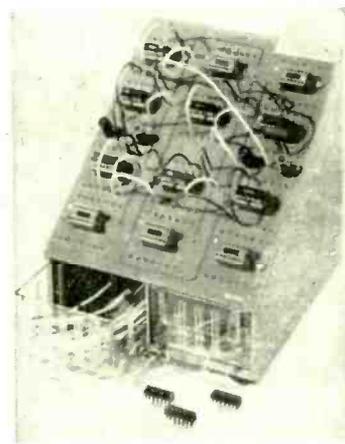
Resin Disintegrator

A disintegration solvent for use with epoxy and polyester resins is available from Oxley-Developments Co. Ltd., Priory Park, Ulverston, North Lancashire. De Solv 8090, as it is called, is non-corrosive to metals (in normal use), non-inflammable and is of low toxicity. It is for use in recovering embedded electronic circuits, and for any applications where the removal of resins, paints and lacquers of the epoxy and polyester type is desirable. The disintegrator can be recovered for further use by filtering out the sediment.

WW 307 for further details

I.C. Breadboard

AN integrated circuit breadboard for dual-in-line i.c.s is manufactured by Spectrum Electronics Ltd. The first unit to be offered is the ICB.707 which has provision for interconnecting twelve dual-in-line circuits. From the wide range of digital and linear dual-in-line circuits available, complex systems can be quickly built, demonstrated and proved. This device features solderless interconnections throughout, and reduces to a minimum the damage to i.c.s. Each pin of the twelve high grade fourteen-lead i.c. sockets is brought out to a five-way socket which may be connected to any desired adjacent socket by colour coded leads. I.C. sockets and five-way sockets are coded for easy identification. Common power and earth points are available at each i.c. socket and are terminated in 2mm binding posts. Two coaxial sockets and binding posts with interconnection sockets are available for input and output signals. Sections of prototype systems can easily be isolated and monitored for demonstration or circuit optimization. Easy insertion and removal reduces the stockholding by making the i.c.s immediately available for other experimental designs. Systems



connections can be changed quickly to investigate a new design or evaluate an alternative supplier's product. The unit is ideal for prototype educational and feasibility studies. A logic handbook is provided for i.c. interconnection leads, and an i.c. extractor tool. The breadboard is $6\frac{1}{2} \times 6\frac{1}{2}$ in and weighs 1½ lb. Spectrum Electronics Ltd., Deneway House, Potters Bar, Herts.

WW 308 for further details

High-frequency Sampling Adaptor

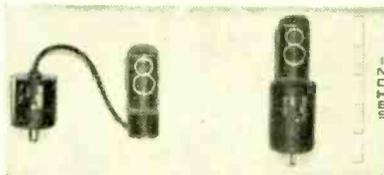
IN the AIM sampling adaptor the gate is open for only 350 picoseconds. This refinement of circuit technology can be better understood if expressed in more practical terms; during the time the gate is open for each sample, a beam of light would travel only five inches. This waveform sampling adaptor type WSA114 gives a 1GHz bandwidth to x-y recorders, oscilloscopes and audio spectrum analysers. It permits the examination of complex repetitive waveforms containing frequencies up to 1,000 MHz. It has four modes of operation, each with good sensitivity and linearity. In "auto" mode it may be coupled to an x-y recorder or low-frequency oscilloscope. Both x and y inputs are provided independently. In "coherent" mode, the unit provides a very slow representation of the original waveform. This may be fed to an x-y recorder, or a spectrum analyser and the original waveform can thus be recorded, analysed or recovered from noise. "Manual" mode provides the facility of scanning point by point through the original waveform. Moreover, in all these modes it is possible to magnify a single section of the waveform by a factor of up to 50. Finally, the "in-

coherent" mode permits the measurement of peak, average or r.m.s. voltage of r.f. waveforms, without the necessity of adjusting synchronization. The technique used in the WSA114 is essentially a stroboscopic one, where samples of the high-frequency waveform are taken at successive intervals, stored for a time in an integral memory, and then assembled into a low-frequency representation of the original waveform. This technique permits recovery of signals which are obscured by up to 20 dB of noise. Moreover, the accuracy of representation of the waveform is said to be better than that of high-speed sampling oscilloscopes. In practice, the input signal is applied to an electronic gate which opens a little later in each scan of the high-frequency waveform so that over, say, 1,000 gate cycles, sufficient samples of the high-frequency trace are collected to permit faithful reconstruction at low speed. The stroboscopic sampler is locked to the incoming signal, and no delicate adjustment is needed to find and then follow a signal whose frequency is drifting. AIM Electronics Ltd., 71 Fitzroy Street, Cambridge.

WW 309 for further details

Counting Modules

A RANGE of plug-in integrated circuit counting modules is being marketed by Darang Electronics under the trade name DIGIC. Each counting stage is encapsulated in an anodized aluminium can, the range being originally designed for use in Darang's Digicron digital clocks, counters and tachometers. The modules are available either with the display tube as an integrated part of the module or with a flying lead up to six feet in length between the display tube and the module. Counting ranges between 0 and 2, 3, 4, 5, 6, 7, 8 or 9 and intermediate ranges 2-4, 3-8, 1-7 are available. The module provides a n.b.c.d. (8421) output and in addition a slave display may be driven from the display tube termination point. The display tube is a standard Mullard type



(ZM 1040) giving a 30 mm digit height; the power requirements are +6 V at 50 mA and +240 V at 5 mA. The input pulse requirements are amplitude +1.5 to 4 V, duration 150 ns minimum and the rise time must not exceed 1 μ s/V. The devices will operate in the temperature range 0-60°C. Darang Electronics Ltd., Restmor Way, Hackbridge Road, Hackbridge, Surrey.

WW 310 for further details

Function Generators

TRIGGER, phase lock and tone burst capabilities are now available in two portable function generators by Wavetek, U.S.A. The Model 115 offers triggered or gated operation as well as phase lock capability. In the trigger mode, a manual or external voltage of ± 0.5 V will generate one cycle. In the gated mode, a discrete number of cycles can be generated by applying a ± 0.5 V gate. The unit will phase lock to the fundamental of the dial frequency with specified accuracy. Model 116 has all the capabilities of the model 115 with the addition of tone burst operation, which may be generated automatically in the trigger mode. Selectable from a front panel control the 116 will generate from 1 to 256 discrete cycles. Both models will also generate sine, square, triangle, ramp and sync pulse waveforms. Nine simultaneous outputs are available over a frequency range of 0.00015 c/s to 1 Mc/s. Additionally, both units are voltage controlled, allowing a 20:1 frequency sweep over the full dial spread.

These two portable instruments have the following common specifications: dial accuracy—0.5% of reading, frequency response amplitude change with frequency less than 0.1 dB, amplitude stability is 0.1% of maximum peak-to-peak values for 30 minutes, and d.c. offset stability is 0.1% of maximum peak-to-peak values for 30 minutes short term. Sine wave distortion is less than 0.5%. Triangle and ramp linearity greater than 99% to 100 kc/s. The square wave rise and fall time is less than 5 nsec. Both models use silicon semiconductors throughout and have individually calibrated dials; each is avail-

able in both a.c. and battery-powered versions. General Test Instruments, Gloucester Trading Estate, Hugglecote, Glos.

WW 311 for further details

Linear Motor

AN electric actuator with linear movement is the description given to the linear motor produced by AB Lineara of Sweden. This type of motor has a stator fixed to a solid member, and a metal guide complete with two end stops. When current is applied to the stator, the guide moves at a speed of 1.2 metres (4 feet)/sec in 20ms with horizontal mounting and unloaded armature. Direction of movement is changed by reversing the current. Although in principle the length of the stroke is infinite, the standard motor has an armature giving a 250mm (10in) stroke length, while the force along the stroke length is constant. For use in moving doors, valves, rejecting packages, moving items in packaging systems, this motor is said to permit a great deal of freedom in design. It can be mounted in any position, although minimum friction between stator and guide occurs when both are vertical. If the guide is fixed, then the stator moves and this method of operation is useful where a mounted or suspended item has to be moved over a definite length. This type of motor is intended for single phase 220 to 240 V 50 c/s operation, thus a phase-shift capacitor is required and is delivered as a standard accessory. The motor control and regulation can

LOGIC SYSTEMS

IN the Farnell logic system simulator, stepped progress can be made from simple logic functions to more complex logic techniques. Binary arithmetic is also introduced and the accompanying manual has a section on Boolean algebra and De Morgan's theorems. The simulator consists of a plinth unit to support the logic modules, a power supply and a range of modules including NOR, AND, NAND units, lamp, switch and binary units. Additional modules available are shaper, generator, photocell and proximity units, and 150 mA and 500 mA driver units.

WW 312 for further details

Variable Delay Line

A VARIABLE delay line adjustable between 10 and 18 μ sec with a dynamic signal-to-noise ratio of 7:1 minimum is available from Sealectro. Deltime LG14 produces 40 mV minimum output across 4.7 k Ω when driven with 10 V at 60 mA peak current. This model is solder-sealed for military applications.

WW 313 for further details

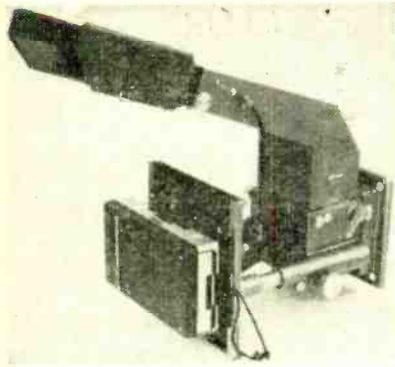
be achieved with conventional electronic equipment. The armature is made from copper as standard, but the material can be any electrically conductive non-magnetic material. The length of the armature is not limited, and its movement can be stopped mechanically without causing motor damage. Motors can be mechanically coupled in series or parallel. The price is £25 10s. The general agent and distributor in Great Britain is Hird-Brown Ltd., Bolton, Lancashire.

WW 314 for further details

Portable Oscilloscope

THE Cossor CDU130 solid-state portable oscilloscope has a bandwidth of d.c. to 15 MHz. Field effect transistors are used to reduce Y amplifier drift, eliminate microphony and ensure accuracy at slow timebase sweep speeds. The sensitivity is 5 mV/division at full bandwidth. The operation of this instrument is possible with external a.c. or d.c. supplies; it will also operate for five hours from the internal battery provided as a standard. A battery charger is contained within the 'scope and the battery is protected against reverse charging. Weight complete is 16½ lb.

WW 315 for further details



OSCILLOSCOPE CAMERA ACCESSORIES

POLAROID film pack backs are now available at no extra cost as alternatives to the present roll-film backs fitted to Telford Type A oscilloscope cameras. The 3,000 ASA eight-exposure pack film is said to be quicker and easier to load and manipulate. As each exposure is processed away from the camera, it is no longer necessary to await for the 15s processing time between successive shots, and multiple photography is greatly simplified where banks of cameras are used. Owners of Type A cameras with roll-film backs can buy pack backs separately, for £30. The pack back, when it is used with the Telford slide plate permits the taking of up to 13 exposures on one print. Also available is a high-speed $f/1.3$ lens, whose wide aperture means that rise times in the order of 10-15 nsec/cm can be photographed, using 10,000 ASA film. Telford Products Ltd., 4 Wadsworth Rd., Greenford, Middx.

WW 316 for further details

POWER TRANSISTORS

FOR use in radar pulse circuits as well as in high-power u.h.f. transmitters, the two transistors 2N5177-8 by TRW Semiconductors Inc. have an r.f. power output of 25 and 50 W respectively. Mounted in a grounded emitter strip-line package, both devices will produce their outputs at 500 Mc/s with a V_{CE} of 28 V. The following parameters are common to both types: V_{CBO} 55 V; V_{CEO} 35 V; and V_{EBO} 3.5 V. The dissipation, collector current and base current for the 2N5177 are 33 W, 4 A and 1 A respectively, and the same parameters for the 2N5178 have the following figures, 65 W, 8 A, and 2 A respectively. M.C.P. Electronics Ltd., Alpertown, Wembley, Middlesex.

WW 317 for further details

Thermoelectric Generators

A STEADY and reliable electric power output, at working temperatures of up to 300°C, is claimed for the range of thermoelectric generator modules by G. V. Planer Ltd. Exploiting the Seebeck effect, these modules are intended for use in marine and aircraft navigational aids, telecommunications systems and remote weather stations. The generators are constructed from 50 thermo-elements which in turn are produced from p and n type semiconductor alloys based on bismuth telluride. Although the elements are connected electrically in series, in order to produce the necessary "hot" and "cold" faces, they are placed in parallel thermally. The establishment of a tempera-

ture difference between the faces produces a voltage (Seebeck effect), the magnitude of which is determined by the temperature gradient and the matrix configuration. The array is encapsulated to give a monolithic, mechanically strong assembly which is capable of operation at elevated temperature. Both types have a maximum hot sink temperature of 300°C and an open circuit voltage of 3.6 V for a temperature difference of 200°C. Type TPG/205 has a matched load output of 750 to 900 mW, and Type TPG/210 has a matched load output of 400 to 500 mW. G. V. Planer Ltd., Windmill Road, Sunbury-on-Thames, Middlesex.

WW 318 for further details

Broadcast Receiver

COVERAGE of the long- and medium-wave broadcast bands and continuous coverage of the shore-wave bands down to below the popular 16-metre band, is provided by the Eddystone EB36 solid-state broadcast receiver. It is completely self-contained, having its own audio amplifier stages and loudspeaker, but an audio output is available for an external tape recorder or hi-fi amplifier. Battery power supplies are provided within the receiver unit, to make the complete receiver independent of any external supply. In this way, it can be operated in a wide variety of portable roles, including road vehicles, small boats and even light aircraft without any additional facilities apart from an aerial. An a.c. mains power unit is available to replace the battery in the receiver. The EB36 incorporates the well-known Eddystone tuning control, with a high tuning ratio to enable precise frequency settings to be obtained. The tuning control is loaded with a heavy flywheel, which makes it possible to spin the dial to cover large changes in frequency very rapidly. Five frequency scales are pro-



vided, covering long-wave, medium-wave and three short-wave bands (from 1.5 to 22 Mc/s). An additional scale, calibrated in arbitrary units, can be used in conjunction with a small vernier dial to provide a very precise definition of points on any of the five frequency scales. The price of the EB36 is £54 5s 7d. Eddystone Radio Ltd., Eddystone Works, Alvechurch Road, Birmingham 31.

WW 319 for further details

Component Packs

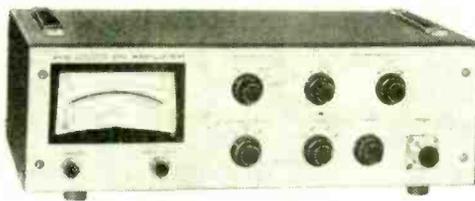
FIRST two in the new range of component packs presented by Peak Sound, designed for use with the "Cir-Kit" system, are available at 15s each. Each pack contains full building and layout instructions. Pack No. 1 contains 15 components to build any one of a range of five different circuits; a high input impedance pre-amplifier with a gain of $\times 100$, a multiple output signal injector, a multimeter high ohms range

extender, multimeter low current range extender, and a mono pre-amplifier for moving coil microphones, giving a gain of $\times 100$. Pack two contains components to build various types of pre-amplifier and multimeter range extenders. Other packs contain components for building amplifiers, pre-amplifiers, and power packs. Peak Sound (Harrow) Ltd., 10 Asher Drive, Ascot, Berks.

WW 320 for further details

D.C. Amplifier

A D.C. amplifier, the 104, providing nanovolt resolution and millisecond rise time for d.c. voltage measuring systems is offered by Keithley Instruments Inc., 28775 Aurora Road, Cleveland, Ohio 44139, U.S.A. The gain range of 100 to 100,000 has an accuracy of $\pm 0.01\%$ and the linearity is ± 5 p.p.m. of full scale. It is particularly useful for process control and automated data handling applications where it is used with a digital voltmeter for measurement of nanovolt and microvolt signals. It has a 10 V full scale output with 10% average for all gain ranges at up to 1 mA at full scale. The peak-to-peak noise

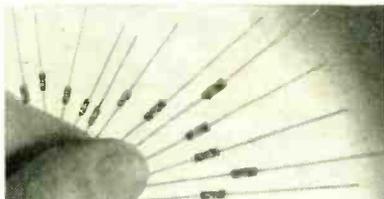


varies from 10 nV (± 50 p.p.m.) at a gain setting of 10^5 to $1 \mu\text{V}$ (± 5 p.p.m.) at a gain setting of 10^2 . Input impedance is greater than 50 M Ω and the output impedance is less than one ohm. Rise times are selectable at nominal settings of 0.05, 0.5, and 5 seconds.

WW 321 for further details

Ceramic Capacitors

MINIATURE ceramic capacitors covering the range 10 pF to 2700 pF are available from Erg Industrial Corporation Ltd., Luton Road, Dunstable, Beds. Although the standard tolerance is $\pm 10\%$, other tolerances are available. The standard temperature coefficient conforms to MK-C-11015C which means that the value observed at 25°C will be maintained within $\pm 15\%$ over the range -55 to $+125^\circ\text{C}$. Working voltages are from 50 to 200 V d.c., and these capacitors can withstand a d.c. potential of 400% of rated voltage applied at 25°C for five seconds with



current limited to 50 mA maximum. Standard leads are tinned copper and dual purpose weldable/solderable leads of gold flashed dumet are available.

WW 322 for further details

Digital Integrated Circuits

A NEW series of digital integrated circuits have been introduced by the Raytheon Company of America. Designated RM2000, the series consists of a quad level translator, a current driver, and a lamp driver. The RM2000 quad level translator consists of four level-shifting inverters, each with two alternative inputs. Signal inputs are at 28 V for one input, 14 V for the other. The RM2001 is a monolithic high voltage (40 V), high current (250 mA) driver with inputs compatible with the 930 Series DTL. Because of this compatibility, the circuit offers logic flexibility in addition to its current and voltage capabilities. Intended primarily for use as a relay or lamp circuit, the RM2002 is a high voltage (40 V), high current (250 mA) unit. The inputs to the driver are compatible with 930 DTL Series circuits. A 930 DTL gate is also provided on the chip for additional logic capability.

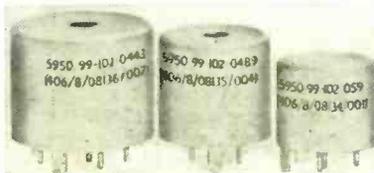
The RM2000 Series is guaranteed

over a temperature range of -55°C to $+125^\circ\text{C}$. The hermetic seal limits leakage to 5×10^{-8} cm³/s of helium. Raytheon Overseas Ltd., Lexington, Massachusetts 02173, U.S.A.

WW 323 for further details

Tunable Pot Cores

ENCAPSULATED tunable pot core assemblies in the Plessey Alpha range have been designed with the close requirements of telecommunications work in mind. One of these requirements is that of temperature co-efficient control and t.c. gradings in these com-



Frequency Doubler and Phase Shifter

THE Brookdeal DP325 frequency doubler/phase shifter has been designed particularly for use in the reference channel of a phase-detection, small signal recovery system where the information frequency is twice that of the excitation or modulating waveform. The output level of 3 V r.m.s. (f.s.d.) can be monitored on the output meter, and inputs from 10 mV to 100 V (f.s.d.) can be accepted. Facilities are provided for phase shifting the output with or without frequency doubling, giving greater than 180° control. The frequency range is 30 c/s to 300 kc/s. Input and output impedances are 100 k Ω and 600 Ω respectively. Compensation is provided within the instrument for input sine waves of poor wave shape, and circuit stabilization is achieved through a high degree of d.c. and signal frequency feedback. Brookdeal Electronics Ltd., Myron Place, London, S.E.13.

WW 324 for further details

STEREO AMPLIFIER

AVAILABLE in kit or assembled form from Daystrom, the TSA-12 Heathkit stereo amplifier has an output of 12 W r.m.s. per channel into an 8 Ω load. The output is also suitable for 15 Ω loudspeakers (8 W r.m.s. per channel) and there are three inputs for gram, radio, and auxiliary signals. Channel separation is 45 dB or better, and the frequency response is stated as 13 Hz to 60 kHz ± 1 dB and 7 Hz to 95 kHz ± 3 dB. Total harmonic distortion at 1 kHz at 0.5% or less at rated output; and at 20 Hz to 20 kHz it is 1% or less at the rated output. It possesses the usual complement of controls and employs 17 transistors and six diodes.

WW 325 for further details

ponents fall into two broad categories arising from the intrinsic characteristics of the ferrites appropriate to the frequency bands. Generally, t.c. is linear for frequencies up to 2 Mc/s and non-linear for frequencies between 2 and 8 Mc/s. This range is suitable for t.c. performance and grading from 0 to 120 p.p.m./ $^\circ\text{C}$ over a temperature range -25°C to $+55^\circ\text{C}$. The encapsulated assemblies are housed in hot tin-dipped copper screening cases, the encapsulant being flexible silicone with good dielectric properties up to 8 Mc/s

WW 326 for further details

Low-Level SCRs

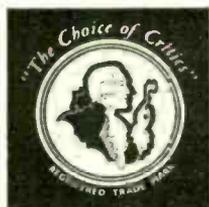
A sensitive gate s.c.r. series rated at 800 mA (forward current r.m.s.) has been designed by Motorola for low-level power control circuits. The series consists of four device types—2N5060 to 2N5063 inclusive, with voltage ranges from 30 to 150 V. Gate current requirements for these units is only 200 μ A. The new geometry used in these devices features larger bonding areas on the die to provide better power dissipation. Additional features include low holding current (5.0 mA max at 25°C), a 6 A peak surge for protection, a 1.7 V peak forward "on" voltage (1A at 25°C), and low blocking currents (50 μ A maximum at rated voltage and 125°C). Motorola Semiconductor Products Inc., York House, Empire Way, Wembley, Middlesex.

WW 327 for further details

VOLTAGE PROBE

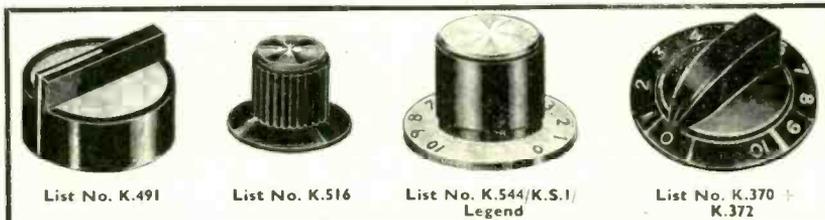
ON the VT100 Amprobe voltage tester, voltages are shown "thermometer" style via a series of lit windows that correspond to the following voltage levels; 115, 220, 277, 440, 550 V a.c. and 115, 220, 400, 600, 750 V d.c. When the probe is connected to the a.c. supply the window indicating the relevant voltage lights up and a buzz is heard the pitch of which is determined by the supply frequency. This instrument will also indicate correct d.c. polarity. The body incorporates a sliding probe and there is another probe attached to an expanding coil cord, thus permitting measurement of points of up to three feet apart. Soss Manufacturing Company, Lynbrook, New York 11563, N.Y., U.S.A.

WW 328 for further details



**THE HOUSE OF BULGIN
AT YOUR SERVICE**

MODERN CONTROL KNOBS



List No. K.491

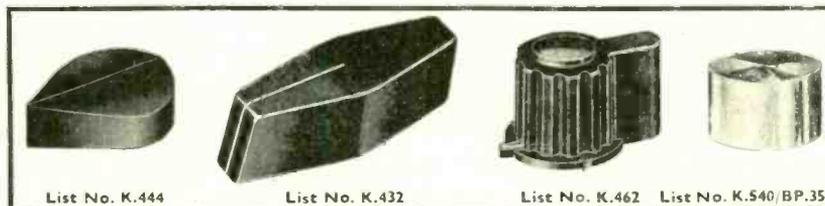
List No. K.516

List No. K.544/K.S.1
Legend

List No. K.370
K.372

★ HIGHLY POLISHED BLACK BODY MOULDINGS of SUPERB QUALITY

★ OTHER COLOURS BY ARRANGEMENT FOR QUANTITY ORDERS



List No. K.444

List No. K.432

List No. K.462 List No. K.540/BP.35

★ HEAVY BRASS INSERTS KEY-LOCKED TO HIGH QUALITY MOULDINGS

★ 4BA. HARDENED STEEL GRUB SCREWS "ALLEN" IF REQUIRED



List No. K.515

List No. K.512

List No. K.437

List No. K.435

★ MANY WITH SPIN STYLING INSERTS HAVING DIAMOND CUT FINISH

★ ALUMINIUM MODELS TURNED FROM SOLID ROD AND POLISHED



List No. K.536/BP.35/
Legend

List No. K.525

List No. K.460/Skirt

List No. K.543/BP.35

★ STANDARDISED BY ALL LEADING MANUFACTURERS

★ A LIFE EXPECTANCY OF AT LEAST 25 YEARS WITHOUT SERVICING

Send for leaflet 1500/C for details of our full range

In addition to our large Standard Range, we can manufacture knobs to customers requirements at 'Low Tool Costs.'

A. F. BULGIN & CO. LTD.,
Bye Pass Rd., Barking, Essex.
Tel: RIPpleway 5588 (12 lines)

MANUFACTURERS AND SUPPLIERS OF RADIO AND ELECTRONIC COMPONENTS TO

| | | |
|--------------|-------------------------|----------|
| ADMIRALTY | MINISTRY OF WORKS | B.S.C. |
| WAR OFFICE | MINISTRY OF AVIATION | G.P.O. |
| AIR MINISTRY | MINISTRY OF SUPPLY | I.T.A. |
| HOME OFFICE | RESEARCH ESTABLISHMENTS | M.P.L. |
| CROWN AGENTS | U.K.A.E.A. | D.S.I.R. |

WW-116 FOR FURTHER DETAILS

The Unknown Warriors

SEEING that the time to ring out the old, ring in the new, is almost upon us, it was the intention of Old Moore Vector to gaze into his crystal ball to report upon the future of the electronics industry. One preliminary side-long peek however, and common humanity made him desist. After all, you are going to have quite enough to put up with as it is, what with forking out for mother-in-law's present, and treading on the holly which the kiddiwinks have installed by their bedsides as a Santa auto-alarm.

So instead I thought it would be nice and seasonable if we paid tribute to the forgotten men of the radio industry. The men who, long after the factories have closed and the labs have locked up for the Christmas, will be tootling around until the small hours of the morning on behalf of those whose sets have gone up in smoke at the last moment. I mean, of course, the chaps in the little shop around the corner; the fellows who have the privilege of repairing that television receiver you bought at cut price in the Tottenham Court Road. Those Tail End Charlies of the receiver industry, the small retailer and his serviceman (often one and the same person).

As we all know to our cost, there are dealers and dealers. There is the city shark with the flashy chromium shop front who welcomes every stranger in with gently smiling jaws (although that was a crocodile wasn't it?). He lives by the late Mr. Barnum's dictum that there is one born every minute and he has never had occasion to quarrel with the sentiment. Then we have an immense variety of chain stores, furniture emporiums, bicycle shops, ironmongers and so on, who run radio as a sideline. Some have qualified personnel; many don't. There's no telling until you've been a customer.

Another phenomenon is the man who, on the strength of having built a simple kit set or two, sets up a pin-money repair business at home. The bonafide dealers love him for his artless habit of adding or subtracting components from the circuit as the mood takes him, then washing his hands of the whole business when the set refuses to work. This chap also has a mysterious source of supply from which he can offer leading makes of receivers at a "little bit off." The dealers love him for that, too.

Finally there is the genuine article; the dealer who runs an honest business and backs it with first-class service. He may be in a big way of business; he may be found in a small village store (one of the best dealer-service engineers I know sells tobacco on the other side of the shop). The tragedy is that from a superficial pavement inspection the genuine article is quite indistinguishable from the riff-raff.

Possession of well-known receiver agencies offers no criterion, for although much lip service is offered by manufacturers to the importance of an efficient service department, a commanding position in the shopping area and a good window-frontage can work wonders in the appointment of a dealer.

One truly startling feature of the radio receiver industry is that prices are actually lower today than they were 45 years ago. You don't believe it? Neither did I, until I came across some radio magazines of 1924 vintage. The price of a reputable two valve set was then roughly £20. So you can get a 10-transistor portable today for less than the price paid for a two valve set in 1924 (off-hand I would say

that the quality of reproduction was about comparable, too, but that's another matter). Compare the price of a television receiver of 1939 vintage with one of today's models and you will see the same downward price trend.

This is in contrast to the "times six" price increase in motor cars and most other commodities over the same period. Receiver manufacturers will argue that this is a tribute to their efficient mass production techniques; in fact, it is more of a tribute to their genius for trying to slit each others' throats and thereby killing the golden goose, if I may mix my metaphors.

The effect on the poor old dealer is all too plain. It means that he is working on the same, or perhaps even a lower, profit margin than he did in 1924. Not merely in percentage but in cash. If he made £5 profit per set in the 1920's he still makes £5 today, in spite of the huge increase in overheads. Take servicing equipment for instance. In the early days he could get by with little more than a buzzer and battery. Today even a modest service department houses many hundreds of pounds worth of equipment. Considering the doldrums in sales which have existed these many years it's not surprising that a lot of dealers have taken a one-way ticket to Carey Street. The wonder is that any have survived at all.

Now colour is with them, like an angry dawn portending more stormy weather; more very expensive servicing equipment and a lower mean time between failures to swallow the extra profit margin. In the cities and stockbroker belts things may not be so bad, but spare a thought for the little man in a remote farm-labouring area. He can count his colour-sales prospects on the fingers of one hand and still have plenty of digits left, but if he sells one colour set he still has to provide the means of servicing it, just as surely as if he was selling them by the hundred.

There was one man, Frank Murphy, away back in the 'thirties, who came up with some ideas which were regarded by his fellow manufacturers as completely screwball. He started making receivers which were engineered to professional standards, with price a secondary consideration (oddly enough, they were only a little higher than average). He appointed his dealers very carefully, making sure that their service departments were of a high standard, but, once appointed, they had exclusive territories of considerable size.

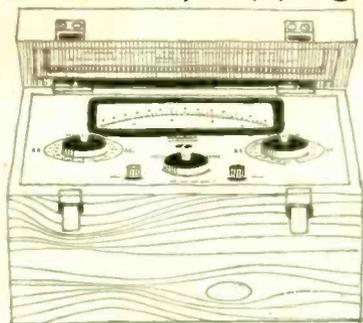
He made the dealer into an external arm of his manufacturing effort by requiring him to provide a monthly return of repairs effected to his sets. If, then, a component was seen to be giving trouble, a better one was substituted, even if production had to be halted temporarily.

The customers were happy because their sets kept working year in, year out. The dealers were happy because their appointment was in effect a certificate of competence and even though their discount was rather less than average, they didn't have any significant free servicing to do. The man who dreamed the system up was happy with a modest profit. Then, surprisingly, he got out of the business altogether, to the great loss of the industry.

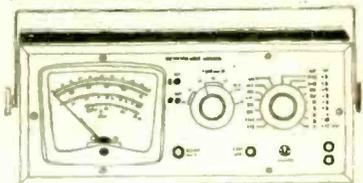
Meanwhile, like any junkie, the industry has relied on periodic shots in the arm to keep it going; the latest of these is colour, over which no doubt, the suicidal price-cutting policies will continue.

When is an Avo meter not an Avometer?

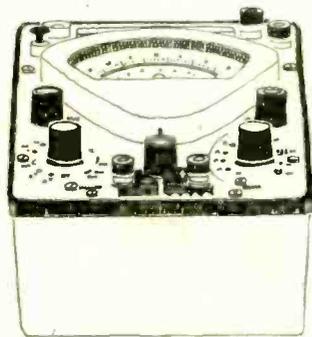
When it gives you (a) $\pm 0.3\%$ accuracy, (b) (c) 100% solid state, (d) (e) (f) semiconductor characteristics data, (g) valve characteristics data, or (h) digital L/C/R measurements.



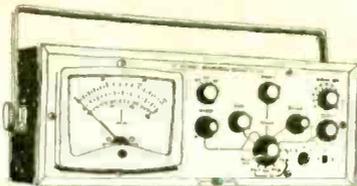
a PRECISION AVOMETER Measures d.c. voltage (1.5-1500V scales, $\pm 0.3\%$ f.s.d.), d.c. current (1.5mA-15A scales, $\pm 0.5\%$ f.s.d.), a.c. voltage (3V-1500V scales, $\pm 0.75\%$ f.s.d.), a.c. current (3mA-15A, $\pm 0.75\%$ f.s.d.). *meets B.S.S. 89/1954 for precision-grade instruments.



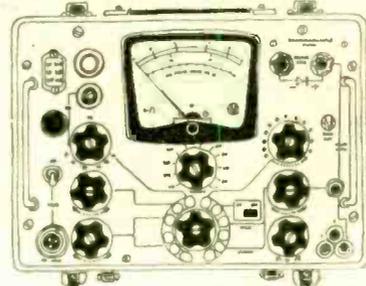
b MULTIMETER HI108 Battery-operated, fully-transistorised, measures a.c./d.c. voltage (100mV-1000V scales, $\pm 4\% \pm 3\%$ f.s.d.), a.c./d.c. current (1 μ A-3A scales, $\pm 4\% \pm 3\%$ f.s.d.), resistance (2k Ω -20M Ω scales), power (-20 to +60db, 9 scales), r.f. voltage (300mV-10V scales, up to 250MHz with external probe available separately).



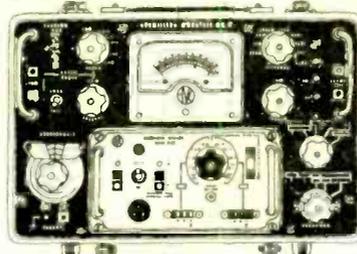
c MULTIMETER CT471A Battery-operated, fully-transistorised, sensitivity 100M Ω /V, measures a.c./d.c. voltage (12mV-1200V scales, $\pm 3\% \pm 2\%$ f.s.d.), a.c./d.c. current (12 μ A-1.2A scales, $\pm 3\% \pm 2\%$ f.s.d.), resistance (12 Ω -120M Ω scales, $\pm 3\%$ m.s.d.), h.f./v.h.f./u.h.f. voltage with multiplier (4V-400V scales up to 50MHz; 40mV-4V up to 1000MHz).



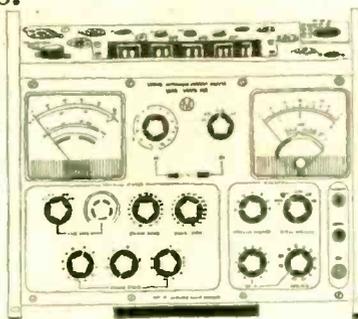
d IN-CIRCUIT TRANSISTOR TESTER TT164 Direct-reading, easy to operate, accurate measurements under static and dynamic conditions. Collector voltage: continuously variable, 0-10V. Collector current: continuously variable 0-10mA, 20mA, 30mA. Measures beta (150-300 scales, $\pm 5\%$) and leakage current (300nA-1mA scales).



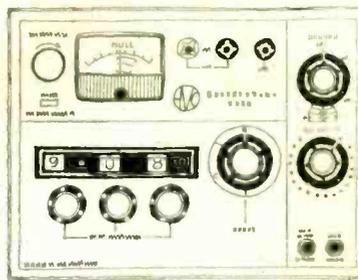
e TRANSISTOR & DIODE TESTER TT537 Measures both transistor and diode characteristics. Collector voltage: continuously variable 0-12V, stabilised. Collector current: 1 μ A-1A. Base current: 0.1 μ A-50mA. Measures hfe (50-1500 scales, $\pm 3\%$), leakage current (50nA-1.5A scales), diode forward voltage drop (1.5-5V scales), 0-500mA forward current and breakdown voltage (100-1000V scales, 3mA & 200 μ A currents limited on short circuit to 13mA & 1.3mA).



f TRANSISTOR ANALYSER MK2 Available in both mains-powered and battery-powered versions; provides accurate measurements in grounded-emitter configuration; accommodates high-power and switching types. Collector voltage: 0.05-12V (up to 150V external). Base current: 1-40mA scales. Collector current: to 1A in 5 ranges. Measures leakage current (from 2 μ A), hfe (25-250 scales), saturation voltage, turn-over voltage and noise factor.



g VALVE CHARACTERISTIC METER VCM163 The most comprehensive instrument of its kind ever offered by Avo. Provision for testing novistors, compactrons and other special types with up to 13 pin connections. No need to back off standing anode current before measuring mutual conductance, which is continuously monitored under all conditions. Heater voltage: 0-119.9V in 0.1V steps. Anode and screen voltages: 12.6V-400V. Grid voltage: 0-100V continuous. Measures gm: 6-60mA/V f.s.d. in 3 ranges.



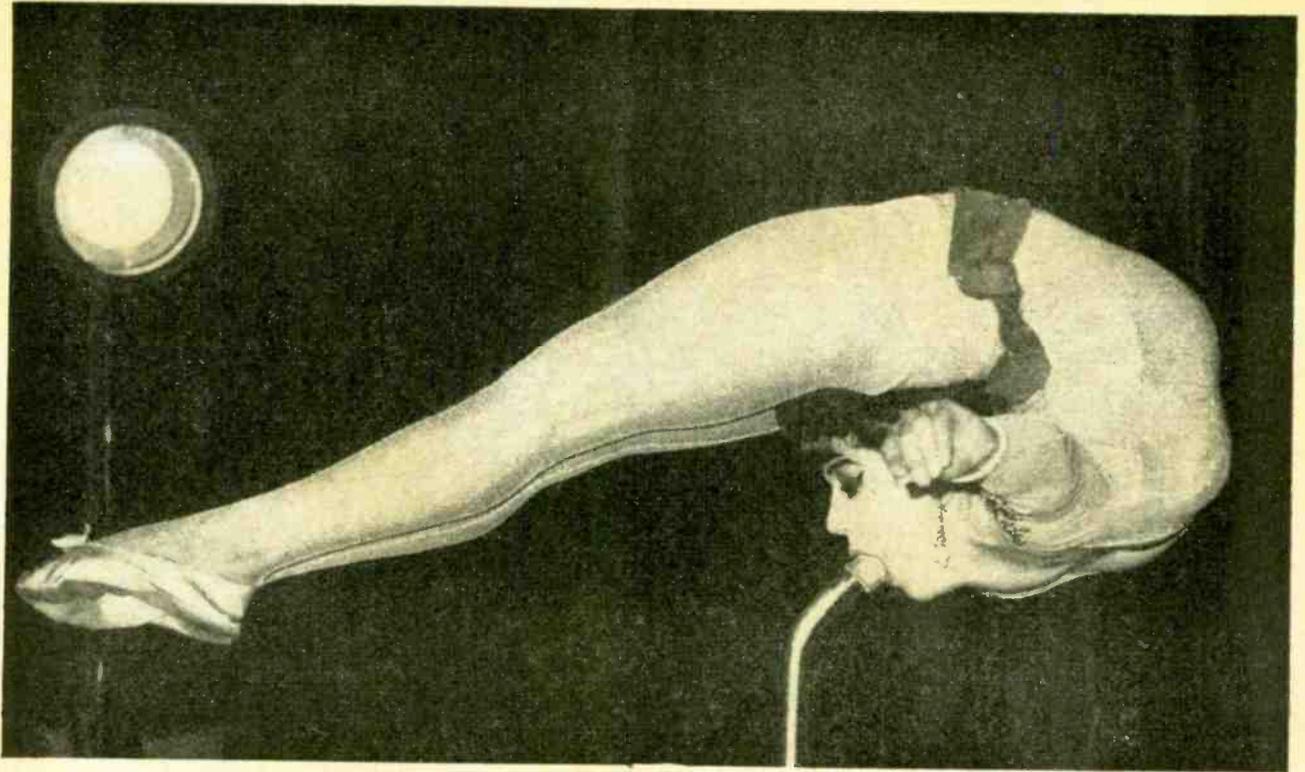
h UNIVERSAL BRIDGE B150 A battery-operated general-purpose bridge with unique automatic digital display of measured component values. No multiplying factors required. Overall accuracy of inductance, capacitance and resistance measurements is $\pm 1\% \pm 1$ digit. Residuals 0.2pF, 0.15 μ H and 2m Ω . Internal 1kHz oscillator & 9V battery, provision for external supplies.

Here are eight members of the Avo test equipment range that combine traditional Avo quality with some of the most advanced instrument technology available anywhere. Start your measurements with a standard Avometer, of course, but as your requirements develop and expand, remember the many other ways in which Avo can continue to help you. For full details, contact Avo Ltd, Avocet House, Dover, Kent. Telephone Dover 2626. Telex 96283.



AV Ω MEANS BASIC MEASUREMENTS ALL OVER THE WORLD

WW-003 FOR FURTHER DETAILS



we are also a very flexible lot at Silentbloc

and when we get
the bit between our teeth
there's no letting go
until we have the solution to your
transmission, shock, vibration
or what-have-you problem.
There is usually more than one way
to approach the answer
and that is where
Silentbloc mental flexibility comes in—
our design team
will bend over backwards
to make sure it's the best possible,
not only functionally but cost-wise too.
The spotlight is on Silentbloc
mountings, couplings, bearings,
ball joints, link assemblies and
every kind of vibration-damping device.

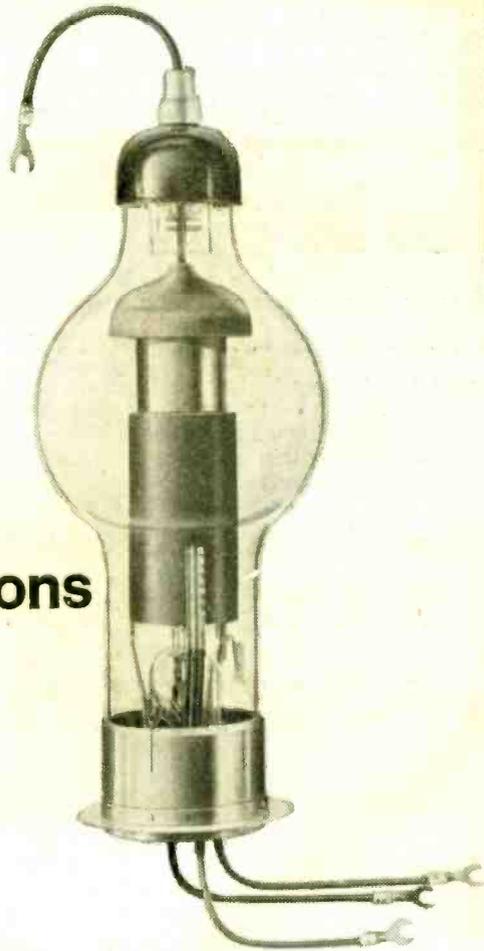
SILENTBLOC

SILENTBLOC LIMITED · MANOR ROYAL · CRAWLEY · SUSSEX
Telephone: Crawley 27733 Telegrams: Silentbloc Crawley Telex: 87177

Andre Rubber Co. Ltd. is another Silentbloc Company. Silentbloc products are also manufactured by Silentbloc (Australia) Pty. Ltd. Melbourne.

WW—004 FOR FURTHER DETAILS

Broadway S/701



Mercury Vapour Thyatrons

DATA

| Type | Service type | Peak inverse voltage max. (kV) | Peak forward voltage max. (kV) | Peak anode current max. (A) | Mean anode current max. (A) |
|------|--------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| BT5 | CV1147 | 1.5 | 1.0 | 12.5 | 2.5 |
| BT17 | — | 1.5 | 1.0 | 40.0 | 6.0 |
| BT19 | CV1144 | 2.5 | 2.5 | 2.0 | 0.5 |
| BT29 | — | 2.0 | 2.0 | 75.0 | 12.5 |
| BT69 | — | 15.0 | 15.0 | 75.0 | 12.5 |
| BT95 | CV5141 | 15.0 | 15.0 | 12.0 | 1.5 |

This range of Mercury Vapour Thyatrons is available from the following E.E.V. stockists. Prices are highly competitive.

Coventry Factors Ltd
Coronet House, Upper Well Street,
Coventry. Tel: Coventry 21051

Downes & Davles Ltd.,
G.P.O. Box 555, 72 Chapelton Street,
Manchester 1. Tel: Ardwick 5292

Edmundson Electronics Ltd.,
60-74 Market Parade, Rye Lane, Peckham,
London SE15. Tel: New Cross 9731

Gothic Electrical Supplies Ltd.,
Gothic House, Henrietta Street,
Birmingham 19
Tel: Birmingham Central 5060

Harper Robertson Electronics Ltd
97 St. George's Road, Glasgow C3
Tel: Douglas 2711

The Needham Engineering Co. Ltd
P.O. Box 23, Townhead Street,
Sheffield 1. Tel: Sheffield 27161

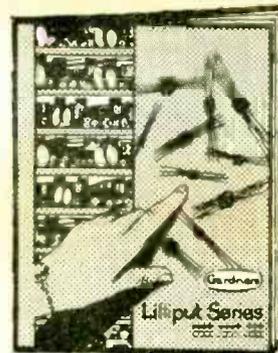
Smith & Cookson Ltd.,
49/57 Bridgewater Street,
Liverpool 1. Tel: Royal 3154-7

Wireless Electric Ltd.,
Wirelect House, St. Thomas Street,
Bristol 1. Tel: Bristol 294313



ENGLISH ELECTRIC VALVE COMPANY LIMITED CARHOLME ROAD, LINCOLN, TELEPHONE: 26352
WW-005 FOR FURTHER DETAILS

The Lilliput Series



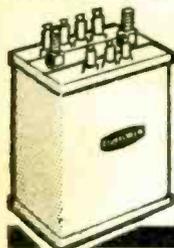
ULTRA MINIATURE, INVERTER, WIDE BAND, CARRIER MATCHING, DRIVER AND PULSE TRANSFORMERS, A.F. AND SMOOTHING INDUCTORS

Gardners Lilliput series of Ultra Miniature transformers has been specifically developed for compatibility with other wired-in modules used on printed circuit boards. Exceptional performance has been achieved by a unique form of construction incorporating extremely thin (down to 3:2 microns) high permeability core materials and a very short length of coil turn. Transformers in this new series are particularly suitable for pulse and switching circuits with rise times of 10 nanoseconds or less

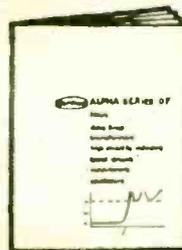
GT 12A. Describes the Lilliput series of Ultra Miniature transformers and gives useful information and data on their application in transistor converter/inverter, wide band communication and high speed pulse circuits.

The Alpha Series

FILTERS, DELAY LINES, TRANSFORMERS, MODULATORS, HIGH STABILITY INDUCTORS, TUNED CIRCUITS, OSCILLATORS

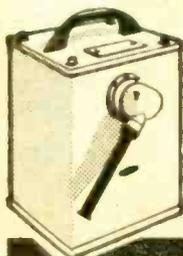


A range of custom built components from simple or hybrid transformers and modulators to highly complex multi-section filters or complete active networks of exceptional stability hermetically sealed to DEF. 5214 Humidity Class H1.

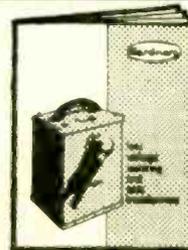


GT 16. Gives a general description of the Alpha series assemblies and describes their suitability for wound components where a high degree of stability is required.

Low Voltage Isolating and Auto Transformers



A comprehensive range of conventional double wound and auto transformers for applications in industry and in the home. Nearly 200 types are available in six different styles and with outputs from 6 volts to 240 volts and from 5VA rating to 2 kilowatts. All types are normally held in stock in reasonable quantities for immediate delivery.



GT 17. Everyone in the electronics industry uses low voltage, isolating and auto transformers at some time or other and this booklet describes the complete Gardner range of this type of transformer in a convenient and presentable form.

Complete coupon and post indicating publication(s) required



Gardners Transformers Ltd., Christchurch, Hampshire
Telephone: Christchurch 1734 Telex 41276

Lilliput Series Alpha Series
 Low Voltage Isolating, Auto Transformers
 Name

Designation

Company

Address

WW-006 FOR FURTHER DETAILS

Voltage Stabilisers



DATA

| Type | Service type | Operating voltage approx. (V) | Striking voltage (V) | | Tube current range (mA) | Regulation max. (V) | Base |
|----------|--------------|-------------------------------|----------------------|-----|-------------------------|---------------------|----------|
| | | | ○ | ● | | | |
| OA2 | CV1832 | 150 | 185 | 225 | 5-30 | 6.0 | B7G |
| OA2WA‡ | CV4020 | 150 | 165 | 225 | 5-30 | 5.0 | B7G |
| OB2 | CV1833 | 108 | 133 | 210 | 5-30 | 3.5 | B7G |
| OB2WA‡ | CV4028 | 108 | 133 | 210 | 5-30 | 3.0 | B7G |
| OC2 | CV8766 | 75 | 115 | 145 | 5-30 | 4.5 | B7G |
| QS75/20 | CV284† | 75 | 110 | 160 | 2-20 | 6.0 | B7G |
| QS75/60 | CV434 | 75 | 117 | — | 5-60 | 5.0 | B8G |
| QS92/10 | CV188†† | 92 | 140 | — | 1-10 | 5.0 | Br.4-pln |
| QS95/10 | CV286 | 95 | 110 | — | 2-10 | 5.0 | B7G |
| QS108/45 | CV422 | 108 | 120 | — | 5-45 | 5.0 | B8G |
| QS150/15 | CV287 | 150 | 170 | — | 2-15 | 5.0 | B7G |
| QS150/45 | CV395 | 150 | 170 | — | 5-45 | 5.0 | B8G |
| QS1202‡ | CV4052 | 108 | 133 | 210 | 2-15 | 3.0 | B7G/F |
| QS1203‡ | CV4053 | 150 | 180 | 225 | 2-15 | 4.5 | B7G/F |
| QS1215 | CV5173 | 90 | 115 | 115 | 1-40 | 8.0 | B7G |

‡ A rugged and reliable type ○ In normal lighting ● In total darkness †† Also CV1070 (operating voltage 100V) † Also CV4083 (operating voltage 70V)

This range of Voltage Stabilisers is available from the following E.E.V. stockists. Prices are highly competitive.

Coventry Factors Ltd
Coronet House, Upper Well Street,
Coventry. Tel: Coventry 21051

Downes & Davies Ltd.,
G.P.O. Box 555, 72 Chapellown Street,
Manchester 1. Tel: Ardwick 5292

Edmundson Electronics Ltd.,
60-74 MarketParade, Rye Lane, Peckham,
London SE15. Tel: New Cross 9731

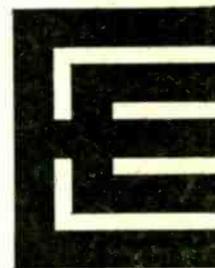
Gothic Electrical Supplies Ltd.,
Gothic House, Henrietta Street,
Birmingham 19
Tel: Birmingham Central 5060

Harper Robertson Electronics Ltd
97 St. George's Road, Glasgow C3
Tel: Douglas 2711

The Needham Engineering Co. Ltd
P.O. Box 23, Townhead Street,
Sheffield 1. Tel: Sheffield 27161

Smith & Cookson Ltd.,
49/57 Bridgewater Street,
Liverpool 1. Tel: Royal 3154-7

Wireless Electric Ltd.,
Wirelect House, St. Thomas Street,
Bristol 1. Tel: Bristol 294313

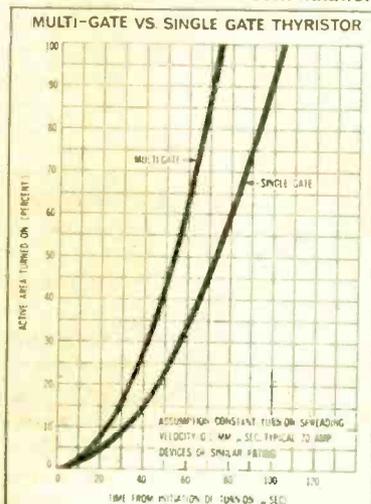


ENGLISH ELECTRIC VALVE COMPANY LIMITED CARHOLME ROAD, LINCOLN, TELEPHONE: 26352
WW-007 FOR FURTHER DETAILS

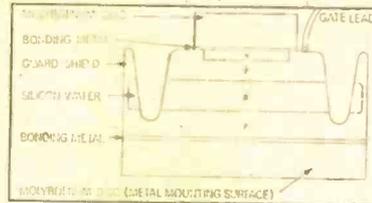
If it's worth 3 minutes of your time to learn the state-of-the-art in Thyristors,

start here: Exclusive Multi-Gate Thyristors When thyristors are to be operated with steeply rising current pulses and/or high repetition rates, great care must be exercised in establishing the operating conditions and selecting the device to be utilized. A self-saturating reactor may be introduced into the circuit to limit the rate-of-rise of current (di/dt); this will permit a conventional high-power thyristor to carry heavy load currents which exhibit high di/dt . Where it is not practical to use such a reactor, which is often bulky and expensive, a thyristor with enhanced turn-on action must be used. Such action can be obtained by providing the thyristor with multiple gates.

IR multi-gate thyristors exhibit reduced turn-on voltage at any given instant during the turn-on period and shorter time for equalization of current flow throughout the entire semiconductor wafer. The consequent reduction in turn-on power losses will permit increased load current to be carried and the device will exhibit faster turn-off time. It will also be able to withstand greater rates of rise of reapplied off-state voltages because of the lower junction temperature at the instant of current commutation.



MIM-Protection IR's epitaxial thyristors offer the exclusive feature of metal-ion migration (MIM) protection.



During manufacture, the silicon wafer for epitaxial thyristors is contoured to improve the high-voltage characteristics of the device. This illustration shows the cross-section of a typical contoured silicon wafer.

Metal-ion migration can occur because of the electrical potential that exists at the junction interfaces at the edge of the wafer. When the device is energized, metal-ions are attracted from the metal mounting surface towards the junction interfaces. Migration may occur even though the wafer has been cleaned by etching and sealed with inert sealers or varnishes. When the minute metallic particles reach the interfaces, they can cause degradation or failure of the device. IR's epitaxial devices employ an exclusive groove etching technique which provides needed contouring and, in addition, builds a guard-shield against metal-ion migration.

Bulk Avalanche Thyristors These devices exhibit true avalanche behaviour in the bulk of the crystal, thus avalanching at approximately the same voltage in both forward and reverse avalanche modes. Bulk avalanche devices are characterised by extremely low leakage current, which is mostly bulk leakage and which does not show any drift or instability under long-term, high-voltage blocking operation. In addition, IR's epitaxial thyristors can be repeatedly broken over into the conduction mode without detrimental effects as long as the power ratings and the rate-of-rise of turn-off current (di/dt) are kept within the listed specifications.

As a result of the epitaxial construction, there is a substantial decrease in the forward voltage drop during turn-on. This reduces the total power loss during the turn-on action, which in turn reduces the temperature of the device. Therefore IR epitaxial thyristors are well adapted for inclusion in inverter and switching applications.

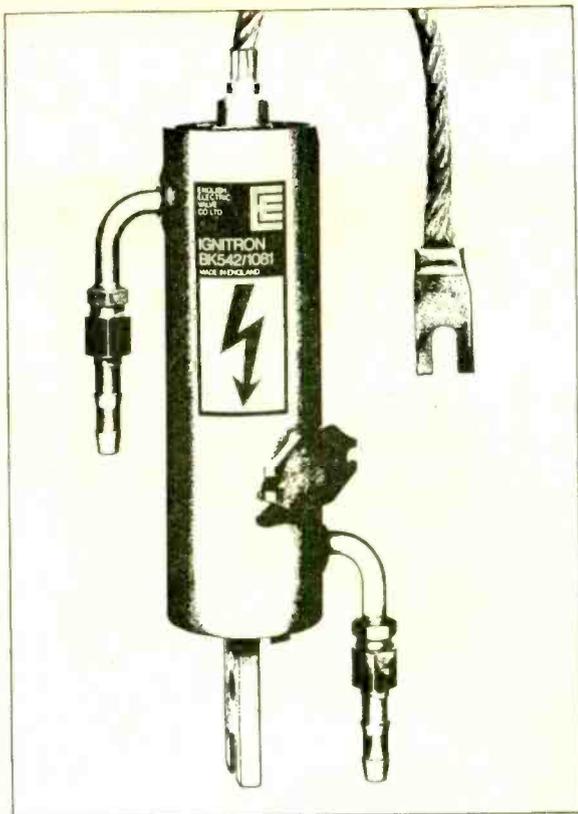
Ultra Fast Turn-Off Thyristors Early this year IR implemented a major technological breakthrough by going into quantity production at Oxted of thyristors exhibiting turn-off times below 3 microseconds, faster than those yet produced by any other semiconductor manufacturer. To date this claim remains undisputed. The devices designated "RCU" are offered in two current ranges of 8 and 10 amperes (full-cycle-average) with voltage ratings of 50-800 volts PRV/PFV. The turn-off times of all IR "RCU" thyristors are measured at maximum base temperature. The maximum operating frequency of a thyristor circuit is obviously dependent on turn-off time, and introduction of "RCU" thyristors means that high-power inverter circuits may be operated at frequencies in excess of 30 kHz. By utilizing "RCU" thyristors, the inverter designer may subsequently reduce the size and cost of the inverter components used in commutating circuits.

The principal applications for the "RCU" thyristors also include high-frequency induction heating, ultrasonic equipment and d.c.-d.c. converters. Detailed information about the world's leading range of thyristors and how they can solve your specific problems is yours on request from International Rectifier. Just ask.

Stop here. Now you know, thanks to

IR

**International Rectifier · Hurst Green
Oxted · Surrey · Telephone: Oxted 3215
Telex: 95219 (RECTIFIER OXTED)**



This looks like
a 'B' size Ignitron

but it controls
65% MORE POWER
and saves money

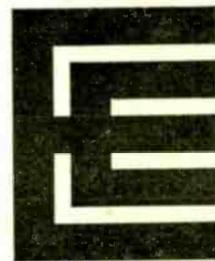
The new EEV Mini 'C' Ignitron

It's well-known that 'B' and 'C' Ignitrons are often used for applications which call for something in between. You can either overwork a 'B' or underwork a 'C'. Whatever you do wastes money. To cut out this waste EEV have developed a new Mini 'C' Ignitron which has a standard international 'B' size envelope, but can handle 65% more KVA than the 'B' size. The new tube has a number of advantages. Take-over voltage is low to minimise misfiring at low current conditions, which in turn increases ignitor life. When used in place of a standard 'B' size ignitron, you will find that the Mini 'C' lasts nearly twice as long. The cooling water is in direct contact with the vacuum envelope, and the inlet

has been streamlined for better water flow. This adds up to better cooling, especially at hot spots, and reduced clogging by sediment. Both water connections are of the quick release type. Plastic coating is optional. The Mini 'C' fits standard 'B' size sockets, so that you can use it to uprate existing equipment to provide new intermediate types. Makers of welding equipment will see in the Mini 'C' a means of extending their range, as there is no need for a new socket size calling for radical design changes. Use the Mini 'C' in place of an overworked 'B' size for longer life, or to replace an underworked 'C' size for lower running costs. In both cases it will save you money.

EEV's new Mini 'C' Ignitron is available from stockists throughout the country.

| | |
|---|----------------------------------|
| Harper Robertson Electronics Ltd, 97 St George's Road | Glasgow C3 Tel: Douglas 2711 |
| Downes & Davies Ltd, G.P.O. Box 555, 72 Chapelton Street | Manchester 1 Tel: Ardwick 5292 |
| Smith & Cookson Ltd, 49/57 Bridgewater Street | Liverpool 1 Tel: Royal 3154-7 |
| The Needham Engineering Co. Ltd, P.O. Box 23, Townhead Street | Sheffield 1 Tel: Sheffield 27161 |
| Coventry Factors Ltd, Coronet House, Upper Well Street | Coventry Tel: Coventry 21051 |
| Gothic Electrical Supplies Ltd, Gothic House, Henrietta Street | Birmingham 19 Tel: Central 5060 |
| Edmundson Electronics Ltd, 60-74 Market Parade, Rye Lane, Peckham | London SE15 Tel: New Cross 9731 |
| Wireless Electric Ltd, Wirelect House, St Thomas Street | Bristol 1 Tel: Bristol 294313 |



ENGLISH ELECTRIC VALVE COMPANY LIMITED CARHOLME ROAD, LINCOLN. TELEPHONE: 26352

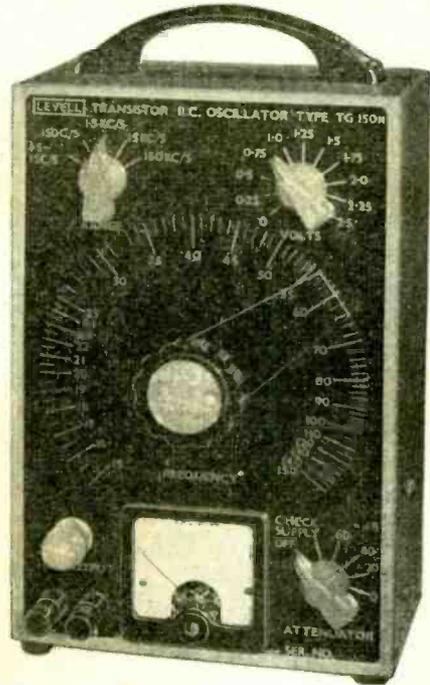
AP329

WW-009 FOR FURTHER DETAILS

LEVELL

PORTABLE INSTRUMENTS

R. C. OSCILLATORS



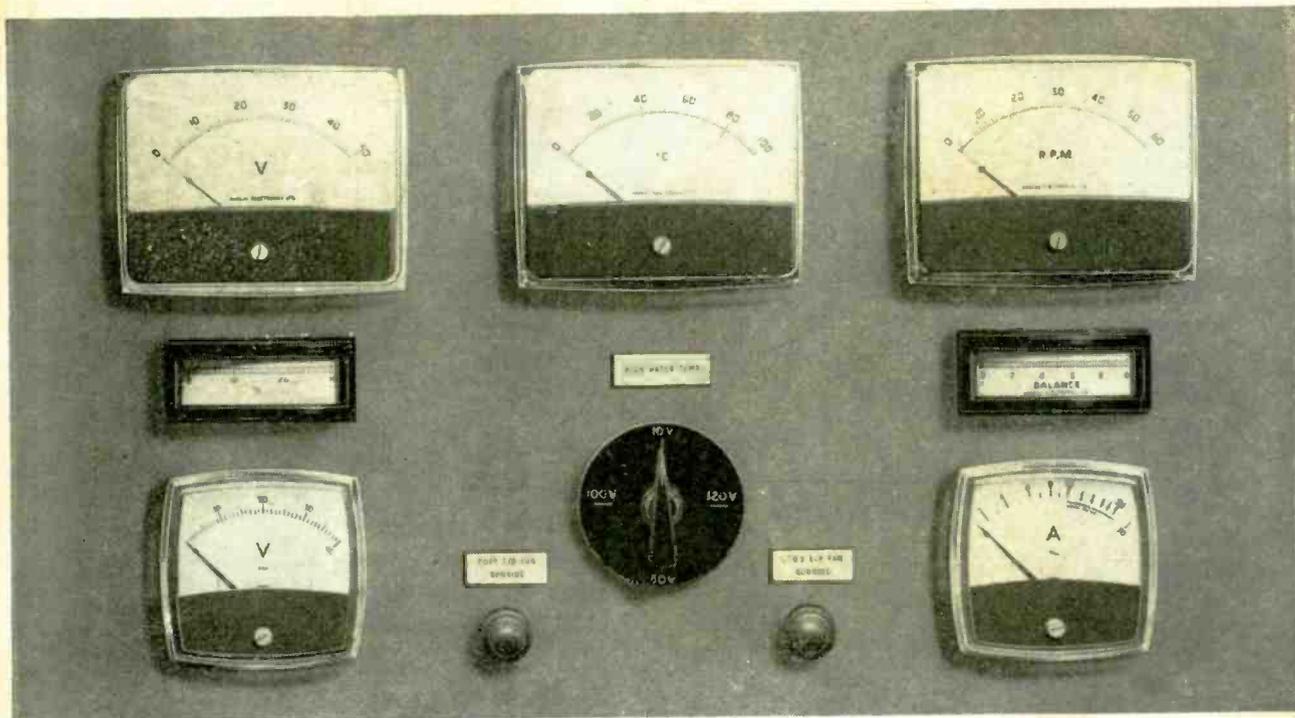
With **DIGITAL** or **ANALOGUE** Frequency calibration

| TYPE | TG66A | TG66B | TG150 | TG150M | TG150D | TG150DM |
|--------------------|--|-------|---|------------------------------|---|------------------------------|
| FREQUENCY | 0.2Hz to 1.22MHz. | | 1.5Hz to 150kHz | | | |
| ACCURACY | ±0.02Hz below 6Hz ±0.3% from 6Hz to 100kHz ±1% from 100kHz to 300kHz ±3% above 300kHz | | ±3% ±0.15Hz | | | |
| DISTORTION | <0.15% from 15Hz to 15kHz <0.5% at 1.5Hz and 150kHz | | <0.1% at 1kHz, <0.3% from 50Hz to 15kHz <1.5% below 50Hz and above 15kHz | | | |
| SINE WAVE OUTPUT | Source voltage variable from 30μV to 5V. Output impedance 600Ω at all settings | | Source voltage variable from 250μV to 2.5V. Output impedance <250Ω above 250mV, 600Ω below 250mV. Less than 1% variation of amplitude throughout frequency range. | | | |
| SQUARE WAVE OUTPUT | None | | None | | Variable up to 2.5V peak. Rise Time 1% of period +0.2μS | |
| OUTPUT METER | Expanded voltage scales and -2dB to +4dB. Scale length 3.5in. | | None | 0 to 2.5V and -10dB to +10dB | None | 0 to 2.5V and -10dB to +10dB |
| POWER SUPPLY | 4 type PP9 batteries, life 400 hours, or A.C. Mains when selected by panel control | | 2 type PP9 batteries, life 400 hours, or A.C. Mains when batteries are replaced by Levell Power Unit | | | |
| SIZE | 7in. x 10½in. x 7in. Weight 12lb. | | 10in. high x 6in. wide x 4in. deep. Weight 6lb. | | | |
| PRICES | £150 | £120 | £32 | £42 | £35 | £45 |
| + Mains Power Unit | included | £15 | £7/10/- | | | |
| + Leather Case | £5 | £5 | £4/10/- | | | |

LEVELL ELECTRONICS LTD., Park Road, High Barnet, Herts. Phone 01-449 5028

WW-010 FOR FURTHER DETAILS

Meter panel of specialists



Here at Anders there's a panel of meter specialists daily creating panels of special meters. And just special meters on their own. For equipment manufacturers, research organisations, nuclear energy establishments. For anybody, in fact, whose meter requirements are a little out of the ordinary, like non-standard calibrations. Or a lot out of the ordinary, like non-standard calibrations plus special modifications, plus . . . well, you name it. Creating specials is an important part of Anders Meter Service.

Manufacture and distribution of electrical measuring instruments and electronic equipment. The largest stocks in the U.K. for off-the-shelf delivery. Prompt supply of non-standard instruments and ancillaries. Sole U.K. distribution of FRAHM vibrating reed frequency meters and tachometers.

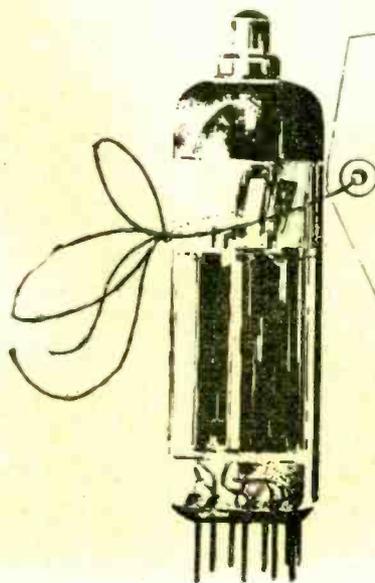
New comprehensive catalogue available free to manufacturers and bona-fide engineers.

ANDERS METER SERVICE

Anders Electronics London • 103 Hampstead Road • London NW1 • Telephone Euston 1639
Ministry of Aviation Approved

WW-011 FOR FURTHER DETAILS

IF THIS
IS NOT THE
ONE YOU
WANT WE STILL
HAVE A FEW
MILLION OTHERS



FOR EXPORT

VALVES FOR:

Radio and Television Manufacturers.
Radio and Television Service Departments.
Radio Relay Companies
Audio Equipment.
Electronic Equipment.
Instrumentation.
Computers.
Marine Radar.
Communication Equipment.
Research and Development.
Government Departments.
Aircraft Military and Civil.

*Ministry of Aviation Approved Inspection. Air Registration Board
Approved Inspection.*

For quality, reliability and world-wide availability, rely on
Hall Electric's speed, intelligence and reputation.

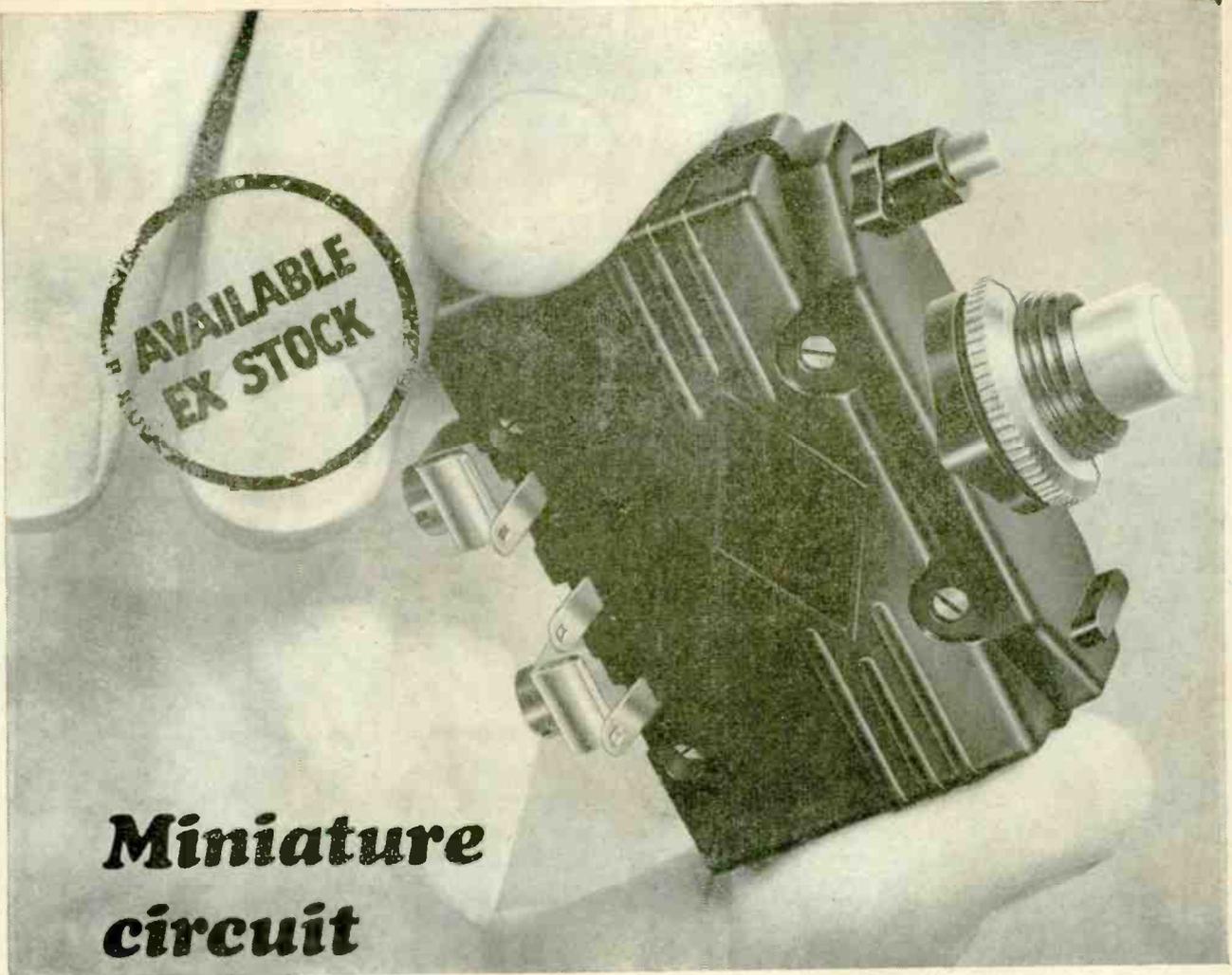
HALTRON

RADIO VALVES & TUBES

Hall Electric Ltd., Haltron House, Anglers Lane, London, N.W.5.

Telephone: 01-485 8531 (10 lines). Telex: 2-2573. Cables: Hallelectric, London, N.W.5.

WW-012 FOR FURTHER DETAILS



**Miniature
circuit
breakers
with BIG
Advantages**

The Belling-Lee "Securex" Miniature Circuit Breaker is a precision unit which provides protection, switching plus a clear indication of the circuit condition. Two basic types are available, thermal or thermal-magnetic. Available in many ratings from 300 mA to 15 A.

FOR FULL SPECIFICATIONS RING ENF 5393
OR WRITE FOR DATA SHEETS E17-E20

BELLING-LEE

COMPONENTS

connecting research to industry

BELLING & LEE LIMITED, GREAT CAMBRIDGE ROAD, ENFIELD, MIDDLESEX

Telephone: 01-363 5393 Telex: 263265

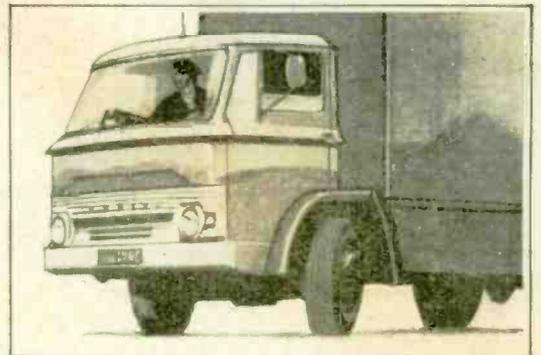
WW-013 FOR FURTHER DETAILS



Always on-the-air

with the rugged **PROVED** reliability of the
PYE 'VANGUARD' mobile radio

- Up to 100W r.f. output
- All-transistor receiver with low current consumption on stand-by
- Up to 4W audio output
- G.P.O. approved; meets U.S., Canadian and European specifications
- Sealed I.F. block fitters
- A.M. or F.M. versions
- Dust and splash-proof
- Option of 12½ kc/s, 20/25/30 kc/s or 40/50/60 kc/s channel spacing
- 1 to 10 channels available



Pye Telecommunications Limited, Cambridge, England
 Telephone Cambridge 61222. Telex 81166

VALUABLE NEW HANDBOOK **FREE** TO AMBITIOUS ENGINEERS

Have you had *your* copy of "Engineering Opportunities"?

The new edition of "ENGINEERING OPPORTUNITIES" is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new "ENGINEERING OPPORTUNITIES" should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

On 'SATISFACTION OR REFUND OF FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

ELECTRONIC ENG.

Advanced Electronic Eng. — Gen. Electronic Eng. — Applied Electronics — Practical Electronics — Radar Tech. — Frequency Modulation — Transistors.

RADIO ENG.

Advanced Radio — Gen. Radio — Radio & TV Servicing — TV Eng. — Telecommunications — Sound Recording — Automation — Practical Radio — Radio Amateurs' Exam.

ELECTRICAL ENG.

Advanced Electrical Eng. — Gen. Electrical Eng. — Draughtsmanship — Illuminating Eng. — Refrigeration — Elem. Electrical Science — Electrical Supply — Mining Electrical Eng.

MECHANICAL ENG.

Advanced Mechanical Eng. — Gen. Mechanical Eng. — Maintenance Eng. — Diesel Eng. — Press Tool Design — Sheet Metal Work — Welding — Eng. Pattern Making — Inspection — Draughtsmanship — Metallurgy — Production Eng.

CIVIL ENG.

Advanced Civil Eng. — Gen. Civil Eng. — Municipal Eng. — Structural Eng. — Sanitary Eng. — Road Eng. — Hydraulics — Mining — Water Supply — Petrol Tech.

AUTOMOBILE ENG.

Advanced Automobile Eng. — Gen. Automobile Eng. — Automobile Maintenance — Repair — Automobile Diesel Maintenance — Automobile Electrical Equipment — Garage Management.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORKS STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power?
A.M.I.E.R.E., A.M.I.Mech.E., A.M.S.E., A.M.I.C.E., B.Sc.,
A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.O.B., A.M.I.Chem.E., A.R.I.C.S.,
M.R.S.H., A.M.I.E.D., A.M.I.Mun.E., C.ENG., CITY & GUILDS,
GEN. CERT. OF EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
446A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE

THIS BOOK TELLS YOU

- ★ HOW to get a better paid, more interesting job.
- ★ HOW to qualify for rapid promotion.
- ★ HOW to put some letters after your name and become a key man . . . quickly and easily.
- ★ HOW to benefit from our free Advisory and Appointments Depts.
- ★ HOW you can take advantage of the chances you are now missing.
- ★ HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.

132 PAGES OF EXPERT CAREER-GUIDANCE

| | |
|---|--|
| <p>PRACTICAL EQUIPMENT</p> <p>Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, etc. A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam., R.T.E.B. Certificate, P.M.G. Certificate, Practical Radio, Radio & Television Servicing, Practical Electronics, Electronics Engineering, Automation.</p> | <p>INCLUDING TOOLS</p> <p>The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.</p> <p style="font-size: 2em; font-weight: bold; text-align: center;">B.I.E.T.</p> |
|---|--|



You are bound to benefit from reading "ENGINEERING OPPORTUNITIES," Send for your copy now—FREE and without obligation.

POST NOW!

TO B.I.E.T. 446A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE. 3d. stamp if posted in an unsealed envelope.

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

.....

NAME

ADDRESS

.....

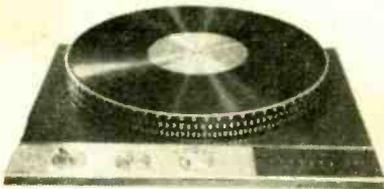
WRITE IF YOU PREFER NOT TO CUT THIS PAGE

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

WW-015 FOR FURTHER DETAILS



Three turntables from the world's greatest range of record playing units designed to enable you to get closer than ever before to your ideal in sound reproduction.



Garrard 401

With its magnetically shielded 4-pole induction motor, gear-cut stroboscopic marking illuminated by an integral high-intensity neon lamp, precise variable speed control, heavy non-magnetic diecast turntable, anti-static mat, and functional styling, the 401 is the ultimate in transcription turntables. It meets the most exacting requirements of radio, television and recording studios throughout the world and of Hi-Fi enthusiasts everywhere. Each unit is supplied with its own test report



Garrard LAB 80 Mk II

The LAB 80 Mk II is a transcription turntable with facilities for changing records when desired. Among the advanced features are low-resonance wood pick-up arm, pick-up bias compensator and cueing facilities on manual. Further refinements are finger-tip tab controls, integral calibrated fine stylus force adjustment, a record-repeat adaptor and automatic play of single records. Optional extras—attractive teak-finish base (WB2) and rigid clear plastic cover (SPC2).



Garrard SP 25 Mk II

A single record-playing unit designed to give exceptional performance at moderate cost. The SP 25 Mk II incorporates a pick-up arm bias compensator and integral calibrated stylus-force adjustment. A special feature is a cueing device which allows the pick-up to be raised or lowered at any point on the record. When a record has been played, the pick-up arm automatically lifts and returns to its rest and the motor switches off. Optional extras—attractive teak-finish base (WB1) and rigid clear plastic cover (SPC1).



Your Hi-Fi dealer will be pleased to show you these superb Garrard units. Ask for leaflets on the complete Garrard range.

Garrard Engineering Limited, Newcastle Street, Swindon, Wiltshire. Telephone: Swindon 5381

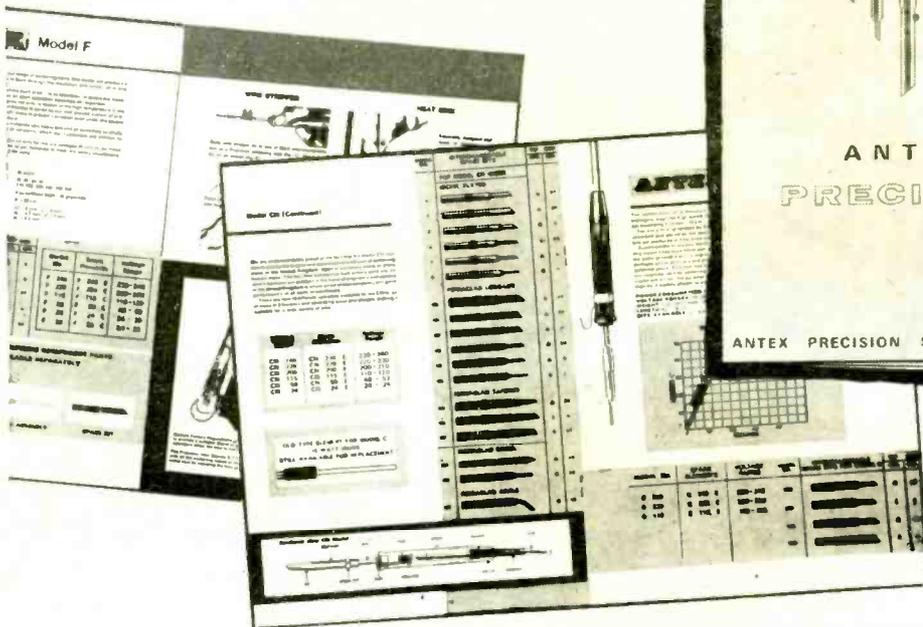
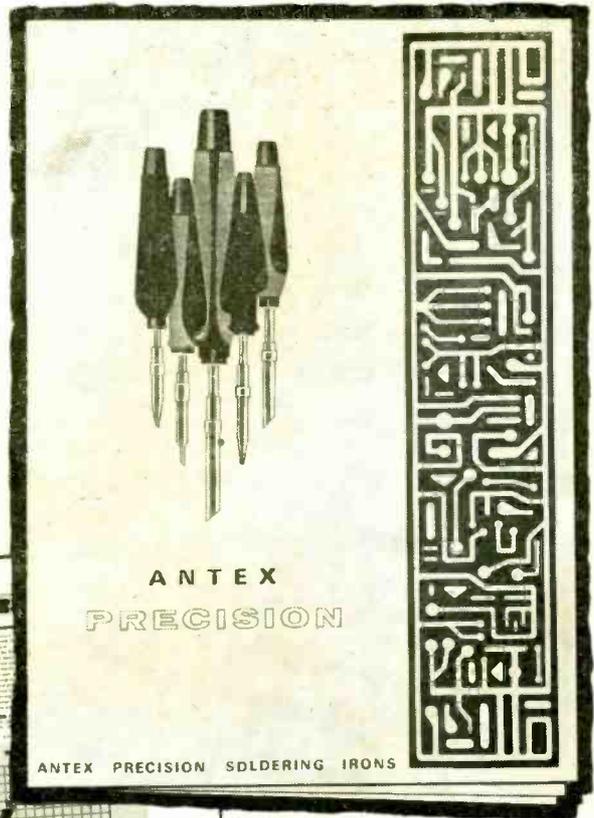
Garrard

looks after your records

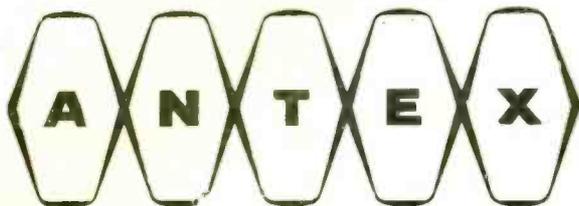
WW-016 FOR FURTHER DETAILS



If you solder, then send for this...



If your production processes call for fine precision soldering, then you must have the new Antex Precision Soldering Equipment Catalogue. This details the range of Antex irons, with complete performance specifications, full details of spare bits etc., as well as information on de-soldering tools, iron stands etc. In fact its' 16 pages (in colour!) deal with every aspect of Precision Soldering. And its free - just send off the coupon.



**TO: ANTEX LIMITED
GROSVENOR HOUSE, CROYDON, CR9 1QE**

Please send me ___ copies of the Antex Precision Soldering Catalogue

NAME _____

POSITION _____

COMPANY _____

ADDRESS _____

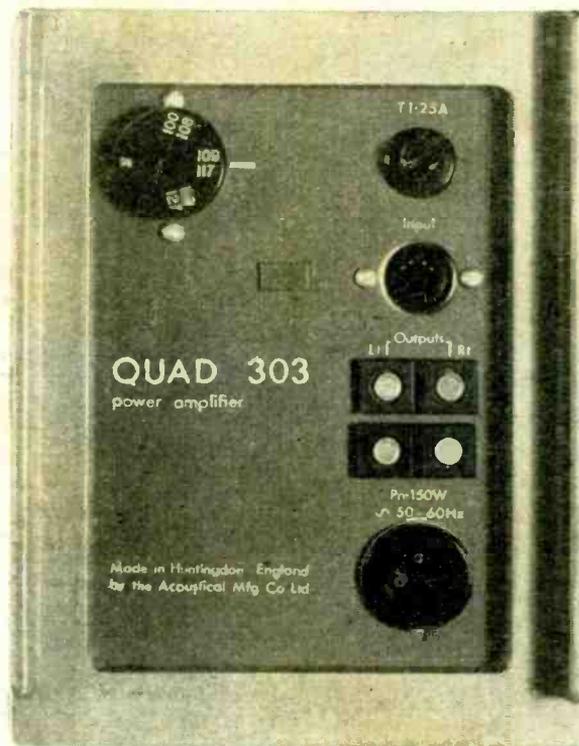
ANTEX LIMITED · GROSVENOR HOUSE · CROYDON CR9 1QE · Telephone: 01-686 2774
 WW-017 FOR FURTHER DETAILS

QUAD for the closest approach to the original sound



NEW

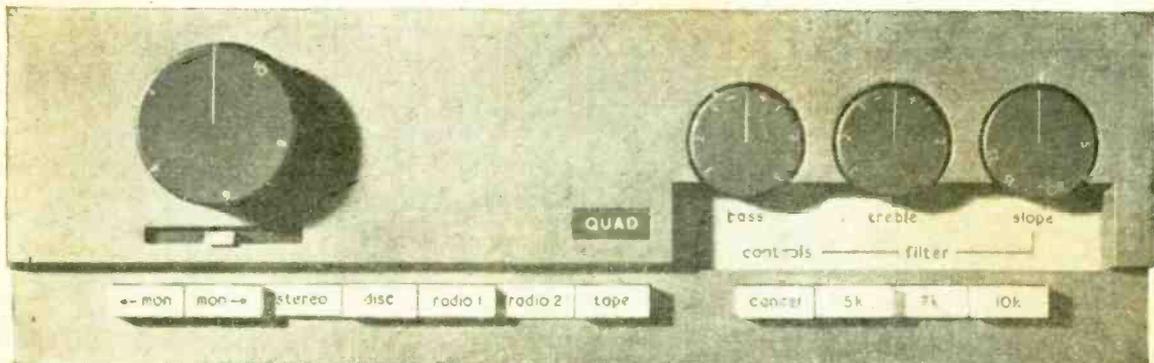
**33 CONTROL UNIT
303 POWER AMPLIFIER**



During December, most dealers will have available demonstration models, and full technical details.

QUAD

**THE ACOUSTICAL
MANUFACTURING
COMPANY LTD.**
Huntingdon, England
Telephone:
Huntingdon
(0480) 2561/2



WW-018 FOR FURTHER DETAILS

TIMERS MICRO SWITCHES

IMMEDIATE DESPATCH

PROCESS TIMERS

611-T Delay Relay



- ★ 2, 5, 15 & 25 secs. Delay.
- ★ 15 amp. c/o micro-switch fitted
- ★ LARGE RANGE OF A.C. & D.C. COILS.

approx. 40/- each, dependent on quantity.

AT-10 PNEUMATIC TIMER - delay relay



- ★ Fully adjustable up to 200 seconds. Fitted with 15 amp. S.P.D.T. switch.
- ★ One model provides delay after energise or delay after de-energise.

approx. £6.0.0 dependent on quantity.

STP Sub-Mini Process Timer

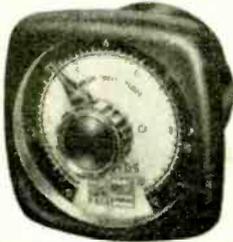
SYNCHRONOUS MOTOR & CLUTCH



- Matchbox size frontal area.
- Automatic re-set.
- ★ PLUG-IN OCTAL BASE
- ★ INSTANTANEOUS AND TIMED OUT 2 AMP CONTACTS
- ★ RANGES: 10 SECS. TO 36 MINS.

approx. £5.0.0 each.

SYS MINI-TIMER



SYNCHRONOUS MOTOR & CLUTCH

- ★ 10 MILLION OPERATIONS
- ★ Instantaneous & Timed out 3 AMP contacts.
- ★ Repeat Accuracy $\pm 1\%$. 10 secs. to 28 Hrs. May also be used as impulse start and automatic reset.

£9.15.0 dependent on quantity. approx.

MAINS OPERATED



YL 2 GPA PROXIMITY SWITCH

- ★ FOR BATCHING, CONVEYORS, MACHINE TOOL CONTROL, PACKAGING, SORTING, etc.
- ★ SENSES FERROUS OBJECTS
- ★ NEEDS NO MECHANICAL FORCE OR PRESSURE TO OPERATE

- ★ SOLID STATE SENSING HEAD INCLUDES CONSTANT VOLTAGE CIRCUIT

approx. £11.0.0 dependent on quantity

OTHER INDUCTIVE AND CAPACITY TYPES AVAILABLE

U.L. APPROVED (Appr. No. 32667)

U.S. MIL. SPEC.

ALWAYS AVAILABLE FROM STOCK

S5G



- ★ 1 MILLION OPS. 5 amp. c/o Sub-miniature Micro-switch.

2/5 each per 1,000

VAQ

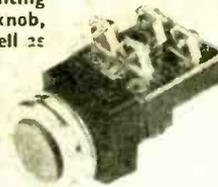


- ★ 10 amp. c/o PUSH BUTTON Panel mounting. Buttons in six colours.

4/2 each per 250.

HEAVY DUTY PUSH-BUTTON SWITCHES

7 different panel mounting actuators including; knob, key, and lever, as well as push on/push off. Up to 4 switch blocks can be fitted. Dust and splash proof, D/P slow make and break, 5 amp rating. Full literature on request.



VV-15-1A



- ★ 15/10 AMPS. c/o
- ★ 100,000 ops.

1/8 each per 1,000

Single Throw 1/4 each

LIMIT SWITCH

WL 10 FNJ

- ★ 10 AMP 2 CIRCUIT
- ★ 5 INCH FLEXIBLE ACTUATOR AS ILLUSTRATED

AS LOW AS 47/7 EACH.

FIVE OTHER STANDARD TYPES AVAILABLE



V-10-1B



- ★ 1 MILLION OPERATIONS.
- ★ 10 amp. c/o.

- ★ COMPARE OUR SPEC. & OUR PRICES WITH OTHER SIMILAR TYPES.

Screw Terms. 2/2 each per 1,000
V-10-1A Solder Tags 1/11 each per 1,000

VV-5GW-1A44



- ★ LIGHT FORCE
- ★ 4 gms. Wire actuator.
- ★ Designed for coin-operated mechanisms.

4/1 each per 1,000

NEW RANGE OF SLOW BREAK-&MAKE HEAVY DUTY PUSH-BUTTON SWITCH ACTUATORS. PANEL MOUNTING, TO BE USED WITH 1 to 4 D/P S/T SWITCH BLOCKS. COLOURED KNOBS. ALSO PUSH-ON/PUSH-OFF TYPES. SUITABLE FOR MACHINE TOOLS, MOULDING & PACKAGING MACHINES & CONTROL PANELS. FULL LITERATURE & DETAILS ON REQUEST.

(Dept. W.W.9)

OMRON PRECISION CONTROLS

313 Edgware Road, London, W.2

Tel.: 01-723 2370

WW-021 FOR FURTHER DETAILS

RE-CREATES THE FINER SHADES OF ORIGINAL SOUND

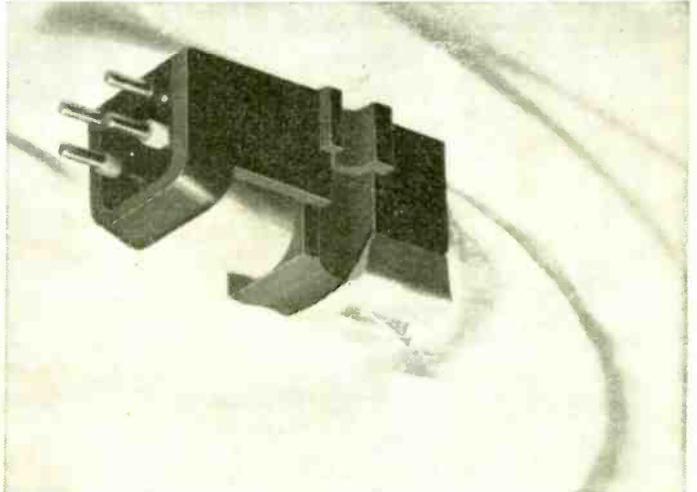
To re-create faithfully the finer shades of original sound, stored as complex mechanical patterns in the micro-grooves of modern records, calls for a cartridge in the precision instrument class. Goldring engineers have spent two years developing such a cartridge . . . the Goldring "800" Free Field Cartridge. At a comparatively modest cost this cartridge rivals the finest in the world, whilst at the same time guaranteeing the complete reliability for which the name "Goldring" has stood for sixty years in record reproduction.

GOLDRING "800" FREE FIELD STEREO CARTRIDGE £12.7.6
tax paid

SPECIFICATION

| | |
|-------------------------------------|---|
| Type | Magnetic—(Free Field) |
| Frequency Response | 20 Hz—20 kHz |
| Sensitivity | 1 mv. per cm/sec. |
| Separation | 25dB at 1kHz and nowhere less than 15dB |
| Load | 100k—47k/ohms |
| Compliance | 20 x 10 ⁻⁶ cm/dyne |
| Stylus | 0.0005" diamond replaceable |
| Effective Tip Mass | 1 mg. |
| Tracking Weight | 1—3 grms. |
| Head Weight | 8 grms. |
| Vertical Tracking Angle | 15° |
| Mu Metal Shield for hum protection. | |

GOLDRING '800' FREE FIELD STEREO CARTRIDGE



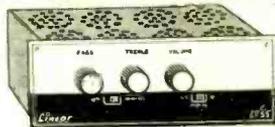
GOLDRING MANUFACTURING CO. (GREAT BRITAIN) LIMITED 486-488 High Road, Leytonstone, London, E.11
WW—022 FOR FURTHER DETAILS



LT55 6 WATT AMPLIFIER

A High Fidelity unit providing excellent results at modest output levels.

- Frequency Response** 30-20,000 cps—2dB
- Sensitivity** 5 mv (max)
- Harmonic Distortion** 0.5% at 1,000 cps.
- Output** for 3-8-15 ohm Loudspeakers.
- Input Sockets** for 'Mike,' Gram, and Radio Tuner/Tape Recorder.

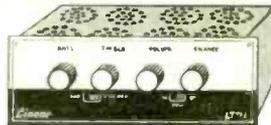


Recommended Retail price 8 GNS
Size 9 1/2 x 2 1/2 x 5 1/2 in.
Controls (5) Volume, Bass, Treble, Mains Switch, Input Selector Switch.

LTA15 15 WATT AMPLIFIER

High Fidelity Output switched inputs for Gram, 'Mike,' Tape, and Radio.

- Frequency Response** 10-40,000 cps—3dB
- Base Control** +18dB to -16dB at 40 cps
- Treble Control** +17dB to -14dB at 14 Kcs
- Hum and Noise** -80dB
- Harmonic Distortion** 0.2% at rated output.



Recommended Retail price 16 GNS
Size 9 1/2 x 3 1/2 x 5 1/2 in.
Output for 3-8-15 ohm Loudspeakers.

Please send a stamped addressed envelope for full descriptive details of above units, also TUNER/AMPLIFIERS STEREO and MONO.

Wholesale and Retail enquiries to:

LINEAR PRODUCTS LTD., ELECTRON WORKS, ARMLEY, LEEDS

WW—023 FOR FURTHER DETAILS

NEW RANGE OF SOLID STATE A.C. MAINS AMPLIFIERS

Employing only high grade components and transistors

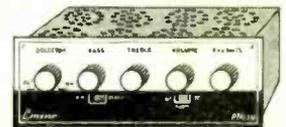
If required an attractive wood cabinet with Satin Teak veneer finish can be supplied for any model. Prices from **£3-10-0**

LT66 12 WATT STEREO AMPLIFIER

A twin channel version of the LT55 providing up to 6 watts High Fidelity output on each channel. Switched Input Facilities

Socket (1) Tape or crystal PU (2) Radio Tuner (3) Ceramic PU Microphone

Controls (6) Volume, Bass, Treble, Balance, Mains Switch, Input Selector Switch. Stereo/Mono Switch
Facia Plate Rigid Perspex with black/silver background and matching black edged knobs with spun silver centres.

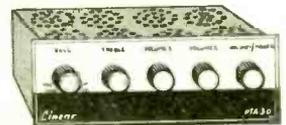


Recommended Retail price 15 GNS
Size 12 x 3 1/2 x 6 in.

PTA30 HI-FI PUBLIC ADDRESS AMPLIFIER

A successor to our popular Conchord 30 watt unit.

- Input Sensitivity** 2 mv (max)
- ★ **Output** 30 watts.
- ★ **Output Terminals** or Loudspeaker or combination of Speakers with total impedance between 3 ohms and 30 ohms.
- ★ **Three individually controlled Jack Inputs** for mixing purposes.



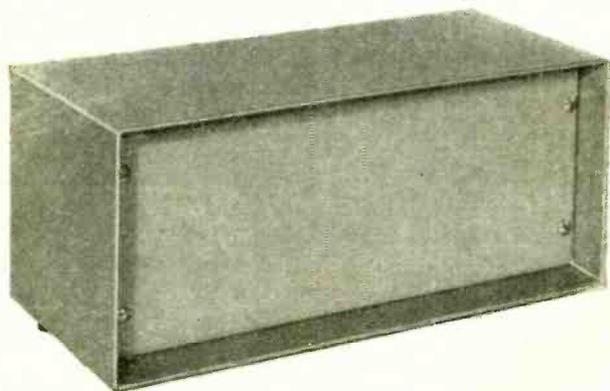
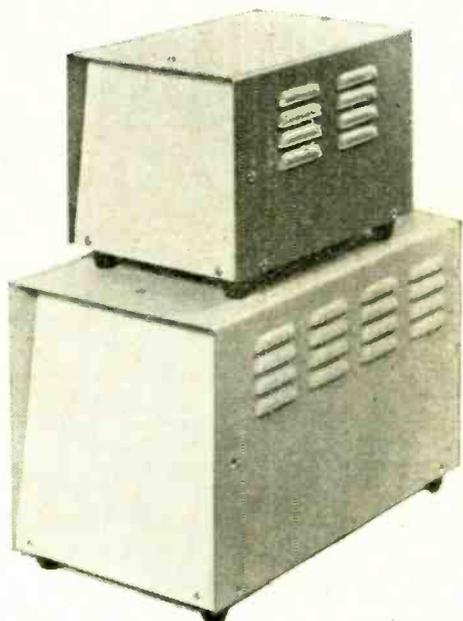
Recommended Retail price 20 GNS
Size 12 x 3 1/2 x 6 in.

Housed in fully enclosed stove enamelled steel case. **Controls** Vol (1) Vol (2) Vol (3) with mains switch, Treble 'lift' and 'cut', Bass 'lift' and 'cut.'

AN IDEAL UNIT FOR VOCAL AND INSTRUMENTAL GROUPS SUITABLE FOR ANY KIND OF 'MIKE' AND INSTRUMENT PICK-UP, ALSO FOR RADIO, TAPE OR GRAM.

OLSON

instrument cases
and chassis



- ADVANCED DESIGN
- HIGH QUALITY
- RIGID CONSTRUCTION
- MADE IN VARIOUS SIZES
- LOW PRICE

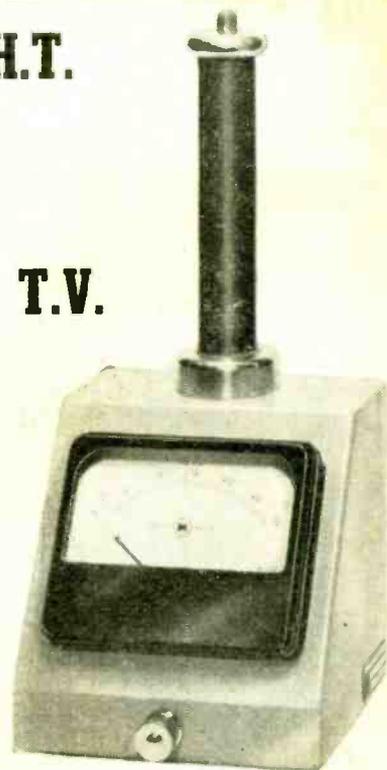
WRITE FOR FURTHER DETAILS TO

OLSON ELECTRONICS LIMITED

FACTORY No. 8 5-7 LONG STREET
LONDON, E.2 TEL. 01-739 2343

WW-024 FOR FURTHER DETAILS

NEW E.H.T. METER FOR COLOUR T.V.



HANDS FREE OPERATION

- ★ High Accuracy
- ★ Specially designed for Colour TV
- ★ Calibrated within 400v at 24kV.
- ★ Compact, Portable, Safe
- ★ Easy connection to CRT

Price—Complete with leads:

£30.10.0
EX WORKS

Obtainable from your service depot or direct from:

MILES  HIVOULT LTD.

Riverbank Works

SHOREHAM BY SEA · Sussex

E.H.T. terminal is fully shrouded and the earth and E.H.T. leads are designed to be attached to the receiver and left on. In this way the E.H.T. is continuously displayed enabling the engineer to carry out other measurements.

Quote TV/DCM/I and ask for details of this and our full range of High Voltage Measuring and Generating Equipment.

WW-025 FOR FURTHER DETAILS

See all these models, and many more... in the latest HEATHKIT Catalogue

LOW-COST TRANSISTOR STEREO AMPLIFIER, TS-23



Incorporates all the essential features for good quality sound reproduction from record, radio and other sources • 16 transistor, 4 diode circuit • Good frequency response • 3 watts r.m.s. (15 ohms) each channel • 6 position selector switch easily handles your record, radio or tape inputs—stereo or mono • Separate controls provide bass boost, treble cut, amplifier balance and

volume • Printed circuit board construction • Compact, slimline styling • Measures 3 1/2 in. high x 13 in. wide x 8 in. deep • Beautiful walnut veneered cabinet (optional extra) • Attractive Perspex front panel.

KIT £17.15.0 (less cabinet) **KIT £18.19.0 (with cabinet)**
Walnut veneered cabinet £2/5/- extra.

THE AVON COMPACT MINI SPEAKER SYSTEM



The ideal compact system for bookshelf or other small spaces • 6 1/2 in. bass speaker • 3 1/2 in. totally enclosed treble unit • Speakers rigidly mounted to 1/2 in. thick aluminium alloy plate • Inductor-capacitor cross-over unit • Strongly constructed, fully finished walnut veneered cabinet • Cabinet resonances are minimised by stout internal bracing and special acoustic absorbent filling • Suitable for use with amplifiers having an output impedance of 8-16 ohms, and power output of 5 to 15 watts.

• Fast, easy assembly • Gives best possible performance relative to smallest possible size • Frequency response 50 c/s-19,000 c/s. • Size: 7 1/2 in. wide x 13 1/2 in. high x 8 1/2 in. deep. Comprising: Walnut veneered cabinet kit £8/18/-. Loudspeakers and cross-over network kit £4/18/- incl. P.T.

TOTAL PRICE KIT £13.16.0 incl. P.T.

NEW! TRANSISTOR AM-FM STEREO TUNER, AFM-2



• 18 Transistor, 7 diode circuit • AM-LW/MW, FM Stereo and FM Mono tuning • Automatic stereo indicator light • Stereo phase control for maximum separation, minimum distortion • Automatic frequency control for positive "lock-in" tuning • Automatic gain control for even, steady volume • Pre-assembled and aligned "front end" FM unit • Separate AM and FM printed circuit boards • Self-

powered • Low-silhouette styling—matches AA-22U amplifier • Handsome fully finished walnut veneered cabinet, available as optional extra. Comprising: AFM-2T RF Tuning Heart kit £7/17/6 incl. P.T., AFM-2A IF Amplifier and power supply kit £24/9/6.

TOTAL PRICE KIT £32.7.0 incl. P.T.

Optional extra: Walnut veneered cabinet £2/5/- extra

TRANSISTOR FM STEREO TUNER, TFM-1S

(Mono version TFM-1M available)



• 14 transistor, 5 diode circuit for cool instant operation • Mono TFM-1M and Stereo TFM-1S models available • Automatic frequency control • Stereo phase control to maximise stereo separation, minimise distortion • 4-stage IF section ensures high sensitivity and selectivity • Filtered outputs for direct "beat-free" stereo recording • Automatic stereo indicator light • Prealigned, preassembled "front-end" tuner and one circuit board for fast, simple assembly. Cabinet £2/5/- extra. Comprising: TFM-T1 RF Tuning Heart Kit, £5/16/- incl. P.T., TFMA-1M (Mono) IF Amplifier, Power supply £19/2/- Kit.

TOTAL PRICE KIT (Stereo) £20.19.0 incl. P.T.

TOTAL PRICE KIT (Mono) £24.18.0 incl. P.T.

Optional extra: Walnut veneered cabinet £2/5/- extra.

All models must perform to published specification when assembled in accordance with the instruction manual. ALL MODELS COVERED BY MONEY BACK GUARANTEE.

BERKELEY SLIM-LINE SPEAKER SYSTEM



• Specially designed to obtain optimum performance from the slim elegant cabinet • Beautiful walnut veneered, fully finished cabinet • Makes attractive addition to any room • Stood on end only uses 17 in. x 7 1/2 in. of floor space • Two specially designed loudspeakers give adequate power handling for most applications • 12 in. low resonance unit and 4 in. Mid/High frequency unit, covers 30-17,000 c/s. • Build it in an evening • Professional attractive styling • Use one for mono and a pair for stereo • Outstanding performance at a low price • Shelf or floor standing • Use vertical or horizontal • Designed to harmonize with modern or traditional decor.

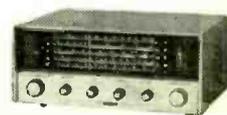
KIT £19.10.0 Assembled £24.0.0

LOW-COST SPEAKER SYSTEM SSU-1 (not illustrated)

• Build it yourself in an evening • All wooden parts accurately pre-cut, drilled and sanded • Wide frequency response • Two specially designed loudspeakers • Hi-Fi on a budget • Glue, sandpaper, etc. are included in kit • Use one for mono, two for stereo • Finish it to match your own furnishing • 16 page instruction manual • 7 in. or 15 in. legs optional extra 1/4/6 • Use vertical or horizontal.

KIT £11.17.6 (less legs)

LOW-COST SHORTWAVE RECEIVER, GR-64E



• 4 bands—3 short wave bands cover 1 Mc/s to 30 Mc/s, plus 550 kc/s to 1,620 kc/s AM broadcast band • Built-in 5 in. permanent magnet speaker for a big, bold sound • Illuminated 7 in. slide-rule dial with extra logging scale • Easy to read lighted bandspread tuning dial for precise station selection • Relative signal strength indicator aids pin-point station tuning • 4-valve superhet circuit plus two silicon diode rectifiers • Variable BFO control for code and SSB transmissions • Built-in external antenna connections • Built-in AM rod antenna • Fast, simple circuit board construction assures stability • Handsome "low-boy" styling —charcoal grey cabinet, black front panel, and green and white band markings • Headphone jack for private listening. Power requirements: 115, 230 v. 50-60 c/s A.C. 30 watts. Dimensions: 13 1/2 in. wide x 6 in. high x 9 in. deep.

KIT £22.8.0 Assembled £27.8.0

GENERAL COVERAGE RECEIVER, GG-1U (not illustrated)

• Powerful 10 transistor, 5 diode circuit • Tunes 580 to 1,550 kc/s and 1.69 to 30 Mc/s in five bands • Bandspread on all bands • Fixed-aligned ceramic IF transformers for best selectivity • Pre-assembled and aligned "front-end" for fast, easy assembly • Built-in 6 in. x 4 in. speaker • Tuning meter for pin-point tuning • Completely self-contained for portability.

KIT £37.17.6 Assembled £45.17.6



NEW! FREE CATALOGUE

Now with more Kits more colour. Fully describes these models along with over 150 models for Stereo/Hi-Fi, test and laboratory instruments, amateur radio gear, intercom, radio educational kits. Includes helpful information on Hi-Fi in your home and planning your Hi-Fi system. Mail coupon or write Daystrom Ltd., Dept. WW1 Gloucester.

VISIT THE HEATHKIT CENTRES

232 TOTTENHAM COURT ROAD, LONDON, W.1
Open Mon.-Fri. 9 a.m.-5.30 p.m. Sat. 9 a.m.-1 p.m.

AND

17-18 ST. MARTINS HOUSE, BULL RING, BIRMINGHAM
Open Tues.-Sat. 9 a.m.-6 p.m. inclusive.

HEATHKIT

To: DAYSTROM LTD., Dept. WW.1, Gloucester. Tel.: 20217.

Enclosed is £..... post paid U.K. only.

Please send model(s).....

Please send me FREE Heathkit Catalogue.

NAME

ADDRESS

CITY

Prices and specifications subject to change without notice.

WW—026 FOR FURTHER DETAILS

Heathkit World-famous Easy-to-build

INSTRUMENTS • HI-FI • RADIO • ELECTRONIC KITS

(Deferred terms available on all orders over £10, U.K. only)

NEW! 12+12W TRANSISTOR STEREO AMPLIFIER
Model TSA-12



Luxury performance at lowest cost

• 17 transistors, 6 diode circuit • ± 1 dB, 16 to 50,000 c/s at 12 watts per channel into 8 ohms • Output suitable for 8 or 15 ohm loudspeakers • 3 stereo inputs for Grams., Radio and Aux. • Modern low silhouette styling • Attractive aluminium, golden anodised front panel • Handsome assembled and finished walnut veneered cabinet available • Matches Heathkit models TFM-1 and AFM-2 transistor tuners.

Kit £30.10.0 (less cabinet) Ass'd £42.10.0
Beautiful Walnut cabinet £2.5.0 extra.

20+20W TRANSISTOR STEREO AMPLIFIER
Model AA-22U



An International Class amplifier which offers superb realism and beauty of music at a very competitive price. Professional, elegant, compact, slim-line styling. The best of American transistor techniques a low high output with low distortion.

5 stereo inputs (five each channel) for pick-up, radio tuner, tape and two other sources. 20 transistor, 10 diode circuit. Beautiful, fully finished walnut veneered cabinet (optional extra).

Kit .. £39.10.0 (less cabinet) Ass'd. £59.15.0 (inc. cabinet)

Walnut cabinet £2.5.0 extra.

5 W HI-FI MONO AMPLIFIER KIT Model MA-5



A low-priced general purpose Hi-Fidelity amplifier based on the popular S-33 for those who do not require a stereophonic system. Separate bass and treble controls. Gram and Radio Inputs. Suitable for most crystal pick-ups. A printed circuit simplifies construction.

Kit £11.9.6 Assembled £15.15.0

STEREO CONTROL UNIT KIT Model USC-1



Incorporates all worthwhile features for Hi-Fidelity stereo and mono. Push-button selection, accurately matched ganged controls to ± 1 dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts Inputs from most tape-heads and any stereo or mono pick-up.

Kit £19.19.0 Assembled £27.5.0

LW/MW TRANSISTOR PORTABLE RADIO KIT Model UXR-1



Beautiful leather case. Easy-to-read scale. 7 semi-conductors. Printed circuit board 7in. X 4in. Special loudspeaker. Pre-aligned IF transformers. 9-volt battery operated. Easy to construct, excellent in performance and value.

Kit £12.11.0 (inc. P.T.)

"MOHICAN" GENERAL COVERAGE RECEIVER KIT Model GC-1U



This fully transistorised receiver which includes 4 piezo-electric transmitters, is in the forefront of receiver design. It is an excellent portable or fixed station receiver. The R.F. "front-end" is supplied as a pre-assembled and pre-aligned unit. Its many features include a 10-transistor circuit, printed circuit board, telescopic whip antenna tuning meter, and a large slide-rule dial giving a total length of approximately 70 inches. Housed in a steel cabinet and powered by two 6 volt dry batteries (not supplied), mounted internally, it gives frequency coverage from 580 kc/s to 30 Mc/s in five bands; thus enabling world-wide reception. Electrical bandspread covers the amateur bands from 80 to 10 metres—each band having a scale length of approximately 8 inches, BFO tuning and Zener diode stabiliser. Size 6 1/2 in. X 12 in. X 10 in.

Kit .. £37.17.6 Assmbld. .. £45.17.6

STABILISED POWER PACK Models MSP-1M and MSP-1W



Specially recommended for industrial and laboratory use, meeting the need for a reliable and versatile stabilised power pack capable of a very high performance. Input 200-250 v. 40-50 c/s., A.C., fully fused. Output: H.T. 200-410 v. D.C. at 0.225 mA. in 3 switched ranges. Unstabilised A.C., 6.3 v. at 4.5 A. centre-tapped. Two 3in. "easy-to-read" meters for reading voltage and current simultaneously. Separate L.T. and H.T. supply transformers. All output circuits are isolated. Size 1 1/2 in. X 8 1/2 in. X 9 1/2 in.

MSP-1M (with meters) Kit .. £36.12.6 Assembled .. £43.12.6
MSP-1W (less meters) Kit .. £29.17.6 Assmbld. .. £36.17.6

BALUN COIL UNIT KIT

Model B-1U. Will match unbalanced co-axial lines to balanced lines of either 75 or 300 Ω impedance. Frequency range 10-80 m., input up to 200 watts.

Kit .. £5.5.6 Assmbld. .. £5.18.0

TAPE PRE-AMPLIFIER KITS Models TA-1M and TA-1S



The Combined Tape Record/Replay Amplifier is available in both monophonic and stereophonic model. Model TA-1M can be modified to the stereo version with modification kit TA-1C.

TA-1M Kit £19.18.0 Assmbld. £28.18.0
TA-1S Kit £25.10.0 Assmbld. £35.18.0
TA-1C Kit .. £6.15.0

All prices are mail order and include free delivery in the U.K.

Deferred Terms are available on all orders above £10

AMATEUR TRANSMITTER KIT Model DX-100U



The World's most popular Amateur TX Kit

Completely self-contained. 150 w. D.C. input. Built-in highly stable VFO and all Power Supplies. The KT88 high-level anode and screen modulator stage gives over 100 watts of audio from less than 1.5 mV input. Keying on CW is via the VFO and buffer amplifier cathodes; the other RF valves are biased beyond cut-off. Provision has been made for remote control operation. Covers all Amateur bands up to 30 Mc/s. 'phone or CW. Kit .. £81.10.0 Assembled .. £106.15.0

AMATEUR BANDS RECEIVER KIT



Model RA-1 The ideal economically priced fixed station, portable or mobile receiver covering the Amateur bands from 160-10 m., each band separately calibrated on a large illuminated slide-rule dial. Features: Signal strength meter, tuned RF amplifier stage, half-lattice filter, adjustable noise limiter. Freq. coverage 160, 80, 40, 20, 15, 10 metre bands. I.F. 1620 kc/s. Kit .. £39.6.6 Assembled .. £52.10.0

AMERICAN HEATHKIT SINGLE SIDE BAND EQUIPMENT

Transmitters, Receivers, Transceivers. Send for details of models. Fully illustrated American Catalogue of Heathkit range sent for only 1/- post-paid. Or see selection of models in British catalogue.

REFLECTED POWER METER KIT

Model HM-11U Indicates reliably but inexpensively, whether the R.F. power output of your transmitter is being transferred efficiently to the radiating antenna. Kit .. £8.10.0 Assembled ... £10.15.0

VARIABLE FREQUENCY OSCILLATOR KIT. Model VF-1U



Specially designed to meet the demand for the maximum possible flexibility from an amateur Transmitter which would otherwise be subject to certain limitations imposed by crystal control. Calibrated for all Amateur bands 160-10 metres, fundamentals on 160 and 40 m. Ideal for Heathkit DX-40U and similar transmitters. Kit .. £10.17.6 Assembled £15.19.6

Q MULTIPLIER KIT. Model QPM-1



A reasonably priced Q Amplifier for the amateur and short-wave enthusiast. This self-powered unit (200-250 v. 50/60 c/s.) may be used with communications receivers to provide both additional selectivity and signal rejection. Models QPM-1 for 470 kc/s. IF. QPM-16 for 1.6 Mc/s. IF. Kit, either model .. £8.10.0 Assembled .. £12.14.0

AERIAL TOWER KITS. Model HT-1, HT-1G

Height 32ft. sq. section 3ft. X 3ft. at base (no stays required). Accessories available as extras: HT-1G Kit (galvanised) £43.15.0 HT-1 Kit (red oxide) £37.15.0

DAYSTROM LTD.

DEPT. WW.1, GLOUCESTER, ENGLAND

Member of the Schlumberger Group including the Heath Company
MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

WW-027 FOR FURTHER DETAILS

Outstanding British Equipment by Heathkit

(All models available as easy-to-build kits or factory assembled).

FM TUNER KIT, Model FM-4U



Tuning range 88-108 Mc/s Fly-wheel tuning. Attractive perspex front panel in two tone grey with golden trim. Thermometer type tuning Indicator, pre-aligned I.F. transformers. Own built-in power supply. Tuning heart model FMT-4U £2/15/- incl. P.T.
I.F. amplifier and power supply, Model FMA-4U. Complete with case and valves £13/13/-. Sold separately.
Kit Total £16.8.0.

STEREO DECODER SD-I

Ideal for use with valve FM Tuners.
Kit .. £8/10/0 Assembled £12.5.0

3+3 W HI-FI STEREO AMPLIFIER Kit Model S-33H

An inexpensive stereo-mono amplifier with the high sensitivity necessary for lightweight miniature ceramic pick-ups (e.g., Decca Deram). De luxe version of the S-33 with attractive two-tone grey Perspex panel.
Kit £15.17.6 Assembled £21.7.6

MONO CONTROL UNIT KIT Model UMC-I

Ideal for use with MA-12 or similar amplifier. Output 0.25 v. Send for full details.
Kit £9.2.6 Assembled £14.2.6



AMATEUR TRANSMITTER KIT Model DX-40U

Covers all amateur bands from 80 to 10 metres, crystal controlled. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for VFO. Filters minimise T.V. interference. Modulator and power supplies are built-in. Single knob band switching is combined with a pi-network output circuit for complete operating convenience. A high-grade moving-coil meter indicates the final grid or anode current. Provision is made for the use of 3 crystals.
Prices now reduced to:—
Kit .. £29.19.0 Assembled £41.8.0

GENERAL COVERAGE RECEIVER KIT RG-I

An inexpensive communications type receiver specially designed for the short wave listener with many refinements found only in receivers costing much more. Freq. coverage 32 Mc/s.-1.7 Mc/s. in 5 ranges also M.W. band.
Kit .. £39.16.0 Assembled £53.0.0
Optional extras available.

GRIP-DIP METER KIT. Model GD-IU

Functions as oscillator or absorption wavemeter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s. to 230 Mc/s.
Kit £11.9.6 Assembled £14.9.6
Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves. 17/6.

TRANSISTOR INTERCOM KITS Models XI-IU and XIR-IU

9 v. battery operated. Up to five remote stations can be operated with each Master. The Master unit can call any one, a combination, or all five Remote stations and any Remote station can call the Master.
Model XI-IU (Master)
Kit .. £11.9.6 Assembled £17.9.6
Model XIR-IU (Remote)
Kit .. £4.9.6 Assembled £5.18.0

HI-FI STEREO AMPLIFIER KIT Model S-99

18 w. output (9 per channel with 0.2 per cent. distortion at 9 w. per channel). It has ganged controls Stereo/Mono gram, radio and tape recorder inputs and push-button selection. Ultra-linear push-pull output. P.C. boards. Attractive Perspex front panel with golden surround and grey metal cabinet.
Kit £28.9.6 Assembled £38.9.6



HI-FI SPEAKER SYSTEM KIT Model SSU-I

Ducted-port bass reflex cabinet "in the white." Frequency response is 40-16,000 c/s. Power rating 10 watts Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies.
Kit (with legs) £12.12.0 (less legs) £11.17.6 (inc. P.T.)



A.M./F.M. TUNER KIT

Tuning range 88-108 M. (FM) 16-50, 200-550, 900-2,000 m. Flywheel tuning. Attractive Perspex front panel in two-tone grey with golden trim. Thermometer type tuning indicator, pre-aligned I.F. transformers. Switched wide and narrow A.M. bandwidths.
TUNING HEART Model AFM-TI £4/13/6 (inc. P.T.) I.F. AMPLIFIER and Power Unit Model AFM-I. Complete with metal cabinet and valves £22/11/6. Sold separately.
Kit Total £27.5.0



ELECTRONIC WORKSHOP KIT EW-I

20 exciting experiments can be made with this one kit.
Kit £7.13.6 (incl. P.T.)

SINE/SQUARE GENERATOR Model IG-82U

Covers 20 c/s-1 Mc/s. in 5 bands. Simultaneous Sine and Square Wave outputs. Less than 0.15µs rise time on Square Wave. Less than 0.5% distortion on Sine wave. Up to 10 volts output. This attractively styled generator is designed for maximum operating convenience. Size 13in. x 8½ x 7in. deep.
Kit £25.15.9 Assembled £37.15.0



OSCILLOSCOPE TRACE DOUBLER KIT Model S-3U



This device will extend the use of your single-beam oscilloscope, and at a nominal cost, will give you the advantages of a double (or other multiple) beam scope.
Kit £13.10.0 Assembled £19.10.0

OSCILLOSCOPE ACCESSORY KITS

Demodulation Probe kit 337-C £2.17.6
Low-cap Attenuator Probe kit Pk-I £3.12.6

See also Oscilloscope page

● Deferred Terms available on all orders above £10.

HI-FI MONO POWER AMPLIFIER KIT Model MA-12



A compact Hi-Fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereo-phonics system. Other applications includes sound reinforcement systems, transmitter modulators, for use with tape recorders.
Kit £12.18.0 Assembled £16.18.0

"COTSWOLD" SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 x 23 x 14½in., and houses a special 12in. base speaker with 2in. speech coil, elliptical middle speaker, together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Its polar-distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, grille cloth, etc. Left in the white for finish to personal taste.
Kit £25.12.0 Also available assembled and finished £33.4.0



4½in. VALVE VOLTMETER KIT Model V-7AU

The world's most popular valve voltmeter with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively D.C. volts to 1,500 and A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 megohms, with internal battery. D.C. input resistance is 11 megohms and dB measurement has a centre-zero scale. Complete with test prod, leads and standardising battery. Power requirements, 200-250 v. 40-60 c/s. A.C. 10 watts. H.V. and R.F. Probes available as optional extras.
Kit £13.18.6 Assembled £19.18.6



DECADE RESISTANCE BOX KIT

Model DR-IU. Range 1-99,999Ω in 1Ω Steps. Ceramic switches throughout. Current rating from 500 mA. to 5 mA. according to decades in circuit. Polished wooden cabinet supplied complete.
Kit £10.18.0 Assembled £14.18.0

● Prices include Postage U.K.

DECADE CAPACITOR KIT Model DC-I

Capacity values 100µF to 0.11µF in 100µF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy.
Kit £7.15.0 Assembled £10.18.0

TELEVISION ALIGNMENT GENERATOR KIT Model HF-W-I

Offers the maximum in performance, flexibility and utility at the lowest possible cost. Several outstanding features have been incorporated in this model which are unusual in instruments in this price range. Frequency coverage 3.6 Mc/s. to 220 Mc/s. on fundamentals. Unique non-mechanical sweep oscillator system. High level output on all ranges. Sweep deviations up to 42 Mc/s. Built-in fixed and variable marker generator (5 Mc/s. crystal supplied).
Kit £38.18.0 Assembled £49.15.0

● Prices quoted are Mail Order Prices; retail prices slightly higher.

DAYSTROM LTD.

DEPT. W.W.I. GLOUCESTER, ENGLAND

Member of the Schlumberger Group including the Heath Company.

MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

WW-028 FOR FURTHER DETAILS

Heathkit World-Leader in INSTRUMENTS · HI-FI · RADIO · Electronic kits

The construction manual provided with the kit ensures successful assembly



5in. WIDE BAND GENERAL-PURPOSE OSCILLOSCOPE, 10-12U

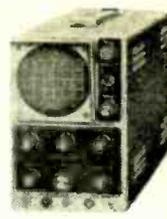
- "Y" sensitivity 10 mV. r.m.s. per cm. at 1 kc/s. • Bandwidth 3 c/s-4.5 Mc/s. • Frequency compensated input attenuator X1, X10, X100. T/B, 10 c/s-500 kc/s. in 5 steps. • Two extra switch selected pre-set sweep frequencies in T/B range. • T/B output approx. 10 v. peak to peak. • Built-in IV callibrator. • Facility for "Z" axis modulation. • Electronically stabilised power supply. • Power req. 200-250 v. A.C., 40-60 c/s., 80 watts. • Fused. • Front panel, silver and charcoal grey. • Cabinet, charcoal grey, size 8½×14×17in. deep. Net weight 23lb. 56-page construction and operation manual.

Kit £35.17.6. Assembled £45.15.0

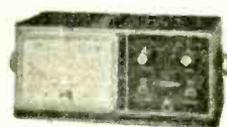
Attenuator and demodulator probes available as optional extras.

3in. PORTABLE GENERAL-PURPOSE SERVICE OSCILLOSCOPE, OS-2

- Modern styling, lightweight and compact size, make this the ideal "scope for service man, laboratory technician, amateur radio enthusiast or hobbyist. • "Y" bandwidth 2 c/s-3 Mc/s±3 dB. • Sensitivity 100 mV/cm. • Push-pull vertical and horizontal amplifiers. • Wide range time-base generator 20 c/s-200 kc/s in four ranges. • Automatic lock-in synchronisation. • Mu-metal c.r.t. shield. • Printed circuit board construction. • Power req. 200-250 v. 50-60 c/s A.C. 40 watts. • Fused. • Front panel silver and charcoal grey. Size 5in. w.×7½in. h.×12in. deep. Weight: 9½lb.



Kit £23.18.0 Assembled £31.18.0



6in. VALVE VOLTMETER, 1M-13U

- Modern styling • Extra features • The ideal VVM for the Electronic Engineer. • 6in. Ernest Turner 200µA. meter with multi-coloured scales. • Unique gimbal bracket allows bench, shelf or wall mounting. • Measures A.C. (r.m.s.), D.C. volts 0-1.5, 5, 15, 50, 150, 500, 1,500. • Resistance range 0.1 to 1,000MΩ with int. battery. • Vernier action zero and ohms adjustment. • Roller-tinned operation manual. • High input resistance (11MΩ). • Comprehensive assembly and operation manual. • Size 5×12½×4½in. Complete with test prod and leads.

Kit £18.18.0 Assembled £26.18.0

4½in. Valve Voltmeter-V-7A (not illustrated). Kit £13.18.6. Assembled £19.18.6

GENERAL-PURPOSE SERVICE RF SIGNAL GENERATOR, RF-1U

- Ideal for the alignment and trouble shooting of RF, IF and audio circuits. • Large easy-to-read dial. • Pre-aligned coil and bandswitch assembly. • RF output of at least millivolts. • 100 kc/s-100 Mc/s. fundamentals up to 200 Mc/s harmonics. • 400 cycle audio signal with 4 v. output. • Dimensions 9½in. wide×6½in. high×5in. deep.



Kit £13.18.0 Assembled £20.8.0

AUDIO SIGNAL GENERATOR, AG-9U (not illustrated)

Kit £23.15.0. Assembled £31.15.0.

See these and other Heathkit models in the FREE catalogue

NEW! PORTABLE STEREO TAPE RECORDER, STR-1

- ½ track stereo or mono record and playback at 7½, 3½ and 1½ i.p.s. • 18 transistor circuit. • Record level indicator. • Digital counter with zero reset. • Stereo mic and aux. inputs. • Speaker/headphone outputs. • Built-in audio amplifier gives 4 watts rms output per channel. • Two high efficiency 8in. X 5in. speakers.

Versatile Recording facilities. So-easy-to-build. Outstanding performance for price.

Kit £45.18.0 Assembled £59.15.0



NEW! PORTABLE STEREO RECORD PLAYER, SRP-1

- Compact, economical stereo and mono record playing for the whole family. • Mains operated. • All "solid state" circuitry. • Modern compact styling. • Detachable second loudspeaker gives optimum stereo effect. • Automatic playing of 16, 33, 45 and 78 rpm records. • Suitcase portability. • Two 8in. X 5in. speakers. • Controls: Volume, Balance and Tone. • Dimensions: overall 27in. wide X 14½in. high X 7½in. deep.



Kit £27.15.0 Assembled price on request.

THE CAR RADIO TO COMPLETE YOUR MOTORING PLEASURE CR-1

Complete your motoring pleasure with this small, compact, high output unit. Superb long and medium wave entertainment whenever you drive. For 12v. positive or 12v. negative car earth systems.

- 8 latest semi-conductors (6 transistors, 2 diode circuit). • Powerful output (4 watts) will drive two speakers. • Styled to harmonise with most car colour schemes. • Supplied in two units, pre-assembled and aligned RF unit kit. £11.3.6 nc. P.T. IF/AF amplifier kit £11.3.6.

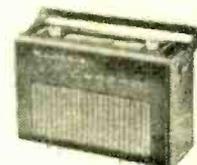
Total price kit (excl. LS)... £12.17.0 inc. P.T.

L/speakers and accessories available as extras.



"OXFORD" LUXURY TRANSISTOR PORTABLE, UXR-2

This superb transistor radio is the ideal domestic or personal portable Medium and Long Wave receiver. • Solid leather case and handle. • Easy-to-read tuning scale. • Extra large loudspeaker. • Push button L, MW and tone. • 10 semi-conductors (7 transistors plus 3 diodes). • Sockets for personal earphones, tape recorder, car aerial. • Internal 9-volt battery (not supplied) lasts for months. • Latest printed circuit techniques. • Comprehensive, easy-to-follow, fully illustrated Instruction Manual.



Kit £14.18.0 inc. P.T.

• Prices quoted are Mail Order, and include free delivery in U.K. • Retail prices slightly higher.

DAYSTROM LTD.

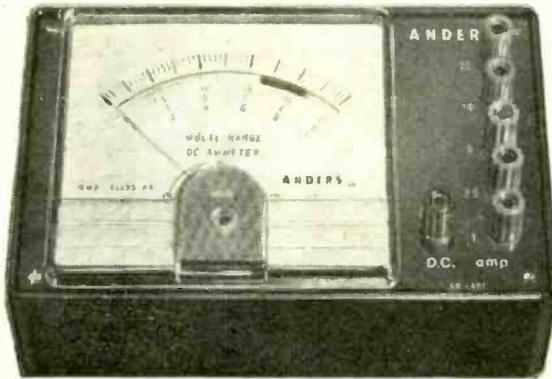
DEPT. WW.1, GLOUCESTER, ENGLAND

Member of the Schlumberger Group including the Heath Company

MANUFACTURERS OF THE WORLD-FAMOUS EASY-TO-BUILD ELECTRONIC KITS

WW-029 FOR FURTHER DETAILS

A NEW RANGE OF SINGLE-FUNCTION PORTABLE METERS AT REALISTIC PRICES



Produced, to Anders' specification, by a leading overseas manufacturer. D.C. accuracies within 1.5% F.S.D. A.C. accuracies within 2.5% F.S.D. Mirror scale approx. 3.5" Case dimensions 7 1/4" x 4 1/4" x 3". Dual connection terminals. Supplied complete with robust leads. Models marked with an asterisk have varistor protection against 50% overload.

- *SM-301. DC MICROAMMETERS, with range selection by rotary switch.
RANGES: 50, 100, 250, 500 and 1,000 Microamperes. **£9.2.6 net**
- *SM-311. DC MILLIAMMETERS, with range selection by rotary switch.
RANGES: 1, 5, 10, 25, 100, 250, 500 and 1,000 Milliampères. **£8.0.0 net**
- SM-321. DC AMMETER, with range selection by terminals.
RANGES: 1, 2.5, 5, 10 and 25 Amperes. **£8.0.0 net**
- *SM-331. DC VOLTMETER, with range selection by rotary switch.
RANGES: 1, 2.5, 5, 10, 25, 50, 100, 250, 500 and 1,000 Volts.
SENSITIVITY: 20,000 Ohms per Volt. **£9.15.0 net**
- *SM-351. AC MILLIAMMETER, with range selection by rotary switch.
RANGES: 5, 25, 100, 250 and 1,000 Milliampères. **£8.10.0 net**
- SM-361. AC AMMETER, with range selection by terminals, incorporating Current Transformer.
RANGES: 1, 2.5, 5, 10 and 25 Amperes. **£9.15.0 net**
- *SM-371. AC VOLTMETER, with range selection by rotary switch.
RANGES: 5, 10, 25, 50, 100, 250, 500 and 1,000 Volts.
SENSITIVITY: 2,000 Ohms per Volt. **£8.15.0 net**

ANDERS ELECTRONICS LIMITED · 103 Hampstead Road · London NW1 · Telephone: Euston 1639
WW-030 FOR FURTHER DETAILS

CHASSIS and CASES

by *Smith's* of EDGWARE ROAD

H. L. SMITH & CO. LTD.
Electronic Components · Audio Equipment
287/289 EDGWARE ROAD, LONDON, W.2.
Tel: 01-723 5891

We shall be pleased to quote for all your component requirements.

BLANK CHASSIS

SAME DAY SERVICE

Of over 20 different forms made up to YOUR SIZE. (Maximum length 35in., depth 4in.)

SEND FOR ILLUSTRATED LEAFLETS

or order straight away, working out total area of material required and referring to table below, which is for four-sided chassis in 16 s.w.g. aluminium.

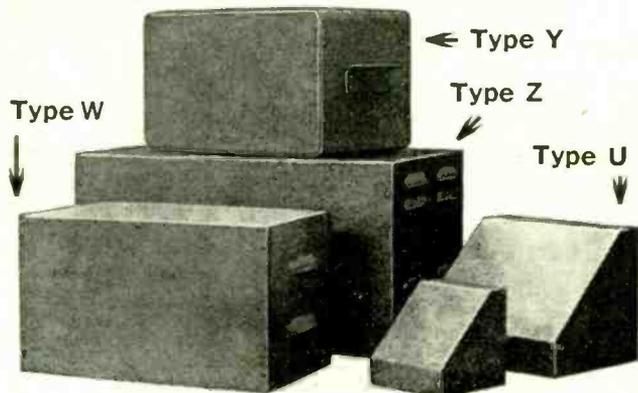
| | | | | | |
|--------------|------|--------------|-------|-------------|---------------|
| 48 sq. in. | 4/6 | 176 sq. in. | 9/10 | 304 sq. in. | 15/2 |
| 80 sq. in. | 5/10 | 208 sq. in. | 11/2 | 336 sq. in. | 16/6 |
| 112 sq. in. | 7/2 | 240 sq. in. | 12/6 | 368 sq. in. | 17/10 |
| 144 sq. in. | 8/6 | 272 sq. in. | 13/10 | | and pro rata. |
| P. & P. 2/6. | | P. & P. 3/-. | | | P. & P. 4/6. |

Discounts for quantities. More than 20 sizes kept in stock for callers.

FLANGES (1/2 in., 1 in.), 6d. per bend.

STRENGTHENED CORNERS 1/- each corner.

PANELS: Any size up to 3ft. at 6/- sq. ft. 16 s.w.g. (18 s.w.g. 5/3). Plus post and packing.



CASES

| ALUMINIUM, SILVER HAMMERED FINISH | | Price | |
|-----------------------------------|-----------------------|-------|-----------------|
| Type | Size | Type | Size |
| U | 4 x 4 x 4" | Y | 8 x 6 x 6" |
| U | 5 1/2 x 4 1/2 x 4 1/2 | Y | 12 x 7 x 7 |
| U | 8 x 6 x 6 | Y | 13 x 7 x 9 |
| U | 9 1/2 x 7 1/2 x 3 1/2 | Y | 15 x 9 x 7 |
| U | 15 x 9 x 9 | Z | 17 x 10 x 9 |
| W | 8 x 6 x 6 | Z | 19 x 10 x 8 1/2 |
| W | 12 x 7 x 7 | | *Height |
| W | 15 x 9 x 8 | | |

Plus post and packing.

Type U has removable bottom or back, Type W removable front, Type Y all-screwed construction, Type Z removable back and front.

WW-031 FOR FURTHER DETAILS

Over 100,000 valves a year are initially stabilised by us for International Computers and Tabulators Limited.

After seven days and nights on the process jig illustrated, potential early failures which could destroy invaluable computer time have been eliminated.

Then follows rigorous mechanical and electrical selection, ending with a vital simulated "user" test.

Only Pinnacle agreed to tackle this job . . .

Just another facet of this Company's unique valve service to the electronics industry.

getting a good start in life...

Pinnacle

PINNACLE ELECTRONICS LTD

ACHILLES ST. · NEW CROSS · LONDON S.E.14
Tel: 01-692 7285



WW-032 FOR FURTHER DETAILS



We've tied up some of the loose ends in Packaged Circuit Amplifiers...

Now the Newmarket Transistors range is rationalised and uprated, but still gives you **off-the-shelf**, all the experience of our team packed into more than a dozen pre-assembled amplifiers, pre-amps and power supplies which are all pre-tested, guaranteed, economical and time-saving. (Ask our world-wide customers!) Specifically, our PC's use higher output transistors for better high-temperature ambient operation and better overload characteristics. So why not unravel your amplifier problem by dropping a line for our revised ABC Guide to Newmarket Packaged Circuits?

Please give me details of your extended range of Packaged Circuits. 5
 My particular interest is: _____

Name _____ Position _____

Company/Address _____

To: Newmarket Transistors Ltd.
 Exning Road, Newmarket,
 Suffolk ONE 8 3381

Newmarket
 TRANSISTORS LIMITED

WW-033 FOR FURTHER DETAILS



£36 checkmate

- 10-100,000Hz (4 ranges; scale length 8½ inches each range).
- Maximum outputs: 25Vrms sine-wave, 50Vp-p squarewave (continuously variable from 1mV).

The new Taylor 192A L.F. Oscillator is designed to meet the requirements of engineers checking the performance of amplifiers, transformers, loudspeakers and other devices. Its low distortion (less than 0.5% at 1kHz) enables you to test both steady-state and transient responses through the audio band and well beyond. Its UK list price is £36.10.0. Trade prices on application.

Complete technical information available from Taylor Electrical Instruments Ltd, Montrose Avenue, Slough, Bucks. Telephone: Slough 21381. Telex 84429.

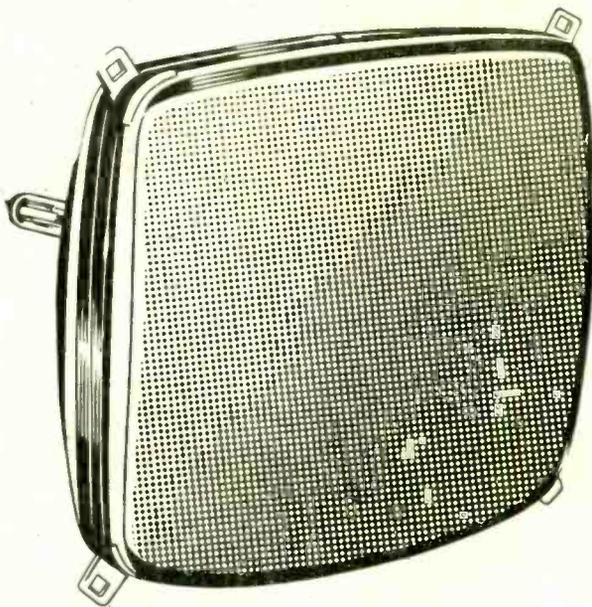


WW-034 FOR FURTHER DETAILS



RCA COLOUR TUBES

two totally unique advantages



New Rare Earth Red Phosphor

These new red phosphors—exclusive to RCA—combined with efficient sulphide blue and green phosphors produce pictures at their brightest and most dependable. They completely overcome the imbalance of the three guns which cause red blooming, colour fringing and failure of the red gun due to overwork. RCA's New Rare Earth Red Phosphor achieves UNITY CURRENT RATIOS—equal beam current from each electron gun; higher brightness, picture contrast and highlight; much longer tube life.

Perma-Chrome

This is a four-point, temperature-compensated shadow mask assembly which accurately adjusts and sets the shadow mask position relative to the screen. Shadow mask expansion limits the performance of a rectangular colour-tube—Perma-Chrome renders this problem negligible. Perma-Chrome produces full-colour fidelity and temperature equilibrium throughout normal operation. It maintains excellent field purity and uniformity.

RCA 'HI-LITE' COLOUR PICTURE TUBES...

THE BRIGHTEST IN THE INDUSTRY

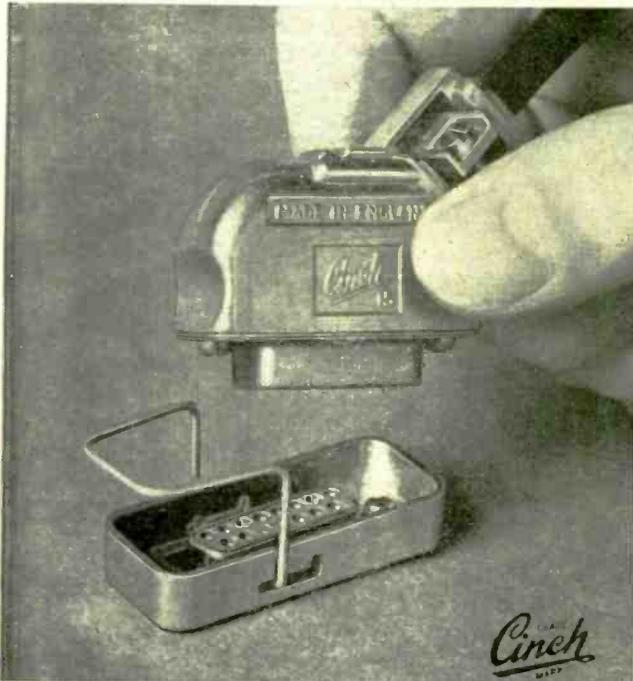
For full technical specification and application information, write to:

RCA COLOUR TUBES LTD · PINFOLD PLACE · PIMBO · SKELMERSDALE · LANCS · TEL: TAWD VALE 4951

WW-035 FOR FURTHER DETAILS

Pat. 110 mono-bloc connectors with closed entry contacts

FULLY APPROVED TO DEF 5325-5 STANDARD FOR
9, 15, 25, 37 AND 50 WAY CONNECTORS.



These connectors consist of one-piece Diallyl Phthalate moulding with hard gold plated plug pins, socket contacts, and beryllium copper contact clips. Closed entry contact design eliminates the risk of damage to the sockets by test probes. The shells are of passivated cadmium plated steel and the covers and cable clamps are of die-cast aluminium Grade LM6.

ELECTRICAL RATINGS Working voltage: 750 volts DC
Current capacity: 5 amps max per contact

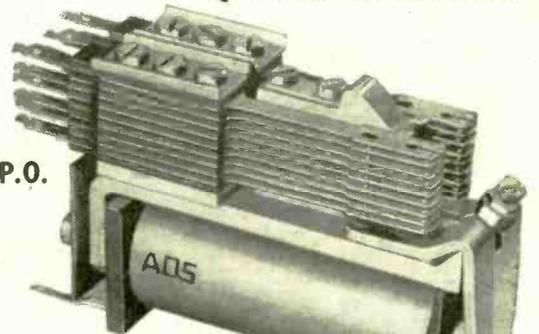
CARR FASTENER CO LTD
the firm with the best connections

Stapleford, Nottingham.
Telephone: Sandiacre 2661.
Sales offices: Wembley,
Birmingham, Sale, Glasgow.



WW-036 FOR FURTHER DETAILS

FULLY APPROVED RELAYS QUICK DELIVERY



A.D.S. P.O.
3000
SERIES

Throughout 30 years' telephone service, and automation refinements, the world's most versatile relay: 1 to 4 coils in limitless permutations from $\frac{1}{2}$ milli-amp to 20 amps (0.1 to 400 volts); fast, slow, and A.C. versions; 1 to 16 contact units (36 springs max.); Standard contacts 0.3 to 1 amp; Alternatives for switching Dry-state, Inductive, and 10 amp circuits. Insulation from 100 to 4,000 volts; Life up to 100 million operations; Plain or tropical finishes; approx. dimensions $1\frac{1}{2}'' \times 3\frac{1}{4}'' \times 2\frac{1}{2}''$ max. An A.D.S. 3000 Type to meet all specifications—G.P.O., E.I.D., C.E.G.B., ADMIRALTY, U.K.A.E.A., ALL COMMERCIAL, ETC.



A.D.S. P.I. PLUG-IN
3000 TYPE

Plug-in version of 3000 and K3000 series; Coils and contacts to G.P.O./R.C.S. and variations; Standard contact insulation is 250v working; 400/750v also provided; bases available for immediate installations ex stock; Relays changed in seconds avoiding stoppages. Another approved Relay. Approx. dimensions $1\frac{1}{8}'' \times 3'' \times 4\frac{1}{4}''$.

A.D.S. P.O. 600
SERIES

Miniaturised 3000 Type with similar, but restricted, specification; requires only $\frac{3}{8}$ in. chassis space (twelve in same length as nine 3000 Type); 1 or 2 coils: 1 to 6 contact units (14 springs max.). Approx. dimensions $1\frac{3}{8}'' \times 3\frac{3}{8}'' \times 1\frac{3}{8}''$.



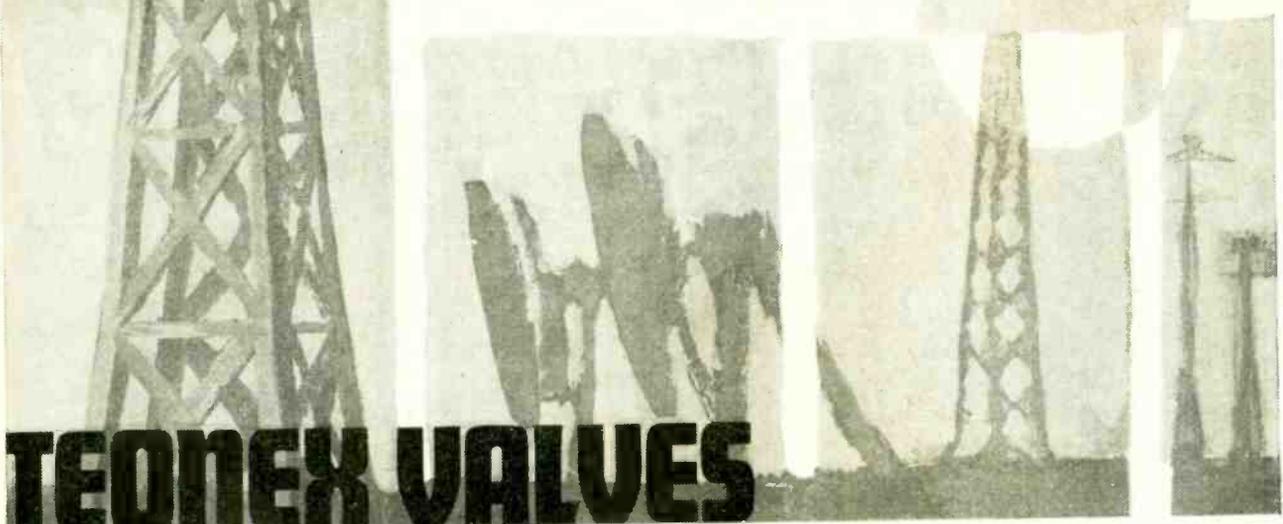
ads RELAYS

**A.D.S. RELAYS
LTD.**

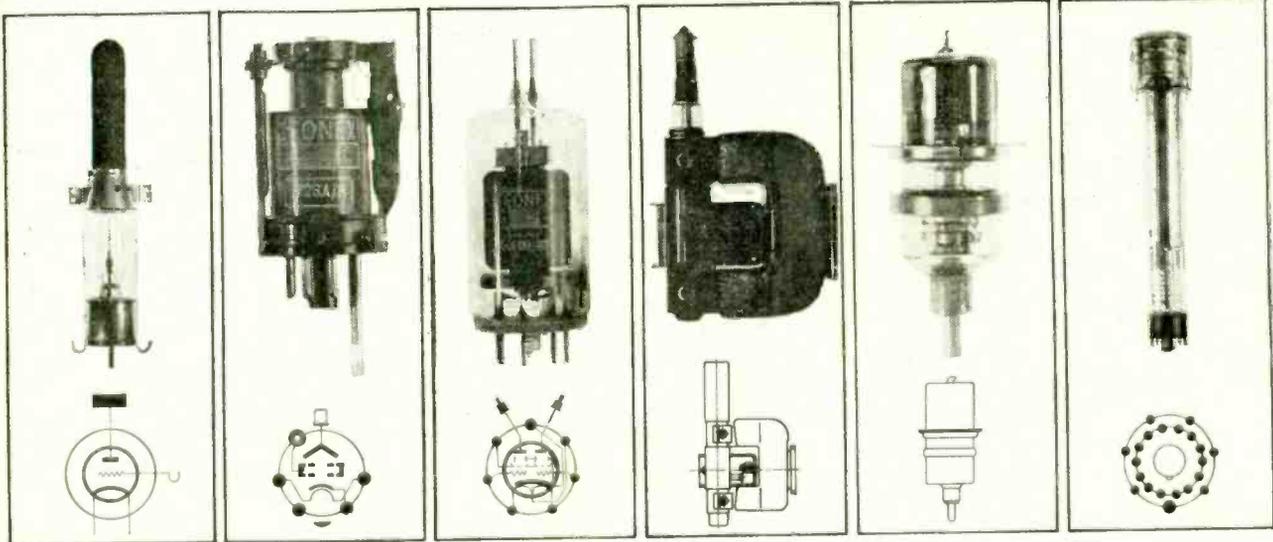
97 ST. JOHN STREET,
LONDON, E.C.1.
Telephone: 01-253 3393

WW-037 FOR FURTHER DETAILS

CHOSEN FOR VITAL CIVIL AND MILITARY ROLES BY OVER FORTY GOVERNMENTS THROUGHOUT THE WORLD —



TEONEX VALVES



The same safeguards in manufacture and control that have won government contracts for TEONEX in over forty different countries apply equally to ensure top quality for private users too. When you require valves to comply with E.V.S. or M.I.L. standards — choose TEONEX. The TEONEX range (for use outside the U.K. only) incorporates the entire series of British-produced valves or their Continental equivalents, including a wide range of colour T.V. valves. Price list and technical specifications may be obtained from:-

Export Enquiries Only Please!

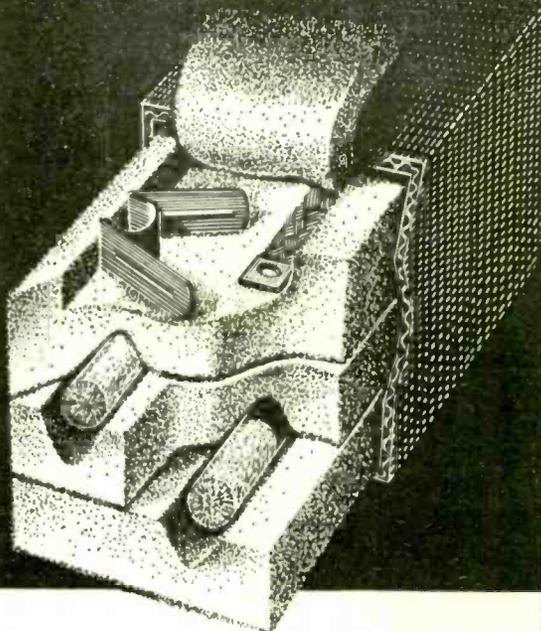
TEONEX LIMITED

2a, Westbourne Grove Mews,
London, W.11
England.



WW-038 FOR FURTHER DETAILS

TRANSIT PACK PROTECTION WITH FOAMAIR



Prevention is better than claim. Even your most fragile apparatus will arrive intact when packed in Foamair. A flexible urethane, Foamair gives complete protection against vibration and shock.

The illustration shows a highly successful transit pack designed for exporting brittle furnace elements to Russia. Commissioned by Morganite Electroheat Limited, the bespoke pack was repeatedly tested at the prototype stage: complete consignments survived four-foot drop tests on to concrete.

As it can be cut or profiled to any shape, let us tailor Foamair to your product. If you cannot risk sending it, we'll arrange to have it collected. Then we'll safely consign it back to you packed in Foamair.



FOAMAIR LIMITED

21 West Ferry Road, Millwall, London, E.14.
Telephone: EAST 5665 (4 lines)
Member of the Kayfoam group of companies

WW-039 FOR FURTHER DETAILS

RADFORD

AUDIO LABORATORY INSTRUMENTS

LOW DISTORTION OSCILLATOR (Series 2)

An instrument of high stability providing very pure sine waves, and square waves, in the range of 5 Hz to 500 kHz. Hybrid design using valves and semiconductors.

Specification

| | |
|------------------------|---|
| Frequency coverage: | 5 Hz-500 kHz (5 ranges) |
| Output Impedance: | 600 Ohms. |
| Output Voltage: | 10 Volts r.m.s. max. |
| Output Attenuation: | 0-110 dB continuously variable. |
| Sine Wave Distortion: | 0.005% from 200 Hz to 20 kHz increasing to 0.015% at 10 Hz and 100 kHz. |
| Square Wave Rise Time: | Less than 0.1 microseconds. |
| Monitor Output Meter: | Scaled 0-3, 0-10, and dBm. |
| Mains Input: | 100 V.-250 V. 50/60 Hz. |
| Size: | 17½ × 11 × 8in. |
| Weight: | 25 lb. |
| Price: | £125. |

Rack mounting version available.

DISTORTION MEASURING SET (Series 2)

A sensitive instrument for the measurement of total harmonic distortion, designed for speedy and accurate use. Capable of measuring distortion products as low as 0.002%. Direct reading from calibrated meter scale.

Specification

| | |
|---------------------|---|
| Frequency Range: | 20 Hz-20 kHz (6 ranges) |
| Distortion Range: | 0.01%-100% f.s.d. (9 ranges) |
| Sensitivity: | 100 mV.-100 V. (3 ranges) |
| Meter: | Square law r.m.s. reading |
| Input Resistance: | 100 kOhms. |
| High Pass Filter: | 3 dB down to 350 Hz. 3 dB down to 35 Hz. |
| Frequency Response: | ±1 dB from second harmonic of rejection frequency to 250 kHz |
| Power Requirements: | Included battery. |
| Size: | 17½ × 11 × 8in. |
| Weight: | 15 lb. |
| Price: | £90. |

Rack mounting version available.

VOLTMETER (new item)

A transistor operated voltmeter satisfying the requirements for audio frequency measurement.

Specification

| | |
|-----------------------|---|
| Sensitivity: | 1 mV.-300 V. f.s.d. (12 ranges) |
| Calibration Accuracy: | 2% f.s.d. |
| Frequency Response: | ±1 dB. 10 Hz-500 kHz. |
| Input Impedance: | 1 MOhm. 1 mV.-300 mV. 10 MOhm. 1 V.-300 V. |
| Meter Scaled: | 0-3, 0-10, and dBm. |
| Power Requirements: | Included battery. |
| Size: | 11½ × 6½ × 6in. |
| Weight: | 7 lb. |
| Price: | £35. |

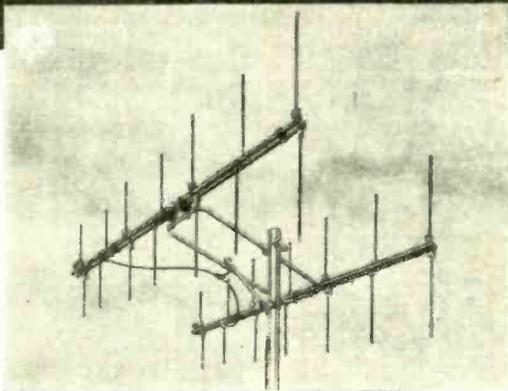
RADFORD LABORATORY INSTRUMENTS LTD

Ashton Vale Road
Bristol 3

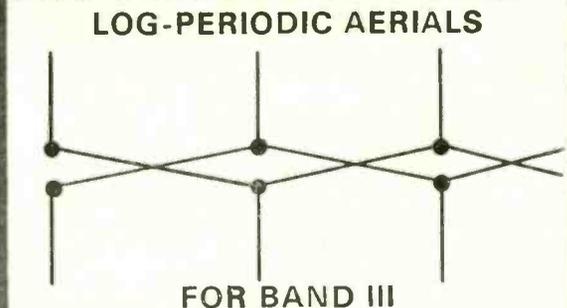
WW-040 FOR FURTHER DETAILS

NOW FROM Antiference

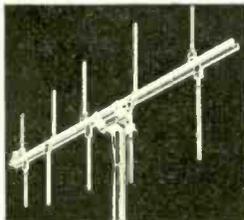
IMPROVED RECEPTION AND
A VITAL BREAKTHROUGH
FOR THE FUTURE



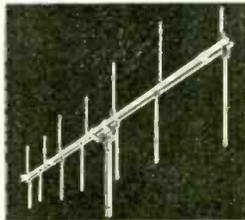
DLP7



Fully covered by: Patent No. 808818 Regd. Des. No. 933070 and others pending.



LP5



LP7

Antiference are first with wide-band tv aerials using the 'log-periodic' principle. Here are aerials with incredibly even response throughout the whole of Band III – not just in respect of forward gain — the front/back ratio, beamwidth and impedance are constant too *No other aerials have cleaner polar diagrams!* The sophisticated technical design has been cleverly matched by uncomplicated aerial engineering. The transmission line feeding the elements is incorporated in the double boom. Because transmission line theory is an integral part of the log-periodic design these aerials stack more efficiently than Yagi's. No compromise has to be made electrically or mechanically. The result No present reception problem is too tough for the L.P. and for the future? No matter what changes are made to Band III channels or standards, Antiference log-periodic aerials can cope better than any other. *Naturally L.P.'s cost a little more than ordinary Band III aerials — but they're worth it! Send for further details.*

Antiference 

Antiference Limited Aylesbury Bucks Tel:2511

Remember 'Antex'... 'Hilo'... 'Trumatch'

WW—041 FOR FURTHER DETAILS

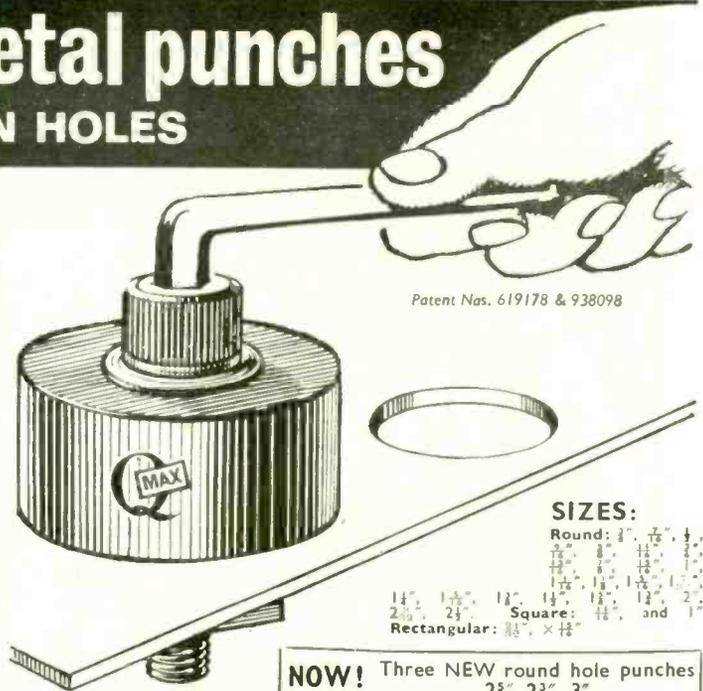
"Q-MAX" sheet metal punches

FOR QUICK AND CLEAN HOLES

- Simple operation
- Quick, clean holes (up to 16 gauge mild steel)
- Saves time and energy
- Burr-free holes—no jagged edges
- Special heat treatment maintains keen cutting edge
- Anti-corrosive finish prevents rusting
- Used all over the world

Used by all government services—Atomic, Military, Naval, Air, G.P.O. and Ministry of Works; Radio Motor and Industrial Manufacturers, Plumbing and Sheet Metal Trades, Garages, etc.

Obtainable from Radio, Electrical and Tool Dealers
WHOLESALE & EXPORT ENQUIRIES ONLY TO



Patent Nos. 619178 & 938098

SIZES:

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Round: | $\frac{1}{8}$ " | $\frac{1}{4}$ " | $\frac{3}{8}$ " | $\frac{1}{2}$ " | $\frac{5}{8}$ " | $\frac{3}{4}$ " | $\frac{7}{8}$ " | $1\frac{1}{8}$ " | $1\frac{1}{4}$ " | $1\frac{3}{8}$ " | $1\frac{1}{2}$ " | $1\frac{3}{4}$ " | $1\frac{7}{8}$ " | $2\frac{1}{8}$ " | $2\frac{1}{4}$ " | $2\frac{3}{8}$ " | $2\frac{1}{2}$ " | $2\frac{7}{8}$ " | $3\frac{1}{8}$ " | $3\frac{1}{4}$ " | $3\frac{3}{8}$ " | $3\frac{1}{2}$ " | $3\frac{3}{4}$ " | $3\frac{7}{8}$ " | $4\frac{1}{8}$ " | $4\frac{1}{4}$ " | $4\frac{3}{8}$ " | $4\frac{1}{2}$ " | $4\frac{3}{4}$ " | $4\frac{7}{8}$ " | $5\frac{1}{8}$ " | $5\frac{1}{4}$ " | $5\frac{3}{8}$ " | $5\frac{1}{2}$ " | $5\frac{3}{4}$ " | $5\frac{7}{8}$ " | $6\frac{1}{8}$ " | $6\frac{1}{4}$ " | $6\frac{3}{8}$ " | $6\frac{1}{2}$ " | $6\frac{3}{4}$ " | $6\frac{7}{8}$ " | $7\frac{1}{8}$ " | $7\frac{1}{4}$ " | $7\frac{3}{8}$ " | $7\frac{1}{2}$ " | $7\frac{3}{4}$ " | $7\frac{7}{8}$ " | $8\frac{1}{8}$ " | $8\frac{1}{4}$ " | $8\frac{3}{8}$ " | $8\frac{1}{2}$ " | $8\frac{3}{4}$ " | $8\frac{7}{8}$ " | $9\frac{1}{8}$ " | $9\frac{1}{4}$ " | $9\frac{3}{8}$ " | $9\frac{1}{2}$ " | $9\frac{3}{4}$ " | $9\frac{7}{8}$ " | $10\frac{1}{8}$ " | $10\frac{1}{4}$ " | $10\frac{3}{8}$ " | $10\frac{1}{2}$ " | $10\frac{3}{4}$ " | $10\frac{7}{8}$ " | $11\frac{1}{8}$ " | $11\frac{1}{4}$ " | $11\frac{3}{8}$ " | $11\frac{1}{2}$ " | $11\frac{3}{4}$ " | $11\frac{7}{8}$ " | $12\frac{1}{8}$ " | $12\frac{1}{4}$ " | $12\frac{3}{8}$ " | $12\frac{1}{2}$ " | $12\frac{3}{4}$ " | $12\frac{7}{8}$ " | $13\frac{1}{8}$ " | $13\frac{1}{4}$ " | $13\frac{3}{8}$ " | $13\frac{1}{2}$ " | $13\frac{3}{4}$ " | $13\frac{7}{8}$ " | $14\frac{1}{8}$ " | $14\frac{1}{4}$ " | $14\frac{3}{8}$ " | $14\frac{1}{2}$ " | $14\frac{3}{4}$ " | $14\frac{7}{8}$ " | $15\frac{1}{8}$ " | $15\frac{1}{4}$ " | $15\frac{3}{8}$ " | $15\frac{1}{2}$ " | $15\frac{3}{4}$ " | $15\frac{7}{8}$ " | $16\frac{1}{8}$ " | $16\frac{1}{4}$ " | $16\frac{3}{8}$ " | $16\frac{1}{2}$ " | $16\frac{3}{4}$ " | $16\frac{7}{8}$ " | $17\frac{1}{8}$ " | $17\frac{1}{4}$ " | $17\frac{3}{8}$ " | $17\frac{1}{2}$ " | $17\frac{3}{4}$ " | $17\frac{7}{8}$ " | $18\frac{1}{8}$ " | $18\frac{1}{4}$ " | $18\frac{3}{8}$ " | $18\frac{1}{2}$ " | $18\frac{3}{4}$ " | $18\frac{7}{8}$ " | $19\frac{1}{8}$ " | $19\frac{1}{4}$ " | $19\frac{3}{8}$ " | $19\frac{1}{2}$ " | $19\frac{3}{4}$ " | $19\frac{7}{8}$ " | $20\frac{1}{8}$ " | $20\frac{1}{4}$ " | $20\frac{3}{8}$ " | $20\frac{1}{2}$ " | $20\frac{3}{4}$ " | $20\frac{7}{8}$ " |
| Square: | $\frac{1}{8}$ " | $\frac{1}{4}$ " | $\frac{3}{8}$ " | $\frac{1}{2}$ " | $\frac{5}{8}$ " | $\frac{3}{4}$ " | $\frac{7}{8}$ " | $1\frac{1}{8}$ " | $1\frac{1}{4}$ " | $1\frac{3}{8}$ " | $1\frac{1}{2}$ " | $1\frac{3}{4}$ " | $1\frac{7}{8}$ " | $2\frac{1}{8}$ " | $2\frac{1}{4}$ " | $2\frac{3}{8}$ " | $2\frac{1}{2}$ " | $2\frac{7}{8}$ " | $3\frac{1}{8}$ " | $3\frac{1}{4}$ " | $3\frac{3}{8}$ " | $3\frac{1}{2}$ " | $3\frac{3}{4}$ " | $3\frac{7}{8}$ " | $4\frac{1}{8}$ " | $4\frac{1}{4}$ " | $4\frac{3}{8}$ " | $4\frac{1}{2}$ " | $4\frac{3}{4}$ " | $4\frac{7}{8}$ " | $5\frac{1}{8}$ " | $5\frac{1}{4}$ " | $5\frac{3}{8}$ " | $5\frac{1}{2}$ " | $5\frac{3}{4}$ " | $5\frac{7}{8}$ " | $6\frac{1}{8}$ " | $6\frac{1}{4}$ " | $6\frac{3}{8}$ " | $6\frac{1}{2}$ " | $6\frac{3}{4}$ " | $6\frac{7}{8}$ " | $7\frac{1}{8}$ " | $7\frac{1}{4}$ " | $7\frac{3}{8}$ " | $7\frac{1}{2}$ " | $7\frac{3}{4}$ " | $7\frac{7}{8}$ " | $8\frac{1}{8}$ " | $8\frac{1}{4}$ " | $8\frac{3}{8}$ " | $8\frac{1}{2}$ " | $8\frac{3}{4}$ " | $8\frac{7}{8}$ " | $9\frac{1}{8}$ " | $9\frac{1}{4}$ " | $9\frac{3}{8}$ " | $9\frac{1}{2}$ " | $9\frac{3}{4}$ " | $9\frac{7}{8}$ " | $10\frac{1}{8}$ " | $10\frac{1}{4}$ " | $10\frac{3}{8}$ " | $10\frac{1}{2}$ " | $10\frac{3}{4}$ " | $10\frac{7}{8}$ " | $11\frac{1}{8}$ " | $11\frac{1}{4}$ " | $11\frac{3}{8}$ " | $11\frac{1}{2}$ " | $11\frac{3}{4}$ " | $11\frac{7}{8}$ " | $12\frac{1}{8}$ " | $12\frac{1}{4}$ " | $12\frac{3}{8}$ " | $12\frac{1}{2}$ " | $12\frac{3}{4}$ " | $12\frac{7}{8}$ " | $13\frac{1}{8}$ " | $13\frac{1}{4}$ " | $13\frac{3}{8}$ " | $13\frac{1}{2}$ " | $13\frac{3}{4}$ " | $13\frac{7}{8}$ " | $14\frac{1}{8}$ " | $14\frac{1}{4}$ " | $14\frac{3}{8}$ " | $14\frac{1}{2}$ " | $14\frac{3}{4}$ " | $14\frac{7}{8}$ " | $15\frac{1}{8}$ " | $15\frac{1}{4}$ " | $15\frac{3}{8}$ " | $15\frac{1}{2}$ " | $15\frac{3}{4}$ " | $15\frac{7}{8}$ " | $16\frac{1}{8}$ " | $16\frac{1}{4}$ " | $16\frac{3}{8}$ " | $16\frac{1}{2}$ " | $16\frac{3}{4}$ " | $16\frac{7}{8}$ " | $17\frac{1}{8}$ " | $17\frac{1}{4}$ " | $17\frac{3}{8}$ " | $17\frac{1}{2}$ " | $17\frac{3}{4}$ " | $17\frac{7}{8}$ " | $18\frac{1}{8}$ " | $18\frac{1}{4}$ " | $18\frac{3}{8}$ " | $18\frac{1}{2}$ " | $18\frac{3}{4}$ " | $18\frac{7}{8}$ " | $19\frac{1}{8}$ " | $19\frac{1}{4}$ " | $19\frac{3}{8}$ " | $19\frac{1}{2}$ " | $19\frac{3}{4}$ " | $19\frac{7}{8}$ " | $20\frac{1}{8}$ " | $20\frac{1}{4}$ " | $20\frac{3}{8}$ " | $20\frac{1}{2}$ " | $20\frac{3}{4}$ " | $20\frac{7}{8}$ " |
| Rectangular: | $\frac{1}{8}$ " | $\frac{1}{4}$ " | $\frac{3}{8}$ " | $\frac{1}{2}$ " | $\frac{5}{8}$ " | $\frac{3}{4}$ " | $\frac{7}{8}$ " | $1\frac{1}{8}$ " | $1\frac{1}{4}$ " | $1\frac{3}{8}$ " | $1\frac{1}{2}$ " | $1\frac{3}{4}$ " | $1\frac{7}{8}$ " | $2\frac{1}{8}$ " | $2\frac{1}{4}$ " | $2\frac{3}{8}$ " | $2\frac{1}{2}$ " | $2\frac{7}{8}$ " | $3\frac{1}{8}$ " | $3\frac{1}{4}$ " | $3\frac{3}{8}$ " | $3\frac{1}{2}$ " | $3\frac{3}{4}$ " | $3\frac{7}{8}$ " | $4\frac{1}{8}$ " | $4\frac{1}{4}$ " | $4\frac{3}{8}$ " | $4\frac{1}{2}$ " | $4\frac{3}{4}$ " | $4\frac{7}{8}$ " | $5\frac{1}{8}$ " | $5\frac{1}{4}$ " | $5\frac{3}{8}$ " | $5\frac{1}{2}$ " | $5\frac{3}{4}$ " | $5\frac{7}{8}$ " | $6\frac{1}{8}$ " | $6\frac{1}{4}$ " | $6\frac{3}{8}$ " | $6\frac{1}{2}$ " | $6\frac{3}{4}$ " | $6\frac{7}{8}$ " | $7\frac{1}{8}$ " | $7\frac{1}{4}$ " | $7\frac{3}{8}$ " | $7\frac{1}{2}$ " | $7\frac{3}{4}$ " | $7\frac{7}{8}$ " | $8\frac{1}{8}$ " | $8\frac{1}{4}$ " | $8\frac{3}{8}$ " | $8\frac{1}{2}$ " | $8\frac{3}{4}$ " | $8\frac{7}{8}$ " | $9\frac{1}{8}$ " | $9\frac{1}{4}$ " | $9\frac{3}{8}$ " | $9\frac{1}{2}$ " | $9\frac{3}{4}$ " | $9\frac{7}{8}$ " | $10\frac{1}{8}$ " | $10\frac{1}{4}$ " | $10\frac{3}{8}$ " | $10\frac{1}{2}$ " | $10\frac{3}{4}$ " | $10\frac{7}{8}$ " | $11\frac{1}{8}$ " | $11\frac{1}{4}$ " | $11\frac{3}{8}$ " | $11\frac{1}{2}$ " | $11\frac{3}{4}$ " | $11\frac{7}{8}$ " | $12\frac{1}{8}$ " | $12\frac{1}{4}$ " | $12\frac{3}{8}$ " | $12\frac{1}{2}$ " | $12\frac{3}{4}$ " | $12\frac{7}{8}$ " | $13\frac{1}{8}$ " | $13\frac{1}{4}$ " | $13\frac{3}{8}$ " | $13\frac{1}{2}$ " | $13\frac{3}{4}$ " | $13\frac{7}{8}$ " | $14\frac{1}{8}$ " | $14\frac{1}{4}$ " | $14\frac{3}{8}$ " | $14\frac{1}{2}$ " | $14\frac{3}{4}$ " | $14\frac{7}{8}$ " | $15\frac{1}{8}$ " | $15\frac{1}{4}$ " | $15\frac{3}{8}$ " | $15\frac{1}{2}$ " | $15\frac{3}{4}$ " | $15\frac{7}{8}$ " | $16\frac{1}{8}$ " | $16\frac{1}{4}$ " | $16\frac{3}{8}$ " | $16\frac{1}{2}$ " | $16\frac{3}{4}$ " | $16\frac{7}{8}$ " | $17\frac{1}{8}$ " | $17\frac{1}{4}$ " | $17\frac{3}{8}$ " | $17\frac{1}{2}$ " | $17\frac{3}{4}$ " | $17\frac{7}{8}$ " | $18\frac{1}{8}$ " | $18\frac{1}{4}$ " | $18\frac{3}{8}$ " | $18\frac{1}{2}$ " | $18\frac{3}{4}$ " | $18\frac{7}{8}$ " | $19\frac{1}{8}$ " | $19\frac{1}{4}$ " | $19\frac{3}{8}$ " | $19\frac{1}{2}$ " | $19\frac{3}{4}$ " | $19\frac{7}{8}$ " | $20\frac{1}{8}$ " | $20\frac{1}{4}$ " | $20\frac{3}{8}$ " | $20\frac{1}{2}$ " | $20\frac{3}{4}$ " | $20\frac{7}{8}$ " |

NOW! Three NEW round hole punches
 $2\frac{5}{8}$ " $2\frac{3}{4}$ " 3 "

"Q-MAX" (electronics) LTD. Napier House, High Holborn, London, W.C.1.

WW-042 FOR FURTHER DETAILS

multi-range testing... mini style

A pocket size instrument with big performance. Measures A.C. and D.C. volts, D.C. current and resistance. Clear scale, knife edge pointer and tough Melamine cover. The movement is built into a pressed steel case, effectively screened from external magnetic fields.

Look at these features :-

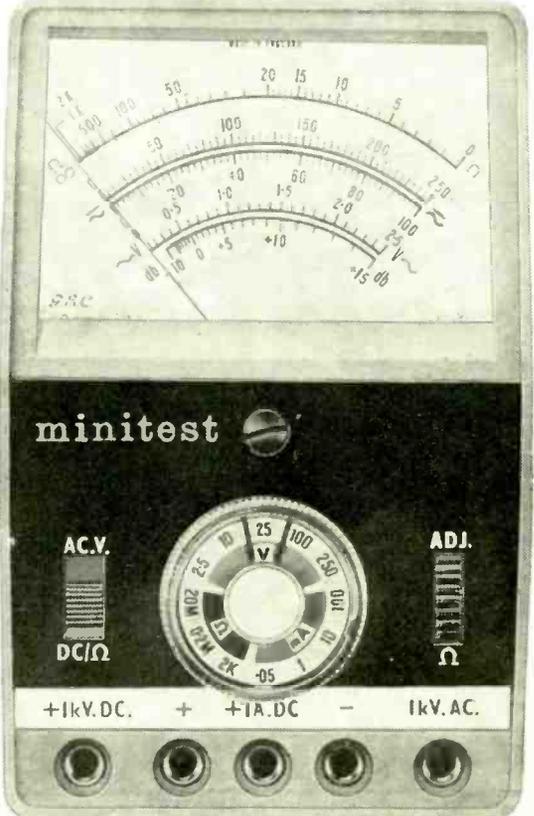
- D.C. sensitivity 20,000 ohms per volt.
- D.C. accuracy $\pm 2\frac{1}{2}\%$ F.S.D.
- A.C. sensitivity 2,000 ohms per volt.
- A.C. accuracy $\pm 2\frac{1}{2}\%$ F.S.D.
- Small size, $5\frac{1}{2}$ " x $3\frac{1}{2}$ " x $2\frac{1}{4}$ "
- A.C. accuracy maintained up to 20kc/s.
- Weight 18ozs.
- 20 ranges.

minitest multi-range test set
 50 uA movement 20,000 ohms per volt
for only £7-17-6 (trade price)

Leaflet on request.

SEI SALFORD ELECTRICAL INSTRUMENTS LIMITED **G&C**

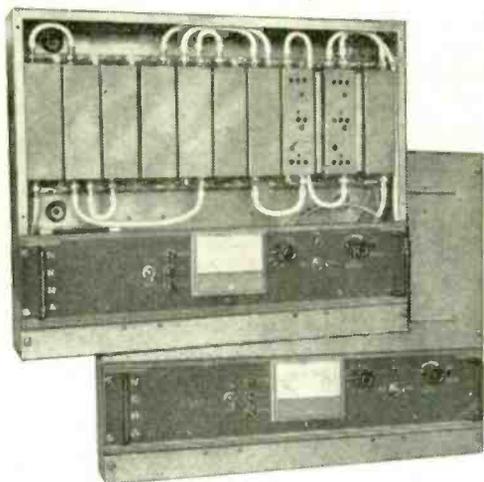
Peel Works, Barton Lane, Eccles, Manchester. Tel.: ECCLES 5081. Telex: 66711
 London Sales Office: Brook Green, Hammersmith, W.6. Tel.: 01-603 9292
 A Subsidiary of the General Electric Co. Ltd. of England.



WW-043 FOR FURTHER DETAILS

NERA

TRANSISTORIZED VHF TV TRANSPOSER



- 100 mW or 500 mW output power
- Fully transistorized
- High stability
- Mains or battery operation
- Rack or cabinet mounting
- For black and white as well as colour transmission

Manufacturers of

- TV Transmitters and Accessories
- FM Broadcast Transmitters
- Microwave Systems

AKSJESELSKAPET
NERA

Pilestredet 75 C, Oslo 3, Norway

Representative for U.K.:

ASH ELECTRONICS LIMITED

12 Swallow Street, Piccadilly, London W. 1

WW-044 FOR FURTHER DETAILS

PRECISION CERAMICS

LOW-LOSS OR HIGH ALUMINA



Our ceramic components, pressed or extruded, have a high reputation for dimensional accuracy at very competitive prices.

Full details available from:

**W.GREENWOOD
(LONDON) LTD.**

21 GERMAIN STREET,
CHESHAM, BUCKS

Chesham
4808/9

WW-045 FOR FURTHER DETAILS

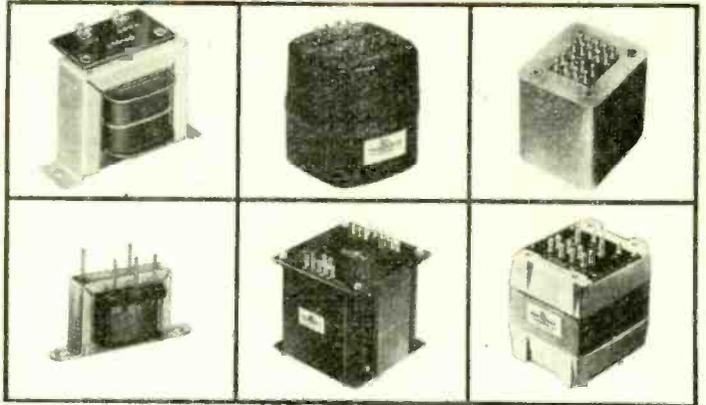
We can't show them all!

The Partridge range of Transformers for Hi-Fi circuits covers most leading published designs. Write now for Data Sheets, or let us have your specific enquiry—there's bound to be a model to suit your needs.

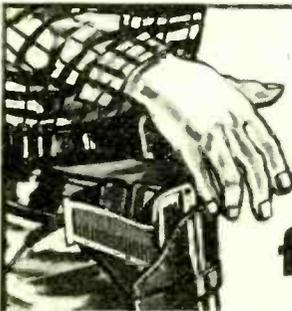


Partridge

FARTRIDGE TRANSFORMERS LTD. ROEBUCK RD., CRESSINGTON, SURREY. LOWER HOOK 4353



WW-046 FOR FURTHER DETAILS

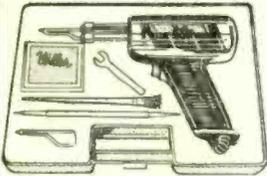


This gun for SALE!

FOR 'INSTANT HEAT' ... SAFE ... EFFICIENT SOLDERING

With a Weller 'Expert' Dual Heat Gun in hand you can successfully tackle any soldering job—from a small printed circuit up to sheet metal work! You get INSTANT HEAT at the press of a trigger—and tip is cool within 10 seconds of releasing trigger. Completely safe for operator ... and components. Simple to use ... speedy and accurate. Dual Heat 120-140 watts Expert Dual Heat Gun 66/- (Kit 87/6). Also available; Marksman Soldering Iron 29/- (Kit 38/-).

Manufactured by the world's largest makers of quality soldering tools. Obtainable from high class Ironmongers, D.I.Y. shops and stores.



Weller

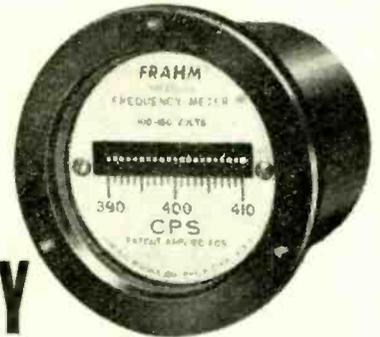
Please send me literature on Weller Soldering Equipment
WELLER ELECTRIC LIMITED,
Horsham, Sussex. Tel. Horsham 61747

Name
Address

WW/1/68

WW-047 FOR FURTHER DETAILS

FRAHM vibrating reed FREQUENCY METERS



are widely used as standards in many industries because:—

- 1) They are accurate (to $\pm 0.3\%$ or $\pm 0.1\%$ as specified)
- 2) They are not voltage or temperature sensitive, within wide limits
- 3) They are unaffected by waveform errors, load, power factor or phase shift
- 4) They will operate on A.C., pulsating or interrupted D.C., and super-imposed circuits
- 5) They need only low input power
- 6) They are compact and self-contained
- 7) They are rugged and dependable

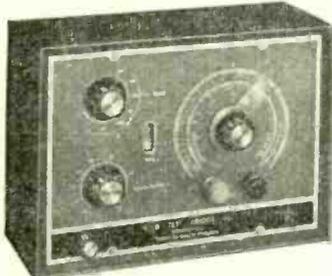
FRAHM Vibrating Reed Frequency Meters are available in miniature, switchboard and portable forms, in ranges from 10 to 1700 cps. Descriptive literature on these meters, and on FRAHM Resonant Reed Tachometers, freely available from the sole U.K. distributors:—

ANDERS METER SERVICE

ANDERS ELECTRONICS LTD. 103 HAMPSTEAD ROAD LONDON NW1
TELEPHONE EUSTON 1639

MINISTRY OF AVIATION APPROVED

WW-043 FOR FURTHER DETAILS



C. R. TEST BRIDGE 32 £10.10.0
TRANSISTORISED

NOMBREX

NEW STYLE IMPROVED INSTRUMENTS
OTHER MODELS AVAILABLE—

- POWER SUPPLY 22 £14.0.0
- A.F. GENERATOR 30 £19.10.0
- INDUCT. BRIDGE 33 £20.0.0

SEE PREVIOUS ISSUES FOR DETAILS

ALL IN FULL PRODUCTION

POST & PKG. 6/6 EACH EXTRA



R.F. GENERATOR 31 £12.10.0
TRANSISTORISED

6d. STAMP FOR ALL LEAFLETS

NOMBREX LIMITED - EXMOUTH - DEVON

TRADE AND EXPORT ENQUIRIES INVITED

WW-049 FOR FURTHER DETAILS

EDDYSTONE COMMUNICATION RECEIVERS

For the Professional or Amateur user who likes the Best.



840C
£66

HIRE PURCHASE TERMS

| Model | Cash Price | Deposit | 12 mthly. of | Total H.P. Price | 24 mthly. of | Total H.P. Price |
|-------|------------|----------|--------------|------------------|--------------|------------------|
| EC10 | £53 | £15 | £3 8 2 | £55 18 0 | £1 19 2 | £62 0 0 |
| 840C | £66 | £16 10 0 | £4 8 9 | £69 15 0 | £2 7 6 | £73 10 0 |
| EB35 | £60 6 3 | £15 6 3 | £4 0 7 | £63 13 3 | £2 3 0 | £66 18 3 |
| 940 | £133 | £34 | £8 17 3 | £140 7 0 | £4 14 9 | £147 14 0 |
| EA12 | £185 | £47 | £12 7 3 | £195 7 0 | £6 12 3 | £205 14 0 |

Payments over 30 months if desired.

Quotation on request.

Delivered Carriage paid by Passenger Train.

CARRIAGE PAID

SEND 6d STAMP FOR LITERATURE TO

The Eddystone
Specialists

SERVICES LTD.

51 COUNTY ROAD
LIVERPOOL, 4

Telephone: AINTREE 1445

ESTAB. 1935



WW-050 FOR FURTHER DETAILS

TELEPRINTERS · PERFORATORS REPERFORATORS · TAPEREADERS EDITING & REPRODUCING SETS

Codes: Int. No. 2 Mercury/Pecanus, Elliot 803.
Binary and special purpose Codes.

2-5-6-7-8 TRACK AND
MULTIWIRE EQUIPMENT

TELEGRAPH AUTOMATION AND COMPUTER PERIPHERAL ACCESSORIES

Picture Telegraph, Desk-Fax, Morse Equipment; Pen Recorders; Switchboards; Converters and Stabilised Rectifiers; Tape Holders, Pullers and Fast winders; Governed, Synchronous and Phonic Motors; Teleprinter Tables and Cabinets; Silence Covers; Distortion and Relay Testers; Send/Receive Low and High

Pass filters; Teleprinter. Morse, Teledeltos Paper, Tape and Ribbons; Polarised and specialised relays and Bases; Terminals V.F. and F.M. Equipment; Telephone, Carriers and Repeaters; Multiplex Transmitters; Diversity

Frequency Shift, Keying Equipment; Line, Mains Transporters and Suppressors; Racks and Consoles; Plugs, Sockets, Key, Push Miniature and other Switches; Cords, Wires, Cables and Switchboard Accessories; Teleprinter Tools; Stroboscopes and Electronic Forks; Cold Cathode Matrices; Test Equipment; Oscilloscopes; Miscellaneous Accessories and Spares.

W. BATEY & COMPANY

Gaiety Works, Akeman Street, Tring, Herts.

Tel.: Tring 3476 (3 lines) Cables: RAHND TRING
STD: 044-282 TELEX 82382

WW-051 FOR FURTHER DETAILS

CONTELEC

WIREWOUND ADJUSTMENT POTENTIOMETERS

* Now Ex-Stock

T125 SERIES



A really high quality single turn, humidity proof potentiometer. Resistance Range 10Ω to 50KΩ. Temperature Range 55°C to 150°C.

TYPE T84



A sub-miniature single turn humidity proof potentiometer. Resistance range 20Ω to 20KΩ. Temperature Range 55°C to 150°C.

Full details of these
and other types from

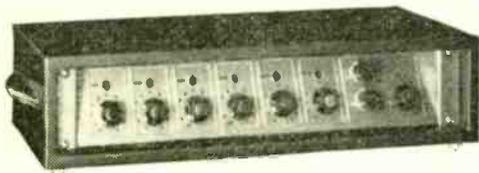
**W.GREENWOOD
(LONDON) LTD.**

21 GERMAIN STREET,
CHESHAM, BUCKS

Chesham
4808/9

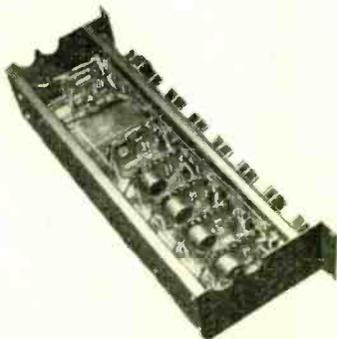
WW-052 FOR FURTHER DETAILS

Audix SOUND SYSTEMS & ELECTRONICS

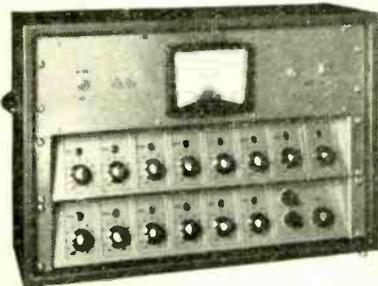


MXT/6 Mixer Unit complete with Modules

- HIGH PERFORMANCE
- COMPACT MODULAR CONSTRUCTION
- RACK OR CONSOLE MOUNTING
- FIRST GRADE COMPONENTS AND MATERIALS



MODULAR AUDIO MIXERS



Assemblies, housing up to fourteen channels with combining amplifier etc., can be supplied for either Rack or Console mounting. Power supplies, v.u. meters can be incorporated to meet individual requirements.

SPECIFICATION

Combining Pre-Amplifier MXT/6. Output Imp. 2K ohms @ 170 mV balanced, or Zero dB @ 600 ohms balanced or floating. Tone Controls: Bzss +10dB -8dB @ 100Hz. Treble: 8dB -10dB @ 10kHz.

MIC. Module MU/30. Input Imp. 50 ohms balanced. Frequency response 50Hz-20kHz. Sensitivity: -80 dB.

MIC. Module MU/200. Input Imp. 200 ohms balanced. Frequency response 50Hz-20kHz. Sensitivity: -80 dB.

MIC. Module MU/1. Input Imp. 50K ohm unbalanced. Frequency response 20Hz-20kHz. Sensitivity: -74 dB.

GRAM. Module GU/1. Input Imp. 1M ohm. Frequency response 20 Hz-20kHz. Sensitivity: -32 dB.

TAPE Module TU/1. Input Imp. 100 K ohm. Frequency response 20 Hz-20kHz. Sensitivity: -16 dB.

RADIO Module RU/1. Input Imp. 100 K ohm. Frequency response 20 Hz-20kHz. Sensitivity: -26 dB.

SIGNAL/NOISE RATIO PER CHANNEL. Better than 60 dB.

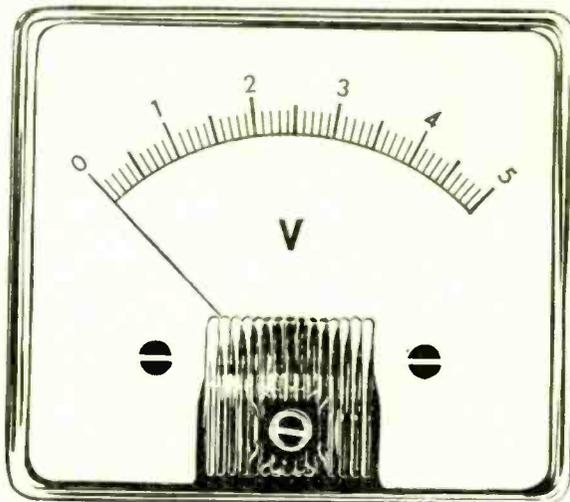
Write for catalogue of full range of Sound Equipment.



STANSTED, ESSEX
PHONE:—
STANSTED:—3132/3437

WW-053 FOR FURTHER DETAILS

METER PROBLEMS?



A very wide range of modern design instruments is available for 10/14 days delivery.

Full information from:

HARRIS ELECTRONICS (London) LTD.
138 GRAYS INN ROAD, W.C.1 Phone: 01/837/7937

WW-054 FOR FURTHER DETAILS

**TRANSFORMERS
COILS
CHOKES**

LARGE OR SMALL QUANTITIES
TRADE ENQUIRIES WELCOMED

SPECIALISTS IN

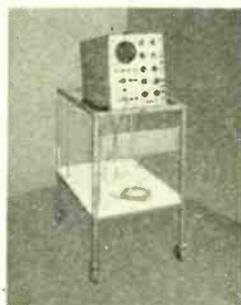
FINE WIRE WINDINGS

MINIATURE TRANSFORMERS
RELAY AND INSTRUMENT COILS, ETC.
VACUUM IMPREGNATION TO APPROVED STANDARDS

ELECTRO-WINDS LTD.

CONTRACTORS TO G.P.O., A.W.R.E. L.E.B., B.B.C., ETC.
123 PARCHMORE ROAD, THORNTON HEATH, SURREY
01.653.2261 CR4.8LZ EST. 1933

WW-055 FOR FURTHER DETAILS



**AVONCEL
EQUIPMENT TROLLEYS**

Medium Duty from £17. Heavy Duty from £35. Wide range of Standard Models. Quick Delivery. Special Models made to order.

“AVONCEL”

AVON COMMUNICATIONS & ELECTRONICS LTD
318 BOURNEMOUTH (HURN) AIRPORT
CHRISTCHURCH, HANTS. Tel. NORTHBOURNE 3774 (P.B.X.)

WW-056 FOR FURTHER DETAILS

M. R. SUPPLIES, LTD.,
(Established 1935)

Universally recognised as suppliers of UP-TO-DATE MATERIAL, which does the job properly. Instant delivery. Satisfaction assured. Prices nett.

FANFLOW EXTRACTOR FANS. Undoubtedly today's greatest bargain for domestic or industrial use. For 200/250 volts A.C. 7,500 cu. ft. per hour. Easily installed. Bitted weatherproof hoppers which open when motor is switched on and closed when off. Only 6 1/2 in. dia. Our nett price only **£6/15/-** (despatch 4/6).

EXTRACTOR FANS. Ring mounted all metal construction. T.F.E. induction motor. Silent operation. 5in. blade, 10in. max. dia. 400 C.F.M. **£5/15/-** (des. 5/3). Same model 10in. blade, 12in. max. dia. 500 C.F.M. **£6/6/-** (des. 5/4).

SMALL GEARED MOTORS. In addition to our well-known range (Diat GM.664), we offer small open type S.P. Units, 200/250 v. A.C. L. 6, 12, 24, 60 r.p.m., approx. 5in. long, with 1in. shaft projection each side and enclosed gearbox. Suitable for display work and many industrial uses. Only **69/6** (des. 3/3).

SYNCHRONOUS TIME SWITCHES. (Our very popular speciality). 200/250 v. 50 c. for accurate pre-set switching operations. Sangamo S.254 providing up to 3 on-off operations per 24 hours at any chosen time, with day-omitting device (use optional). Capacity 20 amps. Compactly housed 4in. dia., 3 1/2 in. deep. **£5/18/6** (des. 4/3). Also same excellent make new Domestic Model, no wiring and easy setting and installation. Forbids with lead and 13-amp. plug, same duty as above (less day-omitting), **£4/9/6** (des. 4/0). Full instructions sent with each.

MINIATURE COOLING FANS. 200/250 v. A.C. With open type induction motor (no interference). Overall 4in. x 3 1/2 in. x 2 1/2 in. Fitted 6-bladed metal impeller. Ideal for projector lamp cooling, light duty extractors, etc., still only **28/6** (des. 4/6).

MINIATURE RUNNING TIME METERS (Sangamo). We have great demands for this remarkable unit and can now supply immediately from stock. 200/250 v. 60 c. synchronous. Counting up to 9,999 hours, with 1/10th indicator. Only 1 1/2 in. square, with cyclometer dial, depth 2in. Many industrial and domestic applications to indicate the running time of any electrical apparatus, easy to install, **60/-** (post paid).

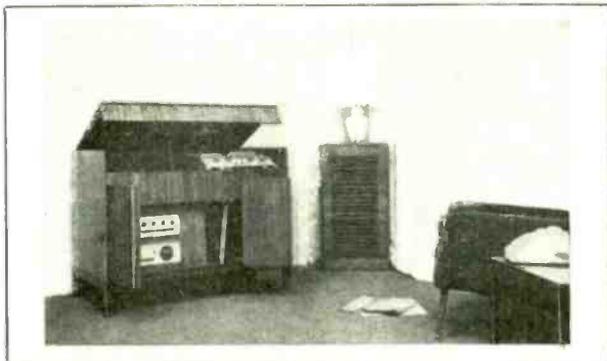
AIR BLOWERS. Highly efficient units fitted induction totally enclosed motor 230/240 v. 50 c. 1 ph. Model 8D28, 60 CFM (free air) to 11.5 CFM at .15 WG (size approx.) 4 x 6 x 7in. Outlets 2 1/2 in. square, **£8/10/-** (des. 5/1). Model 8D27, 120 CFM (free air) to 10 CFM at 1.2 WG, 8 x 7 x 9in., outlet 2 1/2 in. sq., **£11/15/6** (des. 5/2). Model 8D28, 200 CFM (free air) to 127 CFM at 1.5 WG, 11 x 8 x 9in., outlet 3in. sq., **£13/17/6** (des. 5/3).

SYNCHRONOUS ELECTRIC CLOCK MOVEMENTS (as mentioned and recommended in many national journals). 200/250 v. 50 c. Self-starting. Fitted spindles for hours, minutes and central sweep seconds hands. Central one-hole fixing. Dia. 2 1/2 in. Depth behind dial only 1 1/2 in. With back dust cover. **35/-** (des. 1/6). Set of three brass hands in good plain style. For 5/7in. dial 2/6. For 8/10 dial 3/6 set.

SYNCHRONOUS TIMER MOTORS (Sangamo). 200/250 v. 50 c/k. Self-starting 2in. dia. x 1 1/2 in. deep. Choice of following speeds: 1 r.p.m., 12 r.p.m., 1 r.p.h., 1 rev. 12 hours, 1 rev. per day. Any one **39/6** (des. 1/6). Also high-torque model (c.f.c.), 2 1/2 in. x 2 1/2 in. x 1 1/2 in. d r.p.m., **57/6** (des. 1/6).

IMMEDIATE DELIVERY of Stuart Centrifugal Pumps, including stainless steel (most models). Philips Variable Transformers (all models).

M. R. SUPPLIES, Ltd., 68 New Oxford Street, London, W.C.1
(Telephone: 01-636 2958)



HOUSING HI-FI?

FREE HI-FI HOUSING ADVISORY SERVICE

Simply tell us the equipment you propose to house and we will be pleased to recommend the most suitable cabinet. Remember—housing Hi-Fi is our business.

Whatever your set-up there's a **RECORD HOUSING** Cabinet to meet your needs. Amplifiers, tuners, turntables, loud-speakers, records, tapes, tape decks and even a complete tape recorder—you name it we'll house it! The room setting above features our **Schubert Equipment Cabinet** (left) 42 gns. and **Hi-Flex Speaker Enclosure** (centre) 412/19/-. These are examples of the Record Housing range of equipment cabinets, speaker cabinets and record cabinets—over 20 different models priced from 7 gns. Send for free catalogue and list of over 600 stockists (U.K. only).

RECORD HOUSING

(Dept. W.W.1f, Brook Road, London, N.22. Tel: 01-888 7487)

WW-057 FOR FURTHER DETAILS

W.G

NEW

SOLDER REMOVER

Instantly removes unwanted solder from printed circuits and other joints. Saves time, increases production, eliminates risk of damage to components.

79/6

Available now from

W.GREENWOOD INSTRUMENTS LTD

21 GERMAIN STREET, CHESHAM, BUCKS

Chesham 4808/9

WW-058 FOR FURTHER DETAILS

Adamin

MODEL 15

**MICRO
SOLDERING
INSTRUMENT**



- **EXTREME VERSATILITY**
Range of 8 interchangeable bits, from $\frac{3}{16}$ in. (.047 in.) to $\frac{3}{16}$ in., including new non-wearing PERMATIPS.
- **ULTRA-SMALL SIZE**
Length $7\frac{1}{8}$ in. Weight $\frac{1}{2}$ oz. Max. handle dia. $\frac{7}{16}$ in.
- **EXTRA-HIGH PERFORMANCE**
Heating time 90 secs. Max. bit temp. 390°C. Loading 15 watts—equals normal 30/40-watt iron.
- **ALL VOLTAGES**
The ADAMIN range includes five other models (5, 8, 12, 18 and 24 watts), Thermal Strippers (PVC and PTFE) and a De-Soldering Tool. Please ask for colour catalogue A/5.

LIGHT SOLDERING DEVELOPMENTS LTD

23 Sydenham Road, Croydon, CR9 2LL
Tel: 01-833 8593 & 4353

WW-059 FOR FURTHER DETAILS

**If you were born under
AQUARIUS**
remember there's an RTS in the month!

A rewarding phase for engineers. Minor adjustments in stock procedures bring lasting benefits. Aquarians on the look-out for progressive ideas will see particular significance in RTS 'by-return' service on electronic components. Lucky numbers: Cambridge (OCA3) 51471—for orders Cambridge (OCA3) 59101—other business

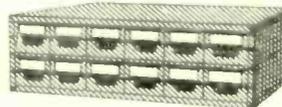
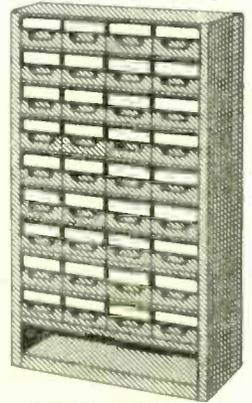
Send for comprehensive catalogue today to see what RTS holds in store for you.
RTS for all your components, by return, even overseas!

RTS
RADIO AND TELEVISION SERVICES LIMITED
P.O. Box 11, Gloucester Street, Cambridge
A MEMBER OF THE GROUP OF COMPANIES

WW-060 FOR FURTHER DETAILS

Those transistors cost money! Protect them!!

**36A SPACESAVER
DRAWER UNIT** 42" high, 24½" wide, 12" deep. 36 drawers each 3" high, 5½" wide, 10½" deep, with identification cards.
(CARRIAGE FREE ON MAINLAND) **£12.0.0 BRAND NEW**



**12A POPULAR DRAWER
UNIT** 9" high, 35" wide, 12" deep, 12 drawers each 3" high, 5½" wide, 10½" deep, with identification cards. Ideal for shelf or table-top.
£4.15.0 BRAND NEW

ORDER NOW
Send for FREE catalogue of our complete range of storage equipment.

N.C.BROWN LTD
INDUSTRIAL SALES DIVISION **pacesetters in storage equipment**

Eagle Steelworks, Heywood, Lancs. Tel: 69018
London: 25/27 Newton St. WC2. Tel: 01-405-7931

Please send 36A Spacesaver Drawer Unit
 12A Popular Drawer Unit

Tick where applicable and send cash with orders under £5

NAME

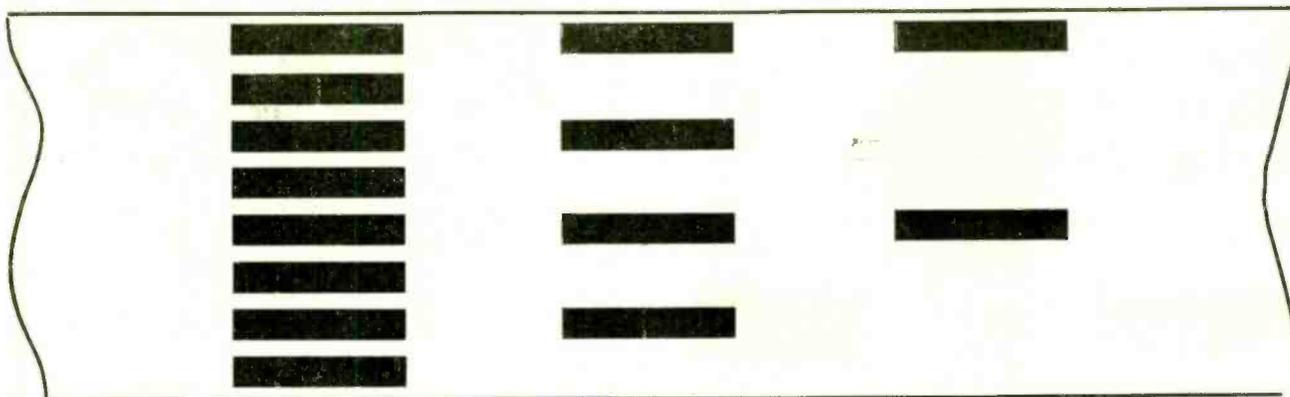
ADDRESS

E29

WW-061 FOR FURTHER DETAILS

8 TRACKS

ON 1/4" TAPE



8/8

4/8

2/8

The ever-increasing application of digital techniques to data acquisition has prompted Marriott Magnetics to investigate track density in 1/4 inch wide magnetic tape. The possibility of using readily available and comparatively cheap tape and tape transport mechanisms opens up new and attractive avenues of approach to many applications which hitherto have been dismissed on cost grounds. This 8/8 head is a valuable newcomer to our standard range which now includes 4/8 and 2/8 in addition to the 4/4—2/4 and 1/4 configuration.

Combination Record/Playback/Erase heads to the above configuration are available for some of the above types.

Marriott Magnetics were the very first company in the world to mass-produce miniature heads, and in 1959 Marriotts scooped the world by mass-producing a four-track head. Well over 5 million heads have been sold since then, and it is the company's firm intention to continue leading the world in the design and manufacture of Magnetic Recording Heads.

RESEARCH AND DEVELOPMENT

Marriott Magnetics' research and development activities are directed towards continuously improving the mechanical and electrical characteristics of their heads through the use of many new ideas, engineering approaches and manufacturing techniques.

Much research and development effort is applied to the development of heads with unique configurations for many special and unusual instrumentation applications. A highly efficient pre-production group works closely with research and development to provide a fast service of prototypes, small quantity production and special heads.

MANUFACTURING

Marriott Magnetics maintain a complete facility; fully equipped with the machines, tools, optical equipment and electronic test instruments for mass production of precision heads. Machinery, assembly, test and inspection operations are performed by operators experienced in close tolerance and precision assembly work.

Material handling methods are used to permit cost reduction and quick delivery of Standard Heads. Assembly, test and inspection procedures are carried out under most controlled conditions.

ENGINEERING

Marriott Magnetics' engineering staff has extensive experience in application of design, manufacturing and test techniques to head production problems, and taking a new design through the prototype stage to quantity manufacture. The ability to analyse and to provide answers quickly to engineering problems peculiar to precision heads results in a quality product with superior operational characteristics and very uniform production runs.

QUALITY CONTROL

Continuous piece part inspection and evaluation of each Sub-Assembly are the two basic points of Marriott Magnetics' quality control system. Incoming materials and parts are closely inspected to ensure that mechanical and electrical specifications are met. All completed heads are vigorously inspected and performance tested to ensure complete customer satisfaction.

MARRIOTT MAGNETICS LTD.

WATERSIDE WORKS

PONSHARDEN

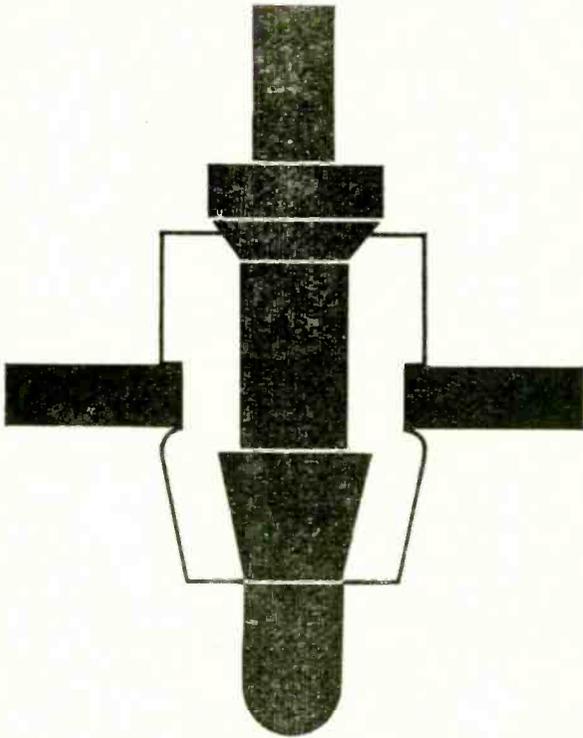
PENRYN

CORNWALL

Telephone: Penryn 3591-3363

WW-062 FOR FURTHER DETAILS

hole in one



OXLEY MINIATURE 'BARB' P.T.F.E. TERMINALS



A SELECTION OF ACTUAL SIZE 'BARB' INSULATORS

The wide range of Oxley "Barb" lead-through and stand-off insulators enable rapid positive assembly into plain drilled or punched holes offering the ultimate in electrical and mechanical performance due mainly to the design and use of dispersion grade P.T.F.E. as the insulating medium.

Assembly is effected by simply inserting the insulating bush into the chassis mounting hole and pressing the heavily silver-plated conducting spall through the bushing, thus expanding the latter below the chassis to provide firm anchorage.

Many of the components have Ministry Approval to 5334B.

The standard finish is silver-plate and optional finishes include gold. All types are available in eleven different colours.

ASSEMBLY'S
A "PUSH OVER"
SIMPLE
QUICK
SECURE

See your Electrical Engineering Index for full technical data.



OXLEY DEVELOPMENTS CO. LTD., ULVERSTON, LANCs.
TEL: ULVERSTON 2621. CABLES: OXLEY ULVERSTON

WW-063 FOR FURTHER DETAILS

WHAT'S THE BIG NEW PLUS

ON

MAY PRECISION COMPONENTS LTD
POTENTIOMETERS
AND CONTROL ACCESSORIES



SAME DAY SERVICE FROM



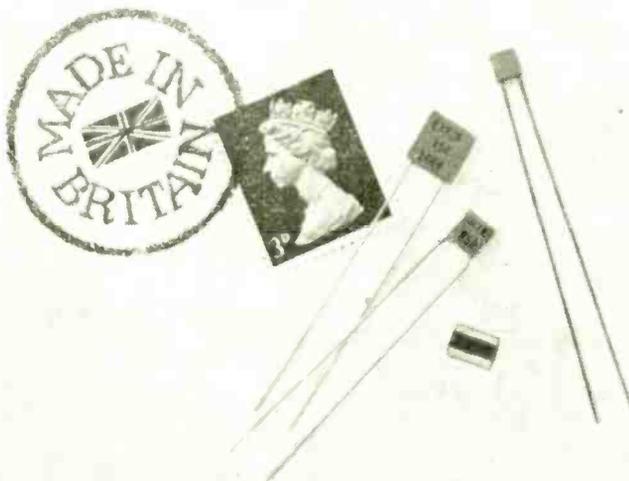
Please send for literature and full RTS catalogue.

RADIO & TELEVISION SERVICES LTD.

P.O. Box 11 · Gloucester St. Cambridge
Ring Cambridge 51471 direct line for spares orders.
Ring Cambridge 59101 for other business.
The STD prefix for Cambridge is OCA3

A MEMBER OF THE  GROUP OF COMPANIES

WW-064 FOR FURTHER DETAILS



We make our monolithic capacitors in Britain

Monobloc ; an advanced product for sophisticated applications. A tiny component that has become the most exciting prodigy this side of the Atlantic. Its capacitance is vast, its size minute – up to 1 uf in 0.3 x 0.3 x 0.1 in. (nine times smaller than a postage stamp). This capacitance-to-volume ratio is achieved by the unique monolithic construction. Wafer-thin ceramic dielectrics and platinum electrodes are fused into a solid, layered structure, to give a volumetric efficiency 10 to

100 times that of conventional capacitors. It's a rugged little device. The layered construction gives excellent stability and resistance to every form of shock and environmental stress. We manufacture a preferred range, concentrated on the individual requirements of the British designer. There are other configurations available for more complicated designs : glass-encased, precision moulded, phenolic coated, and unencapsulated chips for hybrid integrated circuits.

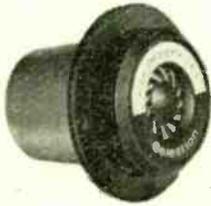
The monolithic capacitor is already a pretty important contribution to the progress of modern electronics – our Monobloc Ceramicon design caters for projects of the future. Contact us for the full details. Technical Sales, **Erie Resistor Limited**, South Denes, Great Yarmouth, Norfolk. Phone : 0493 4911 Telex : 97421 Monoblocs are featured in the 1968 edition 6 catalogue of S.T.C. Electronic Services.

Monobloc and Ceramicon are registered trade marks.

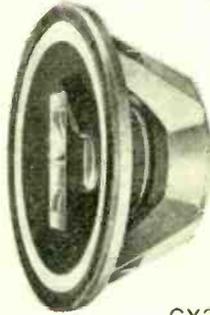


WW-065 FOR FURTHER DETAILS

HF1300 Mk. 2



GD974



CX2012

Celestion Studio Series

loudspeakers for the perfectionist

—for high fidelity

Write for Catalogue No: RCS 2002

Rola Celestion Ltd.

Ferry Works, Thames Ditton, Surrey, England.
Telephone: 01-398 3402 Telex: 266135

WW—066 FOR FURTHER DETAILS

NEW ★ **LOW COST**
★ **HIGH QUALITY**
★ **ALL SILICON PLANAR** **TRANSISTORISED AUDIO KITS**

Silicon transistors fabricated by Planar techniques are characterised by low leakage, low noise and high stability of parameters.

The low noise performance obtained by operating the transistors at extremely low collector currents is of particular interest to high fidelity enthusiasts.

The use of Planar devices in audio equipment has a number of other advantages and these are:

- ★ Very low distortion figures can be obtained since the current gain does not vary appreciably with collector current.
- ★ The low leakage currents of Planar transistors make it possible to design simple biasing circuits of high stability; changes in operating point due to leakage current are so small that they can usually be neglected.
- ★ Transistors manufactured by epitaxial techniques have very low saturation voltages and high collector breakdown voltages, consequently, distortion can be kept low and the early stages of the equipment can tolerate large overload signals.

★ PRE-AMPLIFIERS
P.A.20

- ★ 8 transistor with Zener diode decoupling.
- ★ Rumble filter.
- ★ 6 inputs.
- ★ Equalisation ± 1 dB. of B.S.
- ★ <0.1% total harmonic distortion.
- ★ <0.3% for 10:1 Input overload.
- ★ Signal to noise 60dB.
- ★ Bass +12dB to -15dB at 30 c/s.
- ★ Treble +12dB to -12dB at 15 kc/s.

KIT £10/12/-. BUILT £14/5/6. P.P. 3/-.

15W R.M.S. AMPLIFIER

- ★ 7 transistors with 2 diodes.
- ★ Stabilised bias for drivers to eliminate crossover distortion.
- ★ Sensitivity 20 m/v R.M.S. for rated output.
- ★ Total harmonic distortion <0.25% (1Kc)
- ★ Freq. response with 1dB (20 c/s-20K/s)

KIT £8/15/-. BUILT £10/10/-. P.P. 3/-.

7W AMP.: To same circuit and spec.

KIT £7/16/6. BUILT £9/11/6. P.P. 3/-.

P.A.30

- ★ 3 transistor: 2 diodes
- ★ 5 inputs.
- ★ <0.1% harmonic distortion.
- ★ Signal to noise 60dB.
- ★ Bass +15dB to -15dB at 30c/s.
- ★ Treble ±15dB at 15 k/c.

KIT £8/2/-

BUILT £10/2/0

P.P. 3/-.

30W R.M.S. AMP.

- ★ 9 transistors. 4 diodes.
- ★ 100 Kc/s multivibrator circuit to eliminate crossover distortion.
- ★ Sensitivity 20 m/v.
- ★ Total Harm:dis: <0.4% (1K/c)
- ★ Freq. resp.: within 1dB (20 c/s-20 kc/s)

KIT £14/5/-

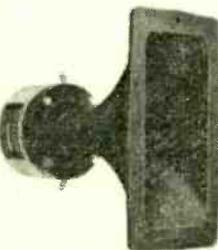
BUILT £16/5/-

P.P. 3/-.

All kits are supplied with first class components including fibreglass P.C.B. Ferranti devices are used and the circuits are to their specifications. Further details and information for power supplies and tape kits are available on application.

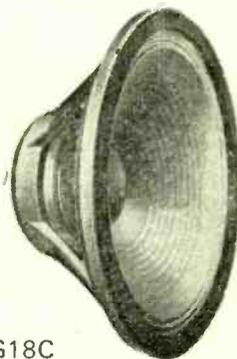
WELBROOK ENG. & ELECTRONICS LTD.
BROOKS STREET, STOCKPORT. Tel. STO 4268

WW—C67 FOR FURTHER DETAILS



MF1000

GD972



G18C

Celestion Studio Series

loudspeakers for the perfectionist

—for guitars and organs

Write for Catalogue No: RCS162

Rola Celestion Ltd.

Ferry Works, Thames Ditton, Surrey, England.
Telephone: 01-398 3402 Telex: 266135

WW—068 FOR FURTHER DETAILS

HOWELLS RADIO LTD.

MINISTRY OF AVIATION INSPECTION APPROVED

TRANSFORMERS

STANDARD RANGE OR DESIGNED TO YOUR SPECIFICATION
0-50KVA. "C" CORE, PULSE, 3 PHASE, 6 PHASE, TOROIDS, ETC.

Transformers for 20W Transistor Amplifier (W.W., Nov. 1966).

Driver 22/6 Carr. 2/-
Mains 29/6 Carr. 4/6
L.P. Filter, Chassis Mounting 11/6. Carr. 1/-.
L.P. Filter, Printed Circuit Mounting 14/6. Carr. 1/-.

***MAINS TRANSFORMERS**

350-0-350 v. 60 mA., 6.3 v. 2 A. £1/15/-. Carr. 4/6.
500 v. 300 mA. 6.3 v. 4 A., 6.3 v. 1 A. £3/12/6. Carr. 5/6
500-0-500 v. 0.25 A., 6.3 v. 4 Act., 6.3 v. 3 Act., 5 v. 3 A. £4/10/6. Carr. 6/6.
525-0-525 v. 0.5 A., 6.3 v., 6 Act., 6.3 v., 6 Act., 5 v. 6 A. £5/5/-. Carr. 6/6.

***LOW VOLTAGE**

30-0-30 v. 4 A. £2/5/6. Carr. 5/6.
15 v. 2 A. £1/12/6. Carr. 3/-.
15 v. 6 A. £2/1/-, Carr. 4/6.
15 v. 10 A. £2/15/-. Carr. 5/6.

STEP DOWN TRANSFORMER

Primary 0-415-440 v. Sec. 250 v. 1.5 A. £5/5/-. Carr. 6/6.

***PRIMARIES 10-0-200-220-240 v.**

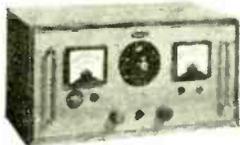
CHASSIS, CABINETS & PRECISION METALWORK
ELECTRONICS—DEVELOPMENT & ASSEMBLY

CASH WITH ORDERS PLEASE

Carlton Street, Manchester 14, Lancashire
TEL. (STD 061) 226-3411

WW-069 FOR FURTHER DETAILS

**VARIABLE—HIGH CURRENT
SMOOTHED POWER SUPPLIES
WITH ACCUMULATOR PERFORMANCE
FROM A.C. MAINS**



PRICE: £131.5.0

TYPES
250VRU/30/20
250VRU/60/10
250VRU/120/5
250VRU/240/2.5

FEATURES. Type 250VRU 30/20 0-30 v. Continuously Variable up to 20A.

RIPPLE CONTENT. Negligible. **IMPEDANCE** and **REGULATION** equivalent to accumulator performance. **SILICON RECTIFIERS.** Inadvertent "SHORT" protection.

OVERLOAD CAPACITY. 200% for short periods. Supplied to M.O. Tech for servicing 28 v. aircraft instrumentation within B.C.A.R.'s. Ref. 10K CA303S. Suitable for "19" RACKMOUNTING.

FIXED OUTPUTS. ALSO AVAILABLE. Smoothed 12 or 24 v. up to 24A.

APPLICATIONS OPERATING AND SERVICING. Transistorised equipment e.g. 12-24 v Mobile Radio Telephone, D.C. motors, etc., direct from AC—WITHOUT THE USE OF ACCUMULATORS. AVOID THE EXTRA EXPENSE OF SUPER REGULATION YOU MAY NEVER NEED.

PRICES: £14.16.0 to £88.4.0.

Please write to
Department C3b
for current literature.



LIMITED

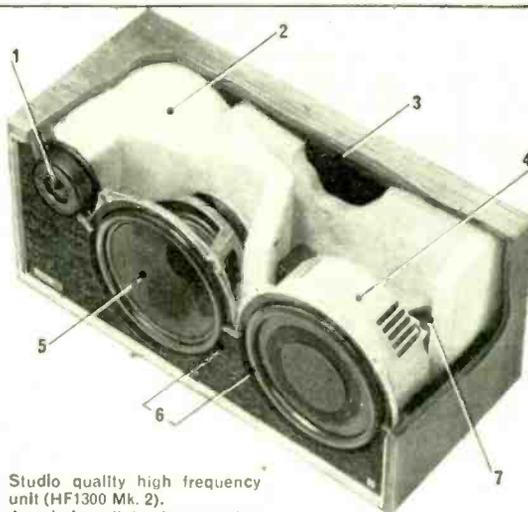
**BROWELLS LANE,
FELTHAM,
MIDDLESEX,
ENGLAND.**

TEL.: FELTHAM 4837-4242. 01-890-4837 4242

VALRADIO and STEREOSONOSCOPE are the registered trade marks of VALRADIO LIMITED.

WW-070 FOR FURTHER DETAILS

**Just what is
this ABR, that
makes such a
vital difference
to the
'DITTON 15'?**



1. Studio quality high frequency unit (HF1300 Mk. 2).
2. Anechoic cellular foam wedge and lining eliminates standing waves.
3. High hysteresis panel loading material to eliminate structural resonances.
4. Auxiliary Bass Radlator (ABR) —plastic foam diaphragm giving high rigidity and low mass; double roll suspension allowing excursions up to 2" with minimal distortion.
5. High compliance bass unit with

massive Ferroba II magnet structure for optimum magnet damping and cone treated with viscous damping layer to suppress resonances.
6. Units mounted flush to eliminate diffraction effects and tunnel resonances; covered by acoustically transparent grille cloth for maximum presence.
7. Full L-C half-section Crossover network.

**It's an interesting story –
and worth enquiring about.**

Fill in the coupon

Celestion

Studio Series

loudspeakers for the perfectionist

ROLA CELESTION LTD.
Ferry Works, Thames Ditton, Surrey Tel: 01-398 3402

Please send me the full story on the Ditton 15'

NAME _____

ADDRESS _____

GD 997

WW-071 FOR FURTHER DETAILS

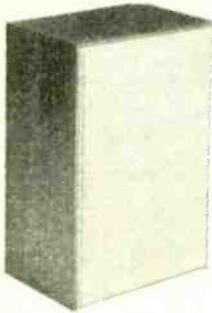
NEW·NEW·NEW

Stentorian

SPEAKER SYSTEMS

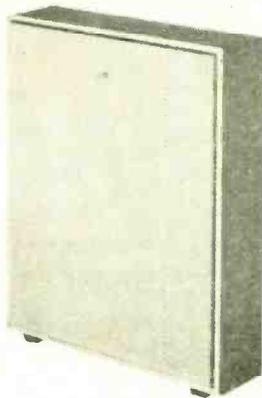
These superb new speaker systems make available even higher standards of performance in sound reproduction and uphold the high reputation gained by Whiteley Stentorian speakers throughout the world.

Attractively designed and soundly constructed, they are available in either Teak or Rosewood finish.



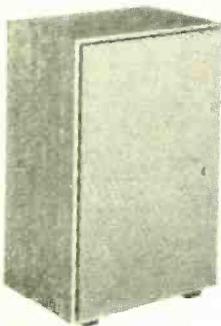
LC93

A 19" x 12½" x 8½" completely enclosed acoustically loaded cabinet housing a 9" graded melamine paper cone with siliconized cambric suspension giving a frequency response of 60Hz to 20KHz.



LC94

A 29½" x 23¾" x 6½" acoustic Labyrinth enclosure fitted with acoustic resistance in the pipe, using the same highly efficient 9" speaker unit used in the LC 93. Frequency response 45Hz to 20KHz.



LC95

The LC95 loudspeaker system is an acoustically loaded Bass Reflex cabinet, measuring 31½" x 20¾" x 13½" fitted with two loudspeakers and a crossover network. The bass loudspeaker being used is a newly developed 12in. unit having a Melamine treated paper cone with a cambric surround. The middle and high frequency unit is a new 8in. loudspeaker having a Melamine treated paper ribbed cone and surround.

Send for full Technical Specifications on these outstanding new additions to the famous Stentorian Range.



**WHITELEY ELECTRICAL
RADIO COMPANY LTD**
MANSFIELD · NOTTS · ENGLAND
Tel: Mansfield 24762
London Office: 109 Kingsway, W.C.2.
Tel: HOLborn 3074

WW-072 FOR FURTHER DETAILS

YOU WANT PARTS URGENTLY

—almost
immediately!

So what do you do?

You reach for the 'phone and dial ONO 239 8072, if it is anything made by the United-Carr Group. You will be surprised how soon you'll get what you want.

Your immediate needs are our business

We exist to supply the small user quickly with *standard* parts made by these Companies and carry large stocks of their fasteners and clips and a wide range of Radio, Electronic and Electrical components. We're geared to speedy handling and dispatch.

But you will need our latest catalogue

For quick and accurate ordering you should keep our comprehensive catalogue by you. This useful reference book gives full details of the wide range of parts we stock—nearly everything of the kind that you are likely to require.

Even though not ordering anything immediately, you should write now for this useful publication and so be ready to handle rush jobs whenever they arise.

United-Carr Supplies Ltd.,
Frederick Road, Stapleford, Nottingham.
Sandiacre 8072 STD ONO 239 8072



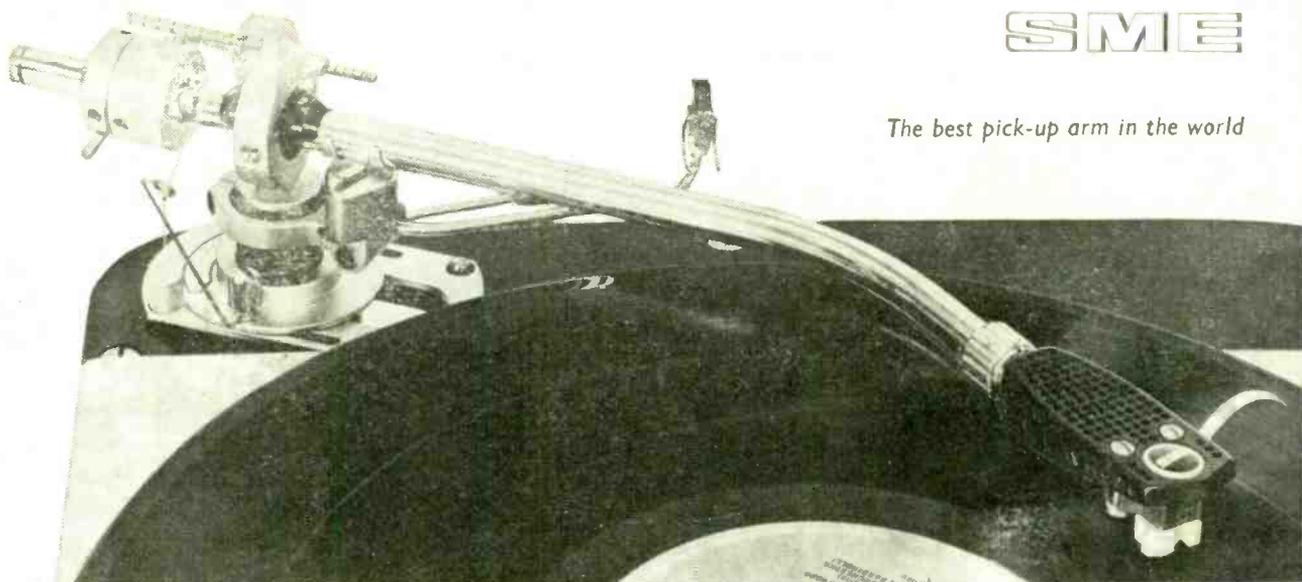
UNITED-CARR
SUPPLIES

UNITED-CARR GROUP

WW-073 FOR FURTHER DETAILS

SME

The best pick-up arm in the world



Only S.M.E. Precision Pick-up Arms offer all these features · Choice of arm length Model 3009 (9in.) or Model 3012 (12in.) for still lower tracking error—of special importance with elliptical styli · low inertia · High precision ball races and knife-edge bearings for minimum pivot friction · Linear offset chosen for lowest distortion · Automatic slow-descent with hydraulic control · Bias adjuster calibrated for tracking force · Exact overhang adjustment with alignment protractor · Precise tracking force from $\frac{1}{2}$ -5 grams applied without a gauge · Shielded output socket · Low capacity 4ft. connecting cable with quality plugs · Light-weight shell · Camera finish in satin chrome, gun-black and anodised alloy · Comprehensive instructions · Rational development—all improvements can be incorporated in any existing Series II arm.

For sales and service ring Steyning 2228

S M E LIMITED · STEYNING · SUSSEX · ENGLAND
 WW-074 FOR FURTHER DETAILS.



**DIGITAL
 DISPLAY
 UNITS**
£4.5.0

0-9 with decimals, lit by 6.3v bulb.

- * Assemble units into groups to give countless permutations of numbers.
- * Maximum legibility from a wide angle through uniform intense characters.
- * Applications in every industry, for instantaneous readout of anything numerical.
- * Price of £4/5/- includes post and packing.

Automatic Machine Service
 (CARDIFF) LTD.

ACE HOUSE, FERRY, ROAD, CARDIFF. TEL. 41456

WW-075 FOR FURTHER DETAILS

Valradio TRANSVERTORS
 (TRANSISTORISED D.C. CONVERTERS/INVERTERS)



TYPE B12/200S.
 PRICE £67-12-0

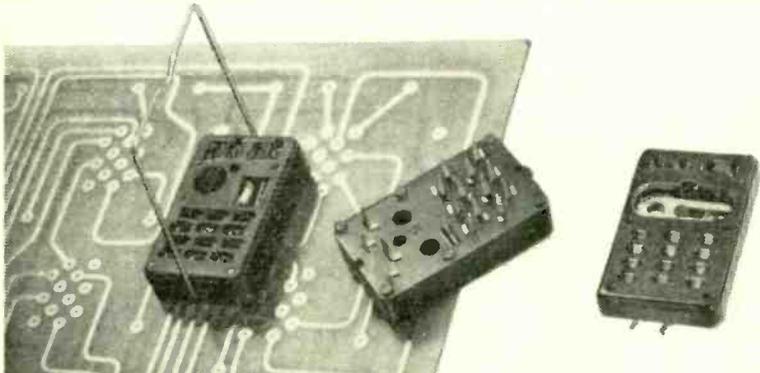
INTRODUCING THE VALRADIO "B" SERIES
 SINE WAVE output 200W (120W also available).
 FREQUENCY: 50 c/s \pm 1 c/s (60 c/s to order).
 OUTPUT V.: 115-230 v. \pm 10%.
 INPUT V.: 12 v. - 10% \pm 25% (24-50 v. also available).

- ★ FREQUENCY REGULATION OF \pm 0.05% WITH ADDITIONAL "RESONATOR".
- ★ INFINITE LIFE.
- ★ WILL OPERATE ALMOST ANY ELECTRONIC OR ELECTRICAL EQUIPMENT.
- ★ SUITABLE FOR SUPER-SENSITIVE RADIO & AUDIO EQUIPMENT.

OTHER MODELS from £10 to £179/12/- 12 v. to 110 v. D.C. up to 1kW

VALRADIO LTD., Dept. C10
 BROWELLS LANE · FELTHAM · MIDDLESEX · ENGLAND
 Telephone: FELTHAM 4837-4242 · 1-890 4837/4242
 VALRADIO and STEREOSONOSCOPES are the registered trade marks of VALRADIO LTD.

WW-076 FOR FURTHER DETAILS



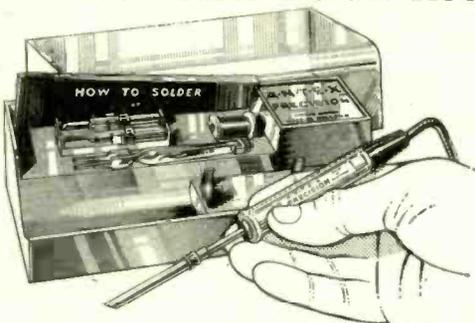
RELAY SOCKETS

Sole Distributors
Super-Electronics Ltd.
5 Violet Hill
London, N.W.8
Tel. Maida Vale 8281

WW-077 FOR FURTHER DETAILS

SOLDERING ?

—you need the Antex
SOLDERING TOOL KIT



- Model CN240 15W Precision Iron with $\frac{1}{16}$ " bit.
- Two spare Interchangeable Bits ($\frac{5}{32}$ " and $\frac{3}{32}$ ")
- Reel of Solder ● Heat Sink ● Cleaning Pad
- PLUS 36-page booklet on "How-to-Solder"

British made. From The Army & Navy Stores, Harrods, and Radio Shops, or if unobtainable locally, direct from:

49/6^d

ANTEX LTD

GROSVENOR HSE · CROYDON · CR31QE
Telephone: 01-686 2774

WW-078 FOR FURTHER DETAILS

Out Now! Wireless World Diary for 1968

Contains a week-at-view Diary and 80 pages of reference material giving a large selection of formulae, charts, Circuit Diagrams etc.

contents

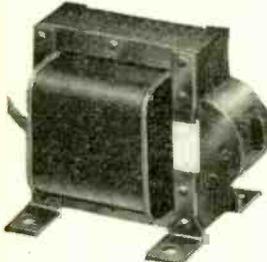
- | | |
|--|--|
| <ul style="list-style-type: none"> Abbreviations Acronyms Addresses of Organizations Aerials Amateur Transmissions Binary Scales Circuit Diagrams Coil Winding Data Colour TV Standards Component Coding Conversion Table Decibel Table Formulae Frequency Allocations Greek Alphabet Licence Regulations Logic Symbols | <ul style="list-style-type: none"> Mathematical Signs Microwave Bands Monochrome TV Standards Morse Code Phonetic Alphabet Resistor Preferred Values Resistors in Parallel Square-Wave Testing Symbols, Graphical Television Channels Television Stations Transistors Transmission Types Unit Abbreviations Valve Connections Wire Tables World TV Standards |
|--|--|

Prices: Leather 9s. post 5d.
Rexine 6s. 6d. post 5d.

available from your bookseller

ILIFFE BOOKS LTD. Dorset House, Stamford St., London, S.E.1.

A.C. SOLENOID TYPE SAM



Now fitted with stainless steel guides—six times the life.

Continuous 14 oz. at $\frac{3}{4}$ in.
Instantaneous to 5 $\frac{1}{4}$ lb.

Larger and smaller sizes available.

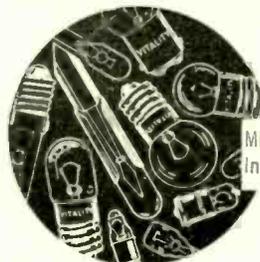
Also Transformers to 8kVA 3-phase.

R. A. WEBBER LTD.

KNAPPS LANE, CLAY HILL, BRISTOL 5 Phone 65/7228/9

WW-079 FOR FURTHER DETAILS

VITALITY



Miniature and Sub-Miniature Indicator Bulbs in sizes from 4.5mm

Catalogue from
VITALITY BULBS LTD
MINIATURE LAMP SPECIALISTS

BEETON'S WAY, BURY ST. EDMUNDS, SUFFOLK. TEL: 2071 STD 0284/2071

WW-084 FOR FURTHER DETAILS

ELECTRONICS

university graduates in Dairying, Food Technology, Science with a minimum of four years' industrial experience, are required for senior positions under the City Control Manager.

TRONIC ENGINEER

Design engineer experienced in both linear and digital fields to work on a major project involving mathematical simulations and electronic and semiconductor technologies. At least four years relevant experience. (ref B. 11).

positions are situated at the facilities of the

PRODUCTS

Oppo

in research

Expansion of research activities at the central laboratories of the Tube Investments Group has now created a number of positions in the Applied Physics and Metallurgy Divisions and applications are invited.

ELECTRONICS ENGINEER/PHYSICIST

To work on the detail design and development of instrumentation for non-destructive testing and this post will suit a graduate or equivalent who has had some experience in solid state switching and digital systems and some knowledge of display systems or testing would be useful.

ELECTRONICS ENGINEER/PHYSICIST

To work on the experimental destructive testing and in processing of ultrasonic data. Recent graduate or some interest in wave theory, mission line theory, installed in the laboratory.

ELECTRONICS ENGINEER/PHYSICIST

Senior Electronic Design Engineer: To work on a wide range of automatic control equipment. A suitable degree or equivalent qualification is essential and industrially based experience desirable. The post will be involved in expanding the work of a new Department and applicants should have a genuine interest in applying control techniques to industrial use.

Electronics Technician or Electronics Engineer: To work on a wide range of interesting automatic control equipment. A suitable degree or an approved high level of industrial background is essential.

TRIPLEX SALES

TEL TEC

Senior Technologist in the Experimental Division. The post will include the design and construction of electronic equipment for the use of the

be in demand WITH CREI

COMPUTER PLANNING

Southern Electricity

Salary £2,085 to £2,300

LOCATION: HAVANT

The Board has purchased a large amount of computer equipment and is seeking a suitable person to coordinate the purchase and lay out of the system.

SENIOR COMPUTER STAFF

for ANALYSIS

INSTITUTE FOR INDUSTRIAL RESEARCH AND STANDARDS

ELECTRONICS

Mechanical Engineering

IRELAND

Applications are invited to the Control Department

CREI CAN BE YOUR EDUCATIONAL LADDER.

to an exacting, exciting and rewarding career. Why? Because CREI offer the most up-to-date home study programmes closely related to the problems of industry and including the latest technological developments and advanced ideas.

No standard text books are used—these are often 2 years out-of-date when printed.

CREI Lesson material contains certain information not published elsewhere—is kept up-to-date continuously. (Over £50,000 is spent annually in revising text material.)

Step-by-step progress is assured by the concise, simply written and easily understood lessons.

Each programme of study is based on the practical applications to and specific needs of the Electronics Industry.

CREI PROGRAMMES ARE AVAILABLE IN:

- Electronic Engineering Technology
 - Industrial Electronics for Automation
 - Computer Systems Technology
 - Nuclear Engineering
 - Mathematics for Electronic Engineers
 - Television Engineering
 - Radar & Servo Engineering
- City & Guilds of London Institute: Subject 49 and Advanced Studies Subject No. 300.
- Over 40 years of experience—20,000 students now taking CREI courses throughout the World.

CREI THE EDUCATIONAL LADDER TO SUCCESS

C.R.E.I. (London) Walpole House, 173-176 Sloane Street, London, S.W.1.

WW-081 FOR FURTHER DETAILS

POST THIS COUPON TODAY

PLEASE SEND ME (FOR MY INFORMATION AND ENTIRELY WITHOUT OBLIGATION) FULL DETAILS OF THE EDUCATIONAL PROGRAMMES OFFERED BY YOUR INSTITUTE

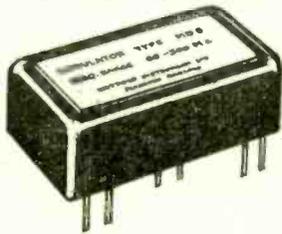
NAME

ADDRESS

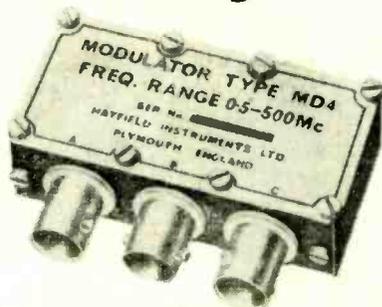
ELECTRONICS EXPERIENCE

C.R.E.I. (LONDON) (DEPT. WW101)
WALPOLE HOUSE, 173/176 SLOANE STREET, S.W.1.

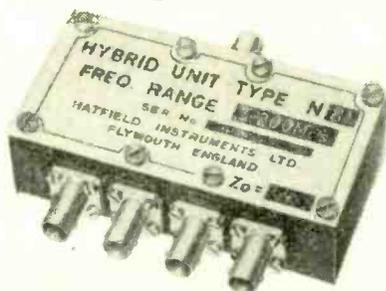
● **Better performance**



● **Wider range**



● **New styles**



3

The Hatfield range of Modulators, Fixed Attenuators, Signal Dividers and Hybrids has been re-styled and extended.

The compact V.H.F. Double Balanced Modulator Type MD4 (2 above) uses "Hot Carrier" Diodes and is capable of very good performance as an amplitude modulator, mixer, phase detector or current controlled V.H.F. Attenuator. Input and output frequency range is 0.5-500 MHz modulation frequency range DC-500 MHz. The newly developed Type MD6 (1 above) has the same general features as Type MD6, but is fully encapsulated and is suitable for direct mounting on printed circuit boards. Large scale production of this type makes possible an extremely competitive price.

The new Hybrids, Types N81 (3 above) and N82 are passive couplers having a very wide operational bandwidth. A significant feature of these new types is that all outputs are in phase, making the units particularly suitable for coupling multiple antennae.

All the new units are fitted with B.N.C. Connectors. Write now for full specifications and for details of new U.H.F. Fixed Attenuators and Signal Dividers.

HATFIELD INSTRUMENTS LTD.

Dept. WW., Burrington Way, Plymouth, Devon.

Tel: Plymouth (0752) 72773/4.

Grams: Sigjen Plymouth.

HATFIELD BALUN

WW-082 FOR FURTHER DETAILS

custom-
built
quality
mass
produced
quantity
computer-
speed
delivery...



Quality, quantity and speed . . . they all add up to Harwin precision turned-parts service!

Quality first. Pins, lugs, inserts - in fact any turned part for electronics must be precision-made. Harwin do it to order - any size, any shape.

Now quantity. Thousands? Millions? Harwin can do it at speed . . . with quick delivery and low costs.

**It all adds up to Harwin service.
Let us have your turned parts problem
....we know three ways we can
solve it better!**

Harwin do you a good turn! Turned parts - indicator units lugs - stand-offs - brackets - insulators - resistors terminal boards . . . and more.

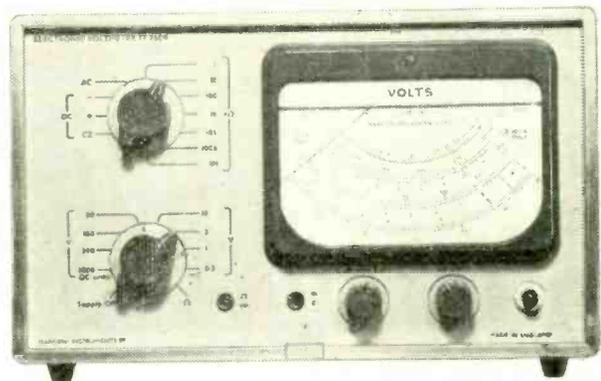
HARWIN

HARWIN ENGINEERS LTD
FITZHERBERT ROAD
FARLINGTON, HANTS.
Tel: Cosham 70451/2/3

WW-085 FOR FURTHER DETAILS

No other electronic voltmeter packs this much performance for £90!

Marconi TF 2604 *Electronic Voltmeter*



- Excellent zero stability: less than 4 mV deflection at full scale on all ranges for changes in mains supply voltage of as much as 10%
- Seven a.c. ranges: 300 mV to 300 V f.s. 20 Hz to 1.5 GHz
- Eight d.c. ranges: 300 V to 1000 V f.s.

- Seven resistance ranges: 500 Ω to 500 M Ω
- Input resistance: 100 M Ω
- Input capacitance: 1.5 pF
- Multipliers available: extend range to 2 kV a.c. and 30 kV d.c.

£90 - U.K. f.o.b. Price. Full technical details on request.



An English Electric Company.

MARCONI INSTRUMENTS LIMITED

Longacres, St. Albans, Herts, England.

Tel: St. Albans 59292 Telex: 23350

WW085

TA 7214

A new science project combining the fascination of optics with electronics . . . the new field of

SUB LASER!

OPTOELECTRONICS

from PROOPS

Demonstrations of these devices operating as

SPEECH LINK
and
ON/OFF LINK

are being given daily at our only address,

52 TOTTENHAM COURT ROAD,
LONDON, W.1.

These new devices offer features which can be exploited in an extremely wide field of applications. Their outstanding modulation and switching capabilities, coupled with completely solid state circuit design and small physical size make them ideally suited to such purposes as short distance speech and data links, remote relay controls, safety devices, burglar alarms, batch counters, level detectors, etc.

MGA100



Post Free **28' 6**
EACH

TYPE MGA 100 General Purpose Gallium Arsenide Light Source
A filamentless, Gallium Arsenide infra-red emitter, only 5.54 mm. dia. and 8.1 mm. long. Features a robust cylindrical package coaxial with the beam, facilitating optical alignment and heat-sinking.

MAX RATINGS

Forward current I_f max.* D.C. 400mA. Forward peak current I_f max.* (pk) 6A
Power dissipation* 600mW. Derating factor for T_{amb} greater than 25°C* 7.5mW/°C
Reverse voltage V_R max. 1.0V.

*When mounted on an aluminium heat sink 1in. x 1/2in. x 1/2in.

Supplied complete with suitable lenses, full Technical Data and Application Sheets, including Line of Sight Speech Link.

TYPE MSP3 Solid State Photo Receiving Device

An ultra-sensitive infra-red and visible light detector, this device is a complete silicon photo-electric receiver with a peak spectral response at 9500A. Size only 6.4 mm. dia. and 25.4 mm. long, yet absolutely complete, the device will generate sufficient power to drive an external relay. Chiefly intended for use in optical links based on Gallium Arsenide Light Sources, they are equally suitable for systems based on visible light. Features a robust cylindrical package coaxial with the incident light facilitating optical alignment and heat-sinking.



85' - EACH
Post Free

MSP3

MAX RATINGS

Total dissipation (in free air, T_{amb} 25°C) 100mW. Derating Factor 2mW/°C
Output Current Intensity 100mA. Voltage 25V. Operating Temperature from -30° to +125°C.

Supplied complete with suitable lenses, full Technical Data and Application Sheets, including Line of Sight Speech Link.

31F2



28' 6 EACH
Post Free

Type 31F2 Micro-miniature Infra-Red Detector

Extremely small photo diodes of silicon NPN passivated planar construction and suitable for Punched Card Readers, Counters, Film Sound Track, etc.

Supplied complete with suitable lenses, full Technical Data and Application Sheets, including Line of Sight Speech Link.

PROOPS BROTHERS LIMITED

52 Tottenham Court Road, London, W.1.
Telephone: LAngham 0141 (01-5800141)

And these new solid state devices

RCA TRIACS Type 40432

Intended primarily for phase control of A.C. loads in light dimming, universal and induction motor control, heater control, etc., these gate controlled full-wave A.C. silicon switches, with integral trigger, switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

Supplied complete with full Data and Application Sheets.



45' - EACH
Post Free

INTEGRATED CIRCUIT RCA-CA 3020 AF POWER AMPLIFIER & PRE-AMPLIFIER (or servo-amplifier)

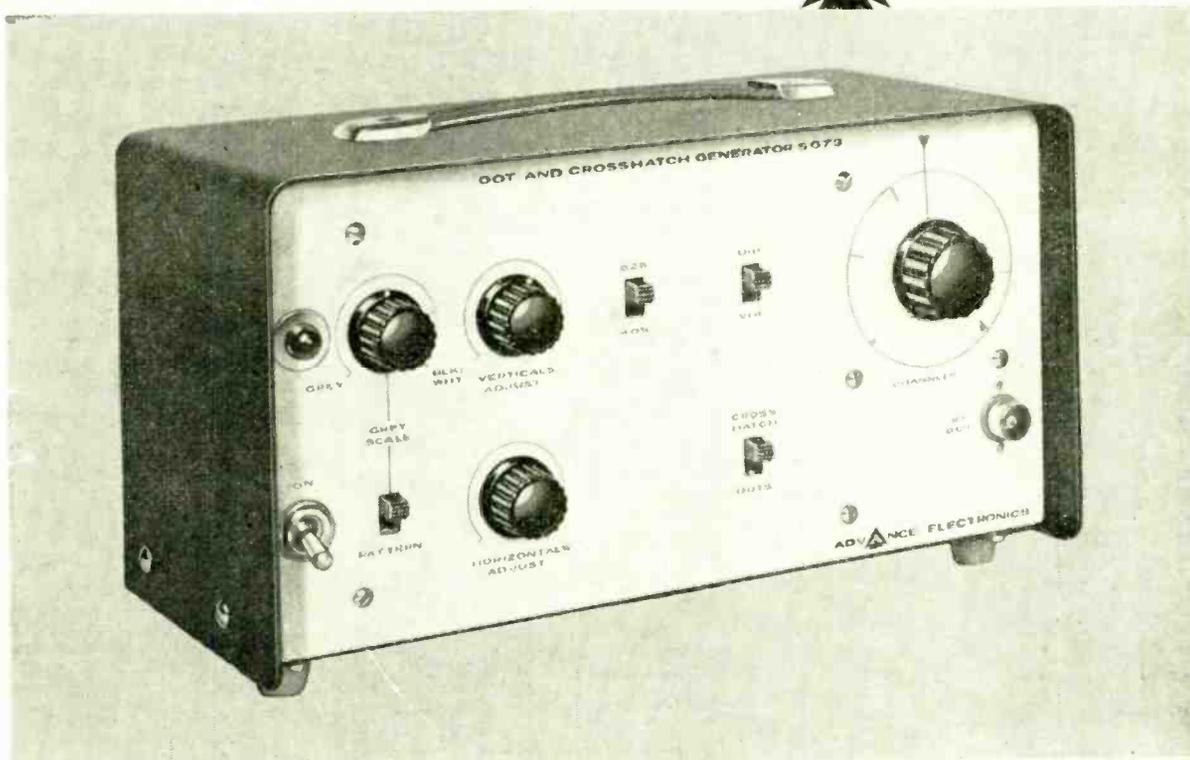
The RCA-CA 3020 is an integrated-circuit, Multistage, Multi-Purpose AF Power Amplifier on a single monolithic silicon chip, providing a stabilized direct-coupled amplifier, performing pre-amp., phase inverter, driver and power output functions without transformers, and with one power supply suitable for sound, communications and control systems.

Supplied complete with full Data and Application Sheets.



42' - EACH
Post Free

Rely on **ADVANCE** to do it better



NEW

Dot and Cross Hatch Generator SG73

for speedy convergence alignment of Colour T.V.

The Advance solid state dot and cross hatch generator provides instant operation and is smaller, neater and half the weight of other similar instruments * All-silicon transistors and glass fibre printed circuit board * Front panel controls vary the number of horizontal and vertical bars * Switches select Grey scale or Pattern, Dots or Cross Hatch, 405/625, VHF/UHF. Stabilised Power Supply 200-260V. 50Hz. Nett trade price £60.



**ADVANCE
INSTRUMENTS**

Hainault Ilford Essex. Telephone 01-500 1000. Telegrams Attenuate Ilford Telex 263785

Division of **ADVANCE ELECTRONICS LIMITED**

WW-087 FOR FURTHER DETAILS

Solder with the NEW & IMPROVED
PRIMAX OR PRIMAXA
SPOTLIGHT SOLDERING GUN



PRIMAX
 60 WW SPOTLIGHTS
99/8d EACH 5/- P.P.P.
PRIMAXA
 100 WW SPOTLIGHTS
129/8d EACH
 5/- P.P.P.

Distributors:
S. KEMPNER LIMITED
 384A Finchley Road · LONDON · N.W.2.
 Tel: 01-794 2371—01-435 6365

WW—088 FOR FURTHER DETAILS

THERE'S A
TRANSIPACK[®]
STATIC INVERTER or
NO-BREAK POWER SUPPLY
 to suit you —



BEST

- DESIGN
- PERFORMANCE
- DELIVERY

SINE AND SQUARE WAVE
 —UP TO 80 K.V.A.—

INDUSTRIAL INSTRUMENTS LIMITED
 STANLEY RD., BROMLEY, KENT
 Tel. 01-460 9212. Telegrams: Transipack, Bromley

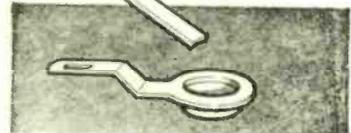
WW—090 FOR FURTHER DETAILS



PRECISION PRESSINGS

Accurate components at competitive prices

produced by progressive tooling and multiform methods



JOHN SMITH LTD.

209 SPON LANE · WEST BROMWICH · STAFFS. TEL. 021-533 2516 (3 LINES)
 WOODS LANE · CRADLEY HEATH · WARLEY · WORCS. TEL. CR 69283 (3 LINES)
 WW—089 FOR FURTHER DETAILS

LONDON microphones

Quality sound—at low cost
 The London Microphone range offers you quality microphones, good characteristics—and good looks, too, at remarkably little cost. Made in Britain.

LM 100 Dynamic
 Omni-directional microphone, available in a range of impedances to suit many different input requirements including transistorised tape recorders. U.K. retail price range £3/3/0-£3/18/6.

LM 200 Dynamic
 cardioid microphone. Balanced output. Eliminates unwanted background noise. Gives good recordings even under difficult conditions.



U.K. prices
 £4/19/6
 £5/15/0

Home and overseas trade enquiries welcome. Write or ring for details:
LONDON MICROPHONE CO. LTD
 182/4 Campden Hill Road London, W.8. Tel. Park 0711. Telex 23894
 WW—091 FOR FURTHER DETAILS

Your choice of Live Sockets - Instantly!

A Lexor DIS-BOARD gives you up to 6 sockets from one power outlet. Portable or permanent fixing. compact units, with safety neon. Over 1,000 socket combinations available from stock. All types of fittings and finishes.

brochure from
LEXOR DIS-BOARDS LIMITED,
 Allesley Old Road, Coventry.
 Telephone 72614 or 72207



WW—092 FOR FURTHER DETAILS



**SOLID STATE GENERAL PURPOSE
AND NEW FROM ADVANCE**

The OS2000 is the latest addition to the Advance Oscilloscope range. It is extremely versatile with X and Y plug-ins, has a bandwidth of 20MHz at 10mV/cm (or 5MHz at 1mV/cm) dual trace, and many features normally associated with the most expensive oscillosopes

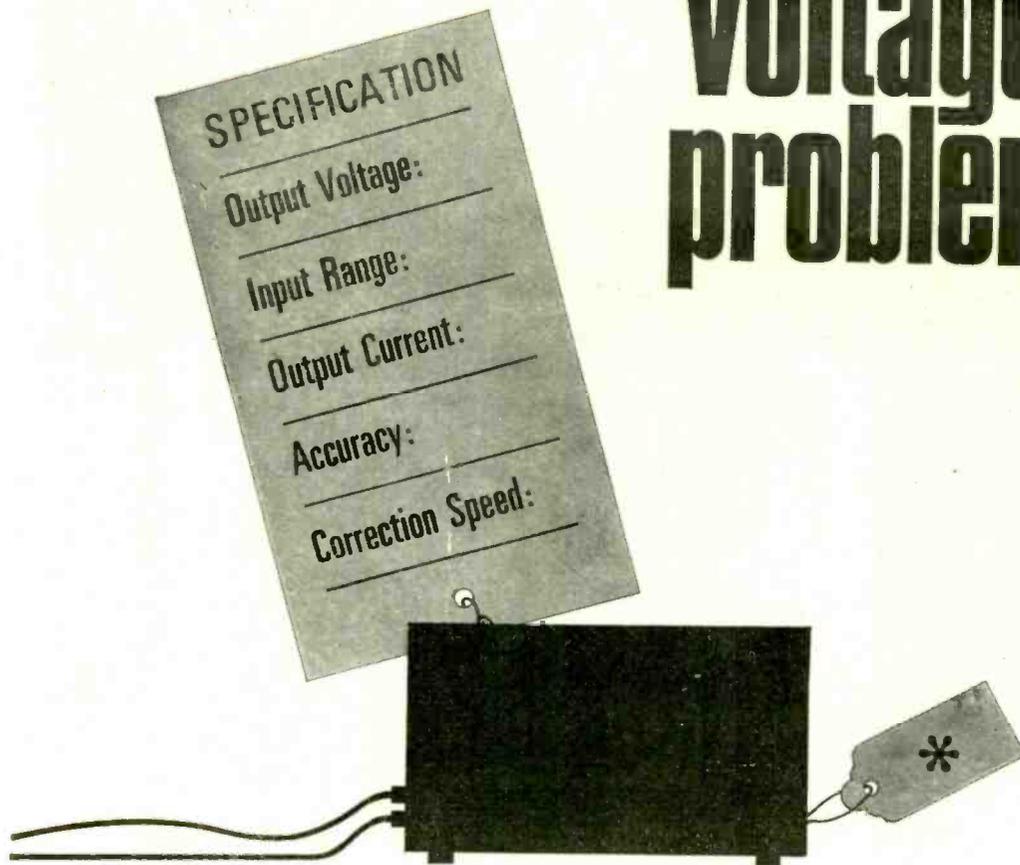
- Fully operational in 15 seconds
- 'Volstat' stabilised supplies maintain calibration accuracy in the presence of large supply fluctuations
- 10mV/cm DC to 20MHz dual trace
- 1mV/cm 5Hz to 5MHz dual trace
- 200ns Signal Delay
- In-built calibrator
- Superb Triggering

The OS2000 is the finest possible addition to your instrumentation.

Seeing is believing • Ask for a demonstration now
 • U.K. Prices: £195 Single Trace & Standard Time Base; £230 Dual Trace & Standard Time Base
ADVANCE ELECTRONICS LIMITED
 Roebuck Road, Hainault, Ilford, Essex.
 Tel: 01-500 1800 Telex: 263785

**ADVANCE
OS 2000**

voltage problems?



there is a standard
Claude Lyons voltage stabiliser
 already built to
your specification
 * *and that includes price*

Claude Lyons make the most comprehensive range of voltage stabilisers available today. You will almost certainly find the stabiliser to suit your application in the Claude Lyons standard catalogue range. Distortionless servomechanical types from 1 to 120 kVA (and 360 kVA 3-phase). Solid-state types from 400 VA to 10 kVA. Simple tap-changing types from 600 VA to 2.4 kVA. All very high quality. All very reasonably priced. Full facts and figures from Publicity Department, Hoddesdon.

Claude Lyons Ltd ■ Valley Works, Hoddesdon, Herts. Hoddesdon 67161. Telex 22724. ■ 76 Old Hall Street, Liverpool 3. MARitime 1761. Telex 62181

CLAUDE LYONS

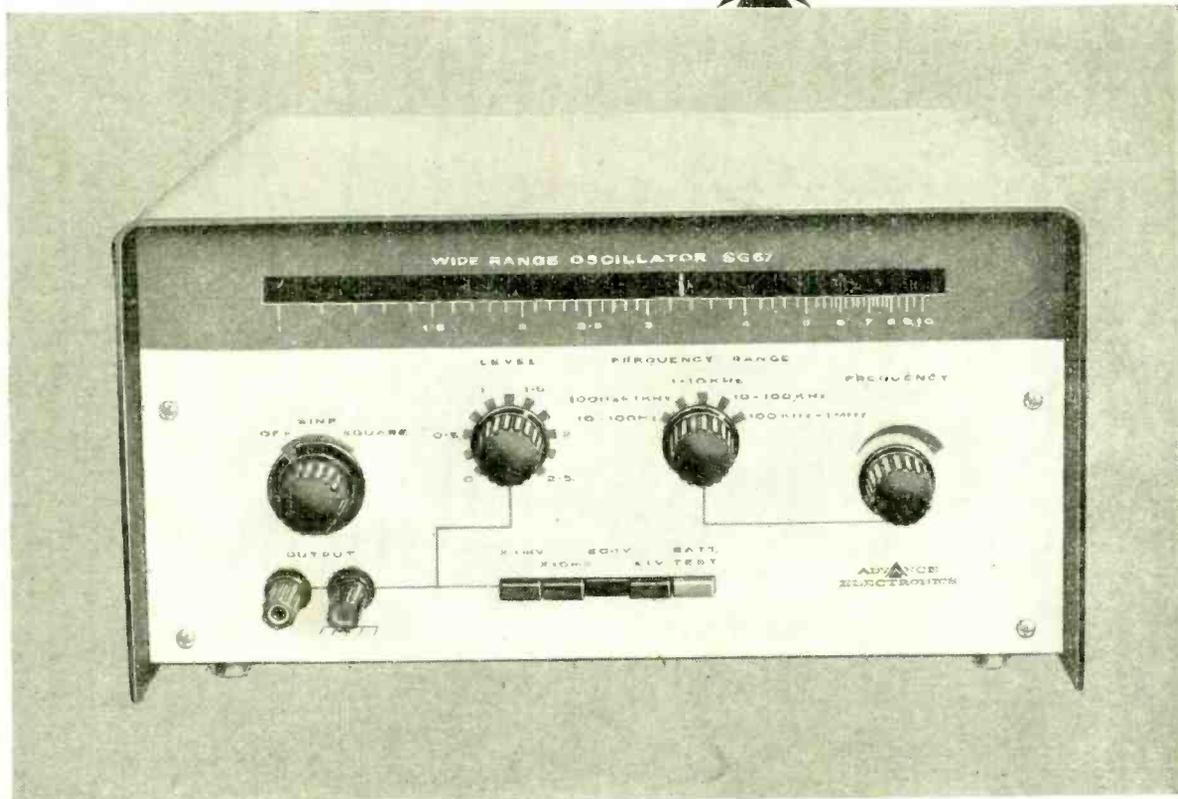
LEADER IN VOLTAGE CONTROL



WW-094 FOR FURTHER DETAILS

CL 17

Rely on **ADVANCE** to do it better



NEW

Wide Range Oscillator SG67

10Hz-1MHz Frequency Range **Sine wave or square wave**
Frequency is continuously variable in five switched ranges covering 10Hz to 1MHz. Sine wave or square wave output selected by a switch.

Amplitude is controlled by a variable level control in conjunction with a four-position push-button attenuator giving an output up to 2.5V r.m.s.

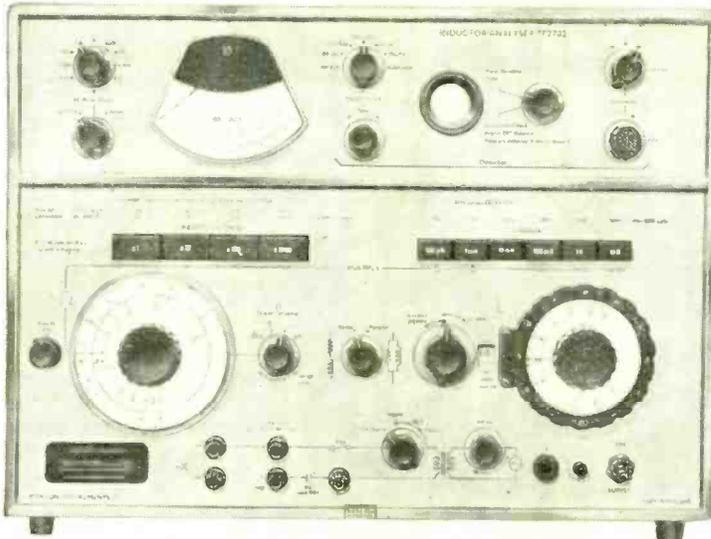
The SG67 is compact and portable, can be run from internal batteries or mains. Send for full specification now.

**ADVANCE
INSTRUMENTS**

Hainault Essex England. Telephone 01-500 1000. Telegrams Attenuate Ilford. Telex 263785

Division of **ADVANCE ELECTRONICS LIMITED**
WW-095 FOR FURTHER DETAILS

Why does this Inductance Bridge have 27 controls, a meter, *and* a cathode-ray tube?



Because we've thought of everything.

Our new TF 2702 answers any inductance analysis problem you are ever likely to meet; it does more than any other bridge at any price—and yet it costs only £490. A remarkably low price for the first true *inductor analyser*—both a self-contained low and medium current inductance bridge and the nucleus of a complete high-power inductor test assembly.

Its inductance range (0.3 μ H to 21,000 henries) is twenty-one times wider than its nearest competitor's. It can be used at any frequency from 20 Hz to 20 kHz—internal frequencies: 10 kHz, 1 kHz, and 50 Hz. And it switches to Maxwell or Hay configuration for equivalent series or parallel inductance, with loss resistance indicated directly in ohms.

The a.c. can be monitored, and d.c. bias applied directly into the bridge up to 0.5 amps—or up to 10 amps using our mixer unit TM 8339.

Easy to Balance. Although its versatility is unequalled, TF 2702 is easier to balance than any inductance bridge ever marketed. It has two detector systems—a cathode-ray tube display for search, and a tuned detector for final balance. The c.r.t. gives a positive indication of the direction of inductance unbalance, shows up iron distortion, and even tells you if the inductor is capacitive at the test frequency. Furthermore, the use of the reactance standard as the inductance-balance variable completely eliminates the interdependence between the L and R balance controls that can make inductance measurement so tedious. There's no "chasing the balance" with this bridge.

If you've grown to enjoy the suspense of hit-or-miss methods of inductor analysis, TF 2702 will spoil your fun—but it will give you the right answer first go—with precisely controllable measuring conditions. Ask now for technical data.



An English Electric Company

MARCONI INSTRUMENTS LIMITED

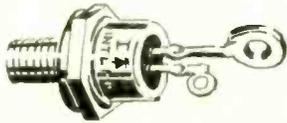
LONGACRES, ST. ALBANS, HERTFORDSHIRE, ENGLAND. TELEPHONE ST. ALBANS 59292, TELEX 23350

WW-096 FOR FURTHER DETAILS

TC33

HARMSWORTH-TOWNLEY & CO.
TODMORDEN LANCs

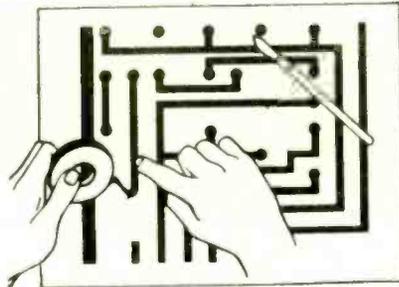
Components Dept. ask for
Todmorden 2601 extension 1



**INTERNATIONAL
RECTIFIER**

Quality Semi-Conductors.
Complete Rectifier Assemblies up
to thousands of Amps, Diodes,
Thyristors, Zeners, Encapsulated
Bridges, Photocells, Klipsel Surge
Protectors.

For experiment and teaching:—
ZENER KITS, THYRISTOR KITS,
bulletins and prices on request.



**PRINTED CIRCUIT
DRAFTING AIDS**

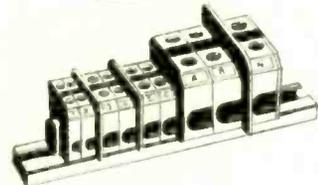
drafting time and costs. Self-
adhesive shapes and tapes. Terminal
circles—fillets—tees—elbows—universal
corners and mounting holes. Bulletins
and prices on request.

ENGLISH ELECTRIC



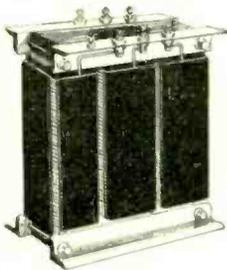
GS FUSES

or the protection of rectifiers and
thyristors.
Bulletins and prices on request.



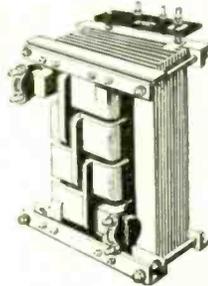
Rail Mounted Terminals and Terminal
Blocks 0.5-250 Amps.
Bulletins and prices on request.

WW-097 FOR FURTHER DETAILS



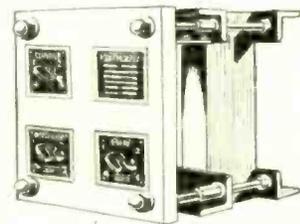
TRANSFORMERS

0.25 kVA to 300 kVA
1 phase and 3 phase



**LOW VOLTAGE HIGH CURRENT
TRANSFORMERS**

with output currents of hundreds,
thousands and tens of thousands of
amps.
1 phase and 3 phase.



VOLTMOBILES

64 steps on load switching Auto-
Transformers. 1 phase and 3 phase.
20-400 Amps.
Zero to 100% Volts or 125% of
Input Volts.
Voltmobiles are low-cost con-
trollers, for furnaces, rectifier sets
and other loads.



DC POWER SUPPLIES

For Magnets, Accelerators, Plating,
Anodising, Spectroscopy, Plasma Arc,
Toronto Arc, Electron Beams, Elec-
trolysis. Welding, Quartz Lamps,
Mercury Vapour Lamps. From 100 W
to 200 KW.

HARMSWORTH-TOWNLEY & CO.
TODMORDEN LANCs

Equipment Dept. ask for
Todmorden 2601 extension 3

WW-098 FOR FURTHER DETAILS



What is the latest In Electronics? Come and see how men, ideas and techniques have advanced in a year.



Be present at the

INTERNATIONAL EXHIBITIONS OF ELECTRONIC COMPONENTS AND OF AUDIO-EQUIPMENT

FROM APRIL 1st TO 6th 1968 - PARIS
PORTE DE VERSAILLES



INTERNATIONAL CONFERENCE ON COLOUR TELEVISION

scientific and technical considerations
FROM MARCH 25th TO 29th 1968 - PARIS

Programme and registration conditions on request

S.D.S.A. - RELATIONS EXTERIEURES
16, RUE DE PRESLES - 75 PARIS 15^e - FRANCE

WW-099 FOR FURTHER DETAILS

DUAL-IN-LINE SOCKETS

Suitable for 14 and 16 pin D-I-L Integrated Circuits. Large contoured entry holes for easy, damage-free I.C. insertion.

Body: Diallyl phthalate, type SDG.

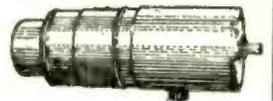
Contacts: Spring temper beryllium copper, gold plated over dull nickel plate. Mounting Saddle. Stainless Steel.

| | PRICES | |
|--------------------------|--------|--------|
| | 1-99 | 100 up |
| 314-AG3A (14 pins) | 8/10 | 7/9 |
| 316-AG3A (16 pins) | 9/2 | 8/1 |
| | + 12½% | |

RASTRA Electronics Ltd.
275/281 King Street, London, W.6. Tel: RIV 2960

WW-125 FOR FURTHER DETAILS

A New delivery of the famous COWL GILL



MOTOR for Beam Rotation

Magnificent fully enclosed motor incorporating 600-1 epicyclic gear box, final speed 11 r.p.m. on 12 V., 15 r.p.m. on 24 V. Limit switches can be removed to provide continuous running in either direction. Size 12in. x 3½in., ½in. dia. splined drive shaft ¾in. long. 4A at 12 V. Condition as new. Instructions supplied for running on A.C. voltages.

55/-

carr. 7/6d

PROOPS BROTHERS LTD.

52, Tottenham Court Road, London, W.1. Telephone LANgham 0141

WW-126 FOR FURTHER DETAILS



STOCKISTS



MULTIMINOR MK. IV

REPAIR SERVICE
7-14 DAYS

We specialise in repair, calibration and conversion of all types of instruments, industrial and precision grade to BSS.89.

Release notes and certificates of accuracy on request.



MODEL 8 MK. III

Suppliers of Elliott, Cambridge and Pye instruments

LEDON INSTRUMENTS LTD

76-78 DEPTFORD HIGH STREET, LONDON, S.E.8

Tel.: TIDeway 2689

E.I.D. & G.P.O. APPROVED CONTRACTOR TO H.M. GOVT

WW-100 FOR FURTHER DETAILS

LABORATORY CAPACITOR BOXES FROM STOCK!



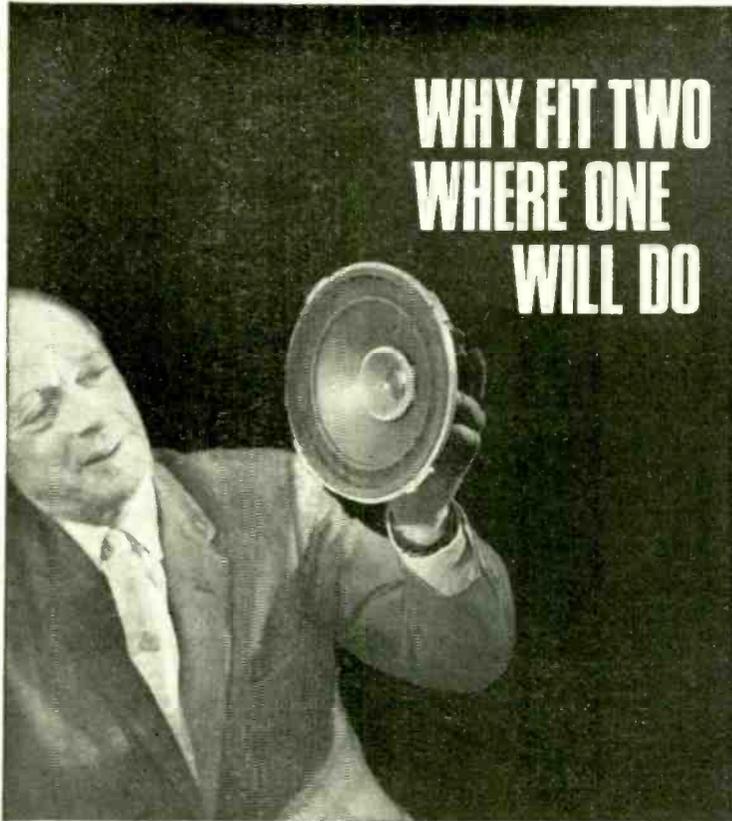
Triple range precision. Air spaced capacitor with slow motion dial and minimum capacitance setting of only 5 pf (including strays)

Compact 140 μ f paper capacitor box designed for stacking in units of up to six. Tolerance $\pm 5\%$. Rated at 300V. AC or DC. Each capacitor individually fused.



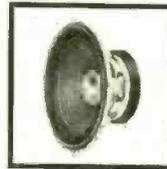
For further details and information on our extensive range of decade boxes, write to:

J. J. LLOYD INSTRUMENTS LTD.
BROOK AVENUE, WARSASH, SOUTHAMPTON
TELEPHONE: LOCKS HEATH 84221



One Wharfedale Super Speaker does the job of bass and treble

If a frequency range of 40 Hz to 20,000 Hz is wide enough to suit your needs, — forget about buying a separate bass and treble. The Speaker you need is a Wharfedale Super 8. In a 2 cu. ft. enclosure this speaker gives superb results. The 14,500 oersted magnet gives increased sensitivity and excellent transient performance. Max. input 6 watts rms or 12 watts peak. Impedance 10/15 ohms. The Super 8/RS/DD (Roll Surround, Double Diaphragm) costs only £7.2.0. (inc. P.T.)



WHARFEDALE SUPER 10/RS/DD Gives even better bass results, and greater sensitivity. A range of 30 Hz — 20,000 Hz. Flux density 16,000 oersteds. Max. input 10 watts rms or 20 watts peak. Impedance 10/15 ohms. Price £11.13.4. (inc. P.T.) Ask at your local dealer



RANK WHARFEDALE LTD, IDLE, BRADFORD, YORKS.



WW—102 FOR FURTHER DETAILS

DIOTESTER IN-CIRCUIT TRANSISTOR TESTER



THE DIOTESTOR detects faulty diodes and transistors when still in circuit without need for unsoldering.

BRITEC LIMITED

17, Charing Cross Road, London, W.C.2
Tel: 01-930-3070

WW—103 FOR FURTHER DETAILS

R, C & L BOXES



CAPACITY 15pf to 111µF
RESISTANCE 0.1Ω to 100KΩ
INDUCTANCE 1mH to 10H
VOLTAGE DIVIDERS and
WHEATSTONE BRIDGES

LIONMOUNT & CO. LTD.
BELLEVUE ROAD, NEW SOUTHGATE,
LONDON, N.11, ENGLAND
Tel: Enterprise 7047.

WW—104 FOR FURTHER DETAILS



for good

SOUND EQUIPMENT

GRAMPIAN REPRODUCERS LTD
Hanworth Trading Estate, Feltham, Middlesex

WW—105 FOR FURTHER DETAILS

You are interested in Radio and T.V.?—Why not

PUT SOME LETTER AFTER YOUR NAME

You can rapidly qualify in your spare time by means of an absorbingly interesting Chambers Postal Course. We offer expert and highly personal training backed by "SATISFACTION-OR-MONEY-BACK" Agreement. Over 75 years' experience... thousands of successes.

FREE 100-PAGE GUIDE



Choose from hundreds of Courses—Practical Radio (apparatus supplied), Radio & T.V. Servicing, Applied Electronics, P.M.G. Cert., City Guilds, R.T.E.B., A.M.I.E.R.E. Radio Amateurs Exam., etc. Send today for the informative 100-Page Chambers Guide To Success—FREE. (Please state Career, exam or subject of interest).

Chambers College

(Dept. E55F) 149 Holborn, London, E.C.4
WW—106 FOR FURTHER DETAILS

Looking for one like this?



6mm tubular midget flange S6/8 cap over-all length 14.5 mm.

It is one of the many Vitality Instrument and Indicator Lamps that are made in an unusually large number of types, ratings and sizes. It may be just what you need for an existing or new project. If not, another from the hundreds of Vitality types and ratings may well be. Catalogue 66, free and post-free, details them all.

**Many a product owes its success to the intelligent addition of an indicator light.*

VITALITY BULBS

VITALITY BULBS LTD MINIATURE AND SUB-MINIATURE LAMP SPECIALISTS
BEETONS WAY, BURY ST. EDMUNDS, SUFFOLK. TEL. BURY 2071. S.T.D. 0284 2071
WW-107 FOR FURTHER DETAILS

TECHNICAL TRAINING by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

First-class opportunities in Radio and Electronics await the ICS trained man. Let ICS train YOU for a well-paid post in this expanding field. ICS courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

- INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS.
- C. & G. TELECOMMUNICATION TECHNICIANS CERTS.
- C. & G. ELECTRONIC SERVICING
- R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.
- RADIO AMATEURS EXAMINATION.
- P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.

Examination Students Coached until Successful.

NEW SELF-BUILD RADIO COURSES

Build your own 5-valve receiver, transistor portable, signal generator and multi-test meter—all under expert tuition.

POST THIS COUPON TODAY and find out how ICS can help YOU in your career. Full details of ICS courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES.

**INTERNATIONAL
CORRESPONDENCE
SCHOOLS**

International Correspondence Schools
(Dept. 222), Intertext House, Parkgate Road
London, S.W.11.

NAME

ADDRESS
Block Capitals Please

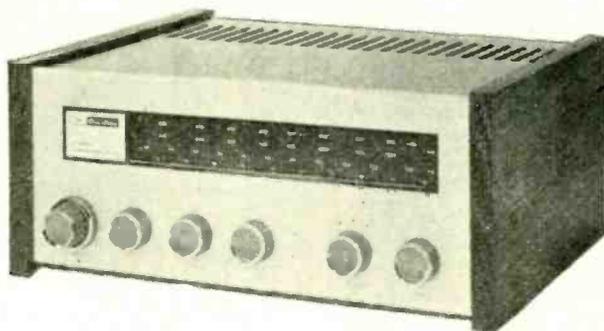
1.68

WW-108 FOR FURTHER DETAILS



Armstrong
high fidelity sound

series 27 TUNER-AMPLIFIERS for the BUDGET SYSTEM



- 127 STEREO TUNER-AMPLIFIER (illustrated) £40.1.6
- 127M MONO TUNER-AMPLIFIER £29.18.9
- 227M MONO TUNER-AMPLIFIER £40.1.6
- OPTIONAL CASE, teak and vinyl hide £3.15.9

Three tuner-amplifiers, identical in size and similar in styling, each with the same high performance AM-FM Tuner incorporated. The 227M provides 10 watts power output whilst the 127M, with 5 watts output, is designed for those whose power requirements are more modest. The 127 is the stereo version of 127M, having two amplifiers, each of 5 watts output. All three have similar facilities; pick-up and tape inputs, tape recording output, bass and treble tone controls.

For full details and technical specifications of all models, including the new series 400, plus list of stockists, post coupon or write mentioning 1WW68.

ARMSTRONG AUDIO LTD., WARLTERS ROAD, N.7
Telephone 01-607 3213

Name

Address

1WW68

WW-109 FOR FURTHER DETAILS

Technicians & Engineers

required for test alignment and servicing of television transmission equipment; applicants should be competent and experienced in the use of standard test instruments. There are good opportunities for promotion to laboratory work.

Apply to:—

Personnel Manager,
British Relay (Electronics) Ltd.,
1-7 Croft Street,
Deptford, London, S.E.8

(Near Surrey Docks Underground Station)

ELECTRONIC TROUBLESHOOTERS

Required by a leading telephone answering machine manufacturer for magnetic recording and transistor pulse circuitry. H.N.C. standard an advantage but a logical approach to fault finding is the main requirement.

Commencing salary £800 - £1,250 p.a., dependent upon qualifications and experience. Non-contributory sick scheme, overtime available.

Apply: Robophone Limited,
Unit "D,"
Menin Works,
Bond Road,
Mitcham, Surrey.
Telephone: 01-648 6278.

Science Research Council RADIO AND SPACE RESEARCH STATION

Ditton Park, Slough, Bucks.

MALE ASSISTANT EXPERIMENTAL OFFICERS are required for a three-year tour of duty at Stanley, Falkland Islands, for operating and maintaining advanced apparatus for recording scientific information transmitted by telemetry from satellites. (Shift work.) Married staff live in rent-free accommodation in modern well-furnished bungalows.

QUALIFICATIONS
University or C.N.A.A. degree, H.N.C. or equivalent qualification. If under age 22, five G.C.E. passes including two science or mathematical subjects at "A" level (or equivalent).

SALARY
Salary whilst overseas on scale £690 per annum rising to £1,318; starting salary at age 21 years £809; at age 26 years or over, £1,092. Additional overseas allowances and shift pay.

Apply:—The Secretary, S.R.C. Radio and Space Research Station, Ditton Park, Slough, Bucks.



TECHNICAL ASSISTANTS

WITH THE INDEPENDENT TELEVISION AUTHORITY

In addition to its present service, Independent Television will soon be entering the field of colour T.V. and U.H.F. Engineering; the future is therefore one of interest and development. The Authority requires young men with some experience in electronics to join its engineering staff; they will be based at Transmitting Stations throughout the United Kingdom and be engaged in the operation and maintenance of television transmitting and ancillary equipment.

SALARY—Commencing salary is in the range £950-£1,225 per annum; subject to qualifications and satisfactory work, salary will progress to £1,650. There are **PROMOTION PROSPECTS** to posts above this level; the Authority's policy is to promote its existing staff whenever possible.

HOURS—Duties are on a shift basis (day and evening) averaging 8 hours with a weekly average of 42 hours inclusive of meal breaks. The evening shifts finish shortly after programme close down at about midnight.

QUALIFICATIONS—Normally a Higher National Certificate or its equivalent would be required but as excellent residential training courses are provided, young men who have not reached this standard will be considered provided their background and experience is suitable.

If you would like to enter this interesting and developing field of engineering, please apply to:—

PERSONNEL OFFICER

THE INDEPENDENT TELEVISION AUTHORITY

70, Brompton Road, London, S.W.3 Quoting Reference WW/583

SCIENCE RESEARCH COUNCIL RADIO AND SPACE RESEARCH STATION DITTON PARK, SLOUGH, BUCKS.

Electrical Engineers or Physicists are required for the following posts:—
(1) **Scientific Officers/Senior Scientific Officers** and **Assistant Experimental Officers/Experimental Officers** for research and development work on electronic and other apparatus for use in experiments to be made in rockets and artificial satellites for investigating the characteristics of the upper atmosphere and ionosphere.

Experiments now in active preparation are to be made as part of the U.K. National and European space research programmes. Opportunities for foreign travel exist.

Qualifications required:—
S.O./S.S.O. 1st or 2nd Class Honours degrees (or equivalent) in appropriate subject plus (for S.S.O.) at least three years post-graduate experience. A.E.O./E.O. University or C.N.A.A. degree, H.N.C. or equivalent qualification. If under age 22, five G.C.E. passes including two science or mathematical subjects at "A" level (or equivalent).

Salaries
S.O./S.S.O. Between £926 and £2,155.
A.E.O./E.O. Between £568 and £1,734.

Apply:—The Secretary,
Science Research Council, Radio and Space Research Station, Ditton Park, SLOUGH, Bucks.
Telephone: SLOUGH 24411.

Government of ZAMBIA

REQUIRES

RADIO SPECIALIST

on contract for one tour of 36 months in the first instance. Salary according to experience in scale rising from £2205 to £2275 gross per annum. A supplement of £250 per annum is also payable direct to an officer's home bank account. Gratuity 25% of total salary drawn. Both gratuity and supplement are normally TAX-FREE. Liberal leave on full salary or terminal payment in lieu. Free passages. Quarters at low rental. Children's education allowances. Outfit allowance £60 and uniform upkeep allowance £24 payable. Contributory pension scheme available in certain circumstances.

The successful candidate, who will serve in the rank of Assistant Superintendent of Police, must hold the equivalent of a Diploma in terminology in electrical engineering/electronics and have

industrial experience in the telecommunications field, or alternatively possess lower academic qualifications but with teaching experience in telecommunications subjects up to Final City and Guilds standard combined with industrial experience. Knowledge of the techniques of S.S.B. and I.S.B. equipment, V.H.F. amplitude and frequency, modulated equipment, multiplex equipment and the construction and operation of teleprinters and low-power diesel plant preferred. Duties include lecturing and training of local officers.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London, S.W.1., for application form and further particulars, stating name, age, brief details of qualifications and experience, and quoting ref: M3D/61357/WF.

Radiomobile

BRITAIN'S CAR RADIO SPECIALISTS

require an experienced

RADIO MECHANIC

As the duties will include the servicing of our complete range of products (both valve and transistorised), the successful applicant will have a good working knowledge of radio theory, together with a number of years of practical experience, preferably, but not essentially, in the Car Radio Industry.

Please write in the first instance, giving personal information and brief details of work history, to:

The Personnel Department,
RADIOMOBILE LIMITED,
 Goodwood Works,
 North Circular Road,
 London, N.W.2.
 GLadstone 0171

SMITHS INDUSTRIES LIMITED
 GODALMING

QUALITY CONTROL

We urgently require an additional Quality Engineer to be engaged on test equipment, some experience in this field is desirable and applicants with H.N.C. or C. & G. in electrical subjects would be preferred.

Please address applications to:
 G. D. Keeble,
 Personnel Officer,



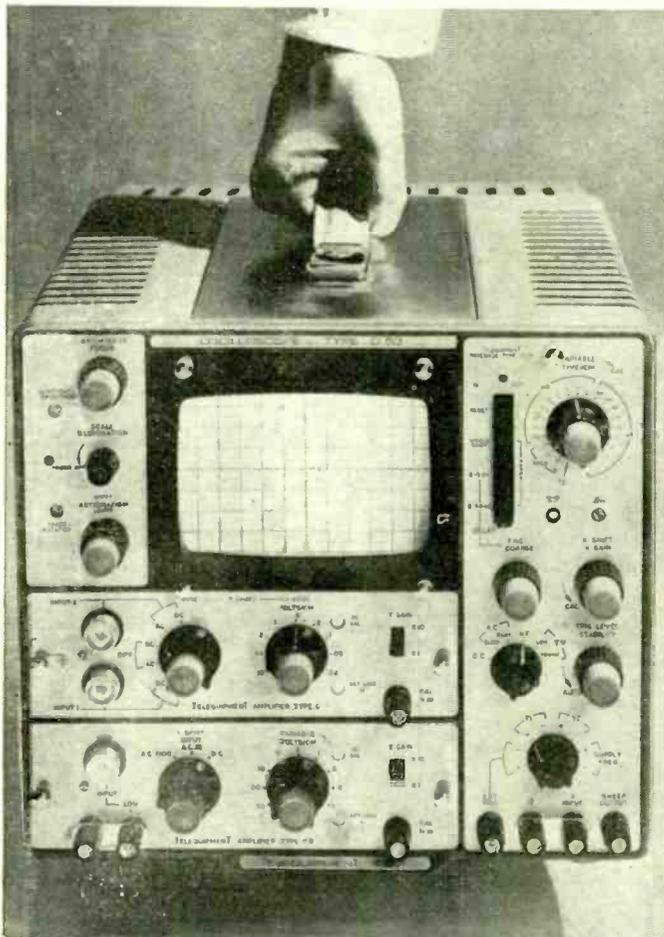
SMITHS INDUSTRIES LIMITED
 Station Road, Godalming, Surrey.
 Telephone: Godalming 2733.

A LOT OF 'SCOPE FOR £221

WITH

1ST

rectangular double beam mesh CRT
signal and sweep delay
proven 25 Mc/s plug-ins



D53

by Telequipment sets the pace for a new generation of low cost oscilloscopes. By adding this new 'scope to the established S & D43 system, the potentialities of the system have been uplifted. D53 accepts the standard range of amplifiers developed for the Telequipment 43 series plus two additional units types CD & HD which utilise the .25 μ sec. signal delay facilities in the 53.

- Type A DC—15 Mc/s, 100 mV/cm;
DC—800 Kc/s, 10 mV/cm.
- Type B Differential, DC—75 Kc/s,
1 mV/cm; Rejection 10,000:1.
- Type CD As type A plus 3 c/s—75 Kc/s,
100 μ V/cm.
- Type D Envelope Monitor.
- Type G Differential, DC—10 Mc/s,
20 mV/cm; DC—500 Kc/s, 2 mV/cm.
- Type HD DC—25 Mc/s, 100 mV/cm;
DC—5 Mc/s, 10 mV/cm.

D53 anticipates the demands of the electronics industry for a general purpose oscilloscope for years to come.

Prices in U.K. £207-£235, depending on choice of amplifiers.

Send for a detailed description of the new D53, and for a copy of the current Telequipment short form catalogue.

TELEQUIPMENT



Telequipment Limited · Southgate · London N14 · Tel: 01-882 1166

WW-110 FOR FURTHER DETAILS

Wireless World

ELECTRONICS, TELEVISION, RADIO, AUDIO

JANUARY 1968

- 619 A Genuine Reject ?
620 Radio Signals from the Heart of Matter *by D. A. Tong*
625 R.F. Measurements and Standards
626 B.B.C. Colour Service
628 The PAL Colour TV System *by S. C. Ryder-Smith*
634 Emitter-coupled, Emitter-timed Multivibrators *by G. B. Clayton*
641 Semiconductor Type Numbering *by T. D. Towers*
645 The Design of a Class D Circuit *by K. C. Johnson*
651 Sub-surface Propagation

SHORT ITEMS

- 624 A Logical Bassoon
638 P.O. Receiving Station Refurbished
638 Changes in Maritime Radio Regulations
644 Units and their Abbreviations
655 Letter from America

REGULAR FEATURES

- | | |
|--------------------------------------|---|
| 619 Editorial Comment | 654 Books Received |
| 638 World of Wireless | 654 H.F. Predictions |
| 640 Personalities | 656 World of Amateur Radio |
| 650 Letters to the Editor | 657 January Meetings |
| 652 News from Industry | 658 New Products |
| 653 1968 Conferences and Exhibitions | 664 Real and Imaginary <i>by "Vector"</i> |

PUBLISHED MONTHLY (3rd Monday of preceding month). Telephone: 01-928 3333 (70 lines). Telegrams/Telex: Wlworld Iliffeprs 25137 London. Cables: "Ethaworld, London, S.E.1." Annual Subscriptions: Home; £2 6s 0d. Overseas; £2 15s 0d. Canada and U.S.A.; \$8.00. Second-Class mail privileges authorised at New York N.Y. BRANCH OFFICES: BIRMINGHAM: 401, Lynton House, Walsall Road, 22b. Telephone: Birchfields 4838. BRISTOL: 11 Marsh Street, 1. Telephone: Bristol 21491/2. COVENTRY: 8-10, Corporation Street. Telephone: Coventry 25210. GLASGOW: 123, Hope Street, C.2. Telephone: Central 1265-6. MANCHESTER: 260, Deansgate, 3. Telephone: Blackfriars 4412. NEW YORK OFFICE U.S.A.: 300 East 42nd Street, New York 10017. Telephone: 867-3900

Editor-in-chief:
W. T. COCKING, F.I.E.E.

Editor:
H. W. BARNARD

Technical Editor:
T. E. IVALL

Editorial:
B. S. CRANK
F. MILLS

Drawing Office:
H. J. COOKE

Production:
D. R. BRAY

Advertisements:
G. BENTON ROWELL
(Manager)
J. R. EYTON-JONES

Iliffe Technical Publications Ltd.,
Managing Director: Kenneth Tett
Editorial Director: George H.
Mansell
Dorset House, Stamford Street,
London, S.E.1

Subscribers are requested to
notify a change of address four
weeks in advance and to return
wrapper bearing previous ad-
dress

© Iliffe Technical Publications
Ltd., 1968. Permission in writing
from the Editor must first be
obtained before letterpress or
illustrations are reproduced from
this journal. Brief extracts or
comments are allowed provided
acknowledgement to the journal
is given.

VOLUME 73 No. 13
PRICE: 3s.

FIFTY-SEVENTH YEAR
OF PUBLICATION

MST SUCCESS

**SALES NOW
EXCEED
£10,000,000**

**More and more
countries are buying
Marconi Self-Tuning
h.f systems...**

and one good reason is:

GREATLY INCREASED TRAFFIC- CARRYING EFFICIENCY

- Great reduction in 'outage' time.
- Earlier generation equipment in use today can take up to 30 minutes to complete a routine frequency change.
- **MST takes less than 1 minute for the same operation.**
- Increased revenue results from this very significant improvement.
- A.F.C. can be entirely dispensed with when operating with other systems of comparable stability.



and other good reasons include:

Reduced capital outlay

MST designs reduce demands for space, and need for standby equipment. Installation costs are decreased.

Increased reliability

Maximum use of solid state techniques plus the use of wideband amplifiers reduces number of moving parts, gives higher reliability and longer equipment life.

Economy of manpower

High equipment reliability together with full remote control facilities permit unmanned station working. Complete h.f systems can be controlled by one man.

World-wide acceptance

30 countries throughout the world have ordered more than £10,000,000 worth of MST equipment to improve their communications services.

Marconi telecommunications systems

AN 'ENGLISH ELECTRIC' COMPANY

The Marconi Company Limited, Radio Communications Division, Chelmsford, Essex, England

WW-112 FOR FURTHER DETAILS

LTD/H71



**NO ONE OFFERS A
WIDER RANGE OF
MONITOR TUBES
THAN BRIMAR**

BRIMAR offers the most comprehensive range of monitor tubes in the country, together with the widest selection of phosphors.

The tubes range in size from 5" to 23". They can be used for television camera viewfinders, studio quality monitors, data displays and closed circuit television – twenty tubes in all! They have been designed to give maximum resolution under high ambient lighting conditions.

A variety of mounting and implosion protection methods, including self protection bonded glass faces are available from BRIMAR who are Britain's leaders in implosion protection.

Common features include magnetic deflection, electrostatic focus and aluminised screens.

The phosphors. In addition to the standard type for television, a wide selection of others is available offering varying degrees of persistence and colour.

**....OR A MORE
PERSONALISED
SERVICE!**

Every BRIMAR tube is backed by a first-class technical service and assistance on any type of problem involving its use in monitors – from special characteristics to circuit design. BRIMAR engineers are always available – contact is on a personal basis. Please telephone or write for full details.



Thorn-A.E.I. Radio Valves & Tubes Ltd.
7 Soho Square, London W1. Telephone: 01-437 5233

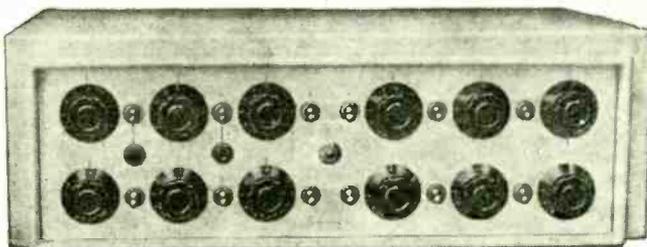
WW-113 FOR FURTHER DETAILS

— Vortexion

quality equipment

12-WAY ELECTRONIC MIXER

The 12-way electronic mixer has facilities for mixing 12 balanced line microphones. Each of the 12 lines has its own potted mumetal shielded microphone transformer and input valve, each control is hermetically sealed. Muting switches are normally fitted on each channel and the unit is fed from its own mumetal shielded mains transformer and metal rectifier.



FOUR-WAY ELECTRONIC MIXER

This unit provides for 4 independent channels electronically mixed without "spurious break through," microphony hum and background noise have been reduced to a minimum by careful selection of components. The standard 15-50 ohm shielded transformers on each input are arranged for balanced line, and have screened primaries to prevent H.F. transfer when used on long lines.

The standard 5 valve unit consumes only 18.5 watts, H.T. is provided by a selenium rectifier fed by low loss, low field, transformer in screening box. The ventilated case gives negligible temperature rise with this low consumption assuring continuance of low noise figures.

20,000 ohms is the standard output impedance, but the noise pick-up on the output lines is equivalent to approximately 2,000 ohms due to the large amount of negative feedback used.

For any output impedance between 20,000 ohms and infinity half a volt output is available. Special models can be supplied for 600 ohms at equivalent voltage by an additional transformer or 1 milliwatt 600 ohms by additional transformer and valve.

The white engraved front panel permits of temporary pencil notes being made, and these may be easily erased when required. The standard input is balanced line by means of 3 point jack sockets at the front, or to order at the rear.

| | |
|---|---------|
| Mixer for 200-250V AC Mains | £40 8 6 |
| Extra for 600 ohm output model | £1 18 6 |
| Extra for 600 ohm 1 milliwatt output | £3 0 6 |
| Size 18½in. wide × 11¼in. front to back (excluding plugs) × 6¼in. high. | |
| Weight 22lb. | |

THREE-WAY MIXER and peak programme meter, for recording and large sound installations etc.

This is similar in dimension to the 4-Way Mixer but has an output meter indicating transient peaks by means of a valve voltmeter with a 1 second time constant in its grid circuit.

The meter is calibrated in dBs, zero dB being 1 milliwatt-600 ohm (.775V) and markings are provided for + 10dB and -26 dB. A switch is provided for checking the calibration. A valve is used for stabilising the gain of this unit. The output is 1 milliwatt on 600 ohms for zero level up to +12 dB maximum. An internal switch connects the output for balance, unbalance, or float. This output is given for an input of 40 microvolts on 15 ohms.

An additional input marked "Ext. Mxr." will accept the output of the 4-Way Mixer converting the unit into a 7-Way controlled unit. This input will also accept the output of a crystal pick-up but no control of volume is available. The standard input is balanced line by means of 3 point jack sockets at rear but alternative 2 point connectors may be obtained to order at the front or rear as desired.

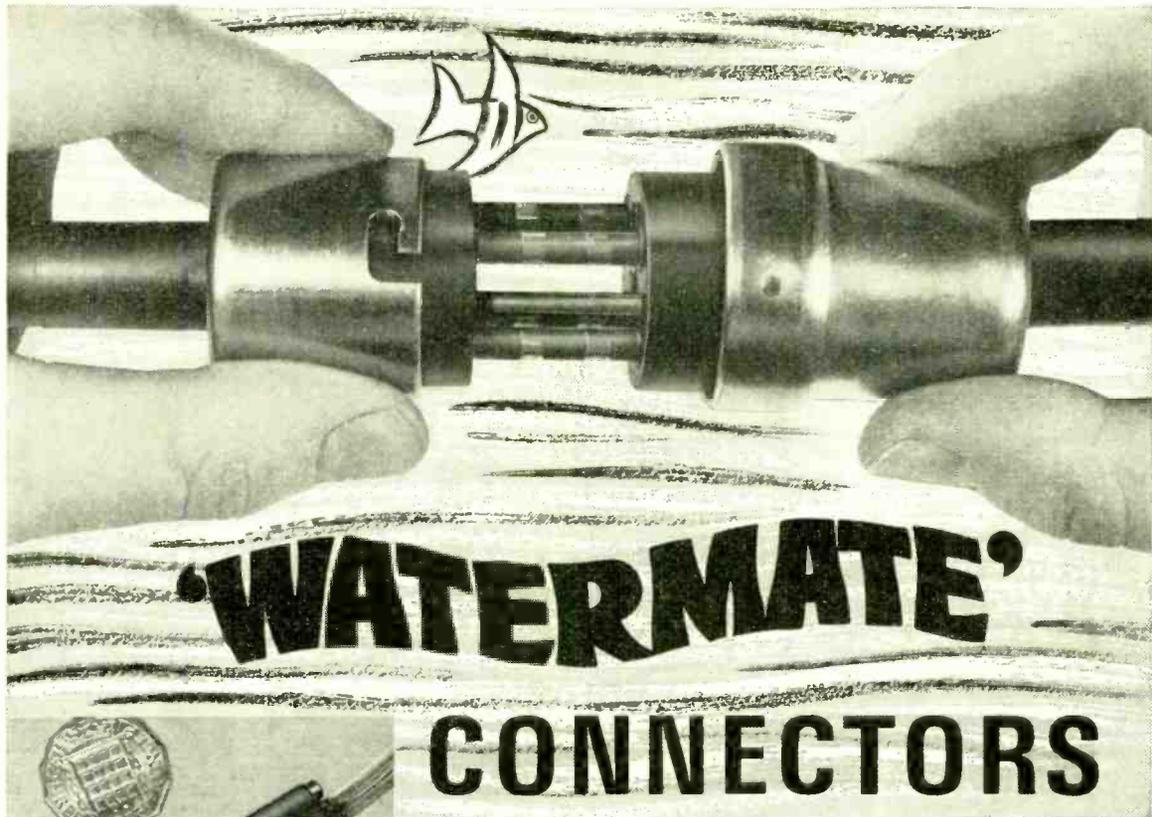
The 8 valves and selenium rectifier draw a total of 25 watts.

| | |
|---|----------------------|
| P.P.M. for 200-250V AC Mains | Price on application |
| Size 18½in. wide × 11¼in. front to back (excluding plugs) × 6¼in. high. | |
| Weight 23lb. | |

- 10/15 watt Amplifier with built-in mixers.
- 30/50 watt Amplifier with built-in mixers.
- 2 × 5-way stereo mixers with outputs for echo chambers, etc.

Full details and prices on request.

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, S.W.19
 Telephone: LIBerty 01-542-2814. 01-542-6242/3/4. Telegrams: "Vortexion London S.W.19."



Depicted here are typical examples of a range of Water-proof Connectors of unique design enabling electrical circuits to be connected or disconnected even when under water. The range caters for electrical loads of 440 volts a.c. 175 amps. down to the signal current levels associated with instrumentation and similar arrangements.

The basic design incorporates a patented principle referred to as "Watermate". Both plug and socket are moulded of a specially compounded neoprene rubber with unusually high insulation resistance and non-wetting surface. As mating occurs water, salt deposits, sand and other foreign matter are wiped from the sockets and ejected from a duct in the socket to form a leak-proof seal. The wiping action assures a dry connection at the moment of contact resulting in a leakage resistance of not less than 100 megohms **WHEN MATED UNDER WATER.**

They are pressure balanced and will not block up under high pressures. There are no glands or threads to seize up in water and the method of moulding to the associated neoprene jacketed cable provides an extremely robust and simple connector for both Military and Civil applications.

For full details of these Connectors and a new Underwater Reed Switch Assembly, please write or telephone to the Technical Sales Department.

MCMURDO

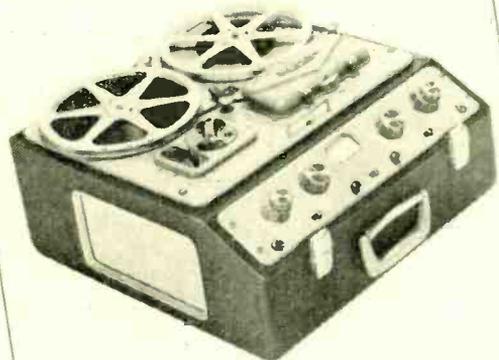
McMURDO INSTRUMENT CO. LTD., RODNEY RD., FRATTON, PORTSMOUTH, Tel: Portsmouth 35361 Telex: 86112
LUGTON & CO. LTD., 209/210 Tottenham Court Road, London, W.1. Tel.: Museum 3261.
SASCO, P.O. Box No. 20, Gatwick Road, Crawley, Sussex. Telephone: Crawley 28703 (also: Chipping Sodbury 2641, Cumbernauld 25601, Hitchin 2242).

BELGIUM Ets. L. de Greef Sprl. 53 Avenue Everard. BRUSSELS 19. **CANADA** Trans Atlantic Electronics Ltd. 1789 Cardinal Avenue. DORVAL, QUEBEC. **CEYLON** Robert Agency. 44 Green Lane. COLOMBO 13.

WW-115 FOR FURTHER DETAILS

MODEL 633

Guaranteed for 3 years



An instrument for the connoisseur...
Designed to a strict specification
Built to endure

- * Three operational speeds:
633— $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.
633H— $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 i.p.s.
- * Monitoring of recorded programme.
- * Comparison by "A-B" switching.
- * Switched bias control.
- * Level meter reads on both record and playback.
- * Mixing facilities with separate gain controls.
- * Modular construction to provide maximum service accessibility.
- * Separate record and replay heads.
- * Separate record and replay amplifiers.
- * Fully compensated input socket for magnetic pick-up.
- * Spot erase.
- * 3 watts undistorted output.

Model 633 120 gns.
Model 633H 125 gns.

Ferroglyph

the incomparable tape recorder

The 633 is the latest addition to the Ferroglyph range and is intended for the serious home recorder as well as the professional user. Each instrument is supplied with an abstract of actual performance in the form of a test certificate. Spare parts—as with all Ferroglyph instruments—are guaranteed available for at least 10 years.

Interested? Then complete and post this coupon to:
THE FERROGRAPH CO. LIMITED
84 Blackfriars Road, London, S.E.1

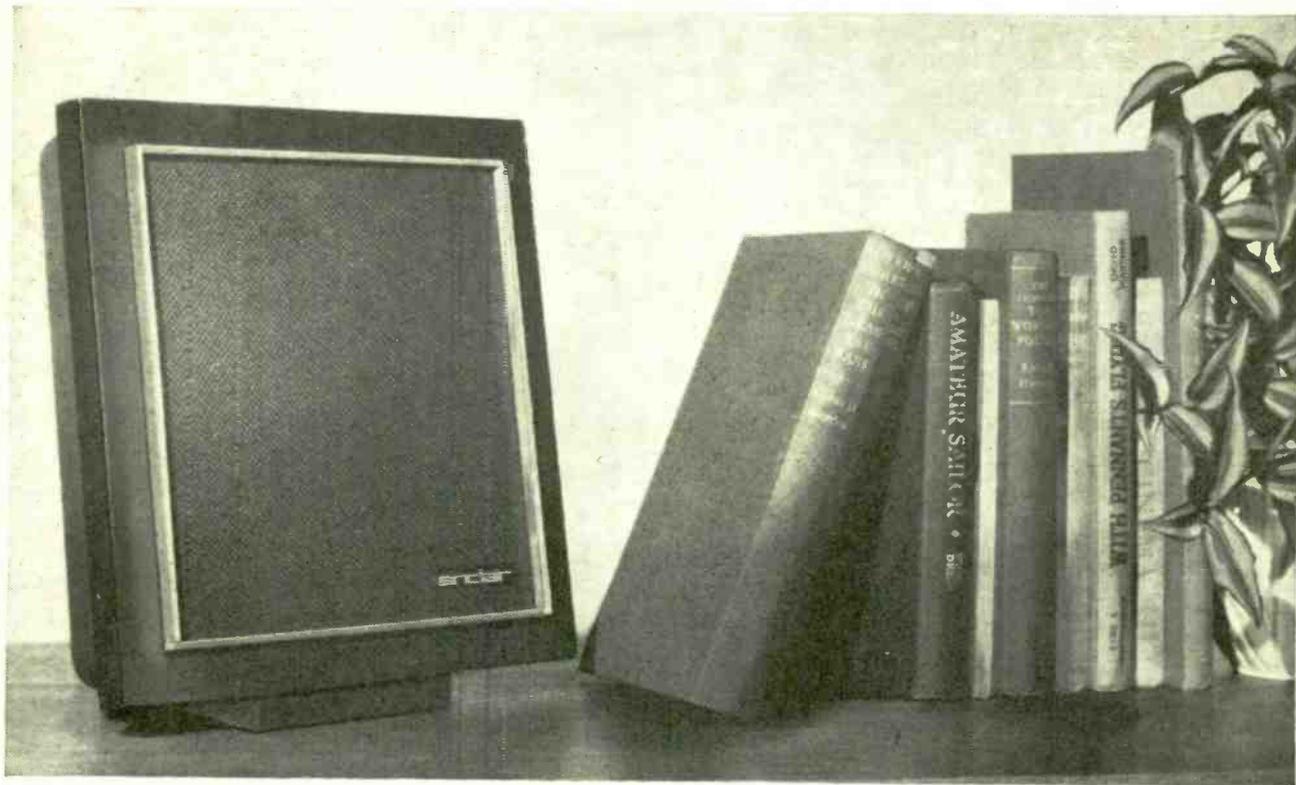
- Please send me the FREE illustrated Ferroglyph leaflets.
 - Please send me the comprehensive 64-page model 633 Ferroglyph Manual, for which I enclose £1—refundable when I purchase my Ferroglyph.
- (Tick items required in box at left)*

NAME _____

ADDRESS _____



WW10


SINCLAIR
Q.14

a truly superb loudspeaker

- ACOUSTICALLY
CONTOURED SOUND CHAMBER
- MAXIMUM LOADING IN
EXCESS OF 14 WATTS
- BRILLIANT TRANSIENT
RESPONSE
- 15 OHMS IMPEDANCE
- OF COMPACT AND
ORIGINAL DESIGN
- AN ALL-BRITISH PRODUCT

Price need no longer stop you enjoying first-class high-fidelity loudspeaker reproduction nor is size any longer a problem. (These considerations are of utmost importance to every enthusiast for stereo.) In the Sinclair Q.14 you will find a loudspeaker of such remarkable quality and so compactly and attractively styled that you will want to change over to Sinclair as soon as you hear it. This is no ordinary loudspeaker. Indeed, at a recent trade demonstration experts were greatly impressed on hearing the Q.14 against speakers costing many times as much. It proves beyond question that good reproduction need not be expensive.

When tested in an independent laboratory a Q.14 from stock showed exceptionally smooth response between 60 and 16,000 c/s with well sustained output both below and above these readings. Its remarkable transient response ensures clean-cut separation between instruments, voices, etc. Much

of its success results from the use of materials different from those found in conventional speaker manufacture. The unusual shape of the sealed, seamless pressure chamber allows the Q.14 to be conveniently positioned on shelves, in wall corners, or flush mounted in assemblies of one or more units.

"More than delighted"

"I have tested them (two Q.14's) side by side with two first class speakers in large reflex cabinets coupled to a very good Hi-Fi stereo set up and can honestly say the Q.14 is superior to the speakers I have been using. Every note came through perfectly. I am more than delighted. I would like to congratulate you on producing such a fine unit."—J.R.H., Blackpool.

Try the Q.14 in your own home by sending the order form off today. If you are not satisfied your money plus the cost of returning the Q.14 to us will be refunded in full.

SENT POST FREE TO ANY PART OF U.K.

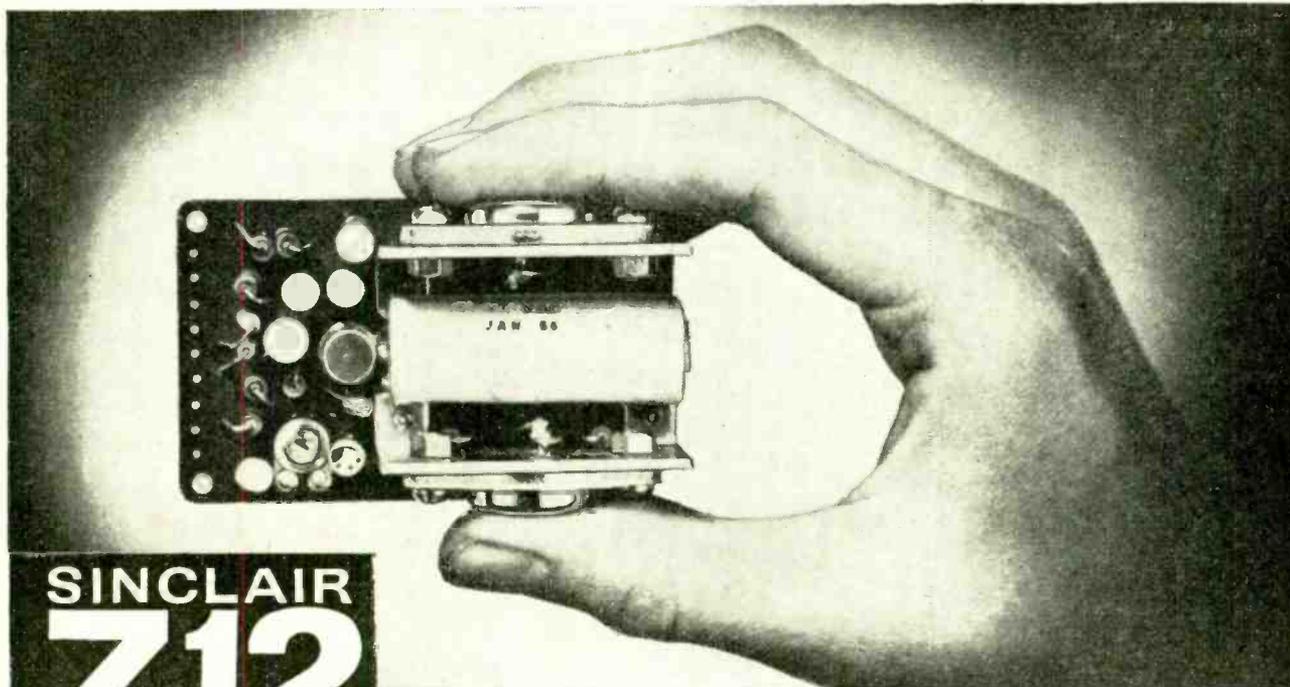
£6 . 19 . 6

sinclair

**SINCLAIR RADIONICS LTD. 22 NEWMARKET ROAD,
CAMBRIDGE.**

Phone: OCA3-52996

WW-118 FOR FURTHER DETAILS



SINCLAIR Z12

COMBINED 12 WATT HI-FI AMP AND PRE-AMP

Fantastic power & versatility

- 12 Watts R.M.S. continuous sine wave. (24 w. peak.)
- 15 watts music power (30 w. peak.)
- Ultralinear class B output
- Input —2mV into 2 K/ohm
- Output suitable for 15, 7.5 and 3 ohm speakers. Two 3 ohm speakers may be used in parallel
- 15-50,000 c/s —1dB
- Ideal for battery operation
- 3" x 1 1/2" x 1 1/4"

BUILT, TESTED AND GUARANTEED

89/6

A NEW SINCLAIR POWER UNIT



SINCLAIR STEREO 25 PRE-AMP/CONTROL UNIT

For use with two Z.12s or any hi-fi stereo system. Frequency response 25 c/s to 30 kc/s ±1dB. Switched inputs for P.U., Radio, Microphone, etc. Equalisation correct to within ±1 dB on RIAA curve from 50 to 20,000 c/s. 6 1/2 in. X 2 1/2 in. X 2 1/2 in. plus knobs. **£9.19.6**
BUILT, TESTED AND GUARANTEED

The Z.12 proves beyond all question that high-fidelity can be combined with very low price. No other integrated amplifier system so successfully meets such a wide range of requirements. The Z.12 will operate from any power supply between 6 and 20 v. D.C. The output is suitable for any impedance between 1.5 and 15 ohms, and consequently for any loudspeaker including, of course, the Sinclair Q.14. This remarkable amplifier has facilities for matching to any types of conventional inputs, details of which are given in the Z.12 manual supplied. Included amongst popular applications for the Z.12 are mono and stereo high fidelity systems (two are needed for stereo), guitars, electric organs, car radios and P.A. and intercom systems, etc. It is also of great value in experimental work where dependable standards are required.

"All you claim for it"

"The Sinclair Z.12 is all and more than you claim for it. Its performance is outstanding. Thank you for your prompt service."—S/Sgt. R., B.A.O.R.

"Performance excels that of many systems"

"I have built a stereogram employing 2 Z.12 amplifiers and a PZ.3. I am delighted with the reproduction which is better than some I have heard costing over double the price. It has also silenced some of the old brigade who stubbornly believe that nothing can beat valves."
—R.H., Argyll.

PZ.4. Heavy duty, stabilized power pack to meet requirements of Z.12 assemblies in stereo, etc. Output 18 V.D.C. at 1.5A **99/6**

GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full and at once without question.

If you prefer not to cut page please quote WW168 when ordering.



SINCLAIR MICROMATIC

The world's smallest radio now includes magnetic earpiece, yet costs less.

Prices of the Micromatic have been substantially reduced. Performance has been improved by the inclusion of a new magnetic type earpiece. These two facts mean that still more enthusiasts can enjoy even better performance from this fabulous little set—and it's all British, too. Keep a Micromatic to hand always—it plays anywhere. Size 1 1/2 in. X 1 1/2 in. X 1 1/4 in. Formerly 59/6 in kit form and 79/6 built and tested. **KIT NOW 49/6** Built and tested **59/6**
Two mercury cells for Micromatic—each 1/11.

MICRO FM



Less than 3ln. X 1 1/2 in. X 1 1/4 in. 7 transistor F.M. Superhet using pulse counting discriminator. Low I.F. makes alignment unnecessary. Tunes 88-108 Mc/s. The telescopic aerial suffices for good reception in all but poorest areas. Signal to noise ratio—30dB at 30 microvolts. One outlet for amplifier or recorder, one for use as a pocket portable. Complete Kit inc. earpiece.

£5.19.6

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Please send POST FREE

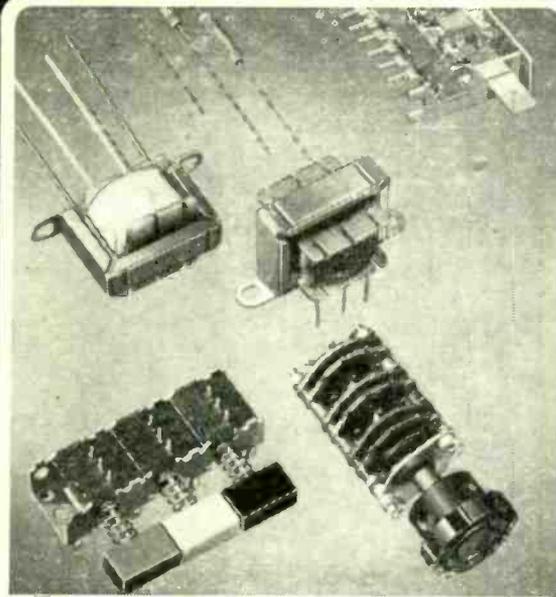
NAME

ADDRESS

For which I enclose cash/cheque/money order.

WW168

WW-119 FOR FURTHER DETAILS



there's a
world of capability in
EMICOMPONENTS

HIGH TORQUE BATTERY MOTOR

Exceptional speed regulation over a wide Load/Voltage range.



8-12 Volts. High Efficiency. Low electrical interference. Many other high quality motors both A.C. and D.C. available in the small F.H.P. range.

EMICOMPONENTS are designed by professionals and used in professional applications ranging from rockets to hi-fi. They are used by EMI themselves in the design and development of systems and equipment where no compromise is permissible - in quality performance or value. This is the reason for their constant reliability. The EMICOMPONENTS range includes A.C. and D.C. Motors, PET Capacitors, Miniature Rotary and Illuminated Push Button Switches and Miniature Transformers with outputs up to 20 VA.

Send coupon for literature giving performance and dimensional details.



EMI SOUND PRODUCTS LIMITED
COMPONENT DIVISION-HAYES-MIDDX
TELEPHONE: 01-573 3888 · EXT: 667

Please send me details of the following EMICOMPONENTS:

A.C. & D.C. MOTORS PET CAPACITORS MINIATURE
ROTARY SWITCHES PUSH BUTTON SWITCHES
MINIATURE TRANSFORMERS *Tick appropriate square*

Name _____

Company _____

Address _____

Tel. No. _____

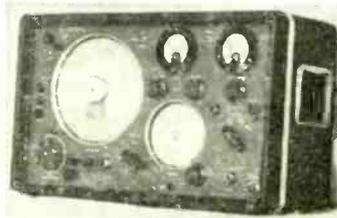
WW-120 FOR FURTHER DETAILS

All overseas enquiries & orders please address to:

COLOMOR (ELECTRONICS) LTD.

170 Goldhawk Rd., London, W.12. Tel. (01) 743 0899

MARCONI SIGNAL GENERATOR TYPE TF801B/3/S



Frequency range 12-485 Mc/s in five ranges. Directly calibrated frequency dial. Output waveform: C.W. sine wave A.M., pulse A.M. (from ext. source only). Internal modulation frequency 1,000 c/s. Output: a, normal - continuously variable directly calibrated from 0.1 μV-0.5 v. b, high; up to 1 v. modulated for 2 v. unmodulated, output impedance 50 ohms. Fine frequency tuning control, carrier on/off switch,

built-in crystal calibration for 2 Mc/s and 10 Mc/s. Stabilised voltage supply. In excellent "as new" condition. Laboratory checked and guaranteed. £115. Carr. 30/-. Including necessary connectors, plugs and instruction manual.

MARCONI SIGNAL GENERATOR TF 801A/1.

10-300 Mc/s. in 4 bands. Internal at 400 c/s, 1 kc/s. External 50 c/s to 10 kc/s. Output 0-100 db below 200 mV from 75 ohms source. Completely new with accessories. £85. P. & P. 2/3/-.

BC 221 FREQUENCY METERS.

125-20,000 kc/s. Accuracy 0.01%. Complete with individual Calibration book. In brand new condition with headphones. £45. P. & P. 20/-.

Mains P.S.U. for above, £11/10/-.

SIGNAL GENERATOR PORTABLE TS 13/AP,

with self-contained wavemeter and power monitor. Freq. 9305-9445 Mc/s. Peak power output, C W pulsed 50 μW per 1/2 F.S.D. Pulsing 1-2 μsec. wide, delay 5,200 μsec. PRR 350-4,000 c/s. £50. P. & P. 20/-.

TEST SET TS 12AP STANDING WAVE INDICATOR EQUIPMENT.

Used for testing 3 cm circuit components. Should be used with a suitable signal source such as above described TS 13 Signal Generator. £25. P. & P. 10/-.

MARCONI VIDEO OSCILLATOR TF 885A.

Sine wave output 25 c/s to 5 Mc/s in 2 bands, Square-wave output 50 c/s to 150 c/s in 2 bands. Freq. accur. ± 2% ± 2 c/s. Power supply 100/125/200/250 v. A.C. £75. Carriage 40/-.

DEVIATION TEST SET TF934.

2.5 to 100 Mc/s. on Fundamentals. Can be extended to 500 Mc/s. on harmonics. A.C. mains operation, £55. Carriage 30/-.

FIELD TELEPHONES TYPE "F"

Housed in portable wooden cases. Excellent for communication in- and out-doors for up to 10 miles. For pair including batteries and 1/6th mile field cable on drum. £5/10/-.

FIELD TELEPHONES TYPE "L"

As above but in portable metal cases. Per pair including batteries and 1/6th mile field cable on drum. £3/15/-.

FIELD 10 LINE MAGNETO TELEPHONE SWITCHBOARD (YA6733).

Withstanding all climatic conditions. Price on application.

HARNES "A" & "B" control units, junction boxes, headphones, microphones, etc.

SUB-MINIATURE "PENNY SIZE" METERS.

1 in. round, flush, ring nut mounted 500 μA FSD, calibrated 0-1 mA. 20/-.

END OF RANGE ITEMS

Offered at special low prices as only a few left, all are in fully tested guaranteed condition.

VALVE VOLTMETER TS 428B/1.

£10/10/-.

WHEATSTONE BRIDGE.

American made. Measures 0.001-ohm to 10M ohms with internal galvanometer. £27/10/-.

CR 150 RECEIVER, 2 Mc/s-60 Mc/s,

with specially built PSU for mains. £49/10/-.

METERS.

4 1/2 in. x 4 1/2 in. 4 in. long, mirror scale panel mounted, calibrated 0-1 mA. £55/-.

LABORATORY TYPE VOLT-METERS.

160 v. A.C./D.C. 8 in. mirror scale in wooden boxes, 9 1/2 in. x 8 1/2 in. x 3 1/2 in. with carrying handle, brand new, 32/-.

SPARES FOR A.R.88D. RECEIVERS.

Ask for your needs from our huge selection.

VARIOMETER for No. 19 sets.

17/6. P. & P. 3/-.

TELEPHONE HANDSETS.

Standard G.P.O. type; new 12/-.

INSET MICROPHONE for telephone handset.

2/6. P. & P. 2/-.

LIGHTWEIGHT, LOW RESISTANCE, HEADPHONES.

Type H.S. 33. Largely used by pilots. Brand new, 27/6. P. & P. 3/-.

MINIATURE METERS.

General Electric 1 1/2 in. round flush, clip mounted:

1 mA. D.C. 22/6.

25 mA. D.C. 20/-.

65 mA. D.C. 18/-.

150 mA. D.C. 15/-.

"S" METER FOR H.R.O. RECEIVERS.

Brand new, £2/10/-.

CRYSTALS for H.R.O. in original National Union Housing.

25/-.

PRECISION VHF FREQUENCY METER TYPE 183.

20-300 Mc/s with accuracy 0.03% and 300-1,000 Mc/s with accuracy 0.3%. Additional ban on harmonics 5.0-6.25 Mc/s with accuracy + - 2 x 10^-4. Incorporating calibrating quartz 100 kc/s + - 5 x 10^-5 120/220 v. A.C. mains. £85. Carriage £2.

FOR EXPORT ONLY

53 TRANSMITTER made up to "as new" standard. All spares available.

COLLINS TCS. Complete installations and spare parts.

FIELD TELEPHONE SETS TYPE "J" YA 7815. Portable. Ideal for tropical climates.

R.C.A. TRANSMITTER TYPE ET 4336. 2-20 Mc/s., complete with M.O., Cryst. mult. and speech ampl. Fully tested and guaranteed. All spares available.

BC 610 E TRANSMITTER. Complete with speech amplifier BC 614E. Aerial tuning unit BC 939A, exciter units, tank coils, etc. Fully tested and guaranteed. All spares available.

No. 19 SETS. HP output increased to 25 watts. Complete installations supplied.

RONTGENS/HOUR MICRO-AMMETERS. FSD 100 μamp. 3 in. x 3 in. x 1 in. width

P. C. RADIO LTD.

170 GOLDHAWK ROAD, W.12 SHEpherd's Bush 4946

VALVES

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| 6G20Q 5/- | 6X4 12/- | 6X5 12/- | 6X6 12/- | 6X7 12/- | 6X8 12/- | 6X9 12/- | 6X10 12/- | 6X11 12/- | 6X12 12/- | 6X13 12/- | 6X14 12/- | 6X15 12/- | 6X16 12/- | 6X17 12/- | 6X18 12/- | 6X19 12/- | 6X20 12/- | 6X21 12/- | 6X22 12/- | 6X23 12/- | 6X24 12/- | 6X25 12/- | 6X26 12/- | 6X27 12/- | 6X28 12/- | 6X29 12/- | 6X30 12/- | 6X31 12/- | 6X32 12/- | 6X33 12/- | 6X34 12/- | 6X35 12/- | 6X36 12/- | 6X37 12/- | 6X38 12/- | 6X39 12/- | 6X40 12/- | 6X41 12/- | 6X42 12/- | 6X43 12/- | 6X44 12/- | 6X45 12/- | 6X46 12/- | 6X47 12/- | 6X48 12/- | 6X49 12/- | 6X50 12/- | 6X51 12/- | 6X52 12/- | 6X53 12/- | 6X54 12/- | 6X55 12/- | 6X56 12/- | 6X57 12/- | 6X58 12/- | 6X59 12/- | 6X60 12/- | 6X61 12/- | 6X62 12/- | 6X63 12/- | 6X64 12/- | 6X65 12/- | 6X66 12/- | 6X67 12/- | 6X68 12/- | 6X69 12/- | 6X70 12/- | 6X71 12/- | 6X72 12/- | 6X73 12/- | 6X74 12/- | 6X75 12/- | 6X76 12/- | 6X77 12/- | 6X78 12/- | 6X79 12/- | 6X80 12/- | 6X81 12/- | 6X82 12/- | 6X83 12/- | 6X84 12/- | 6X85 12/- | 6X86 12/- | 6X87 12/- | 6X88 12/- | 6X89 12/- | 6X90 12/- | 6X91 12/- | 6X92 12/- | 6X93 12/- | 6X94 12/- | 6X95 12/- | 6X96 12/- | 6X97 12/- | 6X98 12/- | 6X99 12/- | 6X100 12/- |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| 6G20Q 5/- | 6X4 12/- | 6X5 12/- | 6X6 12/- | 6X7 12/- | 6X8 12/- | 6X9 12/- | 6X10 12/- | 6X11 12/- | 6X12 12/- | 6X13 12/- | 6X14 12/- | 6X15 12/- | 6X16 12/- | 6X17 12/- | 6X18 12/- | 6X19 12/- | 6X20 12/- | 6X21 12/- | 6X22 12/- | 6X23 12/- | 6X24 12/- | 6X25 12/- | 6X26 12/- | 6X27 12/- | 6X28 12/- | 6X29 12/- | 6X30 12/- | 6X31 12/- | 6X32 12/- | 6X33 12/- | 6X34 12/- | 6X35 12/- | 6X36 12/- | 6X37 12/- | 6X38 12/- | 6X39 12/- | 6X40 12/- | 6X41 12/- | 6X42 12/- | 6X43 12/- | 6X44 12/- | 6X45 12/- | 6X46 12/- | 6X47 12/- | 6X48 12/- | 6X49 12/- | 6X50 12/- | 6X51 12/- | 6X52 12/- | 6X53 12/- | 6X54 12/- | 6X55 12/- | 6X56 12/- | 6X57 12/- | 6X58 12/- | 6X59 12/- | 6X60 12/- | 6X61 12/- | 6X62 12/- | 6X63 12/- | 6X64 12/- | 6X65 12/- | 6X66 12/- | 6X67 12/- | 6X68 12/- | 6X69 12/- | 6X70 12/- | 6X71 12/- | 6X72 12/- | 6X73 12/- | 6X74 12/- | 6X75 12/- | 6X76 12/- | 6X77 12/- | 6X78 12/- | 6X79 12/- | 6X80 12/- | 6X81 12/- | 6X82 12/- | 6X83 12/- | 6X84 12/- | 6X85 12/- | 6X86 12/- | 6X87 12/- | 6X88 12/- | 6X89 12/- | 6X90 12/- | 6X91 12/- | 6X92 12/- | 6X93 12/- | 6X94 12/- | 6X95 12/- | 6X96 12/- | 6X97 12/- | 6X98 12/- | 6X99 12/- | 6X100 12/- |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| 6G20Q 5/- | 6X4 12/- | 6X5 12/- | 6X6 12/- | 6X7 12/- | 6X8 12/- | 6X9 12/- | 6X10 12/- | 6X11 12/- | 6X12 12/- | 6X13 12/- | 6X14 12/- | 6X15 12/- | 6X16 12/- | 6X17 12/- | 6X18 12/- | 6X19 12/- | 6X20 12/- | 6X21 12/- | 6X22 12/- | 6X23 12/- | 6X24 12/- | 6X25 12/- | 6X26 12/- | 6X27 12/- | 6X28 12/- | 6X29 12/- | 6X30 12/- | 6X31 12/- | 6X32 12/- | 6X33 12/- | 6X34 12/- | 6X35 12/- | 6X36 12/- | 6X37 12/- | 6X38 12/- | 6X39 12/- | 6X40 12/- | 6X41 12/- | 6X42 12/- | 6X43 12/- | 6X44 12/- | 6X45 12/- | 6X46 12/- | 6X47 12/- | 6X48 12/- | 6X49 12/- | 6X50 12/- | 6X51 12/- | 6X52 12/- | 6X53 12/- | 6X54 12/- | 6X55 12/- | 6X56 12/- | 6X57 12/- | 6X58 12/- | 6X59 12/- | 6X60 12/- | 6X61 12/- | 6X62 12/- | 6X63 12/- | 6X64 12/- | 6X65 12/- | 6X66 12/- | 6X67 12/- | 6X68 12/- | 6X69 12/- | 6X70 12/- | 6X71 12/- | 6X72 12/- | 6X73 12/- | 6X74 12/- | 6X75 12/- | 6X76 12/- | 6X77 12/- | 6X78 12/- | 6X79 12/- | 6X80 12/- | 6X81 12/- | 6X82 12/- | 6X83 12/- | 6X84 12/- | 6X85 12/- | 6X86 12/- | 6X87 12/- | 6X88 12/- | 6X89 12/- | 6X90 12/- | 6X91 12/- | 6X92 12/- | 6X93 12/- | 6X94 12/- | 6X95 12/- | 6X96 12/- | 6X97 12/- | 6X98 12/- | 6X99 12/- | 6X100 12/- |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| 6G20Q 5/- | 6X4 12/- | 6X5 12/- | 6X6 12/- | 6X7 12/- | 6X8 12/- | 6X9 12/- | 6X10 12/- | 6X11 12/- | 6X12 12/- | 6X13 12/- | 6X14 12/- | 6X15 12/- | 6X16 12/- | 6X17 12/- | 6X18 12/- | 6X19 12/- | 6X20 12/- | 6X21 12/- | 6X22 12/- | 6X23 12/- | 6X24 12/- | 6X25 12/- | 6X26 12/- | 6X27 12/- | 6X28 12/- | 6X29 12/- | 6X30 12/- | 6X31 12/- | 6X32 12/- | 6X33 12/- | 6X34 12/- | 6X35 12/- | 6X36 12/- | 6X37 12/- | 6X38 12/- | 6X39 12/- | 6X40 12/- | 6X41 12/- | 6X42 12/- | 6X43 12/- | 6X44 12/- | 6X45 12/- | 6X46 12/- | 6X47 12/- | 6X48 12/- | 6X49 12/- | 6X50 12/- | 6X51 12/- | 6X52 12/- | 6X53 12/- | 6X54 12/- | 6X55 12/- | 6X56 12/- | 6X57 12/- | 6X58 12/- | 6X59 12/- | 6X60 12/- | 6X61 12/- | 6X62 12/- | 6X63 12/- | 6X64 12/- | 6X65 12/- | 6X66 12/- | 6X67 12/- | 6X68 12/- | 6X69 12/- | 6X70 12/- | 6X71 12/- | 6X72 12/- | 6X73 12/- | 6X74 12/- | 6X75 12/- | 6X76 12/- | 6X77 12/- | 6X78 12/- | 6X79 12/- | 6X80 12/- | 6X81 12/- | 6X82 12/- | 6X83 12/- | 6X84 12/- | 6X85 12/- | 6X86 12/- | 6X87 12/- | 6X88 12/- | 6X89 12/- | 6X90 12/- | 6X91 12/- | 6X92 12/- | 6X93 12/- | 6X94 12/- | 6X95 12/- | 6X96 12/- | 6X97 12/- | 6X98 12/- | 6X99 12/- | 6X100 12/- |
|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|

COLOMOR

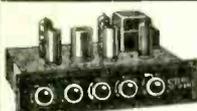
THE VALVE WITH A GUARANTEE

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------|---------|----------|---------|------------|---------|------------|---------|------------|----------|-----------|----------|------------|----------|-------------|----------|-------------|------------|-------------|------------|------------|-----------|------------|-----------|------------|----------|------------|----------|------------|----------|-------------|-----------|--------|----------|----------|----------|-----------|-----------|----------|-----------|-----------|------------|------------|-----------|-----------|----------|----------|----------|----------|----------|------------|------------|----------|---------|--------|---------|--------|----------|--------|----------|--------|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| 25Z6GT 9/6 | 954 4/6 | 28D7 6/- | 955 2/6 | 30C15 15/6 | 956 2/6 | 30C17 14/6 | 957 2/6 | 30C18 16/- | 958A 4/- | 30F6 16/- | 1625 6/6 | 30FL1 17/3 | 1629 4/6 | 30FL12 18/6 | 2051 5/- | 30FL14 18/- | 4043C 35/- | 30FL14 18/- | 4313C 30/- | 30L13 17/3 | 5576 10/- | 30L17 17/3 | 5678 10/- | 30P12 14/9 | 5696 6/6 | 30P19 18/- | 5704 9/- | 30PL1 16/- | 5728 7/6 | 30PL14 18/4 | 6057 10/- | 3A101K | 6060 5/6 | 6064 7/6 | 6065 8/- | 35LGT 7/6 | 6080 22/- | 33W4 5/- | 6146 28/- | 35Z3 11/3 | 6013A 25/- | 35Z4GT 7/6 | 8020 15/6 | 35ZGT 6/6 | 9001 3/- | 9002 4/6 | 9003 6/6 | 9006 2/6 | 9008 2/6 | C.R. Tubes | E4504/B/16 | 083 70/- | VCR139A | 73 5/6 | VCR139B | 76 5/6 | VCR1570B | 78 5/6 | VCR1570C | 81 9/- | 12A17 5/9 | 50C0M31/6 | 50L6GT 8/6 | 50P10 4/6 | 50P12 4/6 | 50P14 4/6 | 50P16 4/6 | 50P18 4/6 | 50P20 4/6 | 50P22 4/6 | 50P24 4/6 | 50P26 4/6 | 50P28 4/6 | 50P30 4/6 | 50P32 4/6 | 50P34 4/6 | 50P36 4/6 | 50P38 4/6 | 50P40 4/6 | 50P42 4/6 | 50P44 4/6 | 50P46 4/6 | 50P48 4/6 | 50P50 4/6 | 50P52 4/6 | 50P54 4/6 | 50P56 4/6 | 50P58 4/6 | 50P60 4/6 | 50P62 4/6 | 50P64 4/6 | 50P66 4/6 | 50P68 4/6 | 50P70 4/6 | 50P72 4/6 | 50P74 4/6 | 50P76 4/6 | 50P78 4/6 | 50P80 4/6 | 50P82 4/6 | 50P84 4/6 | 50P86 4/6 | 50P88 4/6 | 50P90 4/6 | 50P92 4/6 | 50P94 4/6 | 50P96 4/6 | 50P98 4/6 | 50P100 4/6 |
|------------|---------|----------|---------|------------|---------|------------|---------|------------|----------|-----------|----------|------------|----------|-------------|----------|-------------|------------|-------------|------------|------------|-----------|------------|-----------|------------|----------|------------|----------|------------|----------|-------------|-----------|--------|----------|----------|----------|-----------|-----------|----------|-----------|-----------|------------|------------|-----------|-----------|----------|----------|----------|----------|----------|------------|------------|----------|---------|--------|---------|--------|----------|--------|----------|--------|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|

TRANSISTORS, ZENER DIODES, ETC.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------|-----------|------------|-----------|-------------|----------|----------|----------|------------|-----------|-------------|-----------|----------|----------|------------|-----------|---------|------------|----------|----------|-------------|-----------|---------|------------|----------|----------|------------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------|
| 0A5 3/- | 0C15 10/- | 2N1091 9/6 | AF126 6/6 | CR81/10 5/- | GT43 5/- | 0A10 3/- | 0C41 6/- | 2N1306 7/6 | AF126 6/6 | CR81/20 9/6 | JK6A 22/6 | 0A47 2/6 | 0C70 4/- | 2N1307 7/6 | AF127 6/6 | CR81/30 | JK10A 15/- | 0A79 2/6 | 0C71 3/- | 2N3093 10/6 | AF128 6/6 | CR81/35 | JK11A 12/6 | 0C72 2/6 | 0C73 6/- | AC107 10/6 | AFY19 22/6 | CR81/40 | JK12A 22/6 | 0C74 2/6 | 0C75 6/- | AC126 6/6 | AFY21 17/6 | CR81/45 | JK19A 17/6 | 0C76 2/6 | 0C77 6/- | AC127 7/6 | AFY22 10/6 | CR83/05 | MAT100 7/6 | 0C78 2/6 | 0C79 6/- | AC128 6/6 | AFY23 10/6 | CR83/10 | MAT101 8/6 | 0C80 2/6 | 0C81 3/- | AC129 6/6 | AFY24 10/6 | CR83/15 | MAT102 8/6 | 0C82 2/6 | 0C83 6/- | AC130 6/6 | AFY25 10/6 | CR83/20 | MAT103 8/6 | 0C84 2/6 | 0C85 6/- | AC131 6/6 | AFY26 10/6 | CR83/25 | MAT104 8/6 | 0C86 2/6 | 0C87 6/- | AC132 6/6 | AFY27 10/6 | CR83/30 | MAT105 8/6 | 0C88 2/6 | 0C89 6/- | AC133 6/6 | AFY28 10/6 | CR83/35 | MAT106 8/6 | 0C90 2/6 | 0C91 6/- | AC134 6/6 | AFY29 10/6 | CR83/40 | MAT107 8/6 | 0C92 2/6 | 0C93 6/- | AC135 6/6 | AFY30 10/6 | CR83/45 | MAT108 8/6 | 0C94 2/6 | 0C95 6/- | AC136 6/6 | AFY31 10/6 | CR83/50 | MAT109 8/6 | 0C96 2/6 | 0C97 6/- | AC137 6/6 | AFY32 10/6 | CR83/55 | MAT110 8/6 | 0C98 2/6 | 0C99 6/- | AC138 6/6 | AFY33 10/6 | CR83/60 | MAT111 8/6 | 0C100 2/6 | 0C101 6/- | AC139 6/6 | AFY34 10/6 | CR83/65 | MAT112 8/6 | 0C102 2/6 | 0C103 6/- | AC140 6/6 | AFY35 10/6 | CR83/70 | MAT113 8/6 | 0C104 2/6 | 0C105 6/- | AC141 6/6 | AFY36 10/6 | CR83/75 | MAT114 8/6 | 0C106 2/6 | 0C107 6/- | AC142 6/6 | AFY37 10/6 | CR83/80 | MAT115 8/6 | 0C108 2/6 | 0C109 6/- | AC143 6/6 | AFY38 10/6 | CR83/85 | MAT116 8/6 | 0C110 2/6 | 0C111 6/- | AC144 6/6 | AFY39 10/6 | CR83/90 | MAT117 8/6 | 0C112 2/6 | 0C113 6/- | AC145 6/6 | AFY40 10/6 | CR83/95 | MAT118 8/6 | 0C114 2/6 | 0C115 6/- | AC146 6/6 | AFY41 10/6 | CR83/100 | MAT119 8/6 | 0C116 2/6 | 0C117 6/- | AC147 6/6 | AFY42 10/6 | CR83/105 | MAT120 8/6 | 0C118 2/6 | 0C119 6/- | AC148 6/6 | AFY43 10/6 | CR83/110 | MAT121 8/6 | 0C120 2/6 | 0C121 6/- | AC149 6/6 | AFY44 10/6 | CR83/115 | MAT122 8/6 | 0C122 2/6 | 0C123 6/- | AC150 6/6 | AFY45 10/6 | CR83/120 | MAT123 8/6 | 0C124 2/6 | 0C125 6/- | AC151 6/6 | AFY46 10/6 | CR83/125 | MAT124 8/6 | 0C126 2/6 | 0C127 6/- | AC152 6/6 | AFY47 10/6 | CR83/130 | MAT125 8/6 | 0C128 2/6 | 0C129 6/- | AC153 6/6 | AFY48 10/6 | CR83/135 | MAT126 8/6 | 0C130 2/6 | 0C131 6/- | AC154 6/6 | AFY49 10/6 | CR83/140 | MAT127 8/6 | 0C132 2/6 | 0C133 6/- | AC155 6/6 | AFY50 10/6 | CR83/145 | MAT128 8/6 | 0C134 2/6 | 0C135 6/- | AC156 6/6 | AFY51 10/6 | CR83/150 | MAT129 8/6 | 0C136 2/6 | 0C137 6/- | AC157 6/6 | AFY52 10/6 | CR83/155 | MAT130 8/6 | 0C138 2/6 | 0C139 6/- | AC158 6/6 | AFY53 10/6 | CR83/160 | MAT131 8/6 | 0C140 2/6 | 0C141 6/- | AC159 6/6 | AFY54 10/6 | CR83/165 | MAT132 8/6 | 0C142 2/6 | 0C143 6/- | AC160 6/6 | AFY55 10/6 | CR83/170 | MAT133 8/6 | 0C144 2/6 | 0C145 6/- | AC161 6/6 | AFY56 10/6 | CR83/175 | MAT134 8/6 | 0C146 2/6 | 0C147 6/- | AC162 6/6 | AFY57 10/6 | CR83/180 | MAT135 8/6 | 0C148 2/6 | 0C149 6/- | AC163 6/6 | AFY58 10/6 | CR83/185 | MAT136 8/6 | 0C150 2/6 | 0C151 6/- | AC164 6/6 | AFY59 10/6 | CR83/190 | MAT137 8/6 | 0C152 2/6 | 0C153 6/- | AC165 6/6 | AFY60 10/6 | CR83/195 | MAT138 8/6 | 0C154 2/6 | 0C155 6/- | AC166 6/6 | AFY61 10/6 | CR83/200 | MAT139 8/6 | 0C156 2/6 | 0C157 6/- | AC167 6/6 | AFY62 10/6 | CR83/205 | MAT140 8/6 | 0C158 2/6 | 0C159 6/- | AC168 6/6 | AFY63 10/6 | CR83/210 | MAT141 8/6 | 0C160 2/6 | 0C161 6/- | AC169 6/6 | AFY64 10/6 | CR83/215 | MAT142 8/6 | 0C162 2/6 | 0C163 6/- | AC170 6/6 | AFY65 10/6 | CR83/220 | MAT143 8/6 | 0C164 2/6 | 0C165 6/- | AC171 6/6 | AFY66 10/6 | CR83/225 | MAT144 8/6 | 0C166 2/6 | 0C167 6/- | AC172 6/6 | AFY67 10/6 | CR83/230 | MAT145 8/6 | 0C168 2/6 | 0C169 6/- | AC173 6/6 | AFY68 10/6 | CR83/235 | MAT146 8/6 | 0C170 2/6 | 0C171 6/- | AC174 6/6 | AFY69 10/6 | CR83/240 | MAT147 8/6 | 0C172 2/6 | 0C173 6/- | AC175 6/6 | AFY70 10/6 | CR83/245 | MAT148 8/6 | 0C174 2/6 | 0C175 6/- | AC176 6/6 | AFY71 10/6 | CR83/250 | MAT149 8/6 | 0C176 2/6 | 0C177 6/- | AC177 6/6 | AFY72 10/6 | CR83/255 | MAT150 8/6 | 0C178 2/6 | 0C179 6/- | AC178 6/6 | AFY73 10/6 | CR83/260 | MAT151 8/6 | 0C180 2/6 | 0C181 6/- | AC179 6/6 | AFY74 10/6 | CR83/265 | MAT152 8/6 | 0C182 2/6 | 0C183 6/- | AC180 6/6 | AFY75 10/6 | CR83/270 | MAT153 8/6 | 0C184 2/6 | 0C185 6/- | AC181 6/6 | AFY76 10/6 | CR83/275 | MAT154 8/6 | 0C186 2/6 | 0C187 6/- | AC182 6/6 | AFY77 10/6 | CR83/280 | MAT155 8/6 | 0C188 2/6 | 0C189 6/- | AC183 6/6 | AFY78 10/6 | CR83/285 | MAT156 8/6 | 0C190 2/6 | 0C191 6/- | AC184 6/6 | AFY79 10/6 | CR83/290 | MAT157 8/6 | 0C192 2/6 | 0C193 6/- | AC185 6/6 | AFY80 10/6 | CR83/295 | MAT158 8/6 | 0C194 2/6 | 0C195 6/- | AC186 6/6 | AFY81 10/6 | CR83/300 | MAT159 8/6 | 0C196 2/6 | 0C197 6/- | AC187 6/6 | AFY82 10/6 | CR83/305 | MAT160 8/6 | 0C198 2/6 | 0C199 6/- | AC188 6/6 | AFY8 |
|---------|-----------|------------|-----------|-------------|----------|----------|----------|------------|-----------|-------------|-----------|----------|----------|------------|-----------|---------|------------|----------|----------|-------------|-----------|---------|------------|----------|----------|------------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|----------|----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|---------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------------|----------|------------|-----------|-----------|-----------|------|

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER



5 watts high quality output on each channel. Sensitive 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Valve line-up ECC83, ECC83, EL84, E281. For 2-3 ohm speakers. **£8.15/0**

Complete kit, with full wiring diagrams and instructions. Carr. 10/- Or supplied factory assembled with 12 months' guarantee for **11 nra. Terms:** Dep. 36/- and 9 monthly payments 25/5 (Total £13/8/6). Carr. 11/6.

LOUDSPEAKER CORNER CONSOLE CABINETS.

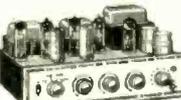
Attractive design with polished walnut finish. Model 8 for 12" speaker and Model 10 for 10" speaker. Size 28x18x12in. **59/11** (tweeter, size 31x22x14in. **5 Gns.**

BASS REFLEX CABINETS FITTED HI-FI 8in. LOUDSPEAKER

Limited number. Finish imitation walnut. Provides excellent reproduction. Peak rating 10 watts. Response 45-15,000 c.p.s. Optional **7 Gns.** Carr. 8/6. 3 ohm or 16 ohm impedance. Size approx. 17 x 12 x 9ins.

R.S.C. STEREO/20 HIGH FIDELITY AMPLIFIER

PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE" GRAM, RADIO OR TAPE 7 Valves ECC83 (2), ECL80 (4), E281. Frequency Response: ±2dB 30-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 20 millivolts max. Harmonic Distortion (each channel): 0.2%. Four-position tone compensation and Input Selector Switch. *Stereo/Mono switch. *Neon panel indicator. *Handsome Perspex Frontplate. *Separate Bass and treble controls. Output transformers point-to-point wiring diagrams. Carr. 12/6. High-quality sectionally wound. Outputs for 3 and 16 ohm speakers. Or factory assembled, with our usual 12 months' guarantee for **19 nra. Carr. 12/6.** Or send Deposit **£3** and 9 monthly payments of **43/2** (Total **£22/8/6**). Send S.A.E. for leaflet.



R.S.C. A10 HIGH FIDELITY 30 WATT AMPLIFIER

Highly sensitive. Push-Pull high output, with Precision Tone Control Klaxon. Performance figures equal to most expensive amplifiers available. Hum level -70dB. Frequency response ±3dB 30-20,000 c/s. Specially designed sectionally wound ultra linear output transformer with 807 output valves. All first grade components. Valves EP84, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that any kind of Microphone or Pick-up is suitable. Designed for Clubs, Schools, Theatres, Dance Halls or Outdoor Functions, etc. For use with Electronic Organ, Guitar, String Bass, etc., Gram, Radio or Tape. Reserve L.T. and H.T. for Radio Tuner. Two inputs with associated volume controls so that two separate inputs such as Gram, and "Mike" can be mixed. 200-250 v. 50 c/s. A.C. mains. For 3 and 15 ohm speakers. Complete kit with point-to-point wiring diagrams and instructions. Carr. 12/6. Supplied factory built with EL34 output valves. 12 months' guarantee for **15 nra. Terms: Deposit 45/-** and 9 monthly payments of **33/2** (Total **£17/10/3**). Twin-handled perforated cover can be supplied for **25/-**. Send S.A.E. for leaflet.



R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allow mixing of "Mike" and gram, etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, E281. High quality sectionally wound output transformer and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. Frequency response ±3dB 30-20,000 c/s. Six negative feedback loops. Hum level -60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s all types "mikes." Comparable with the very best designs. For Musical Instruments such as String Bass, Electronic Guitars, etc. Reserve Power 300 v. 30 mA. and 4.3 v. 1.5 A. for Radio Tuner or Tape Pre-Amp. Size approx. 12 x 9 x 7in. For A.C. mains 200-250 v 50 c.p.s. Output for 3 and 15 ohm speakers. Complete kit. Full instructions and comprehensive wiring diagrams. **£8.15/0** (or factory built with 12 months guarantee **£11/15/6**). Carr. 12/6. 11/6. S.A.E. for leaflet. **TERMS: Deposit 36/6** and 9 monthly payments of **25/9** (Total **£13/8/3**). Twin handled metal cover available at **25/-** extra.



R.S.C. A11T TRANSISTORISED VERSION

of above Complete Kit **9 Carr. 9/6 Gns.**

TWO-WAY TELEPHONE AMPLIFIERS only £3.19.9

Dry-batt. operated. Listen and talk back with both hands free. A handsome, highly efficient Japanese product.

R.S.C. 4 watt GRAM AMPLIFIER KIT

Complete set of parts to build a good quality compact unit suitable for use with any record playing unit. Mains isolated chassis. Separate Bass and Treble controls. Output for 2-3 ohm speaker. For 200-250 v. A.C. **59/11**

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12 v. D.C. output. Max. A.C. input 18 v. 1a. 3/11. 2a 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9. 10a. 25/9. 24v. 15a. 35/9.

POWER PACK KIT

Consisting of mains transformer. Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250 v. A.C. mains. Output 250 v. 60 mA. 4.3 v. 2a. Supplied with case in lieu of chassis **26/11**. Or **22/11** assembled **39/11**.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery illuminator. Size 5 1/2 x 4 1/2 x 2 1/2 approx. Completely replaces batteries supplying 1.5 v. and 90 v. where A.C. mains 200/250 v. 50 c/s is available. Complete kit with diagram **47/9** or ready for use **59/11**.



R.S.C. 6/12v CAR BATTERY CHARGER KITS

For 200-250 v. A.C. mains with variable charge rate selector. Complete kit with Ammeter and circuit.

4 amp 49/9. 6 amp Heavy Duty 69/9

All types factory built 10/- extra.



GLASGOW - LONDON

New branches open. See opposite page

R.S.C. COLUMN SPEAKERS

Covered in two-tone Relexine/Vynallic for vocalists and Public Address. 15 ohm matching. Type C48. 25-30 WATTS. Fitted four 8in. high flux 7 watt speakers. Overall size approx. 42 x 10 x 5in. Or Deposit **44/-** and 9 monthly payments **34/9. 15 Gns.** (Total **£18/1/6**). Carr. 10/-. Type C412. 40 WATTS. Fitted four 12in. 12,000 line 10 watt speakers. Overall size approx. 56 v. 14 x 9in. Carr. 15/-. **22 Gns.** Or Deposit **£3/13/-** and 9 monthly payments of **50/-** (Total **£26/3/-**).

12in. HIGH QUALITY L'SPEAKERS

In leak vented cabinets. 10 Watt Model. Gauss 12,000 lines, 3 or 15 ohms. **5 Gns.** 20 Watt Model. 15 ohm. Size 18x18x10in. Gauss 12,000 lines **8 Gns.** Terms available Relexine covered 10/- extra. 30 Watt Model. Relexine covered **10 gns.**

LOUDSPEAKERS

Limited number at fraction of list price. 15 ohm impedance. Brand new, guaranteed. Terms available.

12in. 20 WATT DUAL CONE £5.11.9 Carr. 6/9.

12in. 30 WATT DUAL CONE £6.19.9 Normally £13 approx. Carr. 10/-.

15in. 40 WATT £12 Gns. Carr. 15/-.

Massive units. Usually 18 gns.

FANE 18in. 100 WATT SPEAKER

Specially constructed for tremendous power handling. Peak 200 watts. (Guaranteed 2 years). **19 Post free GNS.**

TRANSISTOR SALE

Mullard OC71, OC72, OC18, 2/11. OC44, OC45, 3/11. OCT5, 7/9. AF117 6/9. Post 6d. for 3.

FM DIAL & DRIVE ASSEMBLIES 13/9

Jackman Bros. SL16. Sealed 0-100 with escutcheon

T.V. ELECTROLYTICS

200 mfd., 150-150 mfd., 100-200 mfd., 100-100 mfd., 350v., 100-200-60-25 mfd., 300v. 30/- doz. mixed. Mail order only.

STAAR 9v. GRAM TURNTABLES 3 GNS.

2-speed, 33 and 45 r.p.m. with pick-up.

HEAVY DUTY SELENIUM RECTIFIERS

12v. 15 amps. P.W. (Bridged) Only **19/9**

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primarys 200-250v. 50c/s. Screened.

MIDGET CLAMPED TYPE 21 x 21 x 21in.

250v. 40mA. 6.3v. 2a. 14 11
250v. 0-250v. 40mA. 6.3v. 2a. 15 11

FULLY SHROUDED THROUGH MOUNTING

250-0-250v. 60mA. 6.3v. 2a. 0-5-6.3v. 2a. 10/9
250-0-250v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 33/9
300-0-300v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 33/9
300-0-300v. 130mA. 6.3v. 4a. c.t. 6.3v. 1a. 33/9

For Mullard 510 Amplifier 41 9
350-0-350v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 33/9
350-0-350v. 150mA. 6.3v. 4a. 0-5-6.3v. 3a. 42/9
425-0-425v. 200mA. 6.3v. 4a. c.t. 5v. 3a. 67/9
425-0-425v. 200mA. 6.3v. 4a. 0-5-6.3v. 3a. 67/9
450-0-450v. 250mA. 6.3v. 4a. c.t. 5v. 3a. 78/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA. 6.3v. 2a. 0-5-6.3v. 2a. 10/9
250-0-250v. 100mA. 6.3v. 3a. 21/9
250-0-250v. 100mA. 6.3v. 2a. 6.3v. 1a. 22/9
350-0-350v. 80mA. 6.3v. 2a. 0-5-6.3v. 2a. 23/9
250-0-250v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 32/9
300-0-300v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 32/9
300-0-300v. 130mA. 6.3v. 4a. 0-5-6.3v. 1a. 39/9
Suitable for Mullard 510 Amplifier ... 39/9
350-0-350v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 39/9
350-0-350v. 160mA. 6.3v. 4a. 0-5-6.3v. 3a. 39/11

FILAMENT or TRANSISTOR POWER PACK Types

6.3v. 1.5a. 6/9. 6.3v. 2a. 7/9. 6.3v. 3a. 9/9. 6.3v. 6a. 18/9.
12v. 1a. 8/9. 12v. 3a. or 24v. 1.5a. 19/9.
6.3v. 1.5a. 12/9. 0-2-2-4-2v. 25v. 27/9.
CHARGER TRANSFORMERS 0-9-15v. 1.5a. 13/11.
2a. 16/11. 3a. 18/11. 6a. 21/11. 6a. 25/11. 8a. 31/11.

AUTO (Step Up/Step Down) TRANSFORMERS.

0-110/150v. 20-250 watts. 14/9
150 watts. 20/11. 250 watts. 49/9. 500 watts 99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000Ω to 7,000 Ω to 3Ω
Push-Pull 8 watts EL84 to 3Ω or 15Ω ... 11/9
Push-Pull 10 watts 6V8 EL84 to 3, 5, 8 or 15Ω ... 15/2
Push-Pull EL84 to 3 or 15Ω 10-12 watts 19/9
Push-Pull Ultra Linear for Mullard 510, etc. 35/9
Push-Pull 15-18 watts, sectionally wound 4L6, KT66, etc. for 3 or 15Ω ... 29/9
Push-Pull 20 watt high quality sectionally wound, EL24, EL6, KT66, etc. to 3 or 15Ω fully shrouded ... 55/9

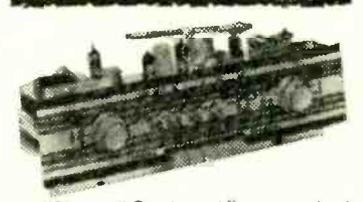
SMOOTHING CHOKES

150mA. 7-10H. 250Ω 12/9
100mA. 10H. 200Ω 9/11
40mA. 10H. 250Ω 7/9
60mA. 10H. 400Ω 4/11



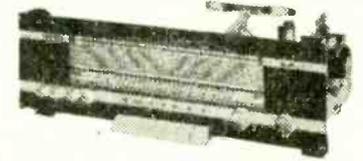
1/2 PRICE SPECIAL RADIO CHASSIS OFFERS

HI-FI CONTINENTAL STEREOPHONIC RADIOGRAM CHASSIS



Magnificent "Continental" stereophonic Radiogram chassis with piano key switches, built-in ferrite rod aerial. Comes complete with two 10in. elliptical loudspeakers, plus a mono/stereo 4-speed automatic record changer. Complete 29 1/2 gns. (Units available separately if required. Chassis only 21 gns.) Special terms available of £7/15/0 deposit followed by 18 monthly payments of £1/10/8 (total H.P. of £35/7/0) plus 17/6 P.P. Send £8/12/6 now.

IMPERIAL HI-FI STEREOPHONIC RADIOGRAM CHASSIS



The Imperial stereophonic 4-waveband chassis has the most advanced specifications yet offered in this country. There is a built-in ferrite rod aerial, seven piano key buttons, controlling mono/stereo selection, Gram Long-Medium-Short-FM-ON/OFF. The unit comes complete with two 10in. elliptical loudspeakers plus a mono/stereo 4 speed automatic record changer. Complete £41/9/6. Chassis only 29 1/2 Gns. Special terms available of £10/7/6 deposit followed by 24 monthly payments of £1/12/6 (total H.P. £49/7/6) plus 17/6 P.P. Send £11/5/0 now.



This most advanced Radiogram chassis with automatic push button selection covers Short, Medium and Long wavebands, plus V.H.F./F.M. Offered complete with 2 10 x 6 speakers, 4 speed Stereo/Mono autochanger, only £35/19/6. Chassis only 25 1/2 gns. Special terms available of £9 deposit followed by 18 monthly payments of £1/15/8 (total H.P. £41/2/0) plus 17/6 P. & P. Send £9/17/6 now.

All Lewis Radio equipment including valves is fully guaranteed for one year, free of charge. Send your cheque or P.O. today while stocks last to Dept. W.117.

LEWIS radio

LEWIS RADIO, 100, CHASE SIDE, SOUTHGATE LONDON, N.14. Telephone: PAL 3733/9666

WW-121 FOR FURTHER DETAILS

Lasky's Radio

DON'T MISS THIS!

GREAT NEWS!

THIS YEAR LASKY'S CELEBRATE THEIR 35th ANNIVERSARY

35 Great Years of service to you based on fair prices and value.

To celebrate our success and your satisfaction we are publishing a 12-page, fully illustrated, colour

"35th Birthday Pictorial" Catalogue

Printed in large 16" x 11in. modern magazine format the "Birthday Pictorial" contains thousands of different items from our vast stocks of Radio, Hi-Fi, TV, Test Gear, Components, Communications and other equipment.

PLUS many bargain offers and prices exclusive to Lasky's

AND in addition every copy of the "Birthday Pictorial" is numbered and automatically enters you in our great "Birthday Draw" with over £100 in Gift Vouchers to be won.

All goods shown in the "Birthday Pictorial" are available over the counter from any of our branches—or by post to any address in the U.K. or overseas—bringing the benefits of shopping at Lasky's to you in your home.



PUBLICATION DATE NOVEMBER. Make sure of your copy **NOW**—just send your address and 4d stamp for postage. **A MUST FOR EVERY ELECTRONICS & HI-FI ENTHUSIAST!**

RECORD PLAYERS



B.S.R. AUTOCHANGERS NEW LOW PRICES

Fully guaranteed complete with cartridge and stylus
 UA16 ov. battery model £5 19 6
 UA20 4-speed mains model £5 19 6

NEW—B.S.R. UA70 (Illustrated)
 4 speed mains autochanger superb modern styling at amazingly low price
LASKY'S PRICE £9/19/6 (ex cartridge)

GARRARD AUTOCHANGERS

| | |
|------------------------------|----------|
| AT60 Mk. I | £9 19 6 |
| AT60 Mk. II | £12 19 6 |
| 3000LM with stereo cartridge | £8 19 6 |
| AT9 | £17 17 0 |
| Lab. A Mono/Stereo | £14 19 6 |
| Lab. A on plinth | £15 19 6 |
| AG0 | £7 17 0 |

| | |
|---------------------------------|---------|
| A1000 | £6 8 0 |
| A2000 | £5 18 6 |
| GARRARD BASES | |
| WB1 | £3 16 3 |
| WB2 | £5 5 0 |
| CLEARVIEW PERSPEX COVERS | |
| WB1 | £5 17 0 |
| WB2 | £5 7 11 |

TRANSCRIPTION MOTORS

| | |
|-------------------------|----------|
| GARRARD 401 | £27 19 0 |
| GARRARD Lab. 80, Mk. II | £25 0 0 |
| CONNOISSEUR | |
| Craftsman II | £17 2 11 |
| Craftsman III | £22 19 6 |
| Model B | £25 4 0 |
| LENCO GL58 | £17 1 9 |
| LENCO GL68 | £19 10 7 |
| LENCO G88 | £15 15 0 |
| LENCO GL70 | £29 18 8 |
| LENCO G99 | £21 19 5 |
| THORENS TD135 I | £26 5 0 |
| THORENS TD135 II | £40 5 8 |
| THORENS TD124 II | £40 5 8 |
| THORENS TD150 | £20 13 2 |

SINGLE PLAYERS

| | |
|--|----------|
| Auto. start and stop. Complete with pick-up and crystal cartridge. | |
| EMI with Stereo cartridge | £3 19 6 |
| COLLARO Junior 4-speed | £3 9 6 |
| GARRARD SRP12 | £4 7 6 |
| GARRARD SRP10 mains model | £4 19 6 |
| GARRARD SRP10 batt. model | £4 19 6 |
| GARRARD SP25 Light 1/2table | £9 19 6 |
| GARRARD SP25 Heavy 1/2table (Garrard SP25's are ex-cartridge) | £10 19 6 |
| PHILIPS AG1016 | £12 12 0 |
| BRAUN FCAL Stereo | £8 19 6 |

All other current models available. Postage on all above 5/- extra.

SPEAKERS



FOSTER FCS 104 SYSTEM

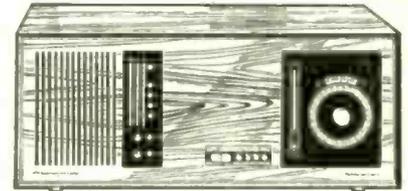
A new high quality bookshelf speaker system, incorporating the latest developments in speaker miniaturisation and has a performance equal to many larger and more expensive units. The sealed infinite baffle type housing is finished in high quality teak veneer. The system comprises a 4in. dual range speaker, tweeter and crossover network—for 8 W, 16Ω imp. operation. Screw tag connections at rear. Cabinet size 9½ x 6½ x 6½in.

LASKY'S PRICE £9.19.6 2 FOR £18 POST 10/-
 Post—5/-.

HUGE PURCHASE OFFER

DEFINITELY THE MOST AMAZING BARGAIN OF THE YEAR!

SHAUB-LORENZ



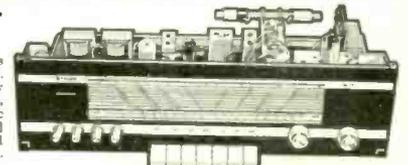
MUSIC CENTRE MODEL 5001 COMBINED 126 TRACK TAPE RECORDER AND VHF/MW/LW/SW RADIO

IDEAL FOR CLUBS, DISCOTHEQUES, RESTAURANTS AND ESPECIALLY HI-FI ENTHUSIASTS.

An incomparable piece of equipment—combining 126 track tape recorder and 4 band radio in one unit of outstanding modern design. The recorder section of the Music Centre gives an almost unbelievable 48 hours continuous unrepeatable playing time—that's right 48 hours on 126 tracks. **Brief Spec, Tape Section:** 20 transistor and 9 diode circuit, a wide magnetic tape records 126 separate tracks of 22 minutes each. Every track is able to record/replay instantly and runs from track one to 126 completely automatically so that you need not touch the machine for the total 48 hours record/replay time. Rewind time for each 22 minute track only 25 seconds. Tape speed 10.5 cm. sec. Frequency response 14-40000 HZ. Inputs for direct recording for V.H.F., external microphone, record player. Pause control fitted. **Radio Amplifier Section:** 7 transistors and 6 diode circuit, 4 bands VHF/Medium/Long/Short with exclusive "Auto Control" which takes over the precise tuning into the station required. Bass and Treble Control. Output 10 watts. Built 10in. loud speaker and tweeter. Sockets for extension speakers. Beautifully finished dark polished wood cabinet size 21 x 13 x 11in. Brand New, boxed and fully guaranteed. Complete with switched audio input adaptor. **Lasky's huge purchase enables us to offer this amazing equipment at a fantastic saving. Value over £200.**

LASKY'S PRICE £61.19.0 Carriage and Package anywhere in the U.K., 30/-.

ANOTHER BULK PURCHASE SCOOP STEREO AM/FM RADIOGRAM CHASSIS BY FAMOUS GERMAN MANUFACTURER



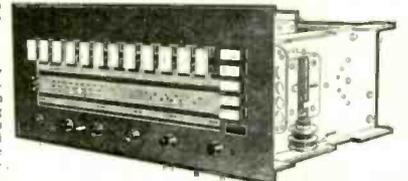
Long, medium and short wave bands coverage, plus VHF FM multiplex. Piano key wave change, separate fly wheel tuning on AM and FM, bass, treble and balance controls, and magic eye tuning indicator. Ferrite Rod aerial. The very latest printed circuitry. Output 6 watts per channel. Complete with multiplex decoder. 5 Valves, line-up: ECC85, ECH801, ECC83, ELL80, EAF801. Full vision tuning scale size: 21 x 6in. Overall dimensions: 21 x 6½ x 8in. Made to very highest standards.

LASKY'S PRICE £38. 6. 6 Carriage and Package 10/-.

AVAILABLE WITHOUT MULTIPLEX, £33.12.0 C & P 8/6.

AMPLIFIERS

SOLID STATE MULTIPLEX STEREO AM/FM TUNER AMPLIFIER CHASSIS



Model T10E—made for U.K. use by famous North American manufacturer and originally installed in De Luxe Hi-Fi console costing several hundred pounds. The chassis is of outstanding appearance and quality and offers many unique features plus an extremely compact, prehensile spec.

Features: • Separate transistorised AM and FM tuners • 3 AM wavebands—L.V. MW and Continental T.R. band • full FM cover with 5 push-button preselected stations (sep. tuning controls for AM and FM ranges) • built-in multiplex decoder with unique FMX feature which provides automatic switching from mono to stereo when stereo signal is received and vice versa • unique split amplifier facility for simultaneous play of radio plus any other source • channel reverse • switched inputs for tape and auxiliaries (sep. sockets for tape in and out) • switched extension speaker outlet • thermal safety trip • socket for stereo headphones. **TECH. spec:** Output 10 watts RMS per channel output imp. 50 p.c.; sensitivity 50mV for 8W output at 1 Kc/s.; input imp. 100K p.c.; 12 unique lumbar type function controls, 8 push-button wavechange and station selection controls, vol., bass, treble and balance controls, push-button contour (loudness) control; illuminated tuning scale; AM ranges: MW 520-1640 kc/s., LW 140-290 kc/s., Continental T.B. 170-345 kc/s.; FM range 88-108 Mc/s. with switched AFC. Operates on 200/250 V. A.C. 50 or 60 c/s. Size: 17½ x 8 x 12½in.

LASKY'S PRICE £61.19.0 FEW ONLY Post & Packing 20/-.

SANSUI MODEL MP-2 STEREO MULTIPLEX DECODER

A high quality auxiliary decoder, see illustration last month, for use with an FM stereo Tuner/Amplifier without multiplex or with a stereo amplifier and sep. FM tuner without multiplex. The unit is housed in a free standing hammer enamel metal cabinet with brushed aluminium control panel and knobs—size 4½ x 4½ x 12½in. Controls for power on/off filter (interference reducer) and dimension (separation) control. Power on neon and stereo beacon which lights when stereo signal is received. **Brief Spec.:** 3 valves with Germanium and Silicon Diodes; Frequency response: 50 c/s to 15 Kc/s.—2dB; Channel separation: over 35 dB at 1 Kc/s.; distortion less than 1% at 0.2-3 v. input signal. Operates on 200/250 V. A.C. Complete with connecting leads and full instructions.

LASKY'S PRICE NOW £8.19.6 Post 5/-.

LASKY'S RADIO FOR FINEST VALUE and COURTEOUS SERVICE

WW-122 FOR FURTHER DETAILS

Lasky's Radio

TAPE RECORDERS

JUST ARRIVED—FANTAVOX TAPE CASSETTE PLAYER

This machine is the first of its type and is designed specifically to replay pre-recorded tape cassettes made for the PHILIPS and other cassette systems. The cassette is simply slipped into the machine and is immediately ready to play—each cassette gives over 40 minutes' play—(twin track), no loss of time in rewinding—simply turn cassette over. Constant tape speed 1 1/2 i.p.s. Only two controls off/play and vol. Fully transistorised, powerful vol. built-in speaker, socket for personal earpiece. Operates on 6 pen-light cells. Very attractively styled shockproof plastic cabinet size 6 1/2 x 4 1/2 x 2 1/2 in. with wrist strap. Complete with earpiece and batteries. There are now over 200 music/casette titles available. JAZZ, POP, SHOWS and CLASSICS—this machine allows you to play the music of your choice anywhere—anytime.



LASKY'S PRICE £9.19.6 Post 5/-.

OUTSTANDING VALUE—THE 'TELETON' 701

7-TRANSISTOR TWO-SPEED CAPSTAN DRIVE MAINS/BATTERY RECORDER

An outstandingly high quality machine that is unparalleled for value. Performance is equal on both mains and battery, excellent music and speech characteristics make this the ideal home or office recorder.



Look at these outstanding features:

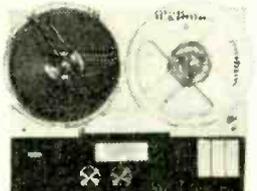
- 7 transistor and 3 diode circuit—800mW output.
- Two speed, 1 1/2 and 3 1/2 i.p.s. capstan drive system (new and better than 0.3% at 3 1/2 i.p.s.).
- Built-in 110/240 v. A.C. converter for mains operation or ones 4 x 1.4 v. batteries.
- Takes 6 in. spools giving 3 hrs. twin track recording at 1 1/2 i.p.s. and 1 1/2 hrs. at 3 1/2 i.p.s.
- Fast forward and rewind.
- Twin track A.C. bias recording system—frequency response 100 to 7,000 cps.
- Record level meter (acts as battery check on replay).
- Piano key function controls, plus vol. and tone controls.
- Coherent type 5 pin inputs for microphone, telephone adaptor, pick-up and direct recording from radio or other recorder; switched input for earphone.
- 2 1/2 x 4 1/2 in. Dynamic speaker.
- Plastic cabinet in two-tone grey with chrome metal trim and carrying handle.
- Accessories: Dynamic stick microphone with clip-on stand, telephone pick-up, 3 in. spool of tape and empty spool, earphone, direct recording lead mains lead with plug, batteries and instruction book with circuit comp. with all accessories. Fully guaranteed.

LASKY'S PRICE £22 Post FREE.

STUDIO DECKS

MAGNAVOX 363 TAPE DECKS

The very latest 3 speed model—1 1/2, 3 1/2, 7 1/2 i.p.s. available with either 1 track or 2 track head. Features include: pause control; digital counter; fast forward and rewind; new 4 pole fully screened induction motor; interlocking keys. Size of top plate 13 1/2 x 11 x 5 1/2 in. deep below unit plate. For 100/250 v. A.C. mains, 50 c.p.s. operation. New unused and fully guaranteed.



LASKY'S PRICE 1 track £10.10.0 Carriage and packing
LASKY'S PRICE 2 track £13.9.6 7/6 extra

SPECIAL FOR OVERSEAS CUSTOMERS—the new Magnavox-Collins 363 Deck for 110/125 v. 50 or 60 c.p.s. mains now available, price as above. Post to any part of the world, 35/-.

NEW MARTIN TAPE RECORD REPLAY AMPS.

Now available from stock—for use with the Magnavox 363 Tape Deck.
1 track model..... LASKY'S PRICE £14/19/6 Carriage & packing 4/6 extra
2 track model..... LASKY'S PRICE £15/19/6 Packing 4/6 extra
Optional Extra: Control counter/phon to tape deck and amplifier controls.
LASKY'S PRICE 12/6. Post & Packing 2/6.

MUSICASSETTES

There are now over 200 Musicassette titles available—Jazz—Pop—Shows—Classics—on Philips, Mercury, Fontana, C.B.S., Pye, Reprise, Chess, W.B., Kama Sutra. Page 1. Send S.A.E. for full list of titles.

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE AT RECORD LOW PRICES

| | | | |
|--|------|--|------|
| 3in. Message tape, 150ft. | 2/6 | 5 1/2in. Long play, 1,200ft. Acetate | 11/6 |
| 3in. Message tape, 225ft. | 3/6 | 5 1/2in. Standard play, 650ft. P.V.C. | 11/6 |
| 3in. Message tape, 300ft. | 4/6 | 5 1/2in. Triple play, 2,400ft. Mylar | 45/- |
| 3 1/2in. Triple play, 900ft. Mylar | 10/- | 5 1/2in. Long play, 1,200ft. Mylar | 15/- |
| 4in. Triple play, 900ft. Mylar | 17/6 | 7in. Standard play, 1,200ft. Acetate | 12/6 |
| 5in. Double play, 1,200ft. Mylar | 15/- | 7in. Miniatur play, 1,200ft. Mylar | 12/6 |
| 6in. Long play 900ft. Acetate | 10/- | 7in. Long play, 1,800ft. Mylar | 19/6 |
| 5in. Standard play, 600ft. P.V.C. | 8/6 | 7in. Double play, 2,400ft. Mylar | 25/- |
| 5in. Triple play, 1,800ft. Mylar | 35/- | 7in. Long play, 1,800ft. Acetate | 15/- |
| 5 1/2in. Double play, 1,800ft. Mylar | 22/6 | 7in. Triple play, 3,600ft. Mylar | 50/- |

1/- Post extra per reel; 4 reels and over Post Free.

SPECIAL INTEREST ITEMS!

TWO BAND TRANSISTOR CAR RADIO BARGAIN! MODEL CR-62

A new high-quality imported all-transistor superbet car radio that really breaks the quality/price barrier. Unique features of this set are the four M/V hand station pre-selection buttons which you yourself set to your own four favourite stations—this is in addition to full M/V hand cover over 150-300 kc/s. (IF frequency 455 kc/s) Externally adjustable aerial trimmers ensure maximum output. Six transistor (including one drift type) and one diode circuit provides powerful 2 W. output. The set is adjustable for use on either pos. or neg. ground 12 v. systems (external line fuse fitted). Standard mounting size 6 1/2 x 5 1/2 x 2 in.—front panel 4 in. larger all round—finished in anodised aluminium with black push buttons. Complete with mounting brackets, full installation instructions and 2 battie boards (for round or elliptical speaker). Fully guaranteed.



LASKY'S PRICE £9.19.6 Post 5/-.

6 x 4 in. elliptical 8 Ω dynamic speaker. 17/6 extra—Post FREE.

SPECIAL OFFER—LOCKING CAR AERIAL

Model 85003 five section 40 in. extension heavy chrome telescopic wing mounting type with unique locking device to protect the antenna when closed. Complete with mounting bracket, lead and plug and two "keys."

LASKY'S SPECIAL PRICE 39/6 Post free with the Royal CR-62. Sep. Post 2/6.

NEW FOR THE RECORDING ENTHUSIAST VOICE ACTUATED MICROPHONE

MODEL B 5001

This new voice actuated microphone is designed for use with tape recorders with facilities for remote control. The microphone is fitted with a three position switch allowing normal hand remote control, voice sensitivity action and off. The degree of voice or sound level required to operate the recorder can be adjusted. The microphone is self powered by one 9V (PP3 type) battery giving 6 to 10 hrs. operating time. Super sensitive 6 transistor circuit. Strong black plastic case. Length 7 1/2 in. Designed for hand-held use or lying flat. Fitted with 2.5 and 3.5 mm. plugs for fitting polarised sockets.



LASKY'S PRICE £6.19.6 Post 3/6.

EXPORT TTC B4002 FM WIRELESS MIC.

Highly sensitive—suitable for either static or mobile use. Signal can be picked up by any FM radio or tuner with recording frequencies between 86-104 Mc/s. over several hundred yards. size only 3 x 2 1/2 x 1 in. (in leather case). Operates on one PP3 type battery. Complete with neck cord, elliptical dynamic extension mike (1 1/2 x 3/8 in.) and battery.



LASKY'S EXPORT PRICE £6.19.6 Post Free. Anywhere in the World.

TTC 13/500. More powerful version of above—size 7 1/2 x 1 1/2 x 1 in. Operates on the PP3 type battery. LASKY'S PRICE 12 Gns. Post Free. Anywhere in the World.

MICROPHONE BARGAIN STC MODEL 414

A high quality omni-directional moving coil microphone—suitable for use with sound reinforcement and P.A. systems, tape recorders, transistor amplifiers, etc. Attractive grey moulded case for free standing or hand-held use—size 2 1/2 x 2 1/2 x 2 1/2 in. complete with 6ft. screened cable. New and unused in maker's cartons—fully guaranteed.



Type A. Low Imp. 200 Ω. LASKY'S PRICE £11/9 Post 2/-.
Type B. High Imp. 60K Ω. LASKY'S PRICE £2/5/-.

LASKY'S PANEL METERS

Precision made in clear plastic HIOKI of Japan. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Spec. quotes for quantities. Add 1/6 post on each.



| | | |
|-----------------------------------|--------|--------------|
| TYPE KR-52 3 x 2 1/2 in. (illus.) | 100 μA | 47/8 |
| 50 μA | 300 μA | 37/8 |
| 5 mA D.C. | 32/6 | 1 mA 8 Meter |
| 300 V D.C. | 32/6 | 39/9 |

| | | | |
|------------------------------|------|--------------------------|------|
| TYPE MK-38A 1 1/2 in. square | 22/6 | TYPE MK-45A 2 in. square | 25/- |
| 1 mA DC | 22/6 | 1 mA DC | 25/6 |
| 5 mA DC | 22/6 | 5 mA DC | 25/6 |
| 300 V DC | 22/6 | 300 V DC | 25/6 |
| 100 μA | 27/6 | 300 V DC | 25/6 |
| 50 μA | 27/6 | 300 μA | 35/- |
| 1 mA 8 Meter | 29/6 | 1 mA 8 Meter | 35/- |
| TYPE KR-65 3 1/2 x 3 in. | | TYPE MK-65A 3 in. square | 36/- |
| 1 mA DC | 36/- | 1 mA DC | 35/6 |
| 5 mA DC | 35/6 | 5 mA DC | 35/6 |
| 300 V DC | 35/6 | 300 V DC | 35/6 |
| 100 μA | 42/6 | 300 μA | 39/6 |
| 50 μA | 42/6 | 1 mA 8 Meter | 37/6 |
| 1 mA 8 Meter | 39/6 | | |

SINCLAIR SUPER MINIATURES

We stock the complete range. Write for details of package deals.

| | | | |
|--------------------------------|---------|--|---------|
| MICRO-FM (tuner/receiver) kit | £5 19 6 | Z-12 12 watt amp. and pre-amp. fully built | £4 9 6 |
| MICROMATIC miniature radio kit | £2 19 6 | PZ-3 POWER PACK for Z-12 | £3 19 6 |
| Fully built and tested | £3 19 6 | STEREO 25 pre-amp. control unit, fully built | £0 19 6 |
| Q-14 14 watt speaker system | £8 19 6 | | |

LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

WW-123 FOR FURTHER DETAILS

P.T.O. FOR MORE NEWS

Lasky's Radio

CONSTRUCTORS BARGAINS



THE SKYROVER DE LUXE

7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31-94M and also 4 separate switched band-spread ranges, 12M., 16M., 19M., and 26M., with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is factory assembled, wired and tested. Superhet, 470 Kc/s. Mullard Transistors. Uses 4 U2 batteries. 5in. Ceramic Magnet P.H. Speaker, 600 MW Output. Telescopic Aerial and Ferrite Rod Aerial. Tone Circuit. In wood cabinet, size 11 1/2 x 6 1/2 x 3 1/2 in. covered with washable material, plastic trim and handle. Car aerial socket fitted.

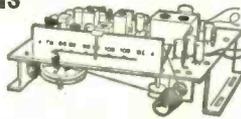
Can now be built for **£8.19.6** Post 5/- extra.

H.P. Terms: 60/- deposit and 11 monthly payments of 12/9 Total H.P.P. £10/0/3.

Data 2/6. Refunded if you purchase parcel. Four U2 batts. 3/4 extra. All components avail. sep. A simple additional circuit provides coverage of the 1100/1550M. Long Waveband. All necessary components with construction data. Only 10/- extra. Post Free. This conversion is suitable for receivers already constructed.

TRANSISTOR FM TUNER CHASSIS

Fully tunable—range 88 to 108 Mc/s. Completely wired on printed circuit. 10.3 Mc/s. 1F. 6 transistors and 3 diodes. Slow motion tuning drive. Size 6 1/2 x 4 x 2 1/2 in. Operates from any 9 v. D.C. source. Full data and circuit.



LASKY'S PRICE **£6.10.0** Post 5/- extra.

MULTIPLEX ADAPTOR

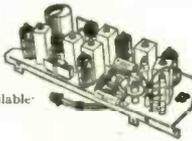
Now you can enjoy stereo sound with the FM Tuner above. Brief spec.: MPX input sensitivity 100mV. Output 150 mV. Self powered by a 9 v. battery. 4 transistor and 6 diode circuit. Size 6 1/2 in. x 2 in. x 1 1/2 in. Also suitable for use with other FM tuners with MPX input.

LASKY'S PRICE **99/6** Post 5/6.

PACKAGE PRICE IF BOUGHT TOGETHER **£11.11.0**. Post 5/-.

TELEVISION IF AMPLIFIERS

Famous Maker's Surplus. 38 Mc/s. Contains a large number of components: 1F transformers, resistors, capacitors, etc., and the following valves: 2 x PCF80, 1 x EB91, EP80, EP183 and EP184. Overall size 1 1/2 x 3 1/2 x 4 in. deep. Ideal for servicemen and experimenters. This IF amplifier when used with the Valve model UPH Tuner provides suitable conversion for B.B.C.2. No circuit available.



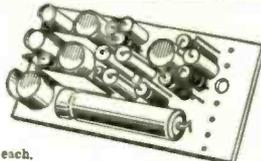
LASKY'S PRICE **29/6** Post and Packing 2/6.

BARGAIN—UHF TV TUNERS

Well known British maker's surplus stocks. Now available for the first time to the Home Constructor. Add 2/6 Post and Packing. **VALVE UHF MODEL.** In metal case, size 4 x 6 x 1 1/2 in. Fully tunable—complete with PC86 and PC88 valves. LASKY'S PRICE with valves, 29/6. Without valves 7/6.

LASKY'S MINIATURE TRANSISTOR AMPLIFIER MODULES

Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extremely small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9 v. miniature battery. Add 1/- P. & P. on each.



- TYPE LRPC 1. 3 transistor. Input sens. 50mV. output 150mW. output imp. 40Ω size 2 x 1 x 1 in. PRICE 27/6
 - TYPE LRPC 4. 5 transistor. Input sens. 150mV. output 330mW. output imp. 15Ω. size 2 1/2 x 1 1/2 x 1 in. PRICE 18/6
 - TYPE LRPC 5. 6 transistor. Input sens. 8mV. output 3W. output imp. 3Ω. size 5 1/2 x 1 1/2 x 1 in. PRICE 59/6
 - LRPC 9. High to Low input matching preamplifier. Input imp. 1 megohm. output imp. 2 k/ohms. Size 1 1/2 x 1 1/2 x 1 in. PRICE 10/6
 - LRPC 10. Magnetic tape replay preamp. designed so that a 450 mH head can be matched into any of the audio amp. modules listed above. Size 2 1/2 x 1 1/2 x 1 in. PRICE 10/6
- Note the LRPC 9 and 10 are ideal for use with the LRPC 1, 4 or 5 and are available at the reduced price of 7/6 if bought with the LRPC 4.
- FULLY ENCAPSULATED MODULES**
Special function modules—all one size 1 1/2 x 1 x 1 1/2 in. Complete with detailed function and installation instructions. Send S.A.E. for specification sheets.
- TYPE PA-1. Public address amp. for use with carbon, crystal or Dynamic microphones. 3Ω output imp. LASKY'S PRICE 30/-
 - TYPE GR-1. Gramophone amp.—provides sufficient power to fill average room. 3Ω output imp. LASKY'S PRICE 30/-
 - TYPE CO-1. Morse code practice oscillator—for use with Morse key and 3Ω speaker LASKY'S PRICE 20/-
 - TYPE MT-1. Metronome module—provides audible and visual beat from 30 to 240 beats per minute (for use with 3Ω speaker) LASKY'S PRICE 22/6

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 3271
Open all day Saturday, early closing 1 p.m. Thursday

33 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-636 2605
Open all day, 9 a.m.—6 p.m. Monday to Saturday

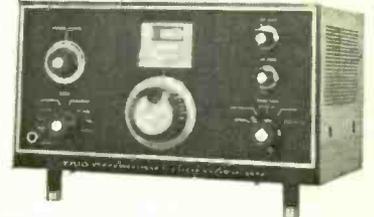
152/3 FLEET STREET, LONDON, E.C.4 Tel.: FLEet St. 2833
Open all day Thursday, early closing 1 p.m. Saturday

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL ST., TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

COMMUNICATION RECEIVERS

NOW AVAILABLE FOR THE FIRST TIME IN GREAT BRITAIN. TWO NEW TRIO RECEIVERS MODEL JR-500SE

This high performance receiver is made especially to cover the amateur bands and utilizes a crystal controlled double heterodyne circuit for extra sensitivity and stability. Brief spec.: Covers all the amateur bands in 7 separate ranges between 3.5 and 29.7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. Special features: Crystal controlled oscillator • Variable BFO • VFO • AVC • ANL • 8 meter • SSB-CW • Stand-by switch • special double gear dial drive with direct reading down to 1 kHz • Remote control socket for connection to a transmitter. Audio output 1 watt. For use on 115/250 V. A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 1/2 x 13 x 10 in. Weight 15 lbs. Fully guaranteed, comp. with instruction manual and service data.



LASKY'S PRICE **£61.19.0**

Carriage and Packing 12/6.

MODEL 9R-59DE

Brief spec.: 4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 16, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. Special features: SSB-CW • ANL • Variable BFO • 8 meter • Sep. band spread dial • IF frequency 455 Kc/s • audio output 1.5 W • Variable RF and AF gain controls. For use on 115/250 V. A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size: 7 x 15 x 10 in. Weight 10 lbs. Fully guaranteed, comp. with instruction manual and service data.

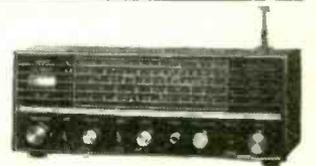


LASKY'S PRICE **£36.15.0**

Carriage and Packing 12/6.

FANTAVOX MODEL HE 50

Covers full medium waveband and 1.6-4.5 Mc/s. 4.6-12.0 Mc/s. and 11.0-30.0 Mc/s. in separate switched band spread ranges. Two aerials are fitted an internal loop and external telescopic. Controls include: B.F.O. Sensitivity. C.W.A.N.L. receiver/stand-by. 8 meter. Easy to read illuminated dial with logging scale. For 200/250 v. A.C. 4 valve plus rectifier. Fitted with internal speaker and socket for phone or external speaker. Cabinet size 13 1/2 x 8 1/2 x 6 1/2 in. Complete with full instruction manual.



LASKY'S PRICE **£16.16.0**

H.P. Terms available. Post 10/-.

NOW AVAILABLE—JOYSTICK AERIALS

Revolutionary Variable Frequency Antenna for transmission and reception, with a variable matching unit these antenna perform as a high "Q" device at any selected Medium or Short waveband. Send S.A.E. for descriptive leaflet.

| | | | | | |
|--------------|---------|----------------|-------------|---------|-----------------------------------|
| VFA Standard | £4/15/- | Matching units | A.T.V. 3A | £3/12/6 | |
| VFA De Luxe | £5/18/6 | | A.T.V. 4 | £4/4/- | Send S.A.E. for full information. |
| | | | A.T.V. 4/RP | £6/6/- | |

DEMONSTRATION STUDIOS

Lasky's High Fidelity Sound Centres

42 Tottenham Court Road, W.1 and 118 Edgware Road, W.2 are London's most comprehensive High Fidelity Sound Centres, designed to provide a real "Home-from-Home" for the discerning Hi-Fi Enthusiast. There you can see, hear and compare any combination of the finest quality equipment; our experienced staff are on hand to help you plan a complete system and to select the equipment most suitable to your requirements. In addition we are often able to offer considerable cash savings when you choose a complete system.

If you cannot call at any of our branches please send details of your requirements to our head office and we shall be pleased to quote without obligation. We operate the "Purchase Tax Free" scheme for overseas visitors. Full H.P. terms available.

PACKAGE DEALS

A Lasky's "Package Deal" allows you to purchase the complete Audio System of your choice at a worthwhile cash saving. We shall be pleased to quote our "Package Deal" price for any selection of equipment of your own choice. Send us details of your requirements. H.P. and Easy Credit Terms can be arranged on "Package Deals."

High Fidelity Audio Centres

42 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-580 2573
Open all day Thursday, early closing 1 p.m. Saturday

118 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 9789
Open all day Saturday, early closing 1 p.m. Thursday

3-PUSH SWITCH

for test meter, hi-fi amp., etc. 1st button operates mains on/off switch, the other two operate change-over switches. Knobs engraved On/Off. Bass, Treble, but engraving easily removed leaving clean surface for re-marking. 2/9 each. 34/- doz.



SATCHWELL OVEN THERMOSTATS

Type T9. With auxiliary tube and sensor. 20 amp. A.C. type and as fitted to many cookers. Adjustable by control knob (not supplied). 12/6 each.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 5v, 9v, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: P11, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor, condensers, and instructions. Real snip at only 18/6, plus 3/6 postage.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-sealed, mostly resin filled. Kit A—16-20w. 18/6. Kit B—30-40w. 17/6. Kit C—50w. 17/6. Kit D—125w. 22/-. Kit E—155. 19/6. Kit MF1 is for 6in., 9in. and 12in. miniature tubes. 19/6. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

MINIATURE WAFER SWITCHES

4 pole, 2 way—3 pole, 3 way—4 pole 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/6 each. 38/- dozen, your assortment.

WATERPROOF HEATING ELEMENT

26 yards length, 70w. Self-regulating temperature control, 10/- post free.

G.E.C. 13 AMP. SWITCHED SOCKETS

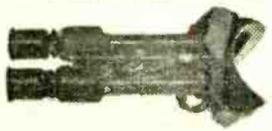
An excellent opportunity to re-equip your house or workshop, or if you are a contractor to rework for future ring main jobs. We offer 12 GEC switch sockets, Brown Bakelite surface mounting. Latest ring main type listed at 6/6 each. You can have a box of 12 for 30/- only—thus showing a saving of £2/8/-. Postage and insurance 4/6 extra.

THERMOSTATS

THERMOSTATS
Type "A" 16 amp. for controlling room heaters, greenhouse, airing cupboard. Has a spindle for pointer knob quickly adjustable from 30-80°F. 9/6, plus 1/- post. Suitable box for wall mounting, 5/-, P. & P. 1/-
Type "B" 16 amp. This is a 17in. long rod type made by the famous Swanik Co. Spindle adjusts this from 50-85°F. Internal screw alters the setting so this could be adjustable over 30° to 1,000°F. Suitable for controlling furnace, oven kiln, immersion heater or to make flame-start or fire alarm. 8/6, plus 2/6 post and insurance.
Type "D" We call this the Ice-stat as it cuts in and out at around freezing point. 2/5 amps. Has many uses, one of which would be to keep the loft pipes from freezing. If a length of our blanket wire (16 yds 10/-) is wound round the pipes, 7/6. P. & P. 1/1.
Type "E" This is standard refrigerator thermostat. Spindle adjustment covers normal refrigerator temperatures. 7/6, plus 1/- post.
Type "F" Glass enclosed for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—develops and chemical baths of all types. Adjustable over range 50° to 150°F. Price 18/-. plus 2/- post and insurance.

See in the Dark

INFRA-RED BINOCULARS



These infra-red binoculars when fed from a high voltage source will enable objects to be seen in the dark, provided the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for T.V. cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby equipment). They are unused and believed to be in good working order but sold without a guarantee. Price £3/17/6, plus 10/- carr. and ins. Handbook 2/6.



GARRARD AUTO RECORD PLAYER Model 2000

This is one of the latest products of the World's most experienced maker of fine record reproducers. Its superior features include—automatic playing of up to 8 mixed size records—stopping and starting without rejecting—manual playing—pick-up pivots to give low stylus pressure—large diameter turntable for max. stability adjustments include pick-up height—pick-up drooping position and stylus pressure. Size is 13 1/2 x 11 1/2 in., clearance 4 1/2 in. above, 2 1/2 in. below—fitted with latest hi-compliance cartridge for stereo—and mono, L.P. and 78. Supplied complete with mounting template and service sheet. Offered this month at the Special Snip price of £8/19/6 plus 7/6 carriage and insurance.

ADMIRALTY MOTOR ALTERNATOR

Admiralty motor alternator fitted regulated 230v. 50 cycle output from 24v. DC supply. Wonderfully giving to stringent application. Rating is 80watts but like other Admiralty equipment this rating can be increased 50% with safety. In grey metal box size 24 x 10 x 14in. approximately. Controls are DC, on/off switch and changeover switch from mains to alternator. On the front panel also is output voltmeter and panel with fuses protecting input and output. Weight approximately 100lb., unboxed. Price £37/10/- each (probably one-tenth of cost to Government). Carriage extra at cost.



DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by fingertip control. Kit includes all parts, covers, everything and full instructions. 19/6, plus 2/6 post and insurance. Or available mail up 32/6.



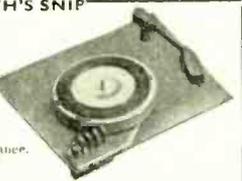
750mW TRANSISTOR AMPLIFIER

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feet-back loops—sensitivity 5mV. Price 12/6. Post and insurance 2/6. Speakers 3in. 12/6. 5in. 13/6. 6 x 4in. 14/6.

THIS MONTH'S SNIP

THE "TECHNICAL" GRAM MOTOR

4 speed, arm. motor with light-weight pick-up, motor electronically balanced and free from wow and flutter. Speed change by push button—16, 33, 45, 78 r.p.m. Price 29/6. Cartridge extra, mono 10/6, stereo 15/- plus 4/6 post and insurance. DON'T MISS THIS TERRIFIC BARGAIN.



DOOR INTERCOM

Know who is calling and speak to them without leaving bed, or chair. Outfit comprises microphone, with call push-button, connectors and master intercom. Simply plugs together. Originally sold at £10. Special snip price 99/6 plus 3/6 postage.



BATTERY OPERATED TAPE DECK



With Capstan control. This unit is extremely well made and measures approx. 6 x 6 x 2 1/2 in. deep. Has three piano key type controls for Record, Play-back and Rewind. Motor is a special heavy duty type intended for operation off 4.5volts. Supplied complete with 2 spools ready to install. Record, Replay head is the sensitive M4 type intended for use with transistor amplifier. Price £4/15/-. Post and insurance 4/6.

TUBULAR HEATERS

New and unused, made by G.E.C.—rated at 60 watts per ft.—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc. curtains or paper can touch them without fear of scorching or fire. Supplied complete with fixing brackets and available in the following sizes: 8ft. 30/-, 10ft. 36/-, 12ft. 42/-. Prices which are about 1/3 of H.P. price includes carriage by B.R.S.

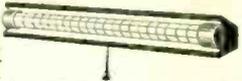
'PILOT' CAPSTAN DRIVEN TAPE RECORDER

Capstan Driven, 4 Transistors SPECIFICATION: 200/7,000 r.p.m.—400 mW output—double track—even speed (3 1/2 and 7 1/2) fast rewind time—1 1/2 in. spool gives one hour playing with standard tape. Complete with batteries, microphone—tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop. Special Snip Price. This Month £9/19/6 post and insurance 6/6.



INFRA-RED HEATERS

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wave length (3 microns). Price for 750 watt element, all parts, metal casing as illustrated, 19/6, plus 3/6 post and insurance. Full switch 3/- extra.



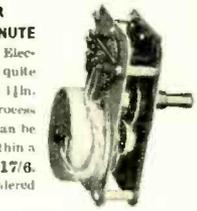
HI-FI SPEAKER BARGAIN

12in. High fidelity loud-speaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 29/6. Will handle in Trolley 35/-, plus 3/6 post and insurance.



GEARED MOTOR

Half rev. per minute. Made by famous Smith Electric, mains operated and quite powerful. Size 3 1/2 x 2 1/2 x 1 1/2 in. deep. Secondary use as process timer. Internal switch can be made to break circuit within a period up to 2 mins. 17/6. P. & P. 2/6 unless ordered with other goods.



BECKASTAT

An Instant Thermostat. Simply push it into 15A wall socket and plug your fire or other appliance into it. Knob setting. Will save its cost in a season. Normally £3. We offer at 19/6, plus 2/- post.

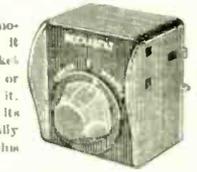


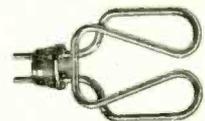
PHOTO-ELECTRIC KIT

All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit. Laminated boards and chemicals. Latching relay, infra-red sensitive Photocell and flood, 2 Transistors, cond., Terminal block, Plastic case. Essential data, circuits and P.C.C. chassis plans of 10 photo-electric device including auto. car parking light, modulated light alarm. Simple in-circuit ray switch—counter—stray light alarm—warning tone electronic alarm—projector lamp stabiliser, etc., etc. Only 39/6, plus 2/- post and insurance.

Multi Purpose Neon Test Unit

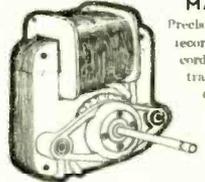
Robust, useful and instructive—tests insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and I.T. fault finder—kit comprises upon indicator—4 way wafers switch—circuit tubes—resistor—condensers—terminals, etc. with diagram only 8/6, plus 2/- post and insurance.

KETTLE ELEMENT



Made by famous "Best" company, suitable for most kettles. 1 1/2 in. dia. hole, 1,600 watts, 230/250v. Normally 30/- each. Our Price 15/- each, plus 2/6 p. & p.

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heater, etc. New and perfect. Size at 9/6. Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.



PP3 Eliminator. Play your pocket radio from the mains! Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. Only 6/6 plus 1/- post.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. B.S.E. with enquiries please.

ELECTRONICS (CROYDON) LIMITED
(Dept. W.W.), 102/3 TAMWORTH RD., CROYDON, SURREY (Opp. W. Croydon Stn.)
also at 266 LONDON ROAD, CROYDON, SURREY. S.A.E. WITH ENQUIRIES PLEASE

BENTLEY ACOUSTIC CORPORATION LTD.

33 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1
 THE VALVE SPECIALISTS Telephone PRIMROSE 9090
 47 NORFOLK ROAD, LITTLEHAMPTON, SUSSEX. Littlehampton 2043

Please forward all mail orders to Littlehampton
 ALL GOODS LISTED BELOW IN STOCK

| | | | | | |
|------------|-------------|-------------|-------------|-------------|------------|
| OA2 5/- | 12BA6 5/- | ECC23 29/1 | MHL1D612/8 | UP42 9/- | GET102 4/9 |
| OB3 5/- | 12BB6 5/3 | ECC24 29/6 | MU14 4/- | UF80 6/9 | GET103 4/4 |
| 4A5 5/- | 12BH7 6/- | ECC40 9/6 | N78 38/4 | UF85 7/3 | GET113 4/6 |
| 4AYGT 7/6 | 12EL 17/6 | ECC81 3/6 | N339 25/- | UF86 9/- | GET116 7/6 |
| 1C5 4/9 | 12JGT 6/6 | ECC82 4/6 | PA1BC80 7/6 | UF89 5/6 | GET118 4/6 |
| 1H6GT 7/- | 12K 8/- | ECC83 4/6 | PC96 8/6 | UL41 8/6 | GET119 4/6 |
| 1L4 2/6 | 12KGT 3/6 | ECC85 5/6 | PC98 8/6 | UL46 9/6 | GET153 8/6 |
| 1N6GT 7/9 | 12K8GT 3/6 | ECC85 5/6 | PC95 6/9 | UL84 5/6 | GET587 8/6 |
| 184 4/9 | 12QGT 3/6 | ECC88 7/6 | PC97 5/9 | U880 5/6 | GET873 4/- |
| 1T4 2/6 | 12QGT8T 3/6 | ECC189 9/- | PC900 8/6 | URIC 6/6 | GET887 4/6 |
| 1U4 5/6 | 19AQ5 5/- | ECC807 18/9 | PC884 5/6 | U8 16/6 | GET889 4/6 |
| 1U5 5/3 | 30D1 13/- | ECP80 7/- | PC885 6/9 | U13N 10/3 | GET890 4/6 |
| 2D21 5/9 | 30P1 20/5 | ECP82 9/- | PC888 10/6 | UY21 3/- | GET896 4/6 |
| 3A4 3/6 | 30P2 11/6 | ECP86 8/6 | PC889 9/9 | UY41 5/6 | GET897 4/6 |
| 3A5 8/- | 30L1 15/6 | ECP804 24/- | PCU189 8/3 | UY85 4/9 | GET898 4/6 |
| 3Q4 5/3 | 30P1 17/6 | ECP805 12/6 | PCF80 6/3 | VP4 14/6 | MAT100 7/9 |
| 3Q9GT 6/6 | 30P3 17/- | ECH21 9/6 | PCF82 6/- | V1105 5/- | MAT101 8/6 |
| 384 4/9 | 30P4 17/6 | ECH35 8/6 | PCF84 6/- | W130 10/3 | MAT102 8/6 |
| 3R40Y 8/9 | 30P5 17/- | ECP82 9/- | PC888 10/6 | W76 3/6 | MAT121 8/6 |
| 5U40 4/9 | 25Z6G 8/6 | ECH81 5/- | PCF801 8/6 | W81M 6/6 | OA5 1/9 |
| 5V4G 8/- | 30C15 12/- | ECH83 7/- | PCF802 8/6 | W107 10/6 | OA10 6/6 |
| 5Y9GT 5/- | 30C17 13/- | ECH84 6/6 | PCF805 9/6 | W229 10/6 | OA47 2/- |
| 5Z3 7/6 | 30C18 9/6 | ECL90 6/- | PCF806 11/6 | X81 6/- | OA70 3/- |
| 5Z4G 7/6 | 30P5 9/6 | ECL92 6/3 | PCF84 6/- | X41met 12/6 | OA73 3/- |
| 6A67 9/6 | 30PL1 15/- | ECL92 6/3 | PC882 8/3 | X65 5/6 | OA79 1/9 |
| 6AK5 4/9 | 30PL2 15/- | ECL84 12/- | PC883 8/6 | X66 7/6 | OA81 1/9 |
| 6AM4 16/6 | 30PL13 6/- | ECL85 11/- | PC884 8/3 | X76M 7/9 | OA85 1/6 |
| 6AQ5 4/9 | 30PL14 12/6 | ECL86 7/9 | PC885 8/3 | Y63 5/6 | OA88 4/- |
| 6AT6 3/9 | 30PL15 14/- | ECL800 | PC886 8/- | | OA91 2/6 |
| 6AV6 5/6 | 30P4 11/6 | EP22 28/9 | PC887 7/- | | OA95 1/9 |
| 6BA6 4/6 | 30P4ME | EP36 3/- | PEN45DD | | OA182 2/- |
| 6BB6 4/3 | | EP37A 7/- | PEN383 9/6 | | OA200 3/- |
| 6BB6 6/6 | 30P12 11/- | EP39 5/- | PFL20013/6 | | OA202 2/- |
| 6BB6 7/- | 30P19 11/- | EP40 8/9 | PL33 9/- | | OA210 9/6 |
| 6BQ7A 7/6 | 30P1 15/- | EP42 8/9 | PL26 9/- | | OA211 13/6 |
| 6BR7 8/- | 30PL13 15/- | EP42 3/8 | PL38 19/9 | | OA22012/- |
| 6BR8 8/- | 30PL14 15/- | EP50 2/6 | PL81 6/9 | | OA220110/6 |
| 6BR7 16/6 | 30PL15 15/- | EP54 8/- | PL82 5/9 | | OA2202 9/- |
| 6BW6 7/- | 35L6GT 6/3 | EP80 4/6 | PL83 6/- | | OA2203 9/6 |
| 6B97 5/- | 35F4 4/6 | EP83 9/6 | PL84 9/3 | | OA2204 9/9 |
| 6BZ6 6/- | 35Z3 10/- | EP85 4/6 | PL600 13/6 | | OA2205 9/- |
| 6C9 10/9 | 35Z4GT 4/6 | EP86 6/3 | PL504 15/- | | OA220710/6 |
| 6C2DG 19/6 | 35Z5GT 5/6 | EP89 4/9 | PM84 9/3 | | OA2210 7/- |
| 6C16 6/- | 60B5 6/3 | EP91 3/3 | PX4 14/- | | OA22413/- |
| 6C74 12/- | 60C5 5/6 | EP92 2/6 | PY31 6/6 | | OC19 25/- |
| 6P1 9/6 | 72L6GT 6/- | EP97 8/6 | PY50 5/- | | OC20 5/- |
| 6F6G 4/- | 72 6/6 | EP98 9/- | PY81 5/- | | OC23 7/6 |
| 6F13 3/6 | 85A2 8/6 | EP183 6/3 | PY82 5/- | | OC24 14/6 |
| 6F18 8/6 | 150B2 14/6 | EP184 5/9 | PY83 5/6 | | OC25 5/6 |
| 6P23 11/6 | 807 11/9 | EP804 20/5 | PY88 7/3 | | OC26 5/6 |
| 6P24 10/- | 5763 10/- | EH90 7/6 | PY800 6/- | | OC28 5/- |
| 6P25 10/6 | 5AEP2 6/- | EP801 6/- | PY801 6/- | | OC29 18/6 |
| 6P28 10/6 | ACJTH110/- | EL33 12/- | QQV03 10/- | | OC30 7/- |
| 6J5G 3/9 | AZ1 8/- | EL34 9/6 | QV04/7 7/- | | OC35 10/- |
| 6J 3/- | AZ31 7/9 | EL36 8/9 | R10 15/- | | OC36 7/6 |
| 6J7G 4/8 | AZ41 6/6 | EL41 8/- | R16 34/11 | | OC38 11/6 |
| 6K7G 6/3 | CY81 6/6 | EL42 7/8 | R19 9/6 | | OC41 10/6 |
| 6K8G 3/6 | DAF91 8/3 | EL43 8/6 | R19 6/9 | | OC42 6/9 |
| 6K8GT 7/6 | DAF96 6/- | EL43 8/6 | TY86F11/10 | | OC43 12/6 |
| 6L4 7/6 | DD4 10/6 | EL44 4/6 | U12/14 7/6 | | OC44 2/6 |
| 6L7GTM 5/6 | DF96 6/- | EL85 7/6 | U12/14 7/6 | | OC44PM 3/3 |
| 6L18 7/6 | DF97 10/- | EL86 8/- | U16 15/- | | OC45 1/9 |
| 6L19 12/6 | EA56 3/6 | EL87 12/6 | U18/20 6/6 | | OC45M 8/6 |
| 6LD20 6/6 | DK40 10/6 | EL95 5/- | U19 40/- | | OC48 3/- |
| 6P1 12/- | DK91 4/9 | ELL80 13/- | U22 5/9 | | OC65 22/6 |
| 6P28 25/- | DK92 7/6 | EM71 14/- | U25 12/6 | | OC66 25/- |
| 6Q7G 5/- | DK96 6/6 | EM80 5/9 | U26 11/- | | OC70 2/3 |
| 6Q7GT 8/9 | DL84 8/6 | EM81 6/9 | U31 6/3 | | OC71 2/6 |
| 6RTG 5/6 | EL96 6/6 | EM82 6/9 | EN23 13/6 | | OC72 6/6 |
| 6U4GT 9/6 | DM70 6/- | EM85 11/- | U45 16/6 | | OC73 16/- |
| 6U5G 5/6 | DM71 9/9 | EM87 6/6 | U37 34/11 | | OC74 8/- |
| 6V6G 3/6 | DY86 5/9 | EY51 5/6 | U45 15/6 | | OC75 2/- |
| 6X4 3/6 | DY87 5/9 | EY81 7/- | U76 4/6 | | OC76 3/- |
| 6X3GT 5/3 | E80F 24/- | EY83 9/- | U91 12/- | | OC77 3/4 |
| 6Y6G 10/6 | E80CC 32/- | EY84 9/6 | U91 8/9 | | OC78 3/- |
| 630L2 12/6 | E83F 24/- | EY86 5/9 | U282 12/3 | | OC78D 3/- |
| 7B6 10/9 | E88CC 12/- | EY87 5/9 | U301 12/6 | | OC79 8/- |
| 7B7 7/- | E180CC 8/- | EY88 7/6 | U329 12/6 | | OC81 2/- |
| 7C6 6/- | E180F 17/8 | EY91 3/3 | U403 6/6 | | OC81D 2/- |
| 7H7 5/6 | EA50 1/6 | EZ40 6/- | U484 6/- | | OC81M 5/- |
| 7H7 12/6 | EA76 13/- | EZ41 8/6 | U491 18/- | | OC82 2/3 |
| 7Y4 6/6 | KABC80 5/9 | EZ80 3/9 | U4030 6/- | | OC82D 2/6 |
| 9BW6 9/6 | KAC91 3/3 | EZ81 4/3 | UABC80 5/3 | | OC83 2/- |
| 9D7 7/6 | KAF42 7/6 | GZ33 12/6 | UAF42 7/9 | | OC84 3/6 |
| 10C1 9/- | KB41 4/9 | GZ34 10/- | UB41 10/6 | | OC123 4/6 |
| 10C2 12/6 | KB71 6/6 | GZ37 14/6 | UB241 6/6 | | OC139 2/6 |
| 10D2 11/9 | EBCC3 6/- | HABC80 9/3 | UBC81 6/6 | | OC140 19/- |
| 10P1 15/- | EBCC41 7/3 | HL1ADD | UBF80 5/6 | | OC169 3/9 |
| 10P3 8/- | EBCC81 6/3 | | UBF89 5/9 | | OC170 2/6 |
| 10P9 9/- | EBP80 5/9 | HL42D DR/- | UBL21 9/- | | OC171 3/4 |
| 10P18 9/- | EBP83 7/- | H1309 26/6 | UC92 5/6 | | OC172 4/6 |
| 10P19 14/6 | EBP89 5/9 | K786 29/1 | UC94 8/6 | | OC20 5/6 |
| 10P14 15/6 | EBL21 10/3 | KT41 19/6 | UCX85 6/6 | | OC201 23/- |
| 12A6 5/- | EC52 4/3 | KT61 12/- | UCF80 8/3 | | OC202 5/6 |
| 12A6G 8/- | EC54 8/- | KT63 4/6 | UCH91 9/- | | OC203 5/6 |
| 12AD6 9/- | EC96 11/8 | KT66 16/6 | UCH42 8/6 | | OC205 7/6 |
| 12AE8 7/6 | EC98 10/6 | KT68 27/6 | UCR81 6/6 | | OC211 27/6 |
| 12A7G 4/6 | EC91 4/- | KTW61 5/9 | UCX82 7/6 | | ORP12 15/- |
| 12AU6 4/9 | EC92 6/6 | KTW62 12/6 | UCL83 9/6 | | P346A 2/6 |
| 12AV6 5/9 | EC93 4/6 | KTW63 5/- | UP41 7/9 | | ZE12V7 1/9 |

MATCHED TRANSISTOR PACKS:
 1-OC81D2-OC81, 7/6; 1-OC82D2-OC82, 8/6; 1-OC442-OC45, 8/6. Set of 3—OC83, 8/6.
 Type LP15 (AC113, AC154, AC157, AA120) 13/6d. Post 6d.

All goods are new, first quality brands only, and subject to maker's full guarantee. We do not handle manufacturers' seconds nor rejects, which are often described as "new and tested" but have a limited and unreliable life.
 Terms of business: Cash with order only. Post/packing 6d. per item. Orders over £5 post/packing free. All orders cleared on day of receipt. Any parcel insured against damage in transit for only 6d. extra. Callers welcome. Mon.-Fri. 9.30 a.m. Sat. 9 a.m.-1 p.m. Complete catalogue of valves, transistors and components with conditions of sale, price 6d.

Microwave Valves

C. H. Dix, B.Sc., F.I.E.E. and W. H. Aldous, B.Sc., A.R.C.S., D.I.C., F.I.E.E.

This book is for the technically educated reader (graduate or H.N.C. level) who wants to understand the physical processes and operation of microwave valves. These processes are described from a fundamental viewpoint with some appropriate mathematical treatment. The treatment is based on the motion of electrons in electric and magnetic fields and the properties of the various types of r.f. circuits and transmission lines that are used in the devices. Microwave triodes are discussed, but the emphasis is on beam devices, both linear and crossed field, and in describing these the space charge wave approach is used consistently. Further chapters cover the formation and focusing of electron beams, the noise properties of devices, construction and applications. 275 pp. 185 illustrations incl. 8 plates. 55s net, 56s 1d by post.

Short-Wave Listening

J. Vastenhou

This easily understood book is intended as a guide for the benefit of the increasingly large numbers of regular listeners to short-wave transmitting stations and also for radio amateurs who are interested in short-wave listening, and fully covers the many problems and possibilities of the subject, ranging from interference to DX clubs. 112 pp. 33 illustrations and 4 plates. 12s 6d net, 13s 5d by post.

Foundations of Wireless

M. G. Scroggie, B.Sc., F.I.E.E.

Seventh Edition

This standard work covers the whole basic theory and, starting from the most elementary principles and assuming no previous knowledge on the reader's part, deals with receivers, transmitters, amplification, valves, transistors, aerials, power supplies and transmission lines. The treatment of frequency changers has been brought into line with modern practice, while common-grid and cascode v.h.f. amplifiers, e.h.t. generators and transistor d.c. voltage raisers are also covered. 388 pp. 278 diagrams. 21s net, 22s 5d by post.

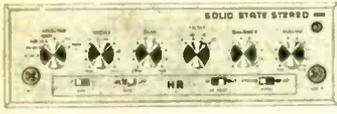
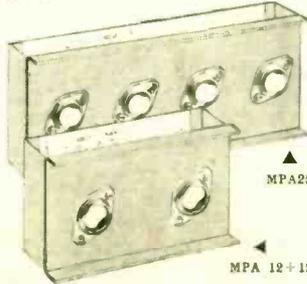
obtainable from all booksellers

ILIFFE BOOKS LTD DORSET HOUSE STAMFORD STREET S.E.1

**NEW SOLID STATE HIGH FIDELITY EQUIPMENT
POWER AMPLIFIERS—PRE-AMPLIFIERS
POWER SUPPLIES—BRITISH MADE**

We PROUDLY PRESENT THIS RANGE OF AUDIO EQUIPMENT developed from DINSDALE Mk. II—each unit or system will compare favourably with other professional equipment selling at much higher prices.

Brief details are below:—



COMPLETE FULLY ILLUSTRATED BROCHURE FREE ON REQUEST.

| SYSTEM | COMPRISING | SYSTEM PRICE |
|--------|---|--------------|
| ★ A | 5 watt mono for 3 to 5 ohm speakers | £10.3.0 |
| ★ 1 | 12 watt mono for 3 to 5 ohm speakers. | £13.17.6 |
| ★ 2 | 12 watt mono for 12 to 16 ohm speakers. | £14.12.6 |
| ★ 4 | 24 watt mono two channel for 12 to 16 ohm speakers. | £20.15.0 |
| ★ 8 | 20 watt mono/stereo for 12 to 16 ohm speakers. | £24.0.0 |
| ★ 9 | 24 watt mono/stereo for 3 to 5 ohm speakers. | £26.15.0 |
| ★ 14 | 40 watt mono/stereo for 7½ to 16 ohm speakers. | £29.10.0 |

VHF FM TUNER 87/105 Mc/s Transistor Superhet. Geared tuning. Terrific quality and sensitivity. For valve or transistor amplifiers. 4 x 3½ x 2½ in. Complete with dial plate. 5 Mullard Transistors, Plus 4 Diodes. (Cabinet Assembly 20/- extra).



TOTAL COST TO BUILD £6.19.6 P.P. 2/6

FM STEREO DECODER

7 Mullard Transistors. Printed Circuit Design with Stereo Indicator. For use with any valve or transistor FM. Uses pot cores to Mullard design and ger. and silicon transistors. As used by B.B.C. and G.P.O. Complete Kit Price £5.19.6 P.P. 2/6



BUILD A QUALITY TAPE RECORDER

using **MARTIN RECORDAKITS**
★ **TWO-TRACK.** Deck £10/10/0. Martin Amplifier, £14/19/6. Cabinet and speaker 7 gns. Complete kits with FREE 7in. 1,200ft. tape, spare spool. Today's Value £45. 27 gns. P.P. 15/-
★ **FOUR-TRACK.** Deck £13/10/0. Martin Amplifier £15/19/6. Cabinet and speaker 7 gns. Complete kits with FREE 7in. 1,200ft. tape, spare spool. Today's Value £50. 30 gns. P.P. 15/-



MW LW QUALITY TRANSISTOR RADIO TUNER Fully tunable superhet with excellent sensitivity and selectivity. Complete with front panel, 9 volt operated. For use with any amplifier or tape recorder. TO BUILD £3.19.6



MANUFACTURERS We wish to Purchase large quantities of **NEW TRANSISTORS & DEVICES**—Please write or phone (01) 723-1008/9, EXTN. 4.

QUARTZ CRYSTALS
1 Mc/s. HCGU sub-min. 20/-
6/12 volt 80C oven Cathodeon .. 22/6
1 Mc/s. plus 100 kc/s. 3 pin .. 22/6
Send for list of 500 types. 1/- post paid

NUMICATORS
Mullard Z520M with base 22/6
Hivac YN3 wire leads .. 15/-
931A photo mult. with base.. 60/-
Z801u Tube .. 15/-

MAYFAIR PORTABLE ORGAN

BELGRAVIA CONCERT ORGAN details on request



TOTAL COST **99 gns**
Deferred terms available

★ Fully TRANSISTORISED POLYPHONIC British design.
★ Build this superb Instrument STAGE BY STAGE in your own home.
★ A Truly portable instrument for all enthusiasts.
★ Call in for a DEMONSTRATION

ORGAN COMPONENTS
We carry a comprehensive stock of organ components for TRANSISTOR AND VALVE FREE PHASE designs: complete details on request.

AUTO-BAN TRANSISTOR CAR RADIO British Made

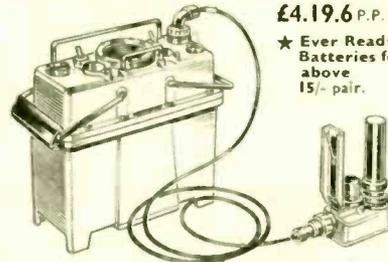
BUY NOW!



6-Transistor MW/LW Car Radio. 12 volt operated. 3 watt output. Push-button wavechange. Supplied built, boxed, ready to use with Speaker and Baffle. Car fixing kit and manufacturers' current guarantee. Special Bargain Offer. Positive or Negative Earth. LIST PRICE 12 GNS. De-luxe Push-button version £11/19/6. P.P. 4/6. **£9.9.0** Send for details on our range of Car Radios.

PORTABLE GEIGER COUNTERS FOR MEASUREMENT OF RADIO-ACTIVITY

Supplied complete with instructions, haversack, cables and probe. List price £70. BRAND NEW.



£4.19.6 P.P. 10/-
★ Ever Ready Batteries for above 15/- pair.

GARRARD RECORD DECKS



COMPLETE RANGE FROM **£4.19.6** SEND FOR ILLUSTRATED BROCHURE

Full details on advertised products free on request.

SALFORD 193A XTAL CHECKER

110/250v A.C. In new condition. £12.10.0 plus carriage 10/-

TRANSISTORS SEMICONDUCTORS

Send for Free List No. 36 of 650 Transistor devices

We have the
★ LARGEST RANGE—OVER 650 TYPES
★ COMPETITIVE PRICES
★ 1st GRADE STOCKS
★ FULLY GUARANTEED

24-PAGE ILLUSTRATED BROCHURE LISTING 2,000 DEVICES. Data and circuits including Valve and Quartz Crystal lists. 1/- post paid.

BUILD THESE PW/PE DESIGNS

| | |
|----------------------------------|---------|
| I.C. P.M. TUNER (with CA9014) .. | 99/8 |
| ANTI-DAZZLE MIRROR | 79/6 |
| EXPLORER | £4/5/- |
| with drilled chassis and cabinet | |
| STABILISED POWER SUPPLY. | 49/6 |
| PHOTO FLASH SLAVE UNIT .. | 42/6 |
| SOLID STATE IGNITION | £6/19/6 |
| SWITCHED P.M. TUNER | 77/6 |
| THYRISTOR POWER CONTROLLER * | |

* Parts LIST and PRICES ON REQUEST

CATALOGUE LATEST EDITION 225 PAGES. 6,000 ITEMS. 1,000 ILLUSTRATIONS.

- ★ 20 pages of transistors and semi-conductors devices, Valves and Crystals.
- ★ 150 pages of components and equipment.
- ★ 50 pages of microphones, decks and Hi-Fi equipment.



The most COMPREHENSIVE—CONCISE—CLEAR COMPONENTS CATALOGUE in G.T. BRITAIN. Complete with 10/- worth DISCOUNT VOUCHERS.

Send today **8/6** POST PAID. FREE WITH EVERY COPY.

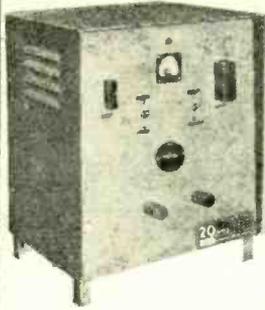
HENRY'S RADIO LTD.



303 EDGWARE ROAD LONDON, W.2

WE CAN SUPPLY FROM STOCK MOST OF THE PARTS SPECIFIED ON CIRCUITS IN THIS MAGAZINE. SEND LIST FOR QUOTATION. PHONE 01-723 1008 9 OPEN MON-SAT. 9 a.m.-6 p.m. THURS. 9 a.m.-1 p.m.

IMMEDIATE DESPATCH FULL SPARES AND SERVICE AVAILABLE



20 Amp. LT. SUPPLY UNIT

As supplied to Min. of Defence and Crown Agents for overseas Govt.
LATEST DESIGN HEAVY DUTY 12/24 VOLT D.C.
 Output: Adjustable up to **20 AMPS. CONTINUOUS** at 12/24 volts. **FULLY FUSED**, Neon indicator, 0-20 amp. meter. Size 16 x 12 x 20in high, in heavy gauge steel cabinet. Grey Hammer finish—Weight 50 lbs. Input: 220/230/240 v. A.C. 50 cycles.
ONLY £32.10.0 Plus 40/- C. & P. G.B. (Inland)

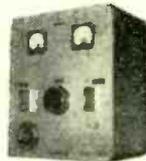
30 Amp. LT. SUPPLY UNIT

UP TO 18 v. I.D.C. WITH SMOOTH STEPLESS VARIATION
 Designed for CONTINUOUS use at max. loading
 ★ Fitted voltmeter and ammeter. ★ Instantaneous overload cut-out.
 Input: Mains A.C. Robust construction, 2 tone finish, steel case.

£55.0.0 C. & P. 40/- G.B. (Inland).
 Entirely suitable for plating plants, Laboratory supplies, etc.

5 AMP. A.C. & D.C. VARIABLE SUPPLY UNIT

Specification: Output: 0-260 v. A.C. 0-240 v. D.C.
 ★ Smooth stepless voltage variation from 0-Max.
 ★ Current consistent throughout the controlled range.
 ★ Ammeter and voltmeter fitted, and neon indicator.
 ★ Fully fused input and output.
 Strong steel case, with carrying handle and rubber feet. 11 x 7 x 14in. high. Made In England.



£30.0.0 C. & P. 40/- Gt. Britain (Inland).

CURRENT PRODUCTION — BUY DIRECT FROM MANUFACTURER

VARIABLE VOLTAGE TRANSFORMERS



Modern styling for modern equipment
 'SLIDE-TRANS' & 'SLIDUP' MODELS
 Fully rated current consistent at all points along the winding
AVAILABLE ONLY FROM I.M.O.

- ★ SMOOTH CONTINUOUS ADJUSTMENT
- ★ ALL MODELS SHROUDED FOR SAFETY (IDEAL FOR EDUCATIONAL AUTHORITIES)
- ★ BENCH OR PANEL MOUNTING
- ★ UP TO 260v. AVAILABLE FROM ALL MODELS
 All models 230v. A.C. 50/60 c.p.s. input

| | |
|----------|--------------|
| 1 Amp. | £4 . 10 . 0 |
| 2.5 Amp. | £5 . 17 . 6 |
| 5 Amp. | £9 . 0 . 0 |
| 8 Amp. | £13 . 10 . 0 |
| 10 Amp. | £18 . 5 . 0 |
| 12 Amp. | £19 . 10 . 0 |
| 20 Amp. | £32 . 10 . 0 |

C. & P. EXTRA



TRANSISTORISED MEGOHMMETER

- ★ PUSH BUTTON TO READ

500 v. = 1,000 Megohms. Superb, portable instrument. Supplied c/w batteries, probes and carrying case.

ONLY £25.0.0 C. & P. 7/6.



36 FT. AERIAL MAST

NEW LATEST PATTERN TUBULAR MAST
 Check these vital points:
 ★ Made from 6 x 1 1/2 in. Sherardized steel sections, for durability and strength.
 ★ Extra strong locating base.
 ★ Top cap fitted with pulley and halyard.
 ★ 2 sets (8) Rotproof Guys.
 ★ Rustproofed Steel Picketing Stakes.

ONLY £15.0.0 ex works
 Carr. 20/-. Returnable wood case 30/-

PORTABLE VARIABLE A.C. POWER SUPPLY UNIT

Designed for engineers whose requirements call for a visual indication of volts applied.

OUTPUT: 0-260 v. 1 1/2 amps.
INPUT: 230 v. A.C. 50/60 c.p.s.
 Fitted with fuse, voltmeter, safety indicator on-off switch and lead.
 Size 8 x 5 x 5in. high.



PRICE £8.17.6 C. & P. 12/6

CONSTANT VOLTAGE TRANSFORMERS

BEAT WINTER !
AUTOMATIC MAINS STABILISER



ONCE AGAIN WE CAN EXPECT THE USUAL VOLTAGE DROPS DUE TO THE COLD WEATHER

- ★ No attention
- ★ No Maintenance
- ★ No Moving Parts
- ★ Corrected Wave

Input: 190-250 v. A.C. Output: 240 v. A.C.
 Accuracy: ±1%. Capacity: 250 watts.
 Maintain "spot-on" test-gear readings at all times
 Weight: 21 lb. Fitted signal lamp and switch.
 Size: 11 x 6 1/2 x 6in. high.

£12.10.0

C. & P. 20/-

LATEST SOLID STATE VARIABLE VOLTAGE CONTROLS

- ★ COMPLETELY SEALED
 - ★ COMPACT AND COMPLETE
 - ★ PANEL MOUNTING
- 230 A.C. Input 25-230 volts output
 5 amp. model £8
 10 amp model £13/5/-



PORTABLE TRANSISTOR TESTER

SUITABLE FOR PRODUCTION & LABORATORY USE

SPECIFICATION:

Alpha 0.7 to 0.997

Beta 5-300

ICO 0-50µA. 5mA.

Capable of measuring GERMANIUM AND SILICON DIODES.

DESIGNED WITH RESISTANCE SCALE 200 ohms to 1 Megohm as an ADDED FEATURE. Housed in heavy duty plastic case, c/w internal battery.



Only **£6.19.6**
 Plus 7/6 C. & P.

I.M.O. (ELECTRONICS) LTD.

(Dept. W.W.7), 313 Edgware Road, London, W.2.

01-723 2233/4

RECEPTION SETS R220/R220

These comprise two crystal controlled AM receivers and can be operated independent of each other on one spot frequency in the band 60-100 Mc/s., with built in monitor speaker. They are housed in one metal cabinet, size 2 1/4 x 12 1/2 x 18 1/2 in. and ready for immediate mains operation (200-250 v. 50 c/s.). Supplied BRAND NEW in original crate, complete with spares and manual. £20. Carr. 50/-.

POWER UNIT TYPE 24 FOR R.216 RECEIVER. A.C. operated 100-125 or 200-250 volts 50 c/s. BRAND NEW AND BOXED. £9 19/6. Carr. 10/6.

FILTER VARIABLE BAND PASS No. 1. Dual channel unit, each channel has variable slot frequency of 500-900 c/s., 1,200-1,600 c/s., and band pass facility. 600 ohms input and output, monitor input and high impedance output jacks. Standard rack mounting 3 1/2 in. deep panel. Mains operation 200/250 v. 50 c/s. BRAND NEW. £5 19/6. Carr. 10/-.

HRO TUNING METER. 0-1 ma. New and boxed 25/- Post 2/-.

BC221 FREQUENCY METER
125 Kc/s. to 20 Mc/s.

This crystal controlled heterodyne frequency meter is too well-known to need further description. Those we offer are complete with correct individual calibration book and are carefully tested and guaranteed. New condition. **£30**

Laboratory Standard

Also some less calibration book, in working order. £9/19/6. Carr. 10/-.

V.H.F. SIGNAL GENERATOR
MARCONI TF-801A/1. Covers 10 to 310 Mc/s. (4 bands). DIRECTLY calibrated. Int. Mod. at 400, 1,000 and 5,000 c/s. Attenuated or force output. Guaranteed overhauled, accurate and in perfect working order. **£35.** Carr. £1.

BEAT FREQUENCY OSCILLATORS
MARCONI TF-195M. Covers 10 cps. to 40 kc/s. in two sweeps. 0 to 20 kc/s. and 20 to 40 kc/s. Output 2 watts into 600 or 2,500 ohms. Panel meter indicates output voltage. A.C. mains operation 100 to 250 volts. First class condition. Fully tested. **£20.** Carr. 30/-.

AMERICAN HEADSET TYPE HS-30-U
600 impedance. BRAND NEW and boxed, 15/-, postage 2/6.

DISTORTION FACTOR METER
MARCONI TF-142E. This instrument measures the percentage of total harmonic distortion in the fundamental frequency range 100 to 8,000 c/s. The lowest scale engraving is 0.05%. Will handle 2 watts (continuous) and will give satisfactory readings with only 1 mW input. Mains operated. Output impedance 600 ohms. Very good condition. **£20.** Carr. 20/-.

MICROAMMETERS
R.C.A. 0-500 microamps. 2 1/2 in. circular flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the No. 19 set. BRAND NEW and boxed 15/- P. & P. 1/6.

AR-88 SPARES
Knobs, Medium size, Set of 8 10/-
Knobs, Large size 5/6
Condenser (3 x 4 mfd.). Post 4/6 12/6
Mains Trans. (L.F.) (postage 9/-) 42/6

MINIATURE RELAYS
240 v. A.C. coils. Contact assembly 2 "makes" and 1 C.O. 5 amps. Size 2 x 1 1/2 x 1 in. Unused and removed from brand new equipment 8/6 post paid.

MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. **22/6.** As above but complete with moving coil microphones 25/-, DLR-5 Low impedance headphones with attached throat microphone. 12/6. All these items BRAND NEW. Postage extra 2/6.

CINTEL NUCLEONIC SCALERS
Nos. 36402 and 36411. Unused with handbook. List Price £300/£320. Our Price **£65.**

CRT Type 89D as used in the Cossor 1035 Oscilloscope. Brand New 59/6. P. & P. 4/6.

ADVANCE TEST EQUIPMENT

| | |
|--|--------|
| H1B Audio Signal Generator | £30 0 |
| J1B Audio Signal Generator | £30 0 |
| J2B Audio Signal Generator | £35 0 |
| TT1S Transistor Tester | £37 10 |
| VM76 AC/DC Valve Voltmeter | £72 0 |
| VM78 AC Millivoltmeter (transistorised) | £55 0 |
| VM79 UHF Millivoltmeter (transistorised) | £125 0 |

These are current production, manufactured in U.K. by Advance Electronics Ltd. (not discontinued models). Showing a saving of approximately 33% on nett trade price. BRAND NEW, all in original sealed carton. Carr. 10/- extra per item. Special offer of 10% discount for schools and technical colleges, etc.

OSCILLOSCOPE TYPE 13A

Double beam. Time base 2 c/s. to 750 kc/s. Band width up to 5 Mc/s. Calibration markers at 100 kc/s. and 1 Mc/s. Operates from A.C. mains 100 to 250 volts. A completely reliable quality instrument. Supplied fully checked with circuit **£22/10/-.** Carr. 30/-.

HRO MODEL 5T £30

The octal valve version. In mint condition. Complete with all nine general coverage coil sets covering 50 kc/s. to 30 Mc/s. Instruction Booklet and circuit, but less external power supply. Carriage 30/- Complete manual available at 30/- extra.

PRICES NOW REDUCED CINTEL EQUIPMENT. ELECTROLYTIC CAPACITANCE AND INCREMENTAL INDUCTANCE BRIDGE No. 36601

A modern instrument, all solid state, which accurately measures the capacity of electrolytic condensers from 0.1µF to 1,000µF under operating conditions. Leakage current and polarizing voltage are separately metered. Inductances from 100 mH to 100 H can also be measured with current up to 100 mA. A.C. mains operation. Unused with handbook. List Price **£220.** Our Price **£70.**

WIDE RANGE CAPACITANCE BRIDGE. No. 1864. A matching instrument to the above. All solid state. Mains operation. Measures from 0.002pF to 100µF. Unused with handbook. List Price **£250.** Our Price **£75.**

MARCONI TEST EQUIPMENT

PORTABLE FREQUENCY METER TYPE TF.1026 SERIES

| | |
|-----------------------------|-----------------------------|
| TF.1026/4 2,000/4,000 Mc/s. | TF.1026/5 1,800/2,200 Mc/s. |
| TF.1026/6 3,800/4,200 Mc/s. | TF.1026/7 1,700/2,100 Mc/s. |
| TF.1026/9 2,425/2,525 Mc/s. | £40 each. |

WIDE BAND MILLIVOLTMETER TYPE TF.1371
100µv to 300 mv in five ranges. 30 c/s. to 30 mc/s. **£45.**

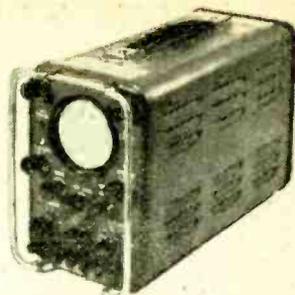
VACUUM TUBE VOLTMETER TYPE TF.1300
A.C. measurement 0.05 to 100 v., 20 c/s. to 300 Mc/s. D.C. measurement 0.1 to 300 v. Each over 5 ranges. Will also measure ohms, 50Ω to 5mΩ in 2 ranges. **£45.**

SENSITIVE VALVE VOLTMETER TYPE TF.1100
100µv to 300 v. A.C. in 12 ranges. 10 c/s to 10 Mc/s. Can also be used as a wide-band amplifier. **£50.**

DELAY GENERATOR TYPE TF.1415.
Provides sweep-delaying facilities when used in conjunction with the TF. 1330 (series) or similar oscilloscope. Alternatively, it may be used independently as a general purpose delay generator. **£35.**

| | |
|--|------|
| TF.867.A Standard Signal Generator | £200 |
| TF.890.A/1 R.F. Test Set | £150 |
| TF.1020.A/2 R.F. Power Meter | £50 |
| TF.1066.B/2 U.H.F. F.M. Signal Generator | £200 |
| TF.1067 Hetrodyne Frequency Meter | £65 |
| TF.1102 Amplitude Modulator | £40 |
| TF.1221 Hetrodyne Unit | £125 |
| TF.1274 V.H.F. Bridge Oscillator | £40 |
| TF.1275 V.H.F. Bridge Detector | £40 |
| TF.1350/1 Power Unit for TF.1346/1 | £40 |
| TF.1400 Double Pulse Generator | £100 |

Detailed technical specifications supplied upon request. Offered BRAND NEW at fraction of original cost.



PORTABLE OSCILLOSCOPE CT.52.

A compact general purpose instrument with many unusual features. Size 9 in. high, 8 in. wide, 6 1/2 in. deep. Time base 10 c/s. to 40 kc/s. Y plate sensitivity 40 v. per cm. Tube 2 1/2 in. Frequency compensated amplifier up to 38 dB gain. Bandwidth up to 1 Mc/s. Single sweep facilities. Operates from A.C. mains 100-250 volts, 50 c/s. Complete with all test leads, metal transit case, instruction book and circuit diagram. BRAND NEW. Tested and guaranteed. **£22/10/-.** Carr. 10/-.

SIGNAL GENERATOR CT-218 (FM/AM). MARCONI TF 937.

Covers 85 Kc/s. to 30 Mc/s. in 8 switched ranges. Effective length of film scale is 50ft. Output level variable in 1 dB steps from 1µV to 100mV (75Ω). Also IV Outputs down to 0.1µV from an outlet at 7.5Ω. Int. mod. at 400 c/s., 1 Kc/s., 1.6 Kc/s. and 3 Kc/s. FM at frequencies above 394 Kc/s. Variable mod. depth and deviation. Crystal calibrator 200 Kc/s. and 2 Mc/s. Monitor speaker for beat detection. Fully metered, blower cooled, Panclimatic. A.C. mains 100 to 150 and 200 to 250 volts, 45 to 100 c/s. 17 x 20 1/2 x 17 in. Weight 117 lbs. Fully tested and guaranteed. Fraction of original cost. **£65.** Carr. 50/-.

T.C.C. METALPACK CONDENSERS.

0.1 mfd. 500 v. D.C. wkg. at 70 C. Brand new, polythene wrapped, 7/6 doz., or £2 per 100.

T.C.C. METALMITE 350 v. D.C. wkg. 0.1 mfd. (CP37N); 0.05 mfd. (CP35N); 0.91 mfd. (CP32N) all at 5/6 doz. or 32/6 per 100. **SPRAGUE METAL CASED CONDENSERS** 0.01 mfd. 1,000 v. D.C. wkg., 5/6 doz., or 32/6 per 100.

T.C.C. VISCONAL CONDENSERS.

8 mfd. 800 v. D.C. wkg. at 71°C. CP 152 v. Size 3 x 1 1/2 x 5 1/2 in. high. BRAND NEW (boxed), 8/6 each. **DUBILIER.** 4 mfd. 600 v. wkg. CP 130T or similar. 1 1/2 x 1 1/2 x 4 1/2 in. high. BRAND NEW (boxed), 4/6 each. All post paid.

STANDARD TRANSFORMERS

Vacuum impregnated, interleaved; E.S. screen, universal mounting. Size 4 x 3 1/2 x 2 1/2 in. ALL BRAND NEW. 24/- each. Post 4/6.

Type 1. 250-0-250 v. 80 mA. 6.3 v. 3.5 a., 6.3 v. 1 a., tapped at 2 a.

Type 2. As above but 350-0-350 v. 80 mA.

Type 3. 30 v. 2 a., tapped at 12, 15, 20 and 24 v. to give 3-4-5-6-8-9-10 v., etc.

Type 5. 0-6-9-15 v. 4 a. Ideal for chargers.



LOW CAPACITANCE BRIDGE

MARCONI TF. 1342. Range 0.002 pF. to 1,111 pF. Accuracy 0.2%. Three terminal transformer ratio arm bridge allows "in situ" measurements. Internal oscillator frequency 1,000 c/s. 12 x 17 x 8 1/2 in. Weight 15 1/2 lbs. A.C. mains 200 to 250 and 100 to 150 v. 40-100 c/s. With leads and handbook. **ABSOLUTELY BRAND NEW.** List Price **£120.** Our Price **£45.**

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE LONDON, W.C.2.

Near Leicester Sq. Station. (Opposite Thorn House). Shop hours 9-6 p.m. (9-1 Thursdays).

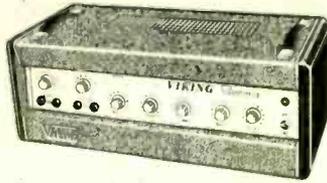
01-836 0545 (Opposite Thorn House). Open all day Saturday.

VIKING TRANSISTOR

40-50 WATT AMPLIFIER

OPERATING INSTRUCTIONS, GENERAL.

An extremely reliable lightweight amplifier capable of giving 40-50 watts of undistorted sound, made possible by the use of the latest semi-conductors (transistors) and techniques which ensure space-age reliability under the most rugged conditions. It is designed as a general purpose amplifier particularly suitable for use with musical instruments that require exceptionally high treble response (not recommended for Bass Guitar). Tremolo facilities are available on Channel 1 only. **INPUTS—CONTROLS—CHANNEL 1 (Tremolo).** This contains two high gain input jack sockets controlled by Volume Control 1 which is mounted directly above the two sockets marked Tremolo. **BASS I.** Gives a controlled boost to the lower frequencies on Channel 1 only. **TREBLE I.** Gives a controlled boost to the high frequencies on Channel 1 only. **TREMOLO.** This operates on Channel 1 only and the variations of intensity and speed of the Tremolo beat is adjusted by the controls DEPTH and SPEED. A socket is provided in the rear of the amplifier so that the Tremolo may be switched on and off by the use of a footswitch plugged into the socket. If you wish the Tremolo to be used without the footswitch, this is possible as the footswitch is only used to short out the effect. **INPUTS AND CONTROLS—CHANNEL 2 (Normal).** This contains two high gain input jack sockets controlled by Volume Control 2 which is mounted directly above the sockets marked Normal. **TREBLE.** Gives a controlled boost to the treble frequencies on Channel 2 only. **MAINS VOLTAGE.** Fully adjustable. 200-250 volts A.C., 50 cycles. **POWER OUTPUT** 40-50 watts sine wave British rating. Very little distortion. **OUTPUT IMPEDANCE** 3 ohms. Price 21 gns., plus £1 postage and packing.



VALVE VERSION OF THE ABOVE AMPLIFIER 40-50 watt, A.C. Mains 200/250 volts for 3 and 15 ohm speakers. Price 27 gns. plus £1 postage and packing. (No Tremolo facilities on this amplifier.)

STAR SR 150 COMMUNICATION RECEIVER

Frequency range: 535 kc/s-30 Mc/s. 4 wavebands. 5 valve superhet. Incorporates BFO, bandspread tuning, "S" meter, external telescopic aerial and ferrite aerial. Built-in 4in. speaker. Easy-to-read dial. For 240 v. A.C. operation. Complete, brand new, with full instruction manual. 15 gns. P. & P. 10/-.



NEW! The DORSET TRANSISTOR PORTABLE RADIO with BABY ALARM Facilities

600 milli-watt solid state 7 transistor plus diode and thermistor.

Completely modulated high quality portable radio featuring complementary N.P.N. and P.N.P. output stage.

The comprehensive easy-to-follow drawings supplied make this the easiest-ever transistor radio set of parts, with the following features:

- ★ Simple connections to only 6 tags on the R.F./I.F. module, 31.F. stages, osc. coil and 3 transistors which, with their associated components are completely wired.
- ★ Only 4 connections on the A.F. module to complete the 4 transistor 600 milli-watt solid state amplifier.
- ★ Pre-aligned R.F./I.F. module built and tested.
- ★ A.F. module built and tested.
- ★ Fully tunable over M.W. and L.W. bands. M.W. 540-1,640 Kc/s (557-183 metres). L.W. 150-275 Kc/s. (2,000-1,100 metres).
- ★ Intermediate Frequency 470 Kc/s.
- ★ Sensitivity: M.W. at 1 Mc/s 10 microvolts plus or minus 3 dB. L.W. at 200 Kc/s. 40 microvolt plus or minus 4 dB.
- ★ High Q internal ferrite rod aerial
- ★ on both wavebands.
- ★ Class "B" modulated output stage with thermistor controlled heat stabilization. Class "B" output stage ensures long battery life. Current drain is proportional to the output level. Total current drain of the receiver under no signal conditions is 10-12 mA. At reasonable listening level 20-30 mA.
- ★ Extension sockets for car aerial input, tape recorder output (independent of volume control) and Ext. Speaker.
- ★ All components (except speaker) mount on the printed circuit board. Easy to follow instructions. Size of cabinet 12in. long, 8in. high and 3in. deep.
- ★ Fingertip controls.

NEW Transistorised SIGNAL GENERATOR

Size 5½ x 3½ x 1½ in. For I.F. and R.F. alignment and A.F. output. 700 c/s frequency coverage 460 kc/s to 2 Mc/s, in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested.

39/6 P. & P. 3/6

RADIO AND T.V. COMPONENTS (ACTON) LTD

21A HIGH STREET, ACTON, LONDON, W.3

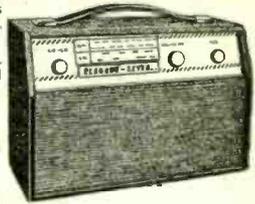
SHOP HOURS 9 a.m. to 6 p.m. EARLY CLOSING WEDNESDAY.

Goods not despatched outside U.K. All enquiries stamped add. envelope. Terms C.W.O.

'ELEGANT SEVEN' MK IIIA

Power supply kit to purchasers of "Elegant Seven" parts, incorporating mains transformer, rectifier and smoothing condenser. A.C. mains 200/250 volts. Output 9 v. 100 mA. 9/6 extra.

SPECIAL OFFER



- ★ De luxe wooden cabinet size 12½ x 8½ x 3½ in.
- ★ Horizontal easy to read tuning scale printed grey with black letters, size 11½ x 2in.
- ★ High "Q" ferrite rod aerial.
- ★ I.F. neutralization on each separate stage.
- ★ D.C. coupled push pull output stage with separate A.C. negative feedback.
- ★ Room filling output 350 mW.
- ★ Ready etched and drilled printed circuit board back printed for foolproof construction.
- ★ Fully comprehensive instructions and point-to-point wiring diagram.
- ★ Car aerial socket.
- ★ Fully tunable over medium and long wave. 168-535 metres and 1,250-2000 metres.
- ★ All components, ferrite rod and tuning assembly mount on printed board.
- ★ Sin. P.M. Speaker.
- ★ Parts list and circuit diagrams 2/6 free with parts.

ONLY **£4.40** Plus 7/6 P. & P.

Buy yourself an easy to build 7 transistor radio and save at least £10. Now you can build this superb 7 transistor superhet radio for under £4/10/-, No one else can offer such a fantastic radio with so many de luxe star features.

ANTI-THIEF CAR BURGLAR ALARM

The Melguard Safermatic consists of an electrical device housed in small metal box 4 x 2 x 1½ in., which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12 v. operation. List price 79/6. **OUR PRICE 29/6** plus 2/6 P. & P. Full easy-to-follow instructions supplied.



FIRST QUALITY PVC TAPE

| | 5½ in. | 7 in. | 3 in. | 5 in. | 7 in. | 5 in. | 7 in. | 5 in. | 7 in. | 5 in. | 7 in. | 5 in. | 7 in. | 5 in. | 7 in. | 5 in. | 7 in. | | | | | | |
|------|--------|----------|-------|--------|----------|--------|----------|-------|----------|-------|--------|-------|----------|-------|----------|-------|----------|------|----------|------|-----------|-----------|--|
| Std. | 850ft. | 9/- | L.P. | 850ft. | 10/6 | Std. | 1,200ft. | 11/6 | 3in. | T.P. | 600ft. | 10/6 | 5in. | T.P. | 1,800ft. | 25/6 | 7in. | T.P. | 2,400ft. | 32/6 | 4 OR MORE | POST FREE | |
| L.P. | 240ft. | 4/- | 5in. | T.P. | 1,800ft. | 25/6 | 5in. | L.P. | 1,200ft. | 11/6 | 5½ in. | T.P. | 3,600ft. | 42/6 | 7in. | T.P. | 3,600ft. | 42/6 | 7in. | T.P. | 900ft. | 15/- | |
| 5in. | L.P. | 1,800ft. | 18/6 | 4in. | T.P. | 900ft. | 15/- | | | | | | | | | | | | | | | | |

600 mW SOLID STATE

4-TRANSISTOR AMPLIFIER

response. Automatic heat compensation. Combined A.C./D.C. feedback. Class B output stage, i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition (I_Q) current drain is approx. 12 mA at 9 volts (4 mA in the output pair). Printed circuit construction. Size: 2½ x 1½ x 1½ in. Speaker output impedance 12 ohms. Output power 600 mW at 5% distortion, 400 mW at 2.5% distortion, 750 mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35-40 mA at full power (speech and music) average 65 mA. Sensitivity for 50 mW output is 10 mW. Frequency response —3dB points 90 c/s. and 12 kc/s. Price 15/- plus 1/- P. & P. 7x4 speaker to suit, 13/6, plus 2/- P. & P.

Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response.

Fairchild Decade Counter, 9 silicon transistors, 17 diodes, divide-by-ten unit. Can be coupled to digitron tube type GR10K. Can be directly coupled to form an efficient digital counter. Zero pulse line incorporated so that all readings can be instantly reduced to zero. Power input +150 v. at 4.5 mA. —70 v. at 150 mA. including digitron feed. Maximum frequency 1 Mc/s. pulse width. Input pulse amplitude not less than 100 mV. £5 plus 2/6 P. & P.

BSR TAPE DECKS 200/250 v. A.C. mains

Type TD2. Tape speed 3½ twin track, £6/19/6. Type TD10, 2-track, 3 speed, plus rev. counter, £7/19/6. Type TD10, 4-track, 3 speed, plus rev. counter, £9/5/-.



EXTRACTOR FAN



A.C. mains 230/250 v., complete with pull switch. Size 6 x 6 x 4 in. Price 27/6, plus 5/- P. & P.

3 TO 4 WATT AMPLIFIER

3-4 watt Amplifier, built and tested. Chassis size 7 x 3½ x 1 in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6, £2/5/- plus 5/6 P. & P.



323 EDGWARE ROAD, LONDON, W.2. PERSONAL SHOPPERS ONLY.

All orders by post must be sent to our Acton address. Early closing Thurs.

LIND-AIR LTD (ELECTRONICS)

LONDON'S LEADING COMPONENT SHOPS

25 & 53 TOTTENHAM COURT RD. LONDON W.1.

Tel: 01-580 4534/7679—Open 9 a.m.-6 p.m. Mon. to Sat. inclusive. Open Thurs. till 7 p.m.

GARRARD DECKS
(at up to 25% off list)



MODEL 3000
with Sonotone
9TAHC stereo
cartridge: £9/19/6

AT80 Mk. I, less cart. £10 19 6
AT80 Mk. II, less cart. £12 19 6
SP25 Mk. II, less cart. £10 19 6
LAB 80 Mk. II, less cart. £24 19 6
P. & P. 7/6 extra.

Mono Cartridge 12/6
Stereo Cartridge 18/6
Plinths with perspex cover £6.0
(for LAB 80 8 chs.) P. & P. 5/6
Agents for Thornton, Duni, Goldring—
prices on request.

**TRANSISTOR
FM TUNER**
£6 7 6 P. & P. 4/.

6 Transistor. Frequency
range 88-108 Mc/s. Size 6in.
x 4in. x 2 1/2in. Ready built for
use with most amplifiers, 9 v.
battery operation. Complete
with instructions.

**FOR THE STEREO EN-
THUSIAST**—Multiplex adap-
tor for Stereo Radio reception.
£5/19/6 extra.

2-WAY RADIOS

Mallard (as illus.) 10 Trans-
istor £18 18 0

Vantone 6 Transis-
tor .. £8 15 0

Vantone 5 Transis-
tor .. £6 15 0

Lafayette 2 channel
long range 65 gns.
P. & P. 5/- each.

**AIRCRAFT BAND
PORTABLE**



The finest radio of its
type available today! 1
Sanyo Aircraft Band
(107-135 Mc/s) and
Medium Wave (200-
350 Metres. (Portable
Radio, 9 transistors, 2 diodes, 1
thermister, 4 x 2 1/2in. oval speaker,
Twin outlets for private earphone, 6
Peulight batteries, Telescopic aerial,
Leather carrying case and straps.
ONLY £16/19/6. P. & P. 6/-.

LIND-AIR XMAS SCOOP!

COMPLETE HI-FI STEREO SYSTEM

ONLY 59 GNS.



**ALL
6 WATTS PER
CHANNEL STEREO HI-FI
SYSTEM OFFERING A PERFORM-
ANCE EQUAL TO IF NOT BETTER THAN
SIMILAR SYSTEMS COSTING UP TO DOUBLE
THE PRICE.** Plus advanced circuitry using latest silicon
transistor. GARRARD 3000 Changer unit fitted. SONO-
TONE 9TAHO STEREO/MONO DIAMOND CARTRIDGE
(4 speeds 78, 45, 33), 161 r.p.m.). 9 records automatically.
Also manual play. Bass, Treble, Volume and Balance controls
also manual play. Mono/Stereo slide switches. TWO
and On/Off. Gram/Carb. Mono/Stereo side switches. TWO
IDENTICAL LOUDSPEAKER SYSTEMS each incorporating separate bass speakers and high frequency units with crossover network and complete with 10ft. leads and plugs.
BRIEF SPEC. Player/Amplifier unit, size 19 1/2 x 14 x 8 1/2 in., 200/250 v. A.C. operation. Inputs for Radio Tuner/Tape Recorder, also outputs for Tape Recorder. Loudspeaker
Systems. Size (each) 13 x 7 x 8 in. Supplied complete with instruction booklet ready to plug in and play. Only 59 gns. plus 20/- Carriage and Insurance. (Rosewood finish £2 gns. ex.)

MULTIMETERS

TTC 1001 (as illus.),
20,000 o.p.v. £3 19 6

C1000, 1,000
o.p.v. £2 2 0

Caby, NI200,
20,000 o.p.v. £6 10 0

Caby B40,
4,000 o.p.v. £6 10 0

TMK500, 30,000
o.p.v. £9 19 6

TTC Model 1030, 50,000 o.p.v. £9 19 6

TTC Model 1031, 100,000 o.p.v. £12 19 6

Post. & Pkg. 3/6

STEREO HEADPHONES

Selection from stock:—

TTC G1110, 16
ohms £3 19 6

AKAI A888, 8
ohms £5 19 6

CORAL E102,
16 ohms £4 19 6

Eagle BE1, 16
ohms £3 19 6

TTC Stethoscope, 8 ohms £2 9 6

P. & P. 4/6 each.

Also stockists of Koss, Beyer, etc.

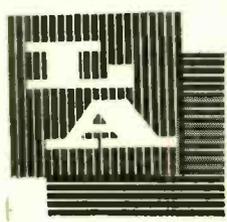


SPECIAL OFFER

THIS COUPON ENTITLES YOU TO RECEIVE 20/- SPECIAL DISCOUNT OFF ANY PURCHASE OVER £15 (Excluding Garrard Decks)

20/- OFF

CUT OUT AND TAKE ALONG TO ONE OF OUR SHOPS OR ENCLOSE WITH YOUR MAIL ORDER TO DEPT. W.W.168, 53 TOTTENHAM COURT RD., LONDON, W.1. VALID UP TO DECEMBER 31st, 1967



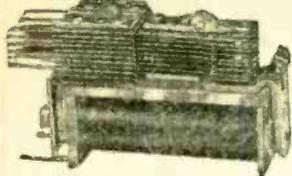
SINCLAIR PRODUCTS

MICROMATIC RADIO. KIT ONLY 49/6. P. & P. 2/6.
MICROMATIC RADIO BUILT. ONLY 59/6.
P. & P. 2/6.

MICRO FM. KIT—£5/19/6 complete. P. & P. 2/6.
Z.12 HI-FI AMP and PRE-AMP £4/9/6. P. & P. 2/6.
STEREO 25 Control Unit £9/19/6. P. & P. 2/6.
P23. Mains Power Supply Unit £3/19/6. P. & P. 2/6.

1000's OF SPECIAL BARGAINS AVAILABLE.
HI-FI EQUIPMENT. TRANSISTOR RADIOS.
TAPE RECORDERS. COMPONENTS. MICRO-
PHONES, etc.

Wilkinson's FOR RELAYS



P.O. TYPE 3000 AND 600
BUILT TO YOUR REQUIREMENTS—QUICK DELIVERY
COMPETITIVE PRICES—VARIOUS CONTACTS
DUST COVERS—QUOTATION BY RETURN

LARGE STOCKS OF MINIATURE SEALED RELAYS DETAILED LIST ON REQUEST

PORTABLE VOLTMETERS 0-160 Moving Iron AC/DC, 5in. mirror scale, in polished wood case, 99/6. Post 0/- Resistor to double the range, 2/6.

PORTABLE AMMETERS 0-3 AC DC 5in., 35/-, p. 3/-

FREQUENCY METERS Model 7, £13 10/- and £15, post 7/-, 230 volts; 6in. flush round. Brand new, £10 10/-

AVOMETER POWER FACTOR WATTAGE UNIT, £7. Resistors wire wound or carbon, potentiometers condensers, quantities ex-stock at low prices.

GEARED MOTORS, 3 R.P.M. or 1 R.P.M., 4 watts very powerful reversible, 24 v. A.C. 35/-, post 2/6, can be operated from 230 v. mains with our 20/- Transformer.

KEY SWITCHES (3 position)
 4 C Non Lock/4 C Non Lock, 16/6.
 4 C Non Lock/6 C Lock, 20/-
 2 C Lock/2 C Lock, 12/6.
 4 C Lock/4 C Lock, 17/6.
 Stop, 4 C Lock, 12/6.

Many other types.
Low Capacitance 8 C Muirhead, 17/6.
 Stop/2 C Lock, 7/6.
 All Stop/4 C Non Lock, 10/6. Post 1/6
 2 C Lock/6 C Lock, 17/6.

MAINS TRANSFORMERS. Output 300-0-300 volts, 250 mA, 6.3 volts, 9 amp., 25/-, Post 6/-

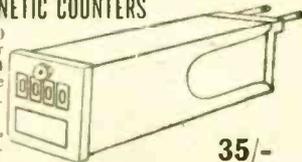
AUTO TRANSFORMERS by S.T.C. Totally enclosed C-core type, 110-250 volts, 8 tappings, 50 cycles, 1,000 watts. Size 6 1/2 x 5 3/8 x 6 1/2 in., £4. Post 10/6.



RATIO ARM UNITS. Sullivan 6000, 6000, 50/-, **DOUBLE HEADPHONES.** High resistance, 4,000Ω, 14/6. Sound powered type DHR, 17/6. Post 3/-

SMALL MAGNETIC COUNTERS

3 1/2 x 1 1/2 in., 10 counts per second with 4 figures. The following D.C. voltages are available, 6 v., 12 v., 24 v., 50 v. or 100 v.



35/-

MAGNETIC COUNTERS, with zero reset 230 v. A.C. or 110 v. Veeder Root 6 fig. 65/- ea. Counting Insts. flush type 48 v. D.C. 90/- ea., post 3/-

P.O. STANDARD RACKS 6ft. U channel sides drilled for 10in. panels, heavy angle base 150/- cge. 20/-

LIGHT TYPE 6ft. high 25/-

JACK PLUGS. 2 Points, with screw-on cover, 2/6, post 1d. PO.201 with cord, 3/-, post 1/6; P.O. 316, 3 Point, 4/6, post 1d.

PLUG-IN RELAYS. Londex 4 change-over HD contacts 28 v. D.C. or 240 v. A.C. with base and cover, 35/- ea.

RELAYS. 24 volt D.C., 4 Make, 4 Break, 10 amp. 5C/3944 with Dust Cover, 12/6 each.

HAIR HYGROMETER. 4in. round by Negretti & Zambira, scaled 0/100 reading relative percentage humidity, 65/-, Post 3/-

METERS GUARANTEED. Complete list available

Microamps 0/100 2 1/2 in. MC 40/-
 Microamps 0/500 2 1/2 in. MC 25/-
 Microamps 0/500 2 1/2 in. MC 37/6
 Milliamps 0/50 2 1/2 in. MC 35/-
 Milliamps 0/500 3 1/2 in. MC 54/-
 Amps 0/5 2 in. MC 37/6
 Volts 5/0/5 2 1/2 in. MC 25/-
 Volts 0/20 2 1/2 in. MC 37/6
 Volts 0/5 A.C. 3 1/2 in. MC 55/-
 Volts 0/10 A.C. 3 1/2 in. MCR 70/-



Microamps 0/50 sealed in Milli Rontgens 2 1/2 in. MC 45/-
 Millivolts 350/0/350 (3.5/0/3.5) Millia 2 1/2 in. MC 35/-

PORTABLE VOLTMETERS. 0/250 Moving Iron AC/DC 6in. scale, in polished wood case, £7 10/-

MINIATURE BUZZERS (as illus.), 12 volt with tone adjuster, 7/6

HIGH NOTE BUZZERS 24 v. A.C./D.C. with tone adjuster, 2 1/2 in. dia. Bakelite case, 10/6. Post 2/-

SUBMINIATURE MICRO SWITCHES HONEYWELL 11SM1-TN13. S.P.D.T. Size: 78 1/2 in. x 250 in. x 35 1/2 in., 6/6 each

MICRO SWITCH. Burgess MK4BR, robust die cast casing, 8/6 each. Post 9d.



WHY NOT CALL AND SEE US? MANY OTHER INTERESTING ITEMS. Open all week (Sats. until 1 p.m.). OWN CAR PARK.

L. WILKINSON (CROYDON) LTD.
 LONGLEY HOUSE LONGLEY RD. CROYDON SURREY
 Phone: THO 0236 Grams: WILCO CROYDON

PRE-PAK

SEMICONDUCTORS

DISTRIBUTED EXCLUSIVELY BY

BI-PRE-PAK LTD. DEPT. B.
 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX
 PHONE: SOUTHEND (0502) 46344

BRAND NEW UNTESTED TRANSISTORS

SAVE £'s TEST THEM YOURSELF

WE TELL YOU WHAT TYPES THEY ARE

DON'T TAKE CHANCES ON UNKNOWN LOTS

LOOK — TRANSISTORS 1/- EACH

SILICON ★ PLANAR ★ N.P.N. ★ P.N.P.
 All these types available

| | | | |
|--------|--------|--------|--------|
| 2N929 | 2N131 | 2N696 | 2N996 |
| 2N601 | 2N512 | 2N697 | 2N2001 |
| 2N2411 | 2N102 | 2N1507 | 2N731 |
| 2N736 | 2N103 | 2N1613 | 2N732 |
| 2N706 | 2N104 | 2N1711 | 2N733 |
| 2N706A | 2N2250 | 2N1893 | |
| 2N3011 | | | |

ALL TESTED AND GUARANTEED TRANSISTORS—UNMARKED. Manufacturers over-runs for the new PRE-PAK range.

PRE-PACKS

| No. | Description | PRICE |
|------|---|-------|
| A1. | 6—Silicon rectifiers BY100 type | 20/- |
| A3. | 20—Mixed marked and tested trans. | 20/- |
| A15. | 2—Power Comp. Pair. AD161/2 | 20/- |
| A19. | 5—Zener diodes inc. Book of Instructions | 20/- |
| B1. | 50—Unmarked untested, trans., new | 10/- |
| B3. | 4—Solar cells, inc. Book of Instructions | 10/- |
| B3. | 4—OAS gold bonded, diodes Mullard | 10/- |
| B5. | 7—Matched set, OC44, 45/81D/81 + diode | 10/- |
| B6. | 16—Red spot AF. trans. or white spot RF | 10/- |
| B8. | 2—Power trans. OC28/35 type | 10/- |
| B9. | 1—Light sensitive cell, ORP12 type | 9/- |
| B10. | 10—50V trans. geom. PNP latest type | 10/- |
| B44. | 1—Tunnel diode, 6BY11, 1050 Mc/s | 10/- |
| B21. | 2—Sil. recs. 10 amp., 50-100 PIV | 10/- |
| B42. | 5—Switching trans. TK22C 8TC | 10/- |
| C2. | 1—Uni junction, 2N2160 or 2N2946 | 15/- |
| C4. | 2—RF power trans., OC22 and 6BY11 | 15/- |
| C31. | 4—Sil. recs. 500 PIV 1 amp. top hat | 15/- |
| C32. | 2—Power trans. TK 400A/NKT404 VUB64 IC 8 amp. | 18/- |
| D18. | 1—ORP60 type light sensitive cell | 5/- |

25 8BY 95 A NPN SILICON TRANSISTORS 10/-

10 1000 PIV. 1 AMP. MIN. SILICON. DIODES 10/-

25 8BY 20-27 NPN SILICON TRANSISTORS 10/-

10 10 WATT SILICON ALL VOLTAGES ZENERS 10/-

25 8BY50-51-52 NPN SILICON TRANSISTORS 10/-

10 4 AMP. STUD SILICON RECTIFIERS 10/-

25 BC107-8-9 NPN SILICON TRANSISTORS 10/-

40 1N914-6 SUB. MIN. SILICON DIODES 10/-

50 MIN. GERMANIUM HIGH QUALITY DIODES 10/-

25 2N706-A NPN SILICON TRANSISTORS 10/-

| TRANSISTORS | PRICE | 8BY25 | 10/- | OC171 | 4/- | POWER TRANSISTORS | |
|-------------|-------|--------|------|--------|------|-------------------|------|
| AC107 | 6/- | 8BY26 | 5/- | OC200 | 5/- | OC20 | 10/- |
| AC126 | 2/6 | 8BY27 | 5/- | OC201 | 8/- | OC23 | 10/- |
| AC127 | 2/6 | 8BY28 | 5/- | OC44 | 1/11 | OC25 | 8/- |
| AC128 | 3/- | 8BY29 | 5/- | OC45 | 1/9 | OC28 | 5/- |
| AC17 | 5/- | 8BY35A | 3/- | 2N711 | 10/- | OC35 | 7/6 |
| AP114 | 4/- | OC41 | 2/6 | 2N1302 | 4/- | OC36 | 7/6 |
| AP115 | 3/- | OC71 | 2/6 | 2N1303 | 4/- | DIODES | |
| AP116 | 3/- | OC72 | 2/6 | 2N1304 | 5/- | AAV42 | 2/- |
| AP117 | 4/- | OC73 | 5/- | 2N1305 | 5/- | OA10 | 1/9 |
| AP118 | 3/6 | OC81 | 2/6 | 2N1306 | 5/- | OA70 | 1/9 |
| AP119 | 3/6 | OC81D | 2/6 | 2N1307 | 6/- | OA79 | 1/9 |
| AP178 | 10/- | OC83 | 4/- | 2N1308 | 8/- | OA81 | 1/9 |
| 8BY66 | 2/- | OC139 | 2/6 | 2N1309 | 7/6 | OA182 | 2/- |
| BC211 | 7/6 | OC140 | 5/- | 2N303 | 2/6 | 1N914 | 1/6 |
| 8BY50 | 15/- | OC170 | 2/6 | | | | |

'FREE' ★

Packs of your own choice to the value of 10/- with all orders over £4.

LARGE RANGE — LOW PRICE

SILICON CONTROLLED RECTIFIERS. SEND FOR FULL RANGE AND CIRCUIT DIAGRAMS. **FREE OF CHARGE.**

GREAT NEWS ★

We now give a written guarantee with all our semi-conductors.

FIRST EVER LOGIC KITS. Learn for yourself how computers work, even make one for yourself. Full instructions for noughts and crosses machine, binary counters, timers, etc. L1 5 ga. L2 10 ga. No need to purchase both kits, you can start with L2 which incorporates L1. **DETAILS FREE**

MAKE A REV. COUNTER FOR YOUR CAR. THE 'TACHOBLOCK.' This encapsulated block will turn any 0-1mA meter into a perfectly linear and accurate **20/- each** rev. counter for any car. State 4 or 6-cylinder.

NO CONNECTION WITH ANY OTHER FIRM. MINIMUM ORDER 10/-. CASH WITH ORDER PLEASE. Add 1/- post and packing per order. **OVERSEAS ADD EXTRA FOR AIRMAIL.**

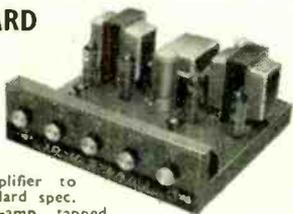
www.americanradiohistory.com

BARGAIN OPPORTUNITIES FROM

Amplifiers

IN KIT FORM AND COMPLETE

**MULLARD
10-10
STEREO**



Valve amplifier to exact Mullard spec. With pre-amp, tapped o/p transformer 3 and 15Ω all controls, H.T. and L.T. outlet, mono, stereo and speaker phase switching. Complete with escutcheon, knobs, plugs, etc. Ready built (p. & p. 12/6) £20.0.0
In kit form with chassis, knobs, plugs, etc. (p. & p. 12/6) £17.10.0

MULLARD 5-10 MONO

5 valve 10 watt basic amplifier, complete with valves and instructions. £9.19.6
With passive network and control panel (p. & p. 7/6) £11.19.6
2 valve pre-amp and control assembly, complete kit with valves and instructions. £6.12.6 (p. & p. 6/-)

SPECIAL MULLARD 2+2 PRE-AMP

Stereo pre-amp and control unit. Complete kit with valves and instructions. S.A.E. brings details. BUILT—13 gns. Kit, complete 10 gns. (P. & P. either 7/6).

PEAK SOUND SA 8-8

14 Transistor Kit builds into superb hi-fi amp. 8W per channel (16W mono) with integrated pre-amp to take high quality ceramic p.u. Unusually easy to build by following the instructions (1/6 purchased separately and refunded when kit is bought). This makes one of the best and most economical stereo transistor amps. we have ever offered. All purchases backed by TRS service facilities. When built and fitted in its special cabinet the SA 8-8 equals the best in modern styling.

- AMPLIFIER KIT (p. & p. 4/-) £9.10.0
- POWER PACK KIT (p. & p. 4/-) £2.10.0
- MODERN SLIMLINE WOOD CABINET (p. & p. 5/-) £2.10.0
- COMPLETE ASSEMBLY post free if ordered at same time. £14.10.0

7 VALVE AM/FM RG CHASSIS

A superbly powerful high performance instrument for the keenest enthusiasts. Provides tuning on long, medium and F.M. wavebands. Excellent sensitivity. Permeability tuning on F.M. Large clear dial, A.V.C. good neg. feedback. Magic eye 3W output. A.C. 220/250V. Circuit diagrams available. Aligned, tested and ready for use (Carr. and ins. 7/6). S.A.E. brings £13.19.6 full details.

SINCLAIR Z.12 AMPLIFIER

This famous amplifier operates from 6 to 20V D.C. and is adaptable to a wide range of applications because of its very small size. Supplied ready built with comprehensive instructions 89/6 manual. Post free.

SINCLAIR STEREO 25

De Luxe pre-amp control unit for use with two Z.12s. Smart front panel and knobs. Ready built. Post free. £9.19.6
SINCLAIR PZ.3 Power supply unit for two Z12s and stereo 25. Post free 79/6

JUST INSTALLED—A new arrangement enabling you to hear in our shop any combination of our advertised amplifiers, speakers, tuners, etc. Personal shoppers are particularly invited to come along and hear this for themselves.

SHOPPING BY POST

Please send cash with Order or pay C.O.D. Please mention "Wireless World".

POSTAGE. Unless stated add 1/- on 1lb. orders, 1/9 on 1lb., 3/6 on 2lb., 5/- on 6lb., 6/6 on 10lb., 8/- on 14lb. Over, 10/6.

GARRARD UNITS AND PLINTHS

FOR IMMEDIATE DELIVERY

LM3000 Record Player with 9T.A. Stereo Cartridge. Brand new as from factory. £8.15.0

AT.60 Mk. II De-luxe Auto-changer. diecast turntable. Less cartridge £11.19.6

SP.25 De luxe single record player, diecast turntable Less cartridge. 9 1/2 gns.

Packing and carriage on any one of above 7/6 extra.

Garrard Plinth. Ideal mounting for the Garrard Units offered here. Will readily suit any hi-fi set-up. In fine Teak Complete with useful soft plastic dust cover. Carriage and pack 5/- 75/-

Garrard clear-view rigid perspex cover (carriage 3/6) 57/6

6 VALVE AM/FM TUNER



Med. and V.H.F.—6 valves metal rectifier. Self-contained power unit. Magic-eye, 3 push-button controls. Diode and high output sockets. Illuminated 2-colour dial, chassis 11 1/2 in. x 4 in. x 5 1/2 in. A.C. 200/250 v. Unbeatable value. Complete kit, inc. Power Pack as illustrated, 11 gns. Carr. 7/6. Ditto less Power Pack, 10 gns. Carr. 7/6. Circuit and Const. details 4/6. Free with kit.

SINCLAIR MICROMATIC AT NEW REDUCED PRICES

The world's smallest radio now includes hi-fi magnetic earpiece, yet costs even less. Complete kit formerly 49/6 59/6, now Ready built and tested 59/6 formerly 79/6, now

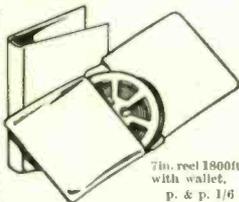
SINCLAIR MICRO FM

Complete kit for building 7-transistor cigarette packet size tuner/receiver unit. For use with amplifier, etc. or pocket receiver. With earpiece and telescopic aerial. £5.19.6

TRS FM DECODER

Based on Mullard design and produced by T.R.S. Built-in indicator, 6-transistor model, readily adaptable for use with valve tuners as well. For 9-15 v. operation. Complete kit with Mullard specified inductors already aligned. £5.50 (p. & p. 2/6).

EXCLUSIVE TRS TAPE WALLET OFFER



With each reel of this fine tape by an internationally famous manufacturer we give you a beautifully made wallet, strongly made in simulated leather with space for a reel of tape each side. This is professional quality full frequency tape with metallised leader/stop foils. These library wallets solve once and for all the problems of storing tapes efficiently and tidily.

- 5 1/2 in. reel, 1200ft., 17/6
- 5 1/2 in. reel, 900ft. 12/6
- 7 in. reel 1800ft., 22/6
- TAPE REELS—7 in. 2/3; 5 1/2 in.—2/-; 5 in.—2/-; 3 in.—1/3 (p. & p. 6d.).

FOR ONLY 6d.

You can start to enjoy not only the bargains to be found in this latest 8-page printed list, but the personal service TRS give with every transaction however large or small. SEND 6d. FOR LATEST TRS LIST TODAY.

LARGE STOCKS OF TRANSISTORS, TRANSISTOR COMPONENTS, COILS, SWITCHES, VALVES, SPEAKERS, ETC. ALWAYS AVAILABLE AT KEENEST PRICES.

VEROBOARD—All standard sizes, including 2 1/2 in. x 5 in., 3/8; 2 1/2 in. x 3 1/2 in., 3/-; 3 1/2 in. x 5 in., 5/2; 3 1/2 in. x 3 1/2 in., 3/9; 2 1/2 in. x 1 1/2 in., 12/6. All accessories and tools in stock.

STEREO BALANCE CONTROLS. Log/ Anti-Log 5K, 1 or 2 Meg., 9/- each. RESISTORS—Modern ratings. Full range 10 ohms to 10 megohms, 10% 1/4 W., 4d. each; 20% 1W. 6d. each; 2W. 9d. each; 5% 1/2-stab 1/4 W. 6d. each; 1W. 8d. each; 1.2-10 meg. 10% 1/4 W. 4d. each; 1W. 5d. each. 1% 1/2-stab, 1/4 W. 1/6 each (below 100Ω, 2/- each).

WIREWOUND RESISTORS—25 to 10kΩ, 5W, 1/3 each; 10W, 1/9 each. 15W, 2/3 each.

CONDENSERS—Silver Mica. All values 2pF to 1,000pF, 6d. each. Ditto ceramics, 9d. Tub. 450V T.C.C. etc. 0.001-0.01 mFd, 10d. each; 0.1-500V, 1/- each. TCC 350V 0.25, 1/9 each; 0.5, 2/- each.

CLOSE TOLS/MICAS—10% 5-500pF, 9d; 600-5,000pF, 1/-; 1%, 2-100pF, 11d 100-250pF, 1/2; 270-800pF, 1/-; 800-5,000pF, 2/-.

ALUMIN. CHASSIS—18g. Plain undrilled, folded four sides, 2in. deep, 6in. x 4in., 4/6; 8in. x 6in., 5/9; 10in. x 7in., 6/9; 12in. x 6in., 7/6; 12in. x 8in., 8/- etc.

TYGAN FREE or Vynard speaker fabric, 12in. x 12in., 2/-; 12in. x 18in., 3/-; 12in. x 24in., 4/-, max. width 48in.

BONDACOUST Speaker Cabinet Acoustic Wadding, approx. 1in. thick 18in. wide, any length cut, 2/3 ft., 6/- yd.

SILICON RECTIFIERS—Miniature. Wire ended, 1in. x 1in. MULLARD Type BY100 800 v. 500mA, 8/6. BY236 250 v. 500mA, 5/-, BY114 450 v. 500mA 8/-, BY237 500 v. 500mA, 6/6.

NEON MAINS INDICATOR LAMP. Wire ends, 3/6.
ENAMELLED COPPER WIRE. 2 oz. reels—14g-20g, 3/-; 22-28g, 3/6; 30-34g 4/3; 36-38g, 4/9; 36-40g, 5/-.
TINNED COPPER WIRE. 10g-22g, 2 oz. 4/-.

SAVE ON SPEAKERS

TRS TEAK ENCLOSURES, size 21in. x 15in. wide x 7 1/2 in. Cut to take tweeter and 8in. or 10in. unit to order. Acoustically loaded for finest quality **FANTASTIC VALUE at £4.15.6** (Add 7/6 for part cost of packing and forwarding)

- 15 OHM UNITS**
- 8in., 15,000 lines, ceramic magnet 10 watts. Foam suspended cone £5.19.6
- 10in. Goodman Axiom £7.5.0
- Type 10 £5.15.0
- 8in. FR8 £5.15.0
- W B 8in. HF12 £4.10.0
- Goodman's 8in. Axiette £6.0.0

The above units are particularly recommended for use with the TRS Teak Acoustic Enclosure and wherever high-fidelity standards are required at modest outlay.

EMI. 3-ohm Elliptical speaker 1 1/4 x 8in. heavy duty 55/- unit.

SINCLAIR Q.14
A remarkable new reproducer from a famous house, 9 1/2 in. sq. 15 ohms. Truly superb quality obtainable in stereo, £6.19.6 each

NEW IMPROVED "CIR-KIT"
Now incorporates 0.1in. matrix board in convenient sizes, together with improved "Cir-Kit" material. Easier than ever to use. No drilling necessary. See H.I.F. NEWS, Nov. issue. 6ft. spool of "Cir-Kit" 2/-, "Cir-Kit" Matrix Board, 5in. x 3 1/2 in., 4/-; 3 1/2 x 2 1/2 in., 2/6; 3 1/2 in. x 2 in., 1/6.

B.B.C. 2 U.H.F. Low Loss Cable, per yard 1/3.
80 OHM CO-AX CABLE—Famous make—1st Grade Quality. Benz-air spaced, low-loss, high quality 80 ohm Aerialaxial Cable. Braided Conductor, standard 1in. dia. approx. 6d per yard. Special Discount for Quantity Lengths, 20 yds. 9/-, 40 yds. 17/6, 80 yds. 29/6, 120 yds. 41/6, 160 yds. 53/6, 200 yds. 65/6, 240 yds. 77/6, 280 yds. 89/6, 320 yds. 101/6, 360 yds. 113/6, 400 yds. 125/6, 440 yds. 137/6, 480 yds. 149/6, 520 yds. 161/6, 560 yds. 173/6, 600 yds. 185/6, 640 yds. 197/6, 680 yds. 209/6, 720 yds. 221/6, 760 yds. 233/6, 800 yds. 245/6, 840 yds. 257/6, 880 yds. 269/6, 920 yds. 281/6, 960 yds. 293/6, 1000 yds. 305/6.

- COAX CABLE ACCESSORIES**
- Coax Plug (Aerialite) etc., each 1/3
- Car Radio Type, ERCO, etc. 1/6
- Coax Socket, Chassis Mounting Belling Lee, etc., each 1/-
- Coax Sockets (teak end type) each 1/9
- Cable Couplers—back-to-back sockets 1/6
- Outlet Boxes—1 in 1-out, each 4/-
- Ditto 1 in—2 out compensated, each 10/-
- Attenuators Plug in type Aerialite Adjustable 6dB-36dB, each 7/6
- Band 1-Band 2-Band 3 Cross over Unit (Splitter Box) 13/6
- Band 1, Band 3 10/6

TRS SPECIAL SERVICE IN TRANSFORMERS

All types, and chokes available in singles or small production runs to specification at competitive prices. Enquiries invited. Private enquiries, please send S.A.E.

TRS RADIO COMPONENT SPECIALISTS

70 BRIGSTOCK RD., THORNTON HEATH, SURREY.

Established 1946

Telephone: THO 2188

Hours 9 a.m.-6 p.m. (1 p.m. Wednesday)

Few doors from Thornton Heath Stn. (Southern, Victoria Section)

BI-PAK SEMICONDUCTORS

(DEPT. WW)

8 Radnor House
93 97 Regent Street
London, W.1

W.W. DIGITAL COMPUTER TRANSISTORS and DIODES
Trans. 2G-371/D1476 8d. each
Trans. Sil. 25301C 2/- each
Diodes Sil. 15130 4d. each
Prices for all qty's. All devices will meet W.W. specifications reqd. BRAND NEW.

ORP12 8/6
ORP60
BC107
BC108
BC109 5/-

NEW TESTED SUPER-PAKS No Duds—Uncoded Devices

| | | |
|----|--|------|
| 40 | SIL. PLANAR TRANS NPN. 8im 2N706/8, BSY26/27, 28103/4 | 10/- |
| 30 | MADT Metal Alloy Diffused Trans. Sim. MAT101/2, MA593, MA820, PNP. | 10/- |
| 50 | Sil. Planar Diodes 250mA. 8im. 1H121/130 OA200/202 | 10/- |
| 30 | AF Germ. Alloy Trans. PNP. 8im. 2G300 Series. OC71/76. AC125/8 | 10/- |
| 12 | Epoxy Case 500mA Sil. Rect. 100-600 p.i.v. 8im. BY101, BY130. | 10/- |
| 30 | Fast Switching Sil. Diodes. 8im. 1N914/916, TR12/16, Micro-Min | 10/- |
| 10 | 1 Amp. Glass Sil. Rect. 200-800 p.i.v. 8im. BYX22/260-800 | 10/- |

* VALUE PACKS for '68 * NEW UNTESTED

| | | | |
|-----|----------------------------|--------------|------|
| 120 | Glass Sub-Min. | GERM. DIODES | 10/- |
| 50 | Mixed Germ. | TRANSISTORS | 10/- |
| 20 | Mixed Volts | ZENERS | 10/- |
| 30 | NPN, PNP, MIXED | SIL. TRANS. | 10/- |
| 60 | 200mA Sub-Min. | SIL. DIODES | 10/- |
| 20 | Germ. 1 Amp. | RECTIFIERS | 10/- |
| 40 | Like OC81, AC128 | TRANSISTORS | 10/- |
| 10 | 2 Amp. Stud | SIL. RECT. | 10/- |
| 25 | Sil. NPN, 200 Mc/s. | TRANSISTORS | 10/- |
| 16 | Top-Hat 750mA | SIL. RECT. | 10/- |
| 75 | GERM. DIODES | GOLD BONDED | 10/- |
| 20 | Like BAY 50 charge storage | DIODES | 10/- |
| 10 | 50-400 PIV 1 Amp. | SCR's | 20/- |

★ QUALITY-TESTED VALVE PAKS ★ BARGAINS ★

| | | |
|----|--|------|
| 2 | Drift Trans. 2N1225 Germ. PNP 100 Mc/s | 10/- |
| 6 | Matched Trans. OC44/45/46/47/48/49 | 10/- |
| 16 | Red Spots AF Trans. PNP | 10/- |
| 16 | White Spot RF Trans. PNP | 10/- |
| 5 | Silicon Rects. 3 A 100-400 PIV | 10/- |
| 2 | 10 A Silicon Rects. 100 PIV | 10/- |
| 2 | OC1 140 Trans. NPN Switching | 10/- |
| 1 | 12 A SCR 100 PIV | 10/- |
| 3 | Sil. Trans. 2N3033 PNP | 10/- |
| 4 | Zener Diodes 250 mW 3-12 V | 10/- |
| 3 | 200 Mc/s Sil. Trans. NPN BSY26/27 | 10/- |
| 3 | Zener Diodes 400 mW 33 V 5% Tol. | 10/- |
| 4 | High Current Trans. OC43 Eqt. | 10/- |
| 2 | Power Transistors 1 OC26 1 OC25 | 10/- |
| 5 | Silicon Rects. 400 PIV 250 mA | 10/- |
| 4 | OC75 Transistors Mullard Type | 10/- |
| 1 | Power Trans. OC20 100 V | 10/- |
| 4 | OA202 Sil. Diodes Sub-min. | 10/- |
| 2 | Low Noise Trans. NPN 2N929/30 | 10/- |
| 1 | Sil. Trans. NPN V18 100 ZTR6 | 10/- |
| 8 | OA81 Diodes (CV448) | 10/- |
| 4 | OC72 Transistors Mullard Type | 10/- |
| 4 | OC77 Transistors Mullard Type | 10/- |
| 5 | Metal Alloy Transistors Mat. Type | 10/- |
| 4 | Sil. Rects. 400 PIV 500 mA | 10/- |
| 3 | GET984 Trans. Eqt. OC44 | 10/- |
| 3 | OC7883 Trans. Eqt. OC45 | 10/- |
| 3 | VHF Sil. Epoxy Trans. NPN 100 Mc/s | 10/- |
| 2 | 2N708 Sil. Trans. 300 Mc/s NPN | 10/- |
| 5 | OT1145 Germ. Trans. PNP Eqt. OC71 | 10/- |
| 3 | OT81 L/L Low Noise Germ. Trans. PNP | 10/- |
| 6 | IN914 Sil. Diodes 75 PIV 75 mA | 10/- |
| 8 | OA95 Germ. Diodes Sub-min. 1N69 | 10/- |
| 3 | NPN Germ. Trans. NKT773 Eqt. AC130 | 10/- |
| 2 | OC22 Power Trans. Germ. | 10/- |
| 2 | OC25 Power Trans. Germ. | 10/- |
| 2 | OC73 Mullard Trans. | 10/- |
| 4 | AC128 Trans. PNP High Gain | 10/- |
| 2 | AC127/128 Comp. pair PNP/NPN | 10/- |
| 10 | Assorted Gold Bonded Diodes | 10/- |
| 3 | 2N1307 PNP Switching Trans. | 10/- |
| 20 | Germ. Diodes General Purpose | 10/- |
| 7 | CG824 Germ. Diodes Eqt. OA71 | 10/- |
| 3 | AF110 Mullard Type Trans. | 10/- |
| 12 | Assorted Germ. Diodes Marked | 10/- |
| 4 | AC126 Germ. PNP Trans. | 10/- |

FREE One 10/- Pack of your own choice free with orders valued 24 or over

| | | |
|----|--|------|
| 5 | 1 Amp. Germ. Rect. 200 PIV | 10/- |
| 1 | ORP12 Photo-conductive cell | 10/- |
| 4 | Silicon Rects. 100 PIV 750 mA | 10/- |
| 1 | AF117 Trans. Mullard Type | 10/- |
| 7 | OC81 Type Trans. | 10/- |
| 3 | OC171 Trans. Mullard Type | 10/- |
| 3 | 2N2926 Sil. Epoxy Trans. | 10/- |
| 7 | OC71 Type Trans. | 10/- |
| 2 | GET9 Power Trans. 60 Vcb. 8 A | 10/- |
| 25 | Trans. Heatsinks fit TO18, 8012, etc. | 10/- |
| 1 | TK400A Power Germ. Trans. -ADY22 | 10/- |
| 2 | 28701 Sil. Trans. Texas | 10/- |
| 2 | Zeners 2Z160F. 15 V 1 watt | 10/- |
| 3 | 12 Volt Zeners 400 mW | 10/- |
| 2 | 10 A 800 PIV Sil. Rects. 18425R | 15/- |
| 3 | 6C108 Sil. NPN High Gain Trans. | 15/- |
| 2 | Zener Diodes 25 W 18 and 22 V | 15/- |
| 1 | 2N910 NPN Sil. Trans. VCB100 80 Mc/s | 15/- |
| 2 | 1000 PIV Sil. Rect. 1.5 A BR510 AF | 15/- |
| 3 | High Volt. AF Trans. PNP ADY17 | 15/- |
| 3 | BSY95A Sil. Trans. NPN 200 Mc/s | 15/- |
| 3 | OC200 Sil. Trans. Mullard | 15/- |
| 2 | Sil. Power Rects. BYZ13 | 15/- |
| 1 | Sil. Power Trans. NPN 100 Mc/s TR201A | 15/- |
| 6 | Zener Diodes 3-15 V Sub-min. | 15/- |
| 1 | 2N1132 PNP Epitaxial Planar Sil. Trans. | 15/- |
| 3 | 2N697 Epitaxial Planar Trans. Sil. | 15/- |
| 4 | Germ. Power Trans. Eqt. OC10 Mullard | 15/- |
| 1 | Unijunction Trans. 2N2846 Eqt. D6E29 | 15/- |
| 2 | Sil. Trans. 200 Mc/s 60Vcb ZTR83/84 | 15/- |
| 1 | Sil. Planar Trans. NPN 100 Mc/s BSY25 | 15/- |
| 1 | Sil. Trans. BS104 150 Mc/s HFE 200 NPN | 15/- |
| 2 | SCRs 50 PIV 1 A TO-5 can | 15/- |
| 1 | Tunnel Diode IN3720 (TD5) G.E. | 15/- |
| 1 | Unijunction Trans. 2N216 OT0-5 can G.E. | 15/- |
| 2 | Sil. Rects. 5 A 400 PIV Stud Type | 15/- |
| 2 | Germ. Power Trans. OC9/29 | 15/- |
| 1 | 10 A Sil. Stud Rect. 800 PIV | 15/- |
| 1 | Tunnel Diode AEW11 1050 Mc/s BTC | 15/- |
| 2 | 2N3712 Sil. Epoxy Planar HFE225 max. | 15/- |
| 6 | BY 100 Type Sil. Rects. | 20/- |
| 25 | Sil and Germ. Trans. Mixed, all marked New | 30/- |
| 10 | New Power Trans. BEC replaces OC16/26/28 | 30/- |
| 1 | 28094 Sil. Power Trans. NPN 100 V 100 W | 30/- |
| 1 | Sil. Potted Bridge Rect. 800 PIV 2 A | 30/- |

UNIUNION

UT46, Eqt. 2N2646, 7/6
Eqt. T1843

SIL. RECTS TESTED

| | |
|-------------------------|--|
| PIV 750mA 3A 10A 30A | |
| 50 2/- 3/- 4/8 9/6 | |
| 100 2/3 3/6 8/- 15/- | |
| 200 2/6 4/8 8/6 20/- | |
| 300 3/- 4/8 8/- 22/- | |
| 400 3/8 6/- 9/- 25/- | |
| 500 4/- 6/8 9/6 30/- | |
| 600 4/3 7/- 10/- 37/- | |
| 800 4/9 8/- 15/- 40/- | |
| 1000 6/- 10/- 17/8 50/- | |

SCR'S LOWEST PRICE LARGEST RANGE

| | |
|-------------------------|--|
| PIV 1AMP 7A 16A 30A | |
| 25 5/- 7/8 30/- | |
| 50 7/8 8/6 10/6 35/- | |
| 100 8/6 10/- 15/- 45/- | |
| 200 12/8 15/- 20/- 55/- | |
| 300 15/- 20/- 25/- 60/- | |
| 400 17/8 25/- 35/- 85/- | |
| 500 30/- 40/- 45/- 95/- | |
| 600 40/- 50/- | |

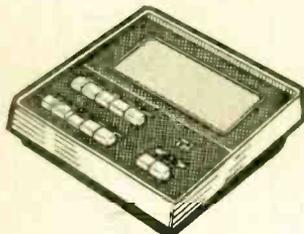
Our vast stocks change daily with hundreds of Semi-conductor bargains becoming available. Just send 2/6 to cover 3 months mailings of our latest stock lists, eqvt. charts, circuits, etc.

Minimum Order 10/-
CASH WITH ORDER PLEASE. Add 1/- postage and packing per Order. GUARANTEED by return postal service. Overseas add extra for Air Mail.

WOW!!

HAVE YOU SEEN THESE

"INTERCOMMUNICATION SYSTEMS"



PR. 103
SUB-STATION

PROFESSIONAL FULL 10-STATION COMPLEMENT COMPRISING:—

"EXECUTIVE" 10-station Master Selector AND 10 Remote Extensions. Excellent Tonal Quality and Performance. Robust—yet attractive enough to grace the finest desk.

We offer these superb equipments, all fully guaranteed, at only

35 GNS.

AT LEAST £90 ELSEWHERE

5-Station version also available at only 15 Gns. Easily worth treble. As supplied to Government Depts. and public organisations.

HORNTON'S ELECTRONICS LTD., 18/19 FREEMAN ST., (off Park St., Bull Ring), BIRMINGHAM 5. MID 0972, MID 5588

"JET SET"

Aircraft Band/Medium Wave Portable Radio

Conversations between control towers and aircraft heard clearly.

ONLY 13 Gns.

BARGAIN OFFER!

"Wireless 2-Way Intercom"

No wiring. Just plug each unit into mains plug wherever required. Up to 1/2 mile distance depending on mains run. Guaranteed. List 12 gns.

Our Price 7 1/2 Gns. plus 6/6 p. & p.

PORCH DOOR/OFFICE RECEPTION

Intercom System

Perfect also for flats. Metal construction. Fully guaranteed. List 8 gns. Our price 99/6 plus 6/6 p. & p.

FROM STANDARD

The Tiniest 2-Band (V.H.F./M.W.) Radio in the World

"Size of a Matchbox." Highly selective through efficient built-in miniature speaker. Comes in delightful presentation case. Our price 17 1/2 Gns. plus 5/6 p. & p.

SPECIAL OFFER!

"Dokoder" Battery/Mains Tape Recorder

Capstan drive. 2 speeds, 2 track. 5in. spools. A real robust machine. Fully guaranteed. List 25 gns. Our price 18 1/2 Gns. plus 8/6 p. & p.

FROM "CROWN" RADIO

Very Latest Portable "Radio-Corder"

A delightful V.H.F./M.W. radio with built-in capstan drive Tape Recorder. Instant radio programmes can be made. Complete with mike, tape, bats. and mains adaptor. Only 36 Gns.

"FOR THE EXECUTIVE'S SON"

A "Radio-Controlled model Buick car

Complete with miniature pocket transmitter. Range up to 35ft. Full control. Steering, reverse, etc., etc. Terrific fun only 15 Gns.

"Bus version" also available at same price.

Very latest "2-Way Telephone Amplifier"

"BURGLAR ALARMS"

Miniature size 3" x 2" x 1" for Car, Office & Home.

"Will wake the whole street!" Our price only 8/11 plus 2/6 p. & p. Incorporating mercury switch.

Samson's

(ELECTRONICS LTD)

LONDON'S LARGEST SUPPLIERS OF
ELECTRONIC EQUIPMENT
9 & 10 CHAPEL STREET
LONDON, N.W.1
Tel. PAD 7851 AMB 5125



HOURS 9.30-6
OPEN ALL DAY
SAT.

SEND 6d. STAMP
FOR LIST

MULTI-TAPPED TRANSFORMERS

**MOST TYPES, FULLY SHROUDED
AND TERMINAL BLOCK CONNEX-
TIONS. ALL PRIMARIES 220-240
VOLTS**

*Denotes Unshrouded Types.

| TYPE | SEC. TAPS | AMPS. | PRICE | CARR. |
|------|-------------|-------|----------|-------|
| 1A | 25-33-40-50 | 15 | £7 19 6 | 9/- |
| 1B | 25-33-40-50 | 10 | £5 19 6 | 7/6 |
| 1C | 25-33-40-50 | 6 | £4 19 6 | 7/6 |
| 1D | 25-33-40-50 | 3 | £2 19 6 | 6/- |
| 2A | 4-16-24-32 | 12 | £5 7 6 | 7/6 |
| 2B | 4-16-24-32 | 8 | £4 2 6 | 7/6 |
| 2C | 4-16-24-32 | 4 | £2 12 6 | 6/- |
| 2D | 4-16-24-32 | 2 | £1 15 0 | 5/- |
| 3A | 25-30-35 | 40 | £12 15 0 | 15/- |
| 3B | 25-30-35 | 20 | £7 19 6 | 9/6 |
| 3C | 25-30-35 | 10 | £5 10 0 | 7/6 |
| 3D | 25-30-35 | 5 | £3 5 0 | 6/- |
| 3E | 25-30-35 | 2 | £2 7 6 | 4/6 |
| 4A | 12-20-24 | 30 | £9 15 0 | 10/- |
| 4B | 12-20-24 | 20 | £5 19 6 | 8/6 |
| 4C | 12-20-24 | 10 | £3 19 6 | 7/6 |
| 4D | 12-20-24 | 5 | £2 15 0 | 6/- |
| 5A | 3-12-18 | 30 | £7 5 0 | 7/6 |
| 5B | 3-12-18 | 20 | £5 9 6 | 7/6 |
| 5C | 3-12-18 | 10 | £3 5 0 | 6/- |
| 5D | 3-12-18 | 5 | £2 5 0 | 5/- |
| 6A | 48-56-60 | 2 | £2 17 6 | 4/6 |
| 6B | 48-56-60 | 1 | £1 19 6 | 4/6 |
| 7A | 6-12 | 50 | £7 10 0 | 9/6 |
| 7B | 6-12 | 20 | £4 10 0 | 7/6 |
| 7C | 6-12 | 10 | £2 19 6 | 6/6 |
| 7D | 6-12 | 5 | £2 2 6 | 5/- |
| 8A | 6-12 | 1 | £1 19 6 | 4/6 |
| 9A | 15-30 | 1 1/2 | 19 6 | 4/6 |
| 10A | 9-15 | 2 | 19 6 | 4/6 |
| 11A | 6-3 | 15 | £1 17 6 | 5/6 |

Note: By using the Intermediate Taps many other voltages can be obtained. Example:
Range One: 7.8-10-15-17-25-33-40-50 v.
Range Two: 4.8-12-16-20-24-32 v.
Range Five: 3.6-9-12-15-18 v.

**DUE TO THE RISING COST OF COPPER
WE ARE COMPELLED TO IN-
CREASE OUR PRICES OF THE ABOVE
LISTED TRANSFORMERS BY 10%. PLEASE
ADD THIS AMOUNT WHEN ORDERING**

LOW RESISTANCE SMOOTHING CHOKES

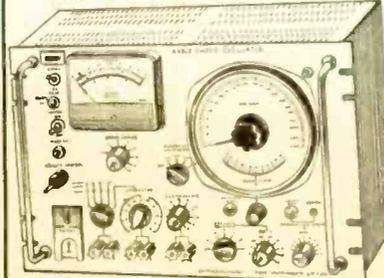
Shrouded type 0.05 H. 0.75Ω 2 amps. 45/-, P.P. 4/-, 0.03 H. 0.4Ω, 4 amps., 55/-, P.P. 4/6, 0.02 H. 0.25Ω, 8 amps. 62/6, P.P. 6/-.

SPECIAL OFFER OF BRAND NEW H.T. TRANSFORMERS

Fraction of maker's price. All tapped primaries 200-250 v. Table top connections. Enclosed type. **GARDNERS**

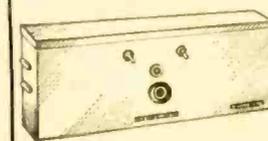
- No. 1 Sec. 500-0-500 v. 200 mA. 6.3 v. 4 A. 6.3 v. 3 A. 6.3 v. 2 A. 5 v. 2 A. 85/-, P.P. 7/6.
- No. 2 Sec. 450-0-450 v. 180 mA. 6.3 v. 3 A. 6.3 v. 3 A. 6.3 v. 3 A. 5 v. 3 A. 75/-, P.P. 7/6.
- No. 3 Sec. 350-0-350 v. 180 mA. 6.3 v. 3 A. 6.3 v. 2.5 A. 6.3 v. 2.5 A. 6.3 v. 2 A. 6.3 v. 2 A. 6.3 v. 0.5 A. 5 v. 2.8 A. 75/-, P.P. 7/6.
- No. 4 Sec. 450-0-450 v. 95 mA. 6.3 v. 3 A. 6.3 v. 3 A. 6.3 v. 2 A. 5 v. 3 A. 65/-, P.P. 7/6.
- No. 5 Sec. 400-0-400 v. 85 mA. 250 v. 50 mA. 6.3 v. 5 A. 6.3 v. 4.75 A. 6.3 v. 0.5 A. 6.3 v. 0.2 A. 75/-, P.P. 7/6.
- No. 6 Sec. 250-0-250 v. 50 mA. 6.3 v. 2 A. 6.3 v. 2 A. 5 v. 2.5 A. 37/6, P.P. 5/-.
- No. 7 Sec. 300 v. 37.5 mA. 300 v. 37.5 mA. 4 kV D.C. wkg. 4 v. 1 A 4 kV D.C. wkg. 4 v. 0.3 A. 30/-, P.P. 4/6.
- No. 8 Sec. 225 v. 100 mA. 6.3 v. 2.5 A. 6.3 v. 1 A., 37/6, P.P. 5/-.
- No. 9 Sec. 45 v. 87 mA. 6.3 v. 4.5 A. 6.3 v. 1.5 A. 6.3 v. 1 A. 6.3 v. 0.2 A. 29/6, P.P. 4/-.
- No. 10 Sec. tapped 450-470 v. 275 mA. 42/6, P.P. 5/-.
- No. 11 PRI 6.3 v. Sec. 2-0-2 v. 4 A. 5,000 v. D.C. wkg. Potted type, 15/-, P.P. 3/6.

DAWE AUDIO SWEEP OSCILLATOR AND CONTROLLER TYPE 443B



20 c/s to 20 Kc/s in a Single Sweep Logarithmic Scale Calibration. Accuracy 1% ± 1 c/s. Power supply 110 v. and 200-250 v. Dimensions: 19 x 12 x 13 ins. Supplied Brand New with Instruction Manual. Less than half Maker's Price. £125, Ex Warehouse. Send 6d. Stamp for Data Sheet.

L.T. SUPPLY UNIT TYPE S.E.1



A.C. input 200-240 volts. D.C. Output tapped to give 12 or 24 volts 8 amps. continuous rating. Fitted with panel fuse mains on/off switch and D.C. output socket. Built in strong metal case. Size 15 x 6 x 6 in. An ideal general purpose L.T. supply unit for operating relays. Contactors, battery charging, etc., £10/19/6, Carr. 10/-.

L.T. SUPPLY UNIT TYPE S.E.2

A.C. input 200-240 v. D.C. output 50 volts 5 amps. Built in metal case, size 15 x 6 x 6 in. Fitted with on/off switch, panel fuse and output socket £10/19/6, carr. 10/-.

VARIABLE D.C. SUPPLY UNITS TYPE SE.4

0-48 volt 10 amps. Continuous from 240 v. A.C. Silicon full wave bridge rectification, isolated transformer with Variac controlled primary 3 inch scale voltmeter and ammeter. Neon indicator. Housed in strong metal case. Size 17 x 7 x 6 1/2 in. £29/10/-, Carr. 15/-.

L.T. SUPPLY UNITS TYPE S.E.5

A.C. input 220-240 v. D.C. Output 12 or 24 v. 10 amps continuous rating. Selenium full wave bridge rectification. 3 inch scale ammeter, neon indicator, housed in strong metal case. Size 17 x 7 x 6 1/2 in. £14/10/-, Carr. 15/-.

ADVANCE COMPONENTS, LTD.

Stabilised low voltage power supply units, Type DC3. Input 200-215-230-245 v. Output 12 v. 1.25A at 55°C. stabilised within ± 1% at full load with supply voltage variation up to ± 15%. Ripple less than 1.5% R.M.S. of total output. Supplied brand new. £5/10/-, 19/- Carr.

WONDERFUL OFFER!!

SCOTCH MAGNETIC TAPE. Type 3M 459. 1 in. 3,600 feet. Suitable for video. Brand new in maker's sealed cartons. List Price £18/10/-. Our Price £3/19/6. P.P. 5/-.

A.C. SYNCHRONOUS GEARED MOTORS

200-250 v., very powerful. 40 R.P.M. Size 2 1/2 x 2 1/2 x 1 in. Easily adapted to oscillate up to half a revolution. 12/6. P.P. 2/6.

REFRIGERATION THERMOSTAT SWITCHES

Suitable for up to 1/2 h.p. mains motors. Brand new, 13/-, P. & P. 2/6.

BRAND NEW SURPLUS L.T. TRANS- FORMERS. ALL BY FAMOUS MAKERS LATEST ARRIVALS

1. PRI 240 v. Sec. 6.5 v. 46 amps. conservatively rated. Table top connections. Open type construction. 75/-, Carr. 7/6.
2. PRI 240 v. Sec. 24 v. 12.5 amps. As above 75/-, Carr. 7/6.
3. PRI 200-250 v. Sec. tapped 13-13 1/2 14 CT. 13-13 1/2-14 v. 2 amps. and 8 v. 1/2 amp. 27/6, open type table top connections. 27/6, P.P. 5/-.
4. PRI 200-240 v. Sec. 6.2 v. 12.5 amps. Open type terminal block connections. 35/-, P.P. 6/6.
5. PRI 200-240 v. Sec. (1) tapped 38-40 v. 10 amps. Sec. (2) 6.2, 6.8, 7.3, 7.9, 8.5, 9, 9.5, 10, 10.6 v. 18 amps., open type T.B. connections. £7/10/-, Carr. 10/-.
6. PRI 240 v. Sec. tapped 53.6 55.2 v. 10 amps. "C" core T.B. connections, 75/-, Carr. 7/6.
7. PRI 220-240 v. Sec. tapped 75, 80 v., 2.4 amps. and 6 v. 1A. "C" core table top connections. 75/-, carr. 7/6.
8. PRI 230-240 v. Sec. (1) 4.5 v. 30A. Sec. 8 v. 1A. Sec. (3) 4.5 v. 1A table top connections. Fully shrouded, 85/-, carr. 7/6.
9. PRI 240 v. Sec. (1) 45 v. 25 mA. Sec. (2) 1 v. 1/2 A. "C" core, 15/-, P.P. 3/6.
10. PRI 240 v. Sec. (1) 22.3 v. 0.9A. Sec. (2) 21 v. 60mA "C" core, 15/-, P.P. 3/6.
11. PRI 230 v. Sec. 70 v. 15 amps. open type T.B. connections. One only, £7/10/-, Carr. 12/6.

SPECIAL OFFER OF WODEN TRANSFORMERS BRAND NEW

No. 1. PRI tapped 200-250 v. E.S. Sec. Tapped 8-15-25-28-30-33-35 v. 15 amps. Tropicly finished table top connects. £5/17/6, Carr. 10/-.

No. 2. PRI 240 v. E.S. Sec. No. 1. 50 v. 4A. Sec. No. 2. 18-0-18 v. 1A 55/-, P.P. 7/6.

No. 3. PRI tapped 200-250 v. E.S. Sec. 1. 315-0-315 v. 110 mA. Sec. 2. 175-0-175 25 mA. Sec. 3 5 v. 1.9A. Sec. 4. 6.3 v. 3.1 A. Sec. 5. 6.3 v. CT4A. Sec. 6.3 v. CT2A. Sec. 6.3 v. 1A. "C" Core table top connections, 50/-, P.P. 7/6.

PARMEKO POTTED SMOOTHING CHOKES

- 10H. 250 mA. 17/6, P.P. 4/6. 1 H. 300 mA. 10/6, P.P. 3/6.
- 1 H. 300 mA 8/6, P.P. 3/6. 10 H. 120 mA. 12/6, P.P. 3/6.
- 10 H. 75 mA. 10/6. P.P. 2/6. 5 H. 150 mA. 12/6, P.P. 3/6.
- 15 H. 75 mA. 12/6. P.P. 2/6. 5 H. 60 mA. 8/6, P.P. 2/6.
- 0.7 H. 450 mA. 17/6, P.P. 3/6. Jupiter Series Swinging Choke 34 H.60 mA-70H. 34 mA. 2.5 kV d.c. wkg. 25/-, P.P. 5/-.

SUNVIC TYPE T.Q.P.

Range 70 F.-190°F. Length of rod 1 1/2 in. Complete with sleeve. 15 amp. demand switch. Changing to 5 amp. satisfied position. Supplied new and guaranteed, 29/6. P.P. 3/6.

SPECIAL OFFER G.E.C. 8 MFD. BLOCK CAPACITORS

600 v. D.C. wkg. at 71°C. Brand new in maker's cartons, six for 29/6, Carr. 7/6. S.T.C. 5 mfd. 400 v. A.C. wkg. 7/6 each. P.P. 2/6.

SPECIAL OFFER OF BRAND NEW HUNTS ELECTROLYTIC CAPACITORS

Can type 130 ± 60-10 mfd. 350 v. wkg. +10 mfd. 500 v. wkg. 25/- per dozen. P.P. 3/6. 100 ± 50-50 mfd. 350 v. wkg. 22/6 per dozen. P.P. 3/-, 50 ± 30 ± 10 mfd. 350 v. wkg. 19/6 per dozen. P.P. 2/6.

HORSTMANN CLOCKWORK TIME SWITCHES

14-day jewelled movement. 250 v. A.C. 5 amp. switch contacts. Once on/off every 24 hours. Complete with key and mounting bracket ex-equipment. But perfect condition. 37/6, P.P. 4/6.

COLOUR TELEVISION

With particular reference to the

PAL SYSTEM

There are 157 diagrams and photographs and 83 illustrations in colour.

by G. N. Patchett

40/- Postage 1/-

HIFI YEARBOOK, 1967/68. 15/- Postage 1/-

AN INTRODUCTION TO MASERS & LASERS, by T. P. Melia. 35/- Postage 1/-

TRANSISTOR SUBSTITUTION HANDBOOK, 7th ed. Pub. F-Sams. 15/- Postage 1/-

INTRODUCTION TO COMPUTER ENGINEERING, by B. S. Walker. 32/6 Postage 1/-

ELECTRONIC ENGINEER'S REFERENCE BOOK, by L. E. C. Hughes and F. W. Holland. 126/- Postage free.

TAPE RECORDER SERVICING MECHANICS, by H. Schröder. 21/- Postage 1/-

Inter.: GEC S.C.R. MANUAL, 4th ed. 25/- Postage 2/-

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST of British and American Technical Books

19-21 PRAED STREET LONDON, W.2

*Phone: PADdington 4185

Closed Sat. 1 p.m.

LONDON CENTRAL RADIO STORES

10-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box handset. Thoroughly overhauled. Guaranteed. £8 10/- per unit.

20-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box. Thoroughly overhauled. Guaranteed. £7 15/- per Unit.

MODERN HAND SETS with coiled lead, grey, white and black. 22/6. P.P. 3/6.

TELEPHONE COILED HAND SET LEADS. 3 core 5/6. P.P. 1/-

MODERN DESK PHONES. 2 tone grey or black, with internal bell and handset with 0.1 dial. £4 10/- P.P. 7/6.

WIRELESS SET No. 38 A.F.V. Freq. range 7.3 to 9.0 Mc/s. Working range 2 to 2 miles. Size 10 1/2 x 8 1/2 in. Weight 0 1/2 lb. Includes power supply 80b and spare valves and vibrator also tank aerial with base. £6 per pair or £3 single. P.P. 25/-

ELECTRICITY SLOT METERS (1/2 in slot) for A.C. mains. Fixed tariff to your requirements. Suitable for hotels, etc. 200/250 v. 10 A. 80/- 15 A. 90/- 20 A. 100/- P.P. 7/6. Other amperages available. Reconditioned as new. 2 years guarantee.

QUARTERLY ELECTRIC CHECK METERS. Reconditioned as new. 200/250 v. 10 A. 42/6; 15 A. 52/6; 20 A. 57/6. Other amperages available. 2 years guarantee.

TWIN GONG TELEPHONE. extension bells. 21/-

8-BANK UNISELECTOR SWITCHES. 25 contacts. alternate wiring £2 15/-; 8 bank half wipe £2 15/-; 4 bank half wipe. 25 contacts 47/6. P.P. 3/6.

DESK PHONES. Black Bakelite cases, complete with hand set and internal bell with 0.1 dial. 42/6. P.P. 6/-

HIGH-SPEED ELECTRO-MAGNETIC COUNTERS. Ex-Govt 4 digit. 25/50 v. D.C. Size 4 x 1 1/2 in. Binic coil. 2.300 Ω. Binic coil 500 Ω. 8/6. P.P. 3/6.

EX. GOVT. BALANCED ARMATURE THROAT MIKES complete with plug, new. 7/6. P.P. 3/6.

DESK PHONES from 35/-. Various types in stock. Final End Selectors. Relays, various callers, also 19 Receivers in stock. All for callers only.

23 LISLE ST. (GER 2969) LONDON W.C.2

Closed Thursday 1 p.m.

Open all day Saturday

SURPLUS BARGAINS

(EX GOVT.)

FAMOUS No. 19 SET TRANS/RECEIVER. Covers 2-8 Mc/s. in 3 bands. 11 valve superhet transceiver including 807 P.A. Power reqs. 1.T. 12 v. H.T. res. 275 v. H.T. transmit 500 v. D.C. Slightly used, 55/-. Selected condition, 85/-. All 19 set ancillary parts available.

No. 31. TRANSCEIVER VHF. 40/48 Mc/s. Tunable. 90/60/44 volts battery operation. 70/-

No. 88. TWO-WAY RADIO. 40/42 Mc/s. Crystal controlled. 4 channel. 50/- each.

No. 38. TWO-WAY RADIO. 7-9 Mc/s. Tunable. 40/- each. B44. VHF RADIO TELEPHONE. 60-95 Mc/s. Crystal controlled. 12 v. D.C. operation. £7 10/-

No. 62. TRANSMITTER RECEIVER. 1.8-10 Mc/s. Tunable or crystal controlled. 12 v. D.C. operation. £18 10/-

R.C.A. C29 TRANSMITTER RECEIVER. 2-8 Mc/s. Complete station. Brand new. 12 or 24 v. D.C. operation. £19 10/-

No. 52 RECEIVERS. Few left. Used (serviceable). £7 10/-

TUBULAR STEEL TELESCOPIC AERIAL MASTS. 30ft. 4 sections. 70/-; 32ft. as above with 12ft. whip. 80/-; 34ft. 6 sections. 90/-

MAKE YOUR OWN AERIAL MAST. 5ft. Bin., 2in. dia. interlocking steel sections (7 sections make 5ft. mast). 20/- per section.

NYLON GUY ROPES with semi-automatic tensioner. 33ft. 6/6. 50ft. 7/6. 60ft. 9/-

CLASS "D" WAVEMETER. 92/6.

ROTARY TRANSFORMERS BY HOOVER. 12 v. D.C. input. Output 250 v. D.C. at 126 mA. 25/-; 12 v. D.C. input. Output 500 v. D.C. at 65 mA. 25/-

REJECTOR UNIT. For rejecting unwanted signals. Switched 4 ranges. 1.2-10 Mc/s. 30/-

R.F. ANTENNA TUNER (A.T.U.). 160/80/40 turns. 25/-

MOVING COIL HEADPHONES. Soft rubber earpads. 19/6.

D.L.R. BALANCED ARMATURE HEADPHONES. 12/6.

HEADSET WITH BOOM MICROPHONE. As used with 88 Set. 22/6

MOVING COIL HEADPHONES AND MICROPHONES. 21/6

MOVING COIL FIST TYPE MICROPHONE. 17/6.

TELE "F" SETS. High Power No. 1. Mk. II. with amplifier. New and unused. 70/- each; or less amplifier. 55/- each.

ALL ITEMS CARRIAGE PAID MAINLAND ONLY

Lists giving fuller details of these and many other surplus bargains, 2/- S.A.E. all enquiries (Please print clearly).

A. J. THOMPSON (Dept. WW)

"Eiling Lodge" Codicote, Hitchin, Herts. Tel.: Codicote 242

ADVANCE TEST EQUIPMENT

VM76 Valve Voltmeter
R.F. Measurements in excess of 100 MHz and d.c. measurements up to 1,000V with accuracy of $\pm 2\%$. D.c. range—300 mV-1 kV f.s.d. A.c. range—300 mV-300 V r.m.s. Resistance in 8 ranges, 0.02-500 Megohms.
Manufacturer's price £90: Our price £72

VM77C: A.C. Millivoltmeter
1 mV-300 V full scale in 12 ranges. Freq. range 15 c/s-4.5 Mc/s. Input impedance 10 Megohms 20 pf. Calibrated in r.m.s. volts for sine wave input and dB. 100-250 V a.c. input.
Manufacturer's price £55: Our price £40

VM78: A.C. Millivoltmeter
Transistorised. 1 mV-300 V in 12 ranges. Freq. 1 c/s-1 Mc/s. Input impedance 2 Megohms 60 pf. Calibrated in r.m.s. for sine wave and input dB.
Manufacturer's price £70: Our price £55

TT1S: Transistor Tester (CT472)
Suitable for measuring medium and low powered transistors. Current gain (B) can be measured in range 10 to 500 for p.n.p. and n.p.n. types, either in circuit using the clip on probes provided. Small compact instrument.
Manufacturer's price £57: Our price £37/10/-

VM79: UHF Millivoltmeter
Transistorised. A.c. range 10 mV-3 V f.s.d., 10 ranges. D.c. current range 0.01 μ A-0.3 mA f.s.d., 10 ranges. Resistance 1 Ohm-10 Megohms in 7 decade ranges. Complete with probe.
Manufacturer's price £180: Our price £125

J1B: Audio Signal Generator
15 c/s-50 kc/s in 3 ranges. Output 600 Ohms, 0.1 mW-1 W (0.25-24 V), variable. Attenuation 20 dB-600 Ohms (Attenuator is incorporated), output 10 mW (2.5 V). 100-250 V a.c.
Manufacturer's price £46: Our price £30

J2B: Audio Signal Generator
Same specification as for the J1B except that this model has an additional 2 in. meter calibrated 0-40 V a.c.
Manufacturer's price £50: Our price £35

H1B: Audio Signal Generator
15 c/s-50 kc/s in 3 ranges. Sine wave 200 μ V-20 V r.m.s. Square wave 1.4 mV-140 V peak to peak (approx.). 100-250 V a.c.
Manufacturer's price £42: Our price £30

Special offer of 10% discount for schools and Technical Colleges, etc. These were manufactured in U.K. by Advance Electronics Ltd. BRAND NEW, all in original sealed carton. Carr. 10/- extra per item.

S.A.E. for all enquiries. If wishing to call at Stores, please telephone for appointment.

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17

Phone: Tottenham 9213

CONDENSERS. 10 mfd. 1,000 v., 12/6, post 2/6. 8 mfd., 1,200 volts, 12/6, post 3/-. 8 mfd. 600 volts, 8/6, post 2/6. 0.25 mfd., 2 kv., 4/-, post 1/6.

AUTOMATIC PILOT UNIT Mk. 2. This complex unit of diodes and valves, relays, magnetic clutches, motors and plug-in amplifiers, with many other items, price £7/10/-. £1 carriage.

APNI ALTIMETER TRANS. REC., suitable for conversion 420 mc/s. complete with all valves 28 v. D.C. Dynamotor and 3 relays, 11 valves, price £3 each, carr. 10/-.

ROTARY TRANSFORMERS. 225 v. input, 175 v. at 40mA output, 25/-, plus 2/- post. 12 v. input, 225 v. at 100 mA. output, 25/-, plus 3/- post. (All the above are D.C. only.)

AVO MULTIRANGE No. 1 ELECTRONIC TEST SET: £25 each, carr. £1.

HRO RECEIVER. Model 5T. This is a famous American High Frequency superhet, suitable for CW, and MCW., reception crystal filter, with phasing control. AVC and signal strength meter. Freq. range 50 kc/s. to 30 mc/s., with set of nine coils. Receiver only in working order, £18/10/-. carr. 15/- each. Set of nine coils, £12/10/-. available only with set. Power unit for HRO 100/240 v. A.C., £2/15/-. carr. 10/-.



SPECIAL OFFER: Complete HRO SET (Receiver, Coils & Power Unit) for £30, plus 30/- carr.

HRO-M-SETS available with UX type valves; secondhand cond., with 5 coil and power unit, £20 each, carr. 30/-.

CONVERTERS. Type 8a; 24 v. D.C., 115 v. A.C. at 1.8 amps 400 cycles/3-phase, £6/10/- each, post 8/-.

MARCONI DEVIATION TEST SET, TF934: freq. 2.5-100 Mc/s. Can be extended to 500 Mc/s. Deviation range 0.5, 0.25 and 0.75 Kc/s. £35 each, carr. £1.

MARCONI IMPEDANCE BRIDGE, TF-373: inductance 5µh-100H in 5 ranges, capacity 5pF-100µF in 5 ranges, resistance .05 meg.-1 meg., power supply 250 v. A.C. £37/10/- each, carr. 15/-.

CT.49 ABSORPTION AUDIO FREQUENCY METER: freq. range 450 c/s-22 Kc/s., directly calibrated. Power supply 1.5 v.-22 v. D.C. £12/10/- each, carr. 15/-.

TACAN. Trans./Receiver, same as ARN21, British made, STC, TR9171 complete with five 2C39As with associated valve-holders. As new price £25. Used condition, £15, carriage £1.

RELAY UNITS. 2 high speed relays H96E, 1700+1700 ohms, 1 change-over relay 14,000 ohms, 1 CV 455, 100 ohms and 1 meg. pot., etc. Mounted in box, 4in. x 6in. x 30in., 30/- each, 4/- post.

RECEIVERS. Type AR88D: freq. 540 Kc/s-32 Mc/s. £45 each, carr. £2. **AR88 SPEAKERS.** New in cartons, metal case with black crackle finish 59/6 ea., post 7/6.

AR88 SPARES. Antenna Coils L5 and 6 and L7 and 8. Oscillator coil L.59. Price 10/- each, post 2/6. By-pass Capacitor K.98034-1, 3 x 0.05 mfd. and M.98034-4, 3 x 0.01 mfd., 3 for 10/-, post 2/6. Trimmers, 95534-502, 2-20 p.f. Box of 3, 10/-, post 2/6. Block Condenser, 3 x 4 mfd., 600 v., £2 each, 4/- post. Filter Choke, L45 and 50, K901433-501, 25/- each, 4/- post.

AIRCRAFT RECEIVER ARR2. 235-258 Mc/s. tunable, 24 v. D.C. input, £3 ea. 7/6 carr.

HEWLETT PACKARD TYPE 400C: 115 v./230 v., input 50/60 c/s. Freq. range 20 c/s-2 Mc/s. Voltage range: 1 mV-300 v. in 12 ranges. Input impedance 10 megohms. Designed for rack mounting, £30 each, carr. 15/-.

COMMAND RECEIVERS: Model 3-6 Mc/s. and 6-9 Mc/s., as new, price £5 10/- each, post 5/-.

SIGNAL GENERATORS:

MARCONI TF-144G: freq. 85 Kc/s-25 Mc/s, internal and external modulation, power supplies 200/250 v. A.C. (secondhand cond.), price £25 ea.; or available in transit case, complete with spares, in first class condition £30 ea., carr. on both 30/- ea.

TS155c/UP (as new): price £75 each, carr. £1.

CT53. Freq. range 8.9-300 Mc/s. with Calibration chart. Output 1µV-100 mV internal square wave and sinuswave modulation at 100 c/s., external modulation 50 c/s-10 Kc/s, 230 v. A.C. Complete with chart, etc., price £27/10/- ea., carr. £1.

MARCONI TF801A 1 Freq. 10-300 Mc/s, 4 bands, output 200mV, Attenuator 0-110dB. Input 75 ohms. £65 each, carr. £1.

MARCONI TF516-F/1: Covering 10-18 Mc/s, 33-58 Mc/s., 150-300 Mc/s. £12/10/- each, carr. £1.

MARCONI CT218: price £65 each, carr. 30/-.

CT.480 and 476: 1.3-4.2 Mc/s, F.M. or A.M., price £75 each, carr. 30/-.

S.A.E. for all enquiries. List available 6d. If wishing to call at Stores, please telephone for appointment.

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17

Phone: Tottenham 9213

TELEPHONE EQUIPMENT:

GPO 'CANDLESTICK' TYPE TELEPHONE. Upright model with receiver, ideal novelty for converting to lampshade. Available any colour, £5 10/- ea., post 7/6.

TELEPHONE WIRE: 220 yds., £1 a roll, post 6/-.

GPO TERMINAL BLOCKS, 7/6 each, **FUSE AND PROTECTOR,** 7/6 each. Post on both 2/6.

TELEPHONES (PORTABLE) TYPE "F." Suitable for all outdoor activities up to a range of 5 miles. Price £7/10/- each, as new, complete with carrying case. Price, £5 10/- each, secondhand. Carr. 10/-.

TELEPHONE EXTENSION CORD. Brown, 3-way; come in lengths of 6ft. and 14ft., 7/6 and 15/- respectively. Post 2/6.

BC-433-G COMPASS RECEIVER: Freq. 200-1,750 kc/s. in 3 bands, suitable for aircraft, boats, etc. Complete with 15 valves, power supply input 24 v. D.C. at 2 amps. Receiver only £5 each. Carr. 15/-.

TCS MODULATION TRANSFORMERS, 20 watts, pr. 6,000 C.T., sec. 6,000 ohms. Price 25/-, post 5/-.

NIFE BATTERIES: 6 v. 75 amps., new, in cases, £15 each, £1 carr.; 6 v. 160 amps., new in cases, £25 each, £1/10/- carr.; 4 v. 160 amps., new, in cases, £20 each, £1/10/- carr.

L.R.7 Cells, only 1.5 v. 75 amps., new, £3 each, 12/- carr. The above batteries are low resistance designed to give heavy surge for starting and can be stored for long periods without any effect to their performance.

WAVE GUIDES FLEXIBLE CG-182/APM40. Length 18 inches. Price £2 each, post 4/-.

MACHMETERS: Range 0: 1 and 0: 1.2, 6A/3384 & 5325 respectively, price 30/- each, postage 5/-.

FUEL INDICATOR Type 113R: 24 v. complete with 2 magnetic counters 0-9999, with locking and reset controls mounted in a 3in. diameter case. Price 30/- each, postage 5/-.

DRY BATTERIES, NO. 1. HT 90 v. and 7½ v., size 2½in. x 3½in. x 5in., 5/- each, or 5 for £1, post 4/- and 7/6 respectively.

BATTERY NO. 4 (suitable for bells, etc.). 4½v., size 4½in. x 6in. x 2½in., 5/- each. Post 3/-.

UNISELECTORS (ex equipment): 10 Bank, 50 Way, alternate wipe, £2/5/- ea. 6 Bank, 25 Way, alternate wipe, £2/2/6 ea. 8 Bank, 25 Way, £2/5/- ea. 6 Bank, 25 Way, £2 ea. 4 Bank, 25 Way, 35/- ea. All the above are 75 ohm coil. Postage 4/- per uniselector.

FREQUENCY METERS: IM-13 or BC-221; 125-20,000 Kc/s., £25 each, carr. 15/-. TS174/U; 20-250 Mc/s. modulated, £45 each, carr. 15/-. TS323/UR; 20-450 Mc/s., £75 each, carr. 15/-. FR-67/U: This instrument is direct reading and the results are presented directly in digital form. Counting rate: 20-100,000 events per sec. Time Base Crystal Freq.: 100 Kc/s. per sec. Power Supply: 115 v., 50/60 c/s., £100 each, carr. £1.

AMERICAN EQUIPMENT: Power supply, PP893/GRC 32A; Filter D.C. Power Supply F-170/GRC 32A; Cabinet Electrical CY 1288/GRC 32A; Antenna Box Base & Cables CY 728/GRC; Mast Erection Kits, 1186/GRC; Receiver type 27 8B; Directional Antenna CRD.6; Comparator Unit, CM.23; Directional Control CRD.6, 567/CRD and 568/CRD; Azimuth Control Units, 260/CRD.

GEARED MOTORS: 24 v. D.C., current 150 Ma, Output 1 r.p.m. 30/- each, 4/- post. Assembly unit with Letcherbar Tuning Mechanism and potentiometer, 3 r.p.m., £2 each, 5/- post.

MOTORISED ACTUATOR: 115 v. A.C. 400 c/s. single phase, reversible, thrust approx. 3 inches complete with limit switches, etc. Price £2/10/- each, postage 5/- (ex equipment).

D.C. MOTOR: 27 v. D.C. with gear box, 4 r.p.m. Price 25/-, postage 3/- (ex equipment).

Actuator Type SR-43: 28 v. D.C. 2,000 r.p.m., output 26 watts, 5 inch screw thrust, reversible, torque approx. 25 lbs., rating intermittent, price £3 each, post. 5/-.

28 v. D.C. 200 r.p.m. current consumption approximately 6 amps. Price £3 10/-, post 7/6.

FRACTIONAL MOTORS & FANS: Low Inertia Motor 5UD/5361. Type 903, 24 v. input D.C., £2 10/- each, 5/- post.

Model PM84: 28 v. D.C. @ 2 amps., 4,500 r.p.m., output 40 watts continuous duty complete with magnetic brake. Price £2 each, postage 4/-.

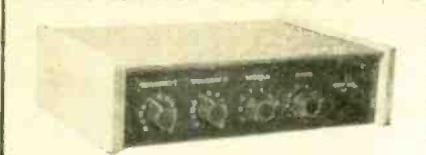
Model SR-2: 28 v. D.C. 7,000 r.p.m., duty intermittent, output 75 watts, price 25/- each, postage 4/-.

A.C. Motor 115 v. 50 c/s. 1/300 H.P., 3,000 r.p.m. Capacitor 1mfd, 25/- post 3/-. Dalmotor SC5, 28 v. D.C. at 45 amps.; 12,000 r.p.m. output 750 W. (approx. 1 h.p.), brand new, £2 10/- each, post 7/6.

CATHODE RAY TUBE UNIT: With 3in. tube, colour green, medium persistence complete with nu-metal screen, £3 10/- each, post 7/6.

TRANSMITTER RECEIVER TCS-12: Freq. 1.5 Mc/s-12 Mc/s, output 25 W., complete stations available with antenna equipment, mast, and petrol generator. Trans-receiver, complete with 12 v. D.C. Power Unit and A.T.U. £25 each, carr. £2/10/-. Petrol Generator Unit for the above £20 each, carr. £3. Complete aerial system £10 each, carr. £2.

TRANSISTOR STEREO 8 + 8



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W. max). Integrated pre-amp. with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief Specification: Freq. response $\pm 3dB$. 20-20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to -18dB. Negative feedback 18dB. over main amp. Power requirements at 25V. at 0 amp.

PRICES:
 Amplifier Kit £9/10/0. P. & P. 4/6.
 Power Pack Kit £2/10/0. P. & P. 4/-
 Cabinet (as illus.) £2/10/0. P. & P. 5/6.
 (Special Offer—£14/10/0, post free if all above ordered at same time).

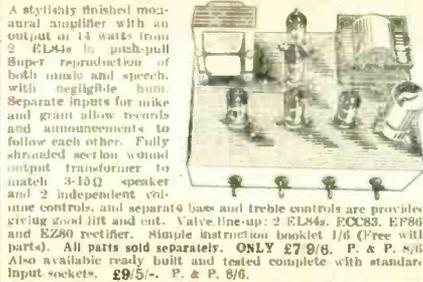
Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.).

HSL "FOUR" AMPLIFIER KIT
 3-VALVE 4 WATT USING ECC83, EL84, EZ80 VALVES FOR A.C. mains 200/240 v. ★ Heavy duty double-wound mains transformer with electrostatic screen. ★ Separate bass, treble and volume controls, giving fully variable boost and cut with minimum insertion loss. ★ Heavy negative feedback loop over 2 stages ensure high output at excellent quality with very low distortion factor. ★ Suitable for use with guitar, microphone or record player. ★ Provision for remote mounting of controls or direct on chassis. ★ All this builds on to a chassis size only 7 1/2 in. wide x 4 in. deep. Overall height 4 1/2 in. ★ All components and valves are brand new. ★ Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ★ Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy). PRICE 79/8. P. & P. 6/-. Comprehensive circuit diagram, practical layout and parts list 9/6 (free with kit).

VIBRATORS. Large selection of 2, 4, 6, 12, and 32 volt. Non sync. 2/8; Sync. 10/-; P. & P. 1/6 per vibrator. S.A.E. with all enquiries.

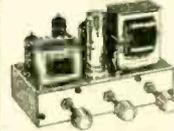
S.T.O. SILICON AVALANCHE HALF-WAVE RECTIFIERS.
 Type: B.A.S. 500 A.S. 5 amps. 300 F.I.V. 1in. long x 1in. dia. approx. List 50/-. OUR PRICE 8/8. Post free.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monoaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speakers and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up: 2 EL84s, ECC83, EP86, and EZ80 rectifier. Simple instruction booklet 1/6 (free with parts). All parts sold separately. ONLY £7 9/6. P. & P. 8/6. Also available ready built and tested complete with standard input sockets. £9/5/-; P. & P. 8/6.

3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records. A.C. mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2 in. w. x 4 in. d. x 4 1/2 in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate bass, treble and volume controls. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only £4/5/-. P. & P. 6/-.

BRAND NEW 3 OHM LOUSPEAKERS
 5in. 12/6; 6 1/2 in. 15/-; 8in. 22/6; 10in. 27/6; 7 x 4in. 16/-; 10 x 6in. 27/6; E.M.I. 8 x 6in. with high flux magnet 21/-; E.M.I. 13 1/2 x 8in. with high flux ceramic magnet 42/- (15 ohms 45/-); P. & P. 6in. 2/-; 6 1/2 in. 2/6; 8in. 2/6; 10 and 12in. 3/6 per spkr.

BRAND NEW. 12in. 15w. H/D Speakers. 3 of 15 ohm. Current production by well-known British maker. Offered below list price at 89/6. P. & P. 5/-. Guitar models: 25w. £5/5/-; 35w. £8/8/-; P. & P. 5/-.
E.M.I. 3in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3.8 or 15 ohms. 15/-; P. & P. 2/6.

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1

● Peak output in excess of 11 watts. ● All standard British components. ● Built on printed circuit panel, size 6 1/2 in. ● Generous size driver and output transformers. ● Output transformer tapped for 3 ohm and 16 ohm speakers. ● Transistors (GEC 114 or 81 Mullard) OC91D and matched pair of OC91, 6/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagrams 2/6 (free with kit). All parts sold separately. SPECIAL PRICE 45/-; P. & P. 3/-. Also ready built and tested 52/6. P. & P. 3/-.
FM/AM TUNER HEAD
 Beautifully designed and precision engineered by Dornier and Wadsworth Ltd. Supplied ready fitted with twin .0005 tuning condenser for AM connection. Prealigned FM section covers 86-102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-. Order quickly! Limited number also available with precision geared 3 : 1 reduction drive. 30/-; P. & P. 3/-.
MATCHED PAIR AM/FM I.F.s. Comprising 1st I.F. and 2nd I.F. discriminator (465 Kcs/11.7 Mc/s). Size 1 1/2 in. x 2 1/4 in. H. Will match above tuner head. 11/- pair. P. & P. 2/6.

4-SPEED PLAYER UNIT BARGAINS

Mains Model. All brand new in maker's original packing.
SINGLE PLAYERS. Carr. 5/6 on each.
 B.S.R. TU12 £3/9/6. Garrard SP25 de luxe. £10 19 6
 B.S.R. GU7 with unit mounted pick-up arm. £4 18 8
AUTO CHANGERS. Carr. 6/6 on each.
 B.S.R. UA25 Super Slim £6/2/6. GARRARD 2060 £7 10 0
 GARRARD 3000 £8/15/-. GARRARD 1000 with 11-51 cord-bridge £6/19/6. Latest GARRARD 4760 Mk. II £12 0 0
 All the above units are complete with mono head with sapphire stylus or can be supplied with stereo head at 12/6 extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II
 A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7 1/2 in. w. x 3 1/2 in. d. x 4 1/2 in. h. Ready built and tested. PRICE 89/6. P. & P. 6/-. ALSO AVAILABLE mounted on board with output transformer and speaker lead to fit cabinet on right. PRICE 89/6. P. & P. 7/6.

DE LUXE QUALITY PORTABLE R.P. CABINET
 Unseen motor board size 14 x 12 in. clearance 2in. below. 5 1/2 in. above. Will take amplifier above and any B.S.R. or GARRARD Autochanger or Single Player Unit (except AT60 or SP25). Size 18 x 15 x 8 in. PRICE £3/9/6. Carr. 9/6.

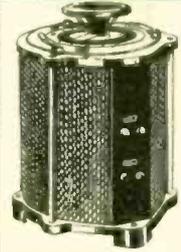
HARVERSON SURPLUS CO. LTD. PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.
 170 HIGH ST., MERTON, LONDON, S.W.19 Tel: 01-540 3985
 S.A.E. all enquiries. Open all day Saturday (Wednesday 1 p.m.)

NO EXCUSES! NO DELAYS! FROM STOCK! VARIABLE VOLTAGE TRANSFORMERS

PORTABLE



Input 230 v. A.C. Output variable 0-260 v. A.C. at 1.5 amp. Fitted in beautifully finished steel case. Complete with voltmeter, pilot lamp, fuse, switch, carrying handle. £8/10/-, P. & C. 10/-.
 Also 2.5 amp. as above. £9/17/6. P. & C. 10/-.



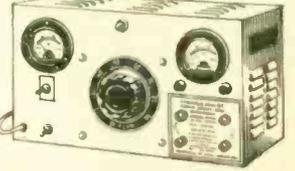
50 AMPS
 I AMP.

INPUT 230 v. A.C. 50/60
 BRAND NEW. Keenest prices in the country. All Types (and Spares) from 1/3 to 50 amp. available from stock.

| | |
|-----------------------------|----------|
| 0-260 v. at 1 amp. | £4 10 0 |
| 0-260 v. at 2.5 amps. | £5 17 6 |
| 0-260 v. at 4 amps. | £8 7 6 |
| 0-260 v. at 5 amps. | £9 0 0 |
| 0-260 v. at 8 amps. | £13 10 0 |
| 0-260 v. at 10 amps. | £17 0 0 |
| 0-260 v. at 12 amps. | £19 10 0 |
| 0-260 v. at 15 amps. | £22 0 0 |
| 0-260 v. at 20 amps. | £32 10 0 |
| 0-260 v. at 37.5 amps. | £65 0 0 |
| 0-260 v. at 50 amps. | £85 0 0 |

5 Amp. AC/DC VARIABLE VOLTAGE OUTPUT UNIT

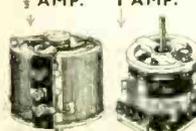
Input 230 v. A.C.
 Output 0-260 v. A.C.
 Output 0-240 v. D.C.
 Fitted large scale ammeter and voltmeter.
 Neon indicator, fully fused.
 Strong attractive metal case 15in. x 8 1/2 in. x 6 in. Weight 24 lb. Infinitely variable, smooth stepless voltage variation over range.



Price £30 P. & C. £2.
7 Amp. A.C./D.C. Mk. II Variable Output Power Unit
 Input 230 v. A.C. Output continuously VARIABLE from 0 to 260 v. A.C. OR 0 to 230 v. D.C. at 7 a. Robustly constructed in metal case, complete with safety fuse, neon indicator, voltmeter and ammeter. Size 17in. x 12in. x 7in. Weight 36 lb. Price £39/10/-; Carry 40/-.

OPEN TYPES

Designed for Panel Mounting
 Input 230 v. A.C. 50/60 Output variable.
 0-260 v.
 1 amp. £3 3 0
 1 amp. £4 10 0
 2 1/2 amp. £5 12 6
 P. & P. 7/6



CONSTANT VOLTAGE TRANSFORMERS

Input 185-250 v. A.C. Output constant at 230 v. A.C. Capacity 250watt. Attractive metal case. Fitted red signal lamp. Rubber feet. Weight 17lbs. Price £11/10/-; P. & P. 10/-.



Double Wound Variable Transformers

Fully isolated, low tension Secondary winding. Input 230 v. A.C. OUTPUT CONTINUOUSLY VARIABLE 0-36 v. A.C.
 0-36 v. at 5 amp. £8.10.0—p. & p. 8/6
 0-36 v. at 20 amp. £19.10.0—15/- p. & c.
 These fully shrouded Transformers, designed to our specifications, are ideally suited for Educational, Industrial and Laboratory use.

36 volt 30 amp. A.C. or D.C. Variable L.T. Supply Unit

INPUT 220/240 v. A.C. OUTPUT CONTINUOUSLY VARIABLE 0-36v.
 Fully isolated. Fitted in robust metal case with Voltmeter, Ammeter, Panel Indicator and chrome handles. Input and Output fully fused. Ideally suited for Lab. or Industrial use. £55 plus 40/- p. & c. Similar in appearance to above illustration.

SERVICE TRADING COMPANY

SERVICE TRADING CO

LIGHT SENSITIVE SWITCHES

Kit and parts including ORP.12 Cadmium Sulphide Photocell. Relay Transistor and Circuit. Now supplied with new Siemens High Speed Relay for 6 or 12 volt operations. Price 25/-, plus 2/6 P. & P. ORP.12 and Circuit 10/- post paid.



A.C. MAINS MODEL

incorporates mains transformer rectifier and special relay with 3x5 amp. mains c/o contacts. Price inc. circuit 47/6, plus 2/6 P. & P.

LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with adjustable lens assembly and ventilated lamp housing to take MBC bulb. Separate photo cell mounting assembly for ORP.12 or similar cell with optic window. Both units are single hole fixing. Price per pair £2/10/-, plus 3/6 P. & P.



UNIVERSAL DEMONSTRATION TRANSFORMERS

A complete composite apparatus, comprising a robustly built Transformer and electro-magnet with removable coils and pole pieces, coil tapped for 230 v., 220 v., 110 v., 115 v. 6, 12, 36, 110 v. A.C. These coils are also used for D.C. experiments. Complete with all accessories as shown. £17 plus 15/- carr. Leaflet on request.

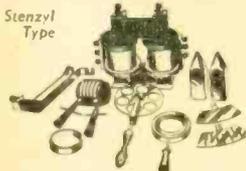


PHOTO MULTIPLIER

Type CV337, this supersedes type 931A, complete with special P.T.F.E. base and divider network 57/6 incl. P. & P.

RESETTABLE HIGH SPEED COUNTERS

3 figure, 24 v. D.C. operation (illustrated). Similar to above, but may be pre-set to any number up to 999 reducing to zero. Either type 32/6, P. & P. 2/6d. 4 figure, 1,000 ohm coil, 36-48 v. D.C. operation. £3/10/-, P. & P. 1/6.

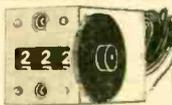


PHOTO ELECTRONIC COUNTER

Can be set for counts of up to 500 per minute. 210-250 v. A.C. powered. Kit of Components, including photo cell, high speed non-resettable counter, transformer, relay, etc., together with clear circuit diagram. £3/2/6, plus 3/6 P. & P. With resettable counter, £4/2/6, P. & P. 3/6.

LATEST HIGH SPEED MAGNETIC COUNTERS (NON-RESETTABLE)

4 figure, 10 impulses per second. Type 100A, 500 ohm coil. Type 100B, 2,300 ohm coil. Either 15/- each, plus 1/6 P. & P.

COAX CABLE

Approximately 100-yard reels, 30/- a reel, plus 7/6d. carriage.

INSULATED TERMINALS

Available in black, red, white, yellow, blue and green. New 15/- per doz. P. & P. 2/-.



SEMI-AUTOMATIC "BUG" SUPER SPEED MORSE KEY

7 adjustments, precision toolled, speed adjustable 10 w.p.m. to as high as desired. Weight 2 1/2 lb. £4/12/6 post paid. TRANSISTORISED MORSE OSCILLATOR Fitted 2 1/2 in. Moving Coil Speaker. Uses type PP3 or equiv. 9 v. battery. Complete with latest design Morse Key. 22/6, plus 1/6 P. & P.



Postage and Carriage shown below are inland only. For Overseas please ask for quotation. We do not issue a catalogue or list.

NICKEL CADMIUM BATTERY

Sintered Cadmium Type 1.2 v. 7AH. Size: height 3 1/2 in., width 2 1/2 in. X 1 1/2 in. Weight: approx. 13 ozs. Ex-R.A.F., Tested, 12/6. P. & P. 2/6.

230 VOLT A.C., GEARED MOTORS

Type D15G 5 r.p.m. 1.7lb. inch, £2/9/6, P. & P. 3/-
Type B16G 80 r.p.m. 26lb. inch, £2/2/-, P. & P. 3/-
Type D16G 13 r.p.m. 1.45lb. inch, £2/17/6, P. & P. 3/-

PRECISION FLATPOT

Manufactured by M.E.C. 50 k. 45 turn. Fly leads, all metal sealed construction. 10/6d. Plus 1/6 P. & P.

GENUINE NEW MULLARD

6 AMP. SILICON DIODES

NOT Rejects or Seconds

BYZ13 200 PIV 7/- BYZ12 400 PIV 8/-
BYZ11 600 PIV 9/- BYZ10 800 PIV 10/-

100 WATT POWER RHEOSTATS

(NEW) Ceramic construction, winding embedded in Vitreous Enamel, heavy duty brush assembly designed for continuous duty. AVAILABLE FROM STOCK IN THE FOLLOWING II VALUES:

1 ohm 10a., 5 ohm 4.7a., 10 ohm 3a.;
25 ohm 2a.; 50 ohm 1.4a.; 100 ohm 1a.; 250 ohm .7 a.; 500 ohm .45 a.; 1,000 ohm 280 mA.; 1,500 ohm 230 mA.; 2,500 ohm .2 a. Diameter 3 1/2 in. Shaft length 2 1/2 in. dia. 1/2 in., 27/6. P. & P. 1/6.



50 WATT POWER RHEOSTATS

1 ohm 7a.; 5 ohm 3a.; 10 ohm 2.25a.; 25 ohm 1.4a.; 50 ohm 1a.; 100 ohm .7a.; 250 ohm .45a.; 500 ohm .3a.; 1,000 ohm .22a.; 2,500 ohm .14a. All at 21/- each. P. & P. 1/6.

25 WATT POWER RHEOSTATS

10 ohm 1.5a.; 25 ohm 1a.; 50 ohm .75a.; 100 ohm .5a.; 250 ohm .3a.; 500 ohm .2a.; 1,000 ohm .15a.; 1,500 ohm .12a.; 2,500 ohm .1a.; all at 14/6, each. P. & P. 1/6.

SWING ARM RHEOSTAT

Especially designed for educational use. 0-10 ohm in precision 1 ohm steps. Max. current 5 amp. Size: Height 1 9/16 in. Width 1 1/2 in. Depth 6 1/2 in. Price £4/19/6. P. & P. 7/6.

DRY REED SWITCHES

New special offer of Dry Reed Switches, 1/2 amp. contact, 1 1/2 x 1/2 in., 4 for 10/-, post paid.

VENNER ELECTRIC TIME SWITCH

200-250 v. A.C. 20 amp. contacts twice on, twice off, at any manually pre-set time. Spring reserve (in case of power cut) fully tested £3/9/6, P. & P. 4/6d. Or complete in weather-proof metal case (illustrated) £3/19/6, plus 4/6 P. & P. Can be supplied with solar dial, on at dusk—off at dawn. Prices as above.



VENNER 14-DAY CLOCKWORK TIME SWITCH. 5 amp. 230 v. contact, 1 on/off every 24-hr. Fitted in metal case with key. Used but guaranteed. 47/-, plus 3/- P. & P.

SANWA Multi Range Meters

Acknowledged throughout the world as the ultimate in test meters.

NEW MODEL U-50D MULTI-TESTER, 20,000 O.P.V. MIRROR SCALED WITH OVERLOAD PROTECTION. Ranges: D.C. volts: 100mV, 0.5 v., 5 v., 250 v., 1,000 v. A.C. volts: 0.5 mA., 5 mA., 50mA., 250 mA. Size: 5 1/2 x 3 1/2 in. Complete with batteries £5.15.0 Post paid. Three other models available from-stock. Descriptive leaflet on request.



SLIDER RESISTANCE

200 ohm 1.25 amp. 37/6. P. & P. 3/6.
5 ohm 10 amp. 37/6. P. & P. 3/6.

230 v. A.C. RELAY. 2 c/o 2 amp. contacts. 9/6 ex new equip. P. & P. 1/6.

THYRISTOR 400 piv, 5 amp., 14/6 post paid.
THYRISTOR 400 piv, 8 amp., 28/6 post paid.

Condenser 5,000 m/d 50 v. 1 1/2 x 4 1/2 in. 12/6. New.

LATEST TYPE SELENIUM BRIDGE RECTIFIERS

30 volt 3 amp., 11/- plus 2/6 P. & P.
30 volt 5 amp., 16/-, plus 2/6 P. & P.

MOVING COIL HEADPHONE AND MIKE
Soft rubber ear-pieces with M/C Mike fitted 5-way plug as on No. 19 set. New, in maker's packing, 16/6 plus 3/6 C. & P.

A.C. AMMETERS 0-1, 0-10, 0-15, 0-20 amp. F.R. 2 1/2 in. dia. All at 21/- each.

A.C. VOLTMETERS 0-25 v., 0-50 v., 0-150 v. M.I. 2 1/2 in. Flush round all at 21/- each. P. & P. extra.
0-300 v. A.C. Rect. M-Coil 2 1/2 in. 29/-
0-300 v. A.C. Rect. M-Coil 3 1/2 in. Type W23 55/-

Latest type VARLEY MINIATURE RELAY in Transparent Case. 4 c/o 700 ohm 14/6. Base 4/-, 2 c/o 700 ohm coil. Size 1 1/2 x 1 1/2 x 1 1/2 in. 15/- inc. base. VARLEY TYPE VP4 (similar to illus.), 5,800 ohm. 4 c/o. New 12/6, less base. Similar to above. Mfd. by GRUNER 4 c/o, 2,400 ohm coil. New, 10/-, less base.

UNISELECTORS SWITCHES

NEW 4-BANK 25-WAY UNISELECTOR

25 ohm coil, 24 v. D.C. operation. £4/17/6 plus 2/6. P. & P.



8-BANK 25-WAY FULL WIPER

24 v. D.C. operation, £6/10/-, plus 4/- P. & P.

STANDARD SIZE UNISELECTOR SWITCHES USED

75 ohm coil, 24 v. D.C., 6 bank 25 position, 5 non-bridging, 1 bridging wiper. 6 bank arranged to give 3 bank, 50 positions ex-equipment, 35/- each. P. & P. 2/6.

MINIATURE UNISELECTOR SWITCH



3 banking of 11 positions plus honing bank. 40 ohm coil. 24-36 v. D.C. operation. Carefully removed from equipment and tested. 22/6, plus 2/6 P. & P.

AIR BLOWER

Highly efficient blower unit fitted with totally enclosed 200/250 v. A.C. 50 cycles. 1/8 h.p. motor, producing 2,800 r.p.m. outlet 2 1/2 x 1 1/2 in. used, but in first class condition and tested. Price £3/15/-, P. & P. 7/6d.



AUTO TRANSFORMERS. Step up, step down. 110-200-220-240 v. Fully shrouded. New. 300 watt type £3 each. P. & P. 4/6. 500 watt type £4/2/6 each. P. & P. 6/6. 1,000 watt type £5/5/- each. P. & P. 7/6.

L.T. TRANSFORMERS

| All primaries 220-240 volts | | | |
|-----------------------------|-----------------------------|---------|-------|
| Type No. | Sec. Taps | Price | Carr. |
| 1 | 30, 32, 34, 36 v. at 5 amps | £3/5/- | 6/- |
| 2 | 30, 40, 50 v. at 5 amps | £5/5/- | 6/6 |
| 3 | 10, 17, 18 v. at 10 amps | £3/10/- | 4/6 |
| 4 | 6, 12, v. at 20 amps | £4/17/6 | 6/6 |
| 5 | 17, 18, 20 v. at 20 amps | £5/12/6 | 6/6 |
| 6 | 6, 12, 20 v. at 20 amps | £5/5/- | 7/6 |
| 7 | 24 v. at 10 amps | £3/15/- | 5/6 |

ALL MAIL ORDERS. ALSO CALLERS AT:

57 BRIDGMAN ROAD,
LONDON, W.4. Phone: 995 1560
Closed Saturdays.

SERVICE TRADING CO.

SHOWROOMS NOW OPEN

Many Bargains for the caller.

AMPLE PARKING

PERSONAL CALLERS ONLY

9 LITTLE NEWPORT STREET,
LONDON, W.C.2.
Tel.: GER 0576

RADIO CLEARANCE (1965) LTD.

27 TOTTENHAM COURT ROAD, LONDON, W.1

Tel. (01) 636-9188
(01) 636-4666/7

ELECTROLYTIC CONDENSERS

| | | <i>s</i> | <i>d</i> | | | <i>s</i> | <i>d</i> | | | <i>s</i> | <i>d</i> |
|------|------|----------|----------|---------|------|----------|----------|-------------|------|----------|----------|
| 1μF | 25v | 1 | 6 | 50μF | 12v | 1 | 6 | 2,500μF | 30v | 3 | 6 |
| 1μF | 350v | 1 | 6 | 50μF | 25v | 1 | 6 | 2,500μF | 50v | 4 | 6 |
| 2μF | 12v | 1 | 6 | 50μF | 50v | 1 | 6 | 4,000μF | 25v | 3 | 6 |
| 2μF | 150v | 1 | 6 | 50μF | 275v | 1 | 6 | 5,000μF | 25v | 3 | 6 |
| 2μF | 275v | 1 | 6 | 50μF | 350v | 2 | 6 | 10,000μF | 25v | 3 | 6 |
| 2μF | 350v | 1 | 6 | 64μF | 450v | 2 | 6 | 30,000μF | 30v | 4 | 6 |
| 2μF | 500v | 1 | 6 | 100μF | 15v | 1 | 6 | 32 × 32μF | 350v | 2 | 6 |
| 4μF | 25v | 1 | 6 | 100μF | 25v | 1 | 6 | 50 × 50μF | 350v | 2 | 6 |
| 4μF | 150v | 1 | 6 | 100μF | 50v | 1 | 6 | 60 × 100μF | 275v | 2 | 6 |
| 4μF | 275v | 1 | 6 | 100μF | 100v | 1 | 6 | 60 × 250μF | 275v | 4 | 6 |
| 4μF | 350v | 1 | 6 | 100μF | 250v | 3 | 6 | 100 × 100μF | 150v | 3 | 6 |
| 4μF | 500v | 1 | 6 | 100μF | 350v | 3 | 6 | 100 × 200μF | 275v | 4 | 6 |
| 5μF | Rev | 1 | 6 | 100μF | 450v | 3 | 6 | 150 × 200μF | 350v | 4 | 6 |
| 5μF | 50v | 1 | 6 | 125μF | 500v | 4 | 6 | 250 × 250μF | 325v | 4 | 6 |
| 5μF | 70v | 1 | 6 | 200μF | 275v | 2 | 6 | | | | |
| 6μF | Rev | 1 | 6 | 200μF | 350v | 3 | 6 | | | | |
| 8μF | Rev | 1 | 6 | 250μF | 12v | 1 | 6 | | | | |
| 8μF | 150v | 1 | 6 | 250μF | 18v | 1 | 6 | | | | |
| 8μF | 275v | 1 | 6 | 250μF | 25v | 1 | 6 | | | | |
| 8μF | 350v | 1 | 6 | 250μF | 50v | 1 | 6 | | | | |
| 8μF | 500v | 1 | 6 | 350μF | 12v | 1 | 6 | | | | |
| 10μF | 5v | 1 | 6 | 350μF | 25v | 1 | 6 | | | | |
| 10μF | 50v | 1 | 6 | 350μF | 25v | 1 | 6 | | | | |
| 10μF | 150v | 1 | 6 | 400μF | 15v | 1 | 6 | | | | |
| 10μF | 300v | 1 | 6 | 400μF | 30v | 1 | 6 | | | | |
| 16μF | 250v | 1 | 6 | 400μF | 50v | 1 | 6 | | | | |
| 16μF | 350v | 1 | 6 | 400μF | 275v | 4 | 6 | | | | |
| 16μF | 500v | 1 | 6 | 500μF | 6v | 1 | 6 | | | | |
| 25μF | 12v | 1 | 6 | 500μF | 15v | 1 | 6 | | | | |
| 25μF | 25v | 1 | 6 | 500μF | 25v | 1 | 6 | | | | |
| 25μF | 50v | 1 | 6 | 1,000μF | 15v | 2 | 6 | | | | |
| 30μF | 6v | 1 | 6 | 1,000μF | 18v | 1 | 6 | | | | |
| 30μF | 10v | 1 | 6 | 1,000μF | 25v | 1 | 6 | | | | |
| 32μF | 150v | 1 | 6 | 1,000μF | 50v | 2 | 6 | | | | |
| 32μF | 350v | 2 | 6 | 1,500μF | 25v | 1 | 6 | | | | |
| 32μF | 450v | 2 | 6 | 1,500μF | 50v | 3 | 6 | | | | |
| 32μF | 500v | 2 | 6 | 2,000μF | 25v | 3 | 6 | | | | |
| | | | | 2,000μF | 50v | 2 | 6 | | | | |

TERMINATION CODING
W.E. Wire Ended
T.1. Tag each end of condenser
T.2. Single end tag termination
T.3. Single end tag termination
Twist prong fixing

| | | | | | |
|-------------|------|-------------|------|----|---|
| 8 × 8μF | 450v | 1 1/2" × 1" | T.1. | 4 | 0 |
| 8 × 16μF | 450v | 2" × 1" | T.1. | 4 | 6 |
| 16 × 16μF | 275v | 2" × 1" | T.1. | 4 | 0 |
| 16 × 16μF | 450v | 2" × 1" | T.1. | 4 | 6 |
| 16 × 32μF | 275v | 1 1/2" × 1" | T.1. | 4 | 0 |
| 32 × 32μF | 275v | 2" × 1" | T.3. | 4 | 0 |
| 50 × 50μF | 300v | 2" × 1" | T.2. | 4 | 6 |
| 50 × 150μF | 300v | 3 1/2" × 1" | T.2. | 6 | 6 |
| 60 × 250μF | 275v | 4" × 1" | T.2. | 9 | 0 |
| 80 × 40μF | 450v | 4" × 1" | T.2. | 12 | 6 |
| 100 × 100μF | 275v | 3" × 1" | T.2. | 6 | 6 |
| 100 × 400μF | 275v | 4 1/2" × 1" | T.2. | 13 | 6 |
| 200 × 200μF | 300v | 4" × 1" | T.2. | 12 | 6 |
| 300 × 300μF | 300v | 4" × 1" | T.2. | 14 | 0 |

The above list represents just part of the extensive range of electrolytic condensers we carry in stock. All condensers are new and carry a twelve month guarantee. Please do not hesitate to contact us for quotations on bulk quantities. If you do not see the exact condenser you require please let us know your exact requirements. Please send S.A.E. for Lists of Transformers, Transistors, Diodes, Rectifiers, Speakers and other components at Bargain Prices.

DAMAGED METER?

Have it repaired by Glaser

Reduce overheads by having your damaged Electrical Measuring Instruments repaired by L. Glaser & Co. Ltd. We specialise in the repair of all types and makes of

INSTRUMENT REPAIRS

Voltmeters, Ammeters, Microammeters, Multirange Test Meters, Electrical Thermometers, Recording Instruments, Leak Detectors, Temp. Controllers, all types Bridges & Insulation Testers, etc.

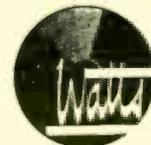
As contractors to various Government Departments we are the leading Electrical Instrument Repairers in the Industry. For prompt estimate and speedy delivery send defective instruments by registered post, or write to Dept. W.W.:-

L. GLASER & CO. LTD.
1-3 Berry Street, London, E.C.1.
Tel.: Clerkenwell 5481-2

SURPLUS HANDBOOKS

| | | |
|--|---------------|------|
| 19 set Circuit & Notes | 4/6 p/p | 6d |
| 1155 set Circuit & Notes | 4/6 p/p | 6d |
| R.R.O. Technical Instructions | 3/6 p/p | 6d |
| 38 set Technical Instructions | 3/6 p/p | 6d |
| 48 set Working Instructions | 5/- p/p | 6d |
| 88 set Technical Instructions | 3/6 p/p | 6d |
| BC.221 Circuit & Notes | 3/6 p/p | 6d |
| Wavemeter Class D Techn. Ins. | 3/6 p/p | 6d |
| 18 set Circuit & Notes | 3/6 p/p | 6d |
| BC.1000 (31 set) Circuit & Notes | 3/6 p/p | 6d |
| CR.100/B28 Circuit & Notes | 8/6 p/p | 6d |
| R.107 Circuit & Notes | 5/- p/p | 6d |
| A.R.88D Instruction Manual | 15/- p/p | 1/6d |
| 62 set Circuit & Notes | 4/6 p/p | 6d |
| 62 set Sender and Receiver Circuits | 6/- post free | |
| BC.1000 (31 set) Circuit & Notes | | |
| R.1116/A, R.1224/A, R.1355, RF.24, 25 & 26, A.1134, T.1164 | | |
| C.R.300, BC.342, BC.348J, E.M.P. 'R', BC624, 22 SET. | | |
| Resistor Colour Code Indicator, 1/6, p/p 6d. | | |

Postage rates apply to U.K. only.
Mail order only to:
INSTRUCTIONAL HANDBOOK SUPPLIES, Dept. W.W.,
TALBOT HOUSE, 28 TALBOT GARDENS, LEEDS, 8.

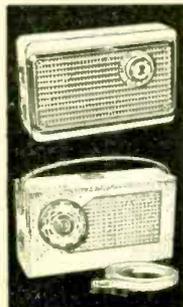


THE ONLY COMPREHENSIVE RANGE OF RECORD MAINTENANCE EQUIPMENT IN THE WORLD!

Send stamps value 9d. for 16 page booklet and supplementary data sheets Nos. 1 and 4 giving the fullest and latest information.

Cecil E. Watts Limited
Darby House
Sunbury-on-Thames, Middx.

BUILD YOURSELF A QUALITY TRANSISTOR RADIO!

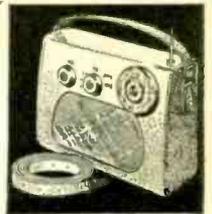


TRANSONA FIVE MED. LONG & TRAWLER BAND. 5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, 3in. speaker, 6 1/2" x 4 1/2" in. **ONLY 42/6.** P. & P. 3/6. Plans and Parts list 1/6 (free with kit).



POCKET FIVE. MED. & LONG WAVES & TRAWLER BAND. 5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, 2 1/2in. speaker, etc. 5 1/2" x 3 1/2" in. **ONLY 39/6.** P. & P. 3/6. Plans and parts list 1/6 (free with kit). Also available Pocket Five Medium and Long Wave version with miniature speaker 29/6. P. & P. 3/6.

ROAMER SEVEN Mk. 4. 7 wavebands—MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. 7 transistors and 2 diodes. Ferrite rod aerial and telescopic aerial. Socket for car aerial. 7 x 4in. speaker. Airspaced ganged tuning condenser, etc. Size 9 x 7 x 4in. **ONLY 45/10/6.** P. & P. 6/8. Plans & parts list 3/-. (free with kit).



ROAMER SIX. 6 wavebands—MW1, MW2, SW1, SW2, LW and Trawler Band. 6 transistors and 2 diodes. Ferrite rod and telescopic aeriels. 3in. speaker. Top grade components. Size 7 1/2" x 5 1/2" x 1 1/2" in. **ONLY 79/6.** P. & P. 3/6. Plans and parts list 2/- (free with kit).

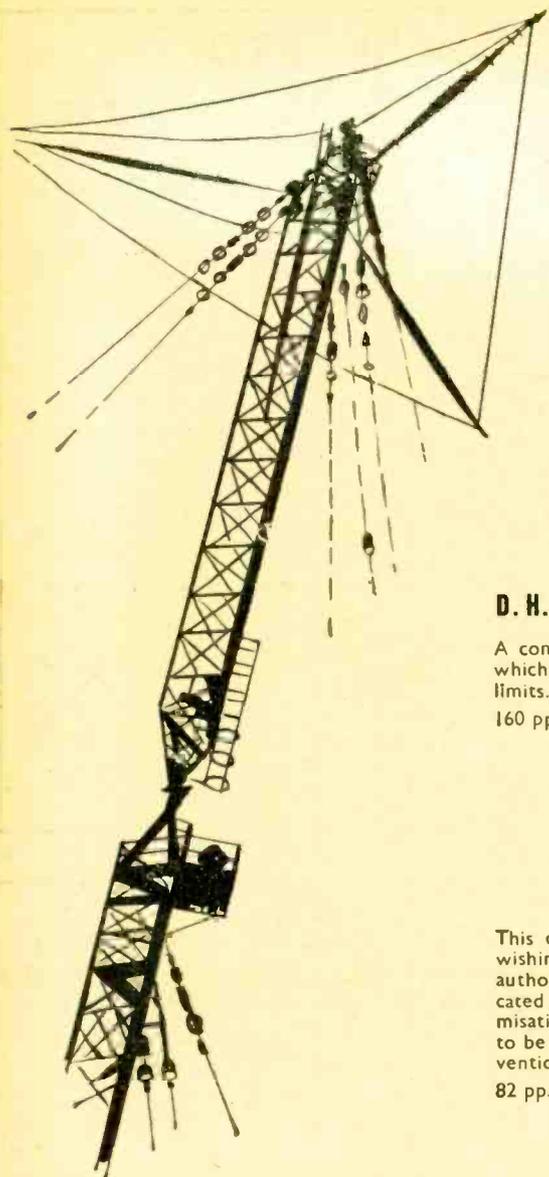


SUPER SEVEN. MED. LONG & TRAWLER BAND. 7 transistors and 2 diodes. 3in. speaker, 2 R.F. stages, push-pull output, etc. 7 1/2" x 5 1/2" x 1 1/2" in. **ONLY 69/6.** P. & P. 3/6. Plans and parts list 2/- (free with kit).

RADIO EXCHANGE. 61 High Street, Bedford.

'Phone: 52367

Callers side entrance Barlatts Shoe Shop. Open 9-5 p.m. (Sat. 9-12.30 p.m.)



*valuable books
for the radio and
electronic engineer!*

Generation of High Magnetic Fields

D. H. Parkinson, M.A., D.Phil., F.Inst.P., and B. E. Mulhall, M.A., Ph.D.

A comprehensive study of the subject covering the whole range of the techniques which may be employed and also the whole range of possible fields up to the extreme limits.

160 pp. 81 illustrations. 70s. net, 71s. 1d. by post.

Transistor Bias Tables

Vol. II: Silicon. E. Wolfendale, B.Sc.(Eng.), F.I.E.E.

This collection of accurately computed tables has been compiled to assist anyone wishing to design or build a transistor amplifier. The tables are on similar lines to the author's previous transistor bias tables for germanium transistors but a more sophisticated computer programme has been written which enables a greater degree of optimisation to be built into the compilation of the tables. This should enable the tables to be used directly to provide the values of the three resistors required for the conventional bias circuit for silicon transistor.

82 pp. 25s. net. 26s. by post.

Electronics and Instrumentation

Robert L. Ramey

Provides a sound groundwork for understanding the basis of existing instruments and their applications; also of instruments which are likely to be invented in the future. A useful introduction for students of electronics, and a single course for students in other branches of science and engineering.

55s. net. By post 56s. 5d. 321 pp. 128 illustrations.

available from your bookseller

ILIFFE BOOKS LTD.

DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



19 transistors, 8 diodes, 11HF music power 30 watts at 8 ohms. Response 30-20,000 ± 3 dB at 1 w. Distortion 1% or less. Inputs 3 mV and 250 mV. Output 3-16 ohms. Separate L. and R. volume controls, Treble and bass controls. Stereo phone jack. Brushed aluminum, gold anodized extruded front panel with complementary metal case. Size 10 1/2 in. x 3 1/2 in. x 7 1/2 in. Operation 115/230 volt A.C. \$25. Carr. 7/8.

GARRARD DECKS

| | |
|----------------------------------|----------|
| SRP12-player, mono or stereo | £4 4 0 |
| 1000 changer, mono or stereo | £5 15 6 |
| 2000 changer, mono or stereo | £6 19 6 |
| A50 Mono or Stereo | £7 17 6 |
| 3000 changer, mono or stereo | £7 19 6 |
| 3000 Sonotone Stereo | £8 19 6 |
| AT 6 Mk. II, mono or stereo | £8 19 6 |
| A70 Mk. II, less cartridge | £12 12 0 |
| A70 Mk. II Sonotone Stereo | £14 14 0 |
| LAB80 Mk. II changer, less cart. | £24 0 0 |
| 401 Transcription Deck | £27 0 0 |

All plus D.F. & P.

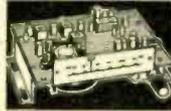


AVOMETERS



Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions. Model 47A £9/19/6 Model 8 £18/0/0 Model 9 £20/0/0 P. & P. 7/6 each.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER SIZE ONLY 6in. x 4in. x 2 1/2in. 3 I.F. stages. Double tuned discriminator, ample output to feed most amplifiers. Operates on 9 volt battery. Coverage 88-108 Mc/s. Ready built ready for use. Fantastic value for money. £8/10/- P. & P. 2/6. STEREO MULTIPLEX ADAPTORS, 5 Gns.

SILICON RECTIFIERS

| | |
|-------------------------|------|
| 200 v. P.I.V. 200mA | 2/8 |
| 200 v. P.I.V. 6 amp. | 5/6 |
| 400 v. P.I.V. 3 amp. | 7/6 |
| 1,000 v. P.I.V. 5 amp. | 10/6 |
| 400 v. P.I.V. 6 amp. | 5/6 |
| 400 v. P.I.V. 8 amp. | 7/6 |
| 1,000 v. P.I.V. 650 mA. | 6/6 |
| 800 v. P.I.V. 500mA. | 5/6 |
| 800 v. P.I.V. 5 amp. | 7/6 |
| 400 v. P.I.V. 500mA. | 3/6 |
| 70 v. P.I.V. 1 amp. | 1/- |
| 150 v. P.I.V. 25 amp. | 10/- |
| 700 v. P.I.V. 100 amp. | 35/- |

Discount for quantities. Post extra.

THYRISTOR SILICON CONTROL RECTIFIERS

| | |
|-------------------|------|
| 400 P.I.V. 3 amp. | 7/6 |
| 100 P.I.V. 5 amp. | 13/6 |
| 200 P.I.V. 5 amp. | 15/6 |
| 400 P.I.V. 5 amp. | 17/6 |

S.T.C. 1 WATT ZENER DIODES

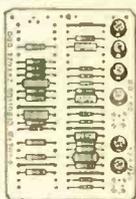
BRAND NEW LIST 17/6 each Available 2,4,7,13,9,4,3,13,10,18,20,30,33 v. 5/- each type. P. & P. extra.

LAFAYETTE HI-FI STEREO HEAD PHONES



★ Air cushioned headband
★ Soft rubber ear pads
★ Frequency response, 25 to 15,000 cycles. ★ High sensitivity. Impedance 8 ohms per phone. Supplied complete with all cables, wires, overhead junction box and 3-connection plug 7/6. P. & P. 2/6.

PRINTED CIRCUITS



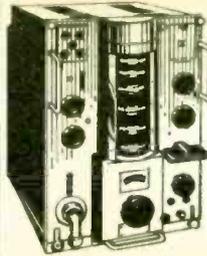
Five assorted printed circuit boards with transistors, diodes, resistors, condensers, etc. Guaranteed minimum 20 transistors. Ideal for experimenters. 5 Boards for 10/- P. & P. 2/-

SOLARTRON CD715.2 DOUBLE BEAM OSCILLOSCOPE



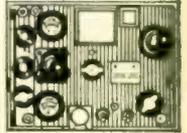
An extremely high quality oscilloscope originally costing £400. Switched beam. Identical Y1, Y2 Amplifiers D.C. to 9 Mc/s. Bandwidth 3mV/cm to 100 V/cm. Time base 10 μsec. to 10 m/sec. Calibrator. X amplifier D.C. to 2.5 Mc/s. 2 Modulation. 110/200/250V. A.C. Supplied in good working order. £65 carriage £2, or available as received from Ministry non-serviced £50. carriage £2. (Handbook £2 extra.)

ADMIRALTY B.40 RECEIVERS



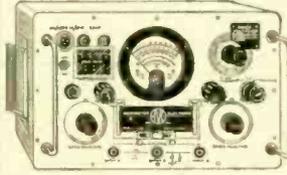
Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s.-30 Mc/s. 1/2 F. 500 Kc/s. Incorporates 2 R.P. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator, i.F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19 1/2 in. x 13 1/2 in. x 16 in. Weight 11 1/2 lbs. Offered in good working condition. £22/10/- carr. 30/-. With circuit diagrams. Also available B41 L.F. version of above. 15 Kc/s-700 Kc/s. £17/10/-, carr. 30/-.

COLLINS TSC TRANSMITTERS



Frequency range 1.5-12 Mc/s. in 3 bands. Employ 7 valves. 2 or 1625 PA, 1625 Buffer, 1625 Mod., 3 x 12 A6 Osc. RT. or C.W. V.F.O. or provision for Xtals, incorporates plate and aerial-current metres. Require ext. P.S.U. Offered in excellent condition. £8/19/6, carr. 15/-.

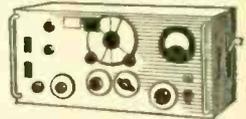
AVO CT.38 ELECTRONIC MULTIMETERS



High quality 97 range instrument which measures A.C. and D.C. Voltage, Current, Resistance and Power output. It ranges D.C. volts 250mV-10,000 v. (10 megΩ-110 megΩ input). D.C. current 10μA-25 amps. Ohms: 0-1,000 megΩ. A.C. volt 100 mV-250 v. (with R.F. measuring head up to 250 Mc/s). A.C. current 10μA-25 amps. Power output 50 microwatts-5 watts. Operation 0/110/200/250 v. C. Supplied in perfect condition complete with circuit lead and R.F. probe £25. Carr. 15/-. AVO CALIBRATION TEST UNIT TYPE CT.155. For use with CT.38 Multimeter. Gives 7 standard voltages 250 mV/1 v./2.5 v./10/20/100 v. A.C. and 250 millivolts D.C. from internal standard cell. Operation 0/110/200/250 v. A.C. Brand new £7/10/- P. & P. 10/6.

MARCONI TEST EQUIPMENT

EX-MILITARY RECONDITIONED TRF 1446 STANDARD SIGNAL GENERATORS, 85 Kc/s-25 Mc/s. £25. carr. 30/-. T.F.3286. Q METER. BRAND NEW, COMPLETE WITH ALL ACCESSORIES. £75. carr. 30/-. T.F.195M. BEAT FREQUENCY OSCILLATOR. 0-40, kc/s. 200/250 v. A.C. £20. carr. 30/-. All above offered in excellent condition fully tested and checked.



Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid. High quality construction. Input 230 v. 50-60 cycles. Output full variable from 0-250 volts. Bulk quantities available. 1 amp.—£4/10/-; 2.5 amp.—£5/17/6; 5 amp.—£9; 8 amp.—£13/10/-; 10 amp.—£17; 12 amp.—£19/10/-; 20 amp.—£32/10/-.



POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. 1/2 in. dia. shafts. Bulk quantities available. 25 WATT. 10/25/50/100/250/500/1000/1500/2500 or 5000 ohms. 14/6. P. & P. 1/6. 50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. 21/-. P. & P. 1/6. 100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms. 27/6. P. & P. 1/6.



ARF-100 COMBINED AF-RF SIGNAL GENERATOR

AF. SINE WAVE 20-200,000 cps. Square wave 20-300,000 cps. O/P HIGH IMP. 21 v. 1/P 600Ω 3.5 v. P/P. R.F. 100 kc/s-300 Mc/s. Variable R.F. attenuation. Int./Ext. Modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240 v. A.C. £27/10/- Carr. 7/6.



TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-250 Mc/s. on 6 bands. Directly calibrated. Variable R.F. attenuator. Operation 200/240 v. A.C. Brand new with instructions £12/10/- P. & P. 7/6. S.A.E. for details.



LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pf - 2,000 infd. 2 ohms-250 megohms. Also checks impedance turns ratio, insulation. 200/250 v. A.C. Brand New. £15. Carr. 7/6.



LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

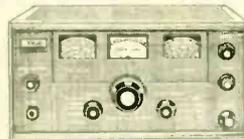
0-20 Kc/s. Output 5K or 500 ohms. 200/250v. A.C. Offered in excellent condition. £12/10/- Carriage 10/-

AMERICAN RECORDING TAPES

First grade quality American tapes. Brand new and guaranteed. Discounts for quantities. 4in. 250ft. L.P. Acetate 4 3/4in. 600ft. T.P. Mylar 10/- 6in. 600ft. Std. plastic 8/6 6in. 900ft. L.P. Acetate 10/- 6in. 1,200ft. D.P. Mylar 15/- 5in. 1,800ft. T.P. Mylar 35/- 5 1/2in. 1,200ft. L.P. acetate 12/6 5 1/2in. 1,800ft. D.P. Mylar 22/6 5 1/2in. 2,400ft. T.P. Mylar 45/- 7 1/2in. 1,200ft. Std. acetate 12/6 7 1/2in. 1,800ft. L.P. acetate 15/- 7 1/2in. 1,800ft. L.P. Mylar 20/- 7 1/2in. 2,400ft. D.P. Mylar 25/- 7 1/2in. 3,000ft. T.P. Mylar 58/6



TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● 8 meter ● Sep. band spread dials ● 1F 455 Kc/s ● audio output 1.5 W. ● Variable RF and AF gain controls. 115/250 V. A.C. Mains. Beautifully designed. Size: 7 x 15 x 10 1/2 in. With instruction manual and service data. £35. Carriage 12/6.

T.M.C. 1000 SERIES KEY SWITCHES



Brand New with knobs as follows. 1 way, 2 c/o 7/6; 1 way, 2 c/o 2b. 7/6; 1 way, 4 c/o 8/-; 2 way, 3m. 3m. 8/6; 2 way, 2 c/o. 2 c/o 8/6; 2 way, 2 c/o. 4 c/o. 10/- Post extra. Quantities available.

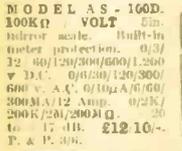
G. W. SMITH & Co. (Radio) Ltd.
3-34, Lisle St., W.C.2.
ALSO SEE OPPOSITE PAGE

MULTIMETERS for EVERY purpose!

LAFAYETTE DE-LUXE 100 KΩ VOLT LAB TESTER 1000 Ω VOLT 500 mV scale. Built-in locky protection. 0.5/2.5/10/50/250/500/1000 v. A.C. 0.5/2.5/10/50/100 mA. 10/100/500 mA. 2.5/10 amp. 0.1K/10K/100K/10M/100MΩ. -10 to +25.4dB. £16/16/- P. & P. 5/-



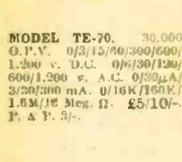
MODEL AS-100D. 100KΩ VOLT 500 mV scale. Built-in meter protection. 0.5/12/60/120/300/600/1200 v. D.C. 0.6/30/120/300/600 v. A.C. 0.1/10/100/500/2000 mA/12 amp. 0.2K/1/200K/2000KΩ. -20 to +17 dB. £12/10/- P. & P. 30/-



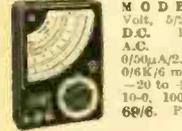
MODEL AF-105 50KΩ VOLT. Mirror scale, built-in meter protection. 0.2/3/12/60/120/300/600/1200 v. D.C. 0.6/30/120/300/600 v. A.C. 0.1/10/100/500/2000 mA/12 amp. 0.1K/1/10/100/100 KΩ. -20 to +17 dB. £8/10/- P. & P. 3/4/-



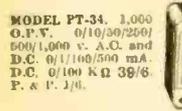
MODEL TE-70. 30,000 O.P.V. 0.5/15/60/300/600/1200 v. D.C. 0.6/30/120/300/600/1200 v. A.C. 0.1/10/100/500/2000 mA. 12 amp. 0.1K/1/10/100/100 KΩ. -20 to +17 dB. £8/10/- P. & P. 3/4/-



MODEL TE-10A. 20KΩ VOLT. 0.25/50/250/500/2500 v. D.C. 10/60/100/500/1000 v. A.C. 0.5/50/250/500/2500 mA. 12 amp. 0.1K/1/10/100/100 KΩ. -20 to +22 dB. 68/6. P. & P. 2/6.



MODEL PT-34. 1,000 O.P.V. 0.1/10/50/250/500/1,000 v. A.C. and D.C. 0.1/100/500 mA. D.C. 0/100 KΩ 39/6. P. & P. 3/4/-



SOLARTRON MONITOR OSCILLOSCOPE TYPE 101. An extremely high quality oscilloscope with time base of 10 μsec. to 20 msec. Internal V amplifier. Separate mains power supply 240/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry £8/19/6. Carriage 30/-.



R.C.A. AR88 SPEAKERS 8", 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available Brand New and Boxed with leads. 59/6. Carr. 7/6.



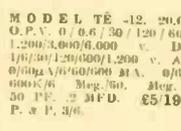
TE-900 20,000Ω VOLT GIANT MULTIMETER 6in. full view meter. 2 colour scale. 0.2/5/10/250/1,000/5,000 v. A.C. 0.2/5/10/50/100/500/1,000/2,000 v. D.C. 0.5/50/250/500 mA /1 amp DC 2K/200K/20 MΩ. O.M. £12/19/6. P. & P. 5/-



NEW MODEL 500. 30,000 O.P.V. with overload protection. Mirror scale. 0.5/2.5/10/50/250/500/1,000/5,000 v. D.C. 0.2/5/10/50/100/500/1,000/2,000 v. A.C. 0.5/50/250/500/1,000 mA. 10/100/500 mA. 2.5/10 amp. D.C. 0.5/50/250. Meg. 50. O.M. £8/17/6. Post paid.



MODEL TE-12. 20,000 O.P.V. 0.5/5/10/50/250/500/1,000 v. D.C. 0.6/30/120/300/600/1,200 v. A.C. 0.6/30/120/300/600 mA. 0.1K/1/10/100/100 KΩ. Meg. 50. Meg. 50. P. & P. 3/4/-



MODEL TE.80. 20,000 O.P.V. 0.1/10/50/100/500/1,000 v. A.C. 0.2/5/50/250/500/1,000 v. D.C. 0.50/50/500 mA. 0.5K/500 KΩ. Meg. 50. P. & P. 3/4/-



PROFESSIONAL 20,000 o.p.v. LAB. TYPE MULTITESTER With automatic overload protection. Mirror scale. Ranges 0.1/10/50/200/500/1,000 v. D.C. and A.C. 0.500/5. 10 mA. 250 mA. Current 0/20K, 200K, 2 megohm. Decibels -20 to +22 dB. £5/10/- P. & P. 2/6.



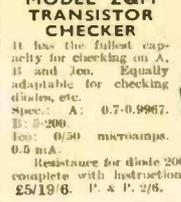
TE-51. NEW 20,000Ω VOLT MULTIMETER 0.6/60/600/1,200 v. A.C. 0.5/30/60/300/600/3,000 v. D.C. 0.6/60/12/300 mA. D.C. 0/60K/6 MΩ. O.M. 85/- P. & P. 2/6.



MODEL 250T. 2,000 O.P.V. 0.7/5/30/500/2,500 v. D.C. 0.1/10/50/500/2,000 v. A.C. 0/2 Meg. Ω. 0/250 mA. -20 to +36 dB. 49/6. P. & P. 2/6.



MODEL ZQM TRANSISTOR CHECKER It has the fullest capacity for checking on A, B and Jpn. Equally adaptable for checking diodes, etc. Spec. A: 0.7-0.9967. B: 0-200. Test: 0/50 microamps. Resistance for diode 200Ω +1 MEG. Supplied complete with instructions, battery and leads. £5/19/6. P. & P. 2/6.



Catalogue of Electronic Components and Equipment

Send today 5/- P&P 1/-



CATALOGUE

- ★ ELECTRONIC COMPONENTS
- ★ TEST EQUIPMENT
- ★ COMMUNICATION EQUIPMENT
- ★ HI-FI EQUIPMENT

We are proud to introduce our first comprehensive catalogue of Electronic Components and Equipment. Over 150 pages, fully illustrated, listing thousands of items, many at bargain prices. Free discount coupons with every catalogue. Everyone in electronics should have a copy. Send for your copy now.

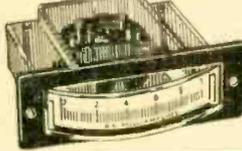
CLEAR PLASTIC PANEL METERS First grade quality. Moving Coil panel meters, available in quantities. S.A.E. for illustrated leaflet. Discounts for quantity. Available as follows: Type M1, 2 1/2" x 3 1/2" square front.

| | | | | | |
|-------------|------|----------|------|-----------|------|
| 100-0-100μA | 27/6 | 200μA | 22/6 | 100V D.C. | 22/6 |
| 500-0-500μA | 22/6 | 500μA | 22/6 | 150V D.C. | 22/6 |
| 1-5-1mA | 22/6 | 500mA | 22/6 | 300V D.C. | 22/6 |
| 5mA | 22/6 | 750mA | 22/6 | 500V D.C. | 22/6 |
| 10mA | 22/6 | 1A D.C. | 22/6 | 750V D.C. | 22/6 |
| 50μA | 32/6 | 2A D.C. | 22/6 | 75V A.C. | 22/6 |
| 100μA | 29/6 | 5A D.C. | 22/6 | 50V A.C. | 22/6 |
| 200μA | 27/6 | 10V D.C. | 22/6 | 150V A.C. | 22/6 |
| 500μA | 25/- | 20V D.C. | 22/6 | 500V A.C. | 22/6 |
| 50-0-50μA | 29/6 | 50V D.C. | 22/6 | 50V A.C. | 22/6 |

POST EXTRA. Larger sizes available - send for list.

NEW RANGE OF "SEW" EDGEWIRE METERS MODEL P270. Dimensions 3 1/2" x 1 1/2" x 2 1/4". Deep overall. Available as follows:

| | | | |
|--------------------|------|---------------|------|
| 50 microamp | 52/6 | 500 microamp | 42/6 |
| 50-0-50 microamp | 49/6 | 1 milliamp | 39/6 |
| 100-0-100 microamp | 49/6 | 300 volt A.C. | 39/6 |
| 100-0-100 microamp | 45/- | VU meter | 55/- |
| 200 microamp | 45/- | Post extra. | |



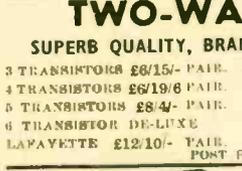
LAFAYETTE MODEL HA-500 SSB/AM CW 80 THROUGH 6 METRE RECEIVER New outstanding 11m Bands only receiver covering the 80/40/20/16/10/6 metre bands. Incorporates 10 valves, product detector, two mechanical filters, 8 meter, dual conversion on all bands, crystal calibrator, V.F.D., noise limiter, aerial trimmer, I.F. & 2.688 Mc/s. and 455 Kc/s. Output 8 ohms and 500 ohms. Operates 220/240 volts A.C. Supplied brand new and guaranteed with handbook 42 Gns. Carr. 10/-, 100 Kc/s. crystal. 35/-.



TWO-WAY RADIOS SUPERB QUALITY, BRAND NEW & GUARANTEED

| | |
|---|--|
| 3 TRANSISTORS £8/15/- PAIR. | 10 TRANSISTOR £22/10/- PAIR. |
| 4 TRANSISTORS £8/19/6 PAIR. | 13 TRANSISTOR 500 MW 2-channel 30 gns. PAIR. |
| 5 TRANSISTORS £8/4/- PAIR. | |
| 6 TRANSISTOR DE-LUXE LAFAYETTE £12/10/- PAIR. | 12 TRANSISTOR 1 WATT 2-channel £35 PAIR. |

POST EXTRA.



HAM-1. 4 BAND COMMUNICATION RECEIVER 6 wavebands covering 535 Kc/s-30 Mc/s. 5 valve superhet circuit. Incorporates 8 meter, 1170 BANDSPREAD TUNING, BUILT-IN 4m. SPEAKER, FERRITE AERIAL & EXTERNAL TELESCOPIC AERIAL. Operation 200/140 v. A.C. Supplied brand new with handbook. £17/17/-, Carr. 10/-.



NEW LAFAYETTE MODEL HA700 AM/CW/SSB AMATEUR COMMUNICATION RECEIVER 8 valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150-400 Kc/s., 500-1,500 Kc/s. 1.6-4.0 Mc/s. 4.8-14.5 Mc/s., 10-5-30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, R.F.O. product detector, electrical bandspread, 8 meter, slide rule dial. Output for phones low to 2K Ω or speaker 4 or 8 ohms. Operation 220/240 volt A.C. Size 7 1/4" x 10 1/2" x 10 1/2". Supplied brand new and guaranteed with handbook. 36 GNS. Carr. 10/- S.A.E. for leaflet.



G.W. SMITH & CO (RADIO) LIMITED Phone: GERRARD 8204/9155 Cables: SMITHEX LESQUARE 3-34 LISLE STREET, LONDON, W.C.2

OPEN 9 a.m. to 6 p.m. every day Monday to Saturday, Trade supplied.

TOA PUBLIC ADDRESS EQUIPMENT IS HERE

THERE'S MORE TO  THAN MEETS THE EYE



Tough compact construction utilising the latest advancements in printed circuitry mean that TOA stationary or mobile P.A. system gives clear

powerful amplification plus maximum adaptability and convenience with minimal maintenance. TOA specialists in SOUND.

*For full details:
AUDIO & DESIGNS (SALES) LTD.
 40 QUEEN STREET, MAIDENHEAD, BERKS
 Tel. Nos. 25630 or 25204.

TRANSISTOR & VALVE AMPLIFIERS, MIXERS, MEGAPHONES, SPEAKERS, HORNS

WW-128 FOR FURTHER DETAILS

VALVES SAME DAY SERVICE NEW! TESTED! GUARANTEED!

| SETS | | 1R5, 1B5, 1T4, 3A4, 3V4, DAF91, DF91, DK91, DL92, DL94. | | Set of 4 for 16/8. DAF96, DF96, DK96, DL96, 4 for 24/6. | |
|-------------|-------------|---|-------------|---|-------------|
| 1A7GT 7/6 | 7Y4 6/6 | DH77 4/- | EP97 7/6 | PCL94 7/- | UCF80 8/3 |
| 1H5GT 7/3 | 10F1 9/9 | DB81 12/6 | EP183 6/6 | PCL95 8/3 | UCH42 8/9 |
| 1N5GT 7/9 | 10P13 10/6 | DK32 7/9 | EP184 5/9 | PCL98 8/0 | UCH81 6/- |
| 1R5 5/6 | 12A77 3/9 | DK91 6/6 | EH90 6/6 | PENA4 6/9 | UCL82 7/- |
| 1B4 4/9 | 12A78 4/9 | DK92 8/- | EL33 6/6 | PEN30CCL51- | UCL83 8/9 |
| 1R5 3/9 | 12A77 4/9 | DK96 6/6 | EL34 9/- | PPL200 13/- | UF41 8/9 |
| 1T4 2/9 | 12A77 4/9 | DL33 6/9 | EL41 8/6 | PL36 9/- | UF80 7/- |
| 3A5 7/- | 12K8GT 7/6 | DL35 5/- | EL84 4/9 | PL81 6/8 | UF89 5/9 |
| 3Q4 5/6 | 20F2 10/6 | DL90 4/9 | EL90 5/- | PL82 6/6 | UL41 8/9 |
| 3R4 4/8 | 20L1 14/6 | DL94 5/6 | EL95 5/- | PL83 6/3 | UL44 20/- |
| 6V4 5/6 | 20P1 9/- | DL96 6/- | EM80 5/9 | PL84 6/3 | UL94 8/- |
| 6U4G 4/6 | 20P3 14/9 | DY86 5/9 | EM81 6/9 | PL500 13/- | UY41 5/6 |
| 6V4G 8/0 | 20P4 17/- | DY87 5/9 | EM84 6/3 | PX25 7/9 | UY85 4/6 |
| 6Y3GT 5/- | 25U4GT11/6 | EABC80 6/- | EM87 6/6 | PY32 8/6 | VP4B 10/6 |
| 6Z4G 7/6 | 30C15 11/6 | EABF42 8/6 | EY51 6/3 | PY33 8/6 | VP1921 21/- |
| 6/30E2 11/9 | 30C17 12/6 | EB01 2/3 | EY86 6/- | PY80 5/3 | W77 3/6 |
| 6AL5 2/3 | 30C18 11/9 | EBL33 7/- | EZ40 6/9 | PY81 5/3 | Z77 3/6 |
| 6AM6 3/6 | 30F5 12/- | EBL41 8/- | EZ41 6/9 | PY82 5/- | Transistors |
| 6AQ6 4/8 | 30FL1 13/9 | EBF80 6/- | EZ80 4/6 | PY83 6/9 | AC107 10/- |
| 6AT6 4/- | 30FL14 12/6 | EBF89 5/9 | EZ81 4/6 | PY88 7/3 | AC127 8/- |
| 6BA6 4/6 | 30L15 12/- | ECC81 3/9 | KT81 6/6 | PY800 6/- | AD140 15/6 |
| 6BE6 4/3 | 30L17 13/6 | ECC82 4/9 | KT81 12/- | PY801 6/- | AF102 18/- |
| 6BG6G 15/- | 30P4 12/- | ECC83 7/- | N18 5/6 | R19 7/- | AF115 6/6 |
| 6BU6 6/9 | 30P12 11/- | ECC84 6/3 | N78 14/9 | R20 12/9 | AF116 6/6 |
| 6BR7 7/9 | 30P19 12/- | ECC85 5/6 | N108 14/6 | U25 11/6 | AF117 5/- |
| 6C96 6/8 | 30P11 14/6 | ECP80 7/- | PC86 8/6 | U29 11/6 | AF118 8/6 |
| 6F1 7/9 | 30P13 14/6 | ECP82 6/9 | PC88 8/6 | U47 12/6 | AF124 7/6 |
| 6F13 3/6 | 30P14 14/6 | ECP86 9/- | PC97 5/6 | U49 18/6 | AF125 7/6 |
| 6F14 9/- | 35L6GT 7/6 | ECH35 6/- | PC900 7/9 | U62 4/6 | AF126 7/6 |
| 6P23 12/6 | 35W4 4/6 | ECH42 9/- | PCC84 5/6 | U78 3/6 | AF127 7/6 |
| 6K7G 1/8 | 3Z24GT 4/6 | KCH81 5/3 | PCO89 9/9 | U181 11/- | OC22 9/8 |
| 6K8G 4/3 | 6063 12/6 | ECL84 6/6 | PCO189 8/6 | U301 13/- | OC25 9/6 |
| 6K8GT 7/6 | A231 9/- | ECL80 6/- | PCF80 6/6 | U801 18/- | OC28 6/6 |
| 6L18 6/- | B36 4/8 | ECL82 6/3 | PCF82 6/- | UABC80 5/9 | OC44 3/6 |
| 6V6G 3/8 | B729 12/6 | ECL86 7/9 | PCF86 9/- | UAF42 7/8 | OC45 3/3 |
| 6V6GT 6/8 | OCH35 9/- | KF39 3/9 | PCF800 11/6 | UB41 6/6 | OC71 3/6 |
| 6X4 3/8 | DAC32 7/3 | EF41 9/6 | PCF801 7/9 | UB41 6/8 | OC72 4/8 |
| 6X5GT 5/9 | DAP91 2/9 | EF80 4/9 | PCF802 9/6 | UBF80 6/- | OC75 5/9 |
| 7B6 10/9 | DAF96 6/- | EF85 5/6 | PCF805 11/9 | UBF89 5/9 | OC81 3/6 |
| 7B7 7/- | DOC90 7/- | EF86 6/3 | PCF806 11/6 | UBL21 9/- | OC81D 3/6 |
| 7C5 12/- | DF33 7/9 | EF89 5/9 | PCF808 12/6 | UC92 5/- | OC82 5/9 |
| 7C6 6/9 | DF91 2/9 | EF91 3/8 | PCL82 6/9 | UC84 7/9 | OC82D 5/- |
| 7H7 5/6 | DF96 6/- | EF92 3/3 | PCL83 8/6 | UC85 6/6 | OC170 8/- |

READERS RADIO

85 Torquay Gardens, Redbridge, Ilford, Essex. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

VALUE FROM ELECTROVALVE NEW RESISTORS

1W All values 5.1Ω to 330kΩ carbon film, low noise, 5% tolerance, 1/10 doz. mixed; 14/6 100 mixed; 13/- 100 in 100's of one ohmic value.
 1W All values 4.7Ω to 10MΩ carbon film, low noise, 10% tolerance, 1/9 doz. mixed; 13/6 100 mixed; 12/- 100 in 100's of one ohmic value.
 2W All values 4.7Ω to 10MΩ carbon film, low noise, 5% tolerance, 2/- doz. mixed; 16/- 100 mixed; 14/6 100 in 100's of one ohmic value.
 All mixtures to your specification. Large quantities stocked. Quality Carbon Skeleton Presets: 100Ω, 250Ω, 500Ω, 1kΩ, 2.5kΩ, 5kΩ, 10kΩ, 25kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1MΩ, 2.5MΩ, 5MΩ, 10MΩ. All values available in horizontal or vertical mounting. 1/- each. Volume controls: 100Ω, 250Ω, 500Ω, etc. to 10MΩ linear, 2/6. 5kΩ, 10kΩ, 25kΩ, etc., to 5MΩ log, 2/6. Electrolytics: 5, 10, 25, 50μF 10V, 5, 10μF 25V 11d. each. 100, 200μF 10V, 25, 50μF 25V 1/1d. each.

Peak Sound Products
 CIR-KIT No. 3 Pack, 12/6 each. Adhesive copper strip 5ft. x 1/2in. or 1in. 2/- Perforated board 0.1in. matrix, 5in. x 3 1/2in. 4/-, 2 1/2in. x 3 1/2in. 2/6. Transistorised Stereo Amplifier type SA8-B. Amplifier kit £10/10/-, power supply £3, cabinet £3.
DISCOUNT ON ALL ORDERS: over £3, 10%; over £10, 15%

BEST QUALITY NEW SEMICONDUCTORS

SILICON
 Low noise, high gain: NPN: BC169 2/6, BC109 4/-, 2N3707 5/-, PNP: 2N4058 5/6. General purpose high gain: NPN: BC168 2/3, BC108 3/11, 2N2926/yel 3/6. PNP: 2N4062 5/6. High Power: NPN: 2N3055 £1, 40465 16/3, MJ5E21 18/3, PNP: MJ5E371 21/-, Field effect: N-channel: MPF105 10/-, 2N3819 14/9, P-channel: 2N3820 24/6. Many others including: 2N3241A 7/3, BC167, 2/9, BC107 4/-, 2N3702 4/-, 2N3703 4/-, 2N3704 4/-, 2N3705 4/-, CS2925 4/9, CS2926/red 3/6.
GERMANIUM
 Many types including: ACY22 3/6, 2G308 4/9, 2G309 7/9, 2N1304 4/-, 2N1305 4/-, NKT274 3/8, NKT403 16/3, NKT675 4/9, 2N2147 15/9, 2N2148 11/9, AD161 9/-, AD162 9/-.

MINIATURE SILICON DIODES 1/- each, 30V 75mA. Other diodes: OA47, OA70, OA81, OA90, OA91, OA95 2/-, OA202 3/-
ALL GOODS BRAND NEW. NO SURPLUS. FAST DELIVERY
 Postage 1/- under £1, post free £1 and over.
DISCOUNTS: 10% over £3, 15% over £10.
ELECTROVALVE, 6 MANSFIELD PLACE, ASCOT, BERKSHIRE

MULLARD

| | | | | | |
|-------|------|------------|------|--------|------|
| AAV11 | 2/- | BCZ11 | 10/- | OC82 | 4/6 |
| AC107 | 14/8 | BFY60 | 6/- | OC82D | 4/3 |
| AC127 | 6/- | BFY61 | 5/- | OC85 | 2/6 |
| AC128 | 4/- | BFY62 | 6/- | OC84 | 4/- |
| AC176 | 7/6 | BF184 | 8/- | OC123 | 7/- |
| AD149 | 11/- | BRX73 | 3/- | OC139 | 12/- |
| AD161 | 7/6 | BTY73-100R | 27/6 | OC140 | 12/- |
| AD162 | 7/6 | BTY97-150R | 23/- | OC169 | 6/- |
| AGY17 | 5/- | BTY91-150R | 35/- | OC170 | 4/- |
| ACX30 | 3/6 | B8X36-100 | 3/- | OC171 | 6/- |
| ACY21 | 4/- | BYZ10 | 11/- | OC200 | 6/- |
| ACY22 | 2/6 | BYZ12 | 7/6 | OC201 | 10/- |
| AFZ11 | 10/- | BYZ13 | 5/- | OC292 | 13/- |
| AFZ12 | 11/9 | BZY93 C94 | 12/- | OC293 | 8/- |
| AF114 | 4/8 | BY100 | 5/- | OC294 | 11/- |
| AF115 | 4/8 | BYX20-200 | 8/- | OC295 | 10/6 |
| AF116 | 4/9 | GET102 | 5/4 | OC297 | 19/6 |
| AF117 | 4/9 | GET103 | 4/4 | ORP12 | 9/- |
| AF118 | 9/- | GET111 | 10/- | ORP60 | 8/- |
| AF186 | 12/- | GHT573 | 10/- | ORP63 | 9/- |
| AF239 | 12/- | OC19 | 5/- | ORP83 | 18/- |
| ASX20 | 5/- | OC29 | 33/- | ORP90 | 19/6 |
| ASX28 | 5/- | OC27 | 13/- | OA3 | 3/- |
| ASZ21 | 4/- | OC28 | 25/- | OA10 | 4/- |
| ASX29 | 6/6 | OC24 | 19/- | OA47 | 1/6 |
| ATZ10 | 38/6 | OC25 | 7/- | OA70K | 1/6 |
| BA138 | 6/- | OC26 | 12/- | OA79K | 1/6 |
| BA115 | 2/6 | OC28 | 12/- | OA41K | 1/6 |
| BC167 | 5/- | OC29 | 15/- | OA43K | 1/6 |
| BC108 | 5/- | OC35 | 9/6 | OA90K | 1/6 |
| BC169 | 5/- | OC36 | 13/- | OA91K | 1/6 |
| BCY10 | 20/- | OC41 | 3/6 | OA95K | 1/6 |
| BCY12 | 22/- | OC45 | 4/- | OA200 | 2/- |
| BCY30 | 7/- | OC44 | 3/- | OA202 | 2/- |
| BCY31 | 13/- | OC45 | 3/- | OA210 | 7/6 |
| BCY32 | 8/- | OC71 | 3/- | SA431 | 7/- |
| BCY33 | 6/- | OC72 | 4/6 | SA436 | 10/- |
| BCY34 | 8/- | OC73 | 3/- | SA438 | 12/- |
| BCY28 | 19/- | OC75 | 5/- | SA2007 | 13/- |
| BCY39 | 19/- | OC76 | 3/- | 618V | 95/- |
| BCY40 | 18/- | OC81 | 3/- | 618K | 95/- |
| BCY71 | 15/- | OC81D | 3/- | 8VU1 | 19/9 |



J.E.D.E.C.

| | |
|--------|------|
| 2N385A | 15/- |
| 2N388A | 9/- |
| 2N696 | 9/- |
| 2N697 | 2/- |
| 2N706 | 4/- |
| 2N711 | 8/- |
| 2N1132 | 10/- |
| 2N1302 | 5/- |
| 2N1303 | 5/- |
| 2N1304 | 6/- |
| 2N1305 | 6/- |
| 2N1306 | 8/- |
| 2N1307 | 8/- |
| 2N1308 | 10/6 |
| 2N1309 | 10/6 |
| 2N2147 | 17/- |
| 2N2160 | 14/8 |
| 2N2646 | 10/- |



INTEGRATED CIRCUITS

| | | | |
|--|----------------------|------------------|-----|
| Types TO3 10 lead | μ1.800 Buffer or 9/1 | μ1.914 Dual Gate | 9/6 |
| μL923 J-K Flip Flop | 12/6 | | |
| 4-page reprint on IC usage circuits data, etc. | 2/6 | | |

Resistors: 1 Watt 5% Minutary type, low noise - high stability. 10, 15, 15, 22, 27, 33, 39, 47, 56, 68, 82 & decades to 820K. 1-25 paces 4d. 25-99 3d. 100 pieces or over, 2d. each. 10% tolerance. 1 Watt, 1 Meg-8.2 Meg., same price.

Fixed potentiometers. Standard or Sub-miniature types. 20% tolerance. Lin. vertical or horizontal. 100, 250, 500 ohm. 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k. 1 Meg, 2.5 Meg. 5 Meg. All at 1/6d. each. Discounts for quantities over 12 of 1 value.

BARGAINS IN SEMICONDUCTORS ALL TYPES

LST COMPONENTS

7 COPTFOLD ROAD BRENTWOOD ESSEX BRENTWOOD 7904 24 HOUR POSTAL SERVICE

WIRELESS WORLD DIGITAL COMPUTER

Send for our complete part list. Competitive prices for all components. Transistors, Diodes, Resistors, Capacitors, Neons, Veroboard, etc.

FAIRCHILD AF 11 20W SOLID STATE AMPLIFIER KIT £8.8.0d Complete

Includes Printed circuits board, Semiconductors, Resistors, Capacitors, Heat sink and short circuit protection components. S.A.E. for details

FREE CATALOGUE: Please send large S.A.E. (9 1/2 in. x 6 1/2 in. min.).

POST & PACKING 9d. per order EXPORT ENQUIRIES WELCOME

TRANSISTOR MANUALS
R.C.A. 27/6d.
G.E. 29/9d.

RETAIL AND WHOLESALE SUPPLIED.

GUARANTEE: All the above-listed semi-conductor devices are Brand New, First Grade, and guaranteed. We will replace at no charge any device found to be faulty. Further: all devices carry the Manufacturer's name or Trade Mark, type number and batch number. We do not offer for sale devices often described as "new and tested" or bearing re-marked type numbers, these often have a short and unreliable life. L.S.T. COMPONENTS.

Jason KITS

TAPE

We offer you fully featured professional and P.M.S. types of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more pence than available, sub-standard, imitated or cheap imports. **TRY ONE AND PROVE IT YOURSELF.**

| Standard | Long |
|----------------------|------------------------|
| 3in. 150ft. 2/3 | 3in. 250ft. 2/9 |
| 4in. 300ft. 4/6 | 4in. 450ft. 5/6 |
| 5in. 600ft. 7/6 | 5in. 900ft. 10/6 |
| 5 1/2in. 900ft. 10/6 | 5 1/2in. 1,200ft. 13/6 |
| 7in. 1,200ft. 12/6 | 7in. 1,500ft. 18/6 |

| Double | Triple |
|--------------------|------------------------|
| 3in. 300ft. 4/- | 4in. 450ft. 13/6 |
| 4in. 600ft. 8/- | 5in. 1,800ft. 25/6 |
| 5in. 1,200ft. 15/- | 5 1/2in. 2,400ft. 34/6 |
| 7in. 2,400ft. 19/6 | 7in. 3,000ft. 44/6 |

Quaduple 3in. 900ft. 8/6

Post. Free less 5% on three trls. Quality and Trade enquiries invited. **NOTE:** Large tape stocks available.

UNREPEATABLE SNIPS

★ 9 Gns. ★

GARRARD AT6 Mk II 59/-

GARRARD SRP12 (110-230v.) 49/-

COLLARO 9 VOLT 49/-

4 SPE. HEAVY TT. LIGHT ALUM. 47 (P&P)

6 BATTERY LESS CARTRIDGES

Base, Cart. add 12/6

Stereo Cartridge Cart. add 19/6

AUTOCHANGE PORTABLE CABINETS. As used on 18 gus. record players. One to four cassette purchases we offer complete with motor board and all fittings at only 49/-

PLEASE NOTE. A wide range of cabinets in colors at all branches.

100 HI-STABS 9/6
1% to 5% 100Ω to 5 MΩ.

CO-AX low loss, 8d. yd. 25 yds. 13/6. 50 yds. 25/-; BNC; HD fringe 1/6 yd. 25 yds. 30/-

100 RESISTORS 6/6
SIZES 1-3 watt.

MICROPHONE CABLE. Highest quality, black, grey, white. 1/- yd.

100 CONDENSERS 9/6
Miniature Ceramic, Silver, Mica. etc. 500 to 50P. LIST VALUE.

OVER 44.

SILICON H.T. RECTIFIERS

Guaranteed performance. Top makes. Tested 250 v. working. 120 mA (3 for 6/6) 2/9 500 mA (3 for 19/6) 7/6

LATEST GARRARD

(POSTAGE 6/-)

| | |
|-------------------------------|----------|
| SRP12 | £4.78 |
| SP25 (De Luxe Die Cast) | £9.19.0 |
| AT.5 | £5.10.0 |
| Model 50 | £7.10.0 |
| Model 1,000 | £6.5.0 |
| Model 2,000 | £6.10.0 |
| Model 3,000 | £8.10.0 |
| AT60 Mk. II | £11.19.0 |
| A70 | £18.10.0 |
| LAB 90 Mk. II | £24.19.0 |
| 601 | £27.10.0 |
| ER60 Stereo Ceramic Cartridge | 24/- |

PLINTHS

Teak de luxe finish cut out for SR25. Model 50, 1,000, 2,000, 3,000

AT60

Diff. super Perspex clear cover, complete £5.15.0

Lab 90, 401, A70, Superb new hinged lid, teak and Perspex plinth (List £12.00) £9.19.0

BARGAIN PARCELS

Including variable condensers, Lf. coils, loud-speaker plugs/sockets, knobs, pads, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we are now packing them in several sizes - **TRY ONE.**

3 lbs. (post 3/-) 9/-
7 lbs. (post 5/-) 17/6
14 lbs. (post 6/-) 29/-

HEAVY DUTY 14 20 watt AMPLIFIER KITS

Famous hi-fi sounding integrated controls, high-life gate primary stages feeding EL34 Push Pull Output, C core transformers, complete with instructions down to the last bolt. Current model at fraction of list price. 8 1/2 Gns.

Transistorised FM Tuner

Demonstration without obligation at all branches

TRADE QUANTITY QUOTATIONS

Order now!

£6-10

HUGE DEMAND ENABLES PRICE REDUCTION

CALLERS A very wide range of electronic components await you at all branches. Your enquiries welcomed.

TECHNICAL TRADING

All Mail Orders to Brighton please

★ LONDON—10 Tottenham Court Rd. Tel: MUS 2639
★ PORTSMOUTH—350-352 Fratton Rd. Tel: 22034
★ SOUTHAMPTON—72 East St. Tel: 25851
★ WORTHING—132 Montague St. Tel: 25851
★ BRIGHTON—Devonian Court, Park Crescent Place
All Mail Order (24-hour Robophone) Brighton 630722

(Please note Postage extra on all items)

FREE FLOG LIST NO 2

SEND S.A.E. OR CALL AT ANY BRANCH FOR YOURS

Scores Special Bargains

Head Office:

44a WESTBOURNE GROVE, LONDON, W.2.

Tel: PARK 5641/2/3

Cables: ZAERO LONDON

Retail branch (personal callers only)

85 TOTTENHAM COURT RD.,

LONDON W.2. Tel: LANgham 8403

A R.B. Approved for inspection and release of electronic valves, tubes, klystrons, etc.

Please send all enquiries, correspondence and Mail orders to Head Office



BECAUSE OF DEVALUATION AND CONSEQUENT INCREASE IN PURCHASE PRICE WE REGRET WE HAVE TO INTRODUCE A SURCHARGE OF 15% (Approx. 2d in Is. 0d) ON ALL PRICES ON THIS PAGE.

SOME HARD-TO GET-ITEMS IN STOCK

Table with 4 columns of part numbers and prices, including items like 1Z2, 3A3, 6X4, etc.

WHEN ORDERING BY POST PLEASE ADD 2/6 IN £ FOR HANDLING AND POSTAGE. NO C.O.D. ORDERS ACCEPTED. IN ORDER TO AVOID DELAYS PLEASE SEND ALL MAIL ORDERS AND CORRESPONDENCE TO OUR HEAD OFFICE AT 44A WESTBOURNE GROVE, W.2, AND NOT TO THE RETAIL SHOP

FULLY GUARANTEED



VALVES FIRST QUALITY

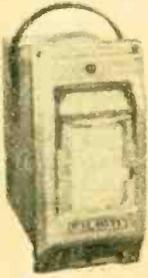
Main table listing various electronic components (valves, tubes) with columns for part numbers, descriptions, and prices. Includes items like 6AB4, 6AK5, 6AR5, etc.

WE REQUIRE URGENTLY: KLYSTRONS 2K25 and 723A/B; VALVES 4C35, 813, 5C22, 845, 810, 30/- EACH PAID SUBJECT TO TEST.

WW-129 FOR FURTHER DETAILS

Z AND AERO SERVICES LTD

PEN RECORDERS



Elliot portable recording milliammeters.
As D.C. recorder: 1 mA. FSD. Movement resistance 1200Ω.
As A.C. current or voltage recorder: Movement resistance at 30 cps. 1900Ω. Sensitivity 1 mA. A.C. FSD.
As decibel meter: source impedance 600Ω. Range 1.5 to 10 dB. Frequency response 50 cps. to 15 kc/s.
Chart drive: 230 v. A.C. at 100 and 60. per hour. Movement is fitted with "high" and "low" alarm contacts which can be set for any value of the current.
Strip chart 3 1/2 in. wide. Cartridge brass. PRICE £40
Packing and carriage 15/-

RECORD PORTABLE RECORDING MILLIAMMETERS

These are similar to the above but are somewhat smaller and lighter, and D.C. resistance of the movement is 400Ω. Other details as above. PRICE £32 10 0
Packing and carriage 15/-
These are also available as decibel meters. Type 19 A.C.T.A. Range +30/- -3 dB Ω with current of 500μA at 0 dB. Movement resistance 1900Ω. PRICE £45 0 0

THYRISTORS

Type 3/40, 400 p.i.v., 3 amps., stud mounted: Gate voltage 3.0 v. at 20 mA 7 6
Line spot, 200 p.i.v., 3 amps., stud mounted: Gate voltage 3.25 v. at 120 mA 12 6
Green spot, 400 p.i.v., otherwise as above 17 6

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS

1020X 10 100 p.i.v. 2 amps., dimensions 1.4 x 1.4 x .6 in. 25/-
1140X 10 100 p.i.v. 4 amps., dimensions 1.4 x 1.4 x .6 in. 30/-
11100M10, 100 p.i.v. 10 amps., dimensions 2 1/2 x 2 1/2 x .6 in. 85/-
Postage 1/8 per rectifier.

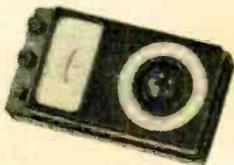
24 WATTS 210-240V. SOLDERING IRONS

Recently imported extremely attractive and sturdy built soldering irons, with angle bite. Chromium plated steel body and polished wooden handle. No Bakelite or breakable plastics used in construction.
Price 16/-
Spare bits 1/3
Spare heating element 3/-
Handling and postage 2/-

HEADPHONES No. 10 ASSY. (OR CANADIAN No. 1 ASSY)

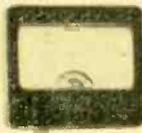
Moving Coil Headphones with moving coil Hand Microphone fitted with press-to-talk switch. Rubber earpads. Cord terminated with army type 5-point moulded connector. Low impedance. Brand new, 20/- ea.
P. & P. 3/6 per set.

SLIDEWIRE WHEATSTONE BRIDGE



Battery Powered Portable Resistance Bridge. Range 0.5 to 50 ohms with multiplier settings of 0.1-1-100-1000, providing a measuring range of 0.05 to 50,000 ohms. Accuracy in the middle 3 ranges—0.5% approx. PRICE £15 15 0

CURRENT PRODUCTION FIRST QUALITY MOVING COIL METERS



1.5% Accuracy
Type 70DA and 70DV. 80 mm. square flange. Flush mounted. 68 mm. dia. body. 40 mm. depth from the panel.
Type 85DA and 85DV. 85 mm. dia. flange. Flush mounted. 67 mm. dia. body. 48 mm. depth from the panel.
Type 120DA and 120DV. 150 mm. square flange. Flush mounted. 68 mm. dia. body. 40 mm. depth from the panel.

| RANGE | 70DA | 85DA | 120DA |
|-------|------|------|-------|
| 40μA | 66/- | 59/- | 82/- |
| 60μA | 62/- | 53/- | 78/- |
| 100μA | 62/- | 49/- | 74/- |
| 150μA | 54/- | 42/- | 65/- |
| 250μA | 52/- | 44/- | 64/- |
| 400μA | 49/- | 36/- | 60/- |
| 600μA | 46/- | — | — |
| 1mA | — | — | 58/- |
| 2.5mA | — | — | 58/- |
| 5mA | 46/- | 34/- | — |
| 10mA | — | — | 58/- |
| 150mA | 46/- | 34/- | — |
| 250mA | 46/- | 34/- | — |
| 400mA | 46/- | — | — |
| 600mA | 46/- | 34/- | — |
| 1A | 46/- | — | 58/- |
| 1.5A | — | — | 58/- |
| 2.5A | 46/- | — | 58/- |
| 4A | — | 35/- | — |
| 10A | — | 35/- | 60/- |
| 40A | — | 39/- | 64/- |

| RANGE | 70DV | 85DV | 120DV |
|-------|------|------|-------|
| 6V | 82/- | — | — |
| 10V | — | 40/- | — |
| 15V | — | — | 62/- |
| 25V | — | 40/- | — |
| 40V | — | 39/- | — |
| 60V | 82/- | — | 62/- |
| 100V | — | — | 62/- |
| 150V | 82/- | 46/- | — |
| 250V | 59/- | 46/- | 65/- |
| 400V | — | 47/6 | — |
| 600V | 59/- | 50/- | 77/- |

ZENER DIODES

| 5% 280 mW | 15% 280mW | 5% 1 Watt |
|------------------|------------------|----------------|
| 0AZ200 4.7V 10/- | 0AZ208 4.3V 6/6 | 22A240F 2.4V |
| 0AZ201 5.1V 9/6 | 0AZ209 4.7V 6/6 | 22A270F 2.7V |
| 0AZ202 5.6V 7/- | 0AZ210 6.2V 9/- | 22A300F 3.0V |
| 0AZ203 6.2V 7/- | 0AZ211 7.5V 6/6 | 22A360F 3.6V |
| 0AZ204 6.8V 7/- | 0AZ212 11.0V 6/6 | 22A1000F 10.0V |
| 0AZ205 7.5V 7/- | 0AZ213 12.0V 6/6 | 22A2000F 20.0V |
| 0AZ206 8.2V 7/- | | All at 5/6. |
| 0AZ207 9.1V 6/6 | | |

5% 10-WATT STUD MOUNTED

Z4.7v.; Z5.1v.; Z6.6v.; Z8.2v.; Z9.6v.; Z11.0v.; Z12.0v.; Z15v.; Z16v.; Z18v.; Z20v.; Z24v.; Z27v.; Z30v.; Z36v.; Z45v.; Z47v.; all at 7/6.

DRY REED INSERTS

Glass dry reed inserts approx. 4in. dia. x 1in. long with axial leads. One "make" contact of 100mA capacity at 50V. Can be operated by permanent magnet or 30-50 Amp-turns relay coils. PRICE 18/- per doz. post free.

BEEHIVE TRIMMERS

30pF and 50pF. 15/- per dozen, in any combination. 2/- P.P.

MICROWAVE DIODES

Cartridge Type
3000 mc/s.: 1N21, 4/-; 1N210, 6/-; 1N28, 20/-; 6,000 mc/s.: C82A, 5/-; CV101, 5/-; CV102, 5/-; CV201, 12/-; 9,375 mc/s.: 1N21, 4/-; 1N28A, 4/-; 1N23B, 6/-; 1N29C, 8/-; 1N29E, 20/-; 1N29WE, 100/-; C810B, 70/-; 10,000 mc/s.: C83A (CV253), 20/-; 12,000 mc/s.: C83B, 17/6; C84B, 37/6; C801B, 30/-; C810B, 70/-; CV111, 8/-; CV112, 8/-; CV226, 70/-; CV227, 85/-; CV235, 200/-; B132 (CV2154), 37/6; B130 (CV2155), 37/6; 34,950 mc/s.: V X3136 (CV2391), 65/-.

AVALANCHE SILICON RECTIFIERS

Type BANGORAF, 900 p.i.v. at 6 amps. max. stud mounted 10 6

CATHODE RAY TUBES

2A7P—2in. screen, Green Trace Medium Persistence Oscilloscope Tube. EHT required 500 to 1000V. Sensitivity approx. 100V. DC/in to 200V. DC/in. 6.3v. heaters. U8A11 Base. Overall length 7 1/2 in. PRICE 40/-
3A9P31—D117-91—2 1/2 in. screen Flat Face Green Trace Medium Persistence Oscilloscope Tube. EHT required 1500 to 2000V. Sensitivity approx. 700-1000V. Suitable for symmetrical and asymmetrical operation. Sensitivity Y = 30V. DC/in; X = 30V. DC/in. 6.3v. heaters. B9C Base. Overall length 10 in. PRICE 110/-
3BP1—3in. screen Green Trace Medium Persistence Oscilloscope Tube. EHT required 1500 to 2000V. Sensitivity approx. 100-150V. DC/in. at 1500V. and 150-200V. DC/in. at 2000V. 6.3v. heaters. B14A base. Overall length 10 1/2 in. PRICE 55/-
48P31—4in. screen Flat Face Green Trace Medium Persistence TWIN GUN Oscilloscope Tube. EHT required 1000 to 1800V. Sensitivity Y = 26V. DC/in; X = 40V. DC/in. 6.3v. heaters. B12F Base. Overall length 12 in. PRICE 100/-

Please consult our Catalogue for full range of Cathode Ray Tubes.



VALVES FOR EXPORT

Here are a few examples from our stock of over 2,500 items.

| | | | | | | | |
|-------|------|-------|------|-----------|-------|--------|------|
| 0A2 | 3/- | 2D21 | 3/11 | 6B40 | 12/6 | 68N70T | 3/2 |
| 0A3 | 5/9 | 2E26 | 18/4 | 6CV5-1311 | 6V6GT | 3/2 | |
| 0B2 | 3/6 | 3CA5 | 4/6 | 8CW4 | 8/9 | 810A | 30/8 |
| 0C2 | 14/4 | 3V4 | 3/2 | 6B84 | 8/2 | 811A | 28/9 |
| 0C3 | 4/7 | 5U4GB | 3/11 | 6J4 | 8/1 | 388A | 23/- |
| 0D3 | 4/4 | 5Y3GT | 3/6 | 6J50T | 3/6 | 399A | 23/- |
| 188GT | 3/6 | 5Z4GT | 4/4 | 6J7 | 5/2 | 807 | 6/4 |
| 1L4 | 2/6 | 6AK5 | 3/6 | 6J80C | 4/11 | 811A | 34/6 |
| 1V2 | 3/9 | 6AL5 | 1/9 | 6N7GT | 4/4 | 813A | 70/- |
| 1Z2 | 20/2 | 6AQ5 | 2/8 | 68L7GT | 3/9 | 829B | 58/- |

THE ABOVE PRICES ARE FOR DIRECT EXPORT, I.E. FOR DELIVERY TO OVERSEAS ADDRESSES. OR TO THE SUPPLIERS. FOR VALVES TYPE MARKED AND BULK PACKED, IN LOTS OF 100 PER TYPE.

FULL EXPORT PRICE LIST AVAILABLE ON REQUEST

OUR NEW 1967/68 VALVE CATALOGUE AND PRICE LIST IS NOW READY. IT CONTAINS FULL REFERENCE DATA ON SEMI-CONDUCTORS, CATHODE RAY TUBES, ETC. Please send s.a.c. (quarto).

R.S.T. VALVE MAIL ORDER CO.

146 WELLFIELD ROAD, STREATHAM, S.W.16

| | | | | | |
|--------------|------------|-------------|------------|------------|------------|
| AZ31 9/- | EY51 7/- | Q8150/30 | 8A05 5/8 | 85A2 7/3 | OC24 15/- |
| C1C 12/- | EY81 8/6 | Q8150/36 | 8A86 6/- | 90A3 45/- | OC25 11/- |
| CHL31 15/- | EY83 8/6 | Q8150/40 | 6A87 15/- | 90AV 45/- | OC26 7/6 |
| CU135 21/- | EY88 7/6 | Q8150/45 | 6AT6 4/- | 90C1 12/- | OC28 16/- |
| DAF91 4/- | EY88 6/6 | Q8150/50 | 6B40 16/- | 90C2 25/- | OC29 15/- |
| DAF96 6/3 | EZ41 8/- | Q8150/55 | 6BA6 4/6 | 90CV 25/- | OC35 11/6 |
| DC730 7/- | EZ80 5/- | Q8150/60 | 8HE5 4/6 | 150H9 9/6 | OC44 4/6 |
| DT91 3/- | EZ81 5/- | Q8150/65 | 8HE6 7/- | 150H13 8/- | OC45 4/- |
| DT96 6/3 | GT1C 17/6 | Q81209 7/3 | 6H16 7/- | 201 6/- | OT 71 4/6 |
| DI13 91 85/- | EZ30 10/- | QV03-12 | 6BK4 27/8 | 803 35/- | OC72 6/- |
| DK91 5/- | EZ32 9/6 | QV03-15 | 6BN6 7/8 | 807 7/- | OC74 6/- |
| DK92 8/- | EZ34 10/- | QV04-7 12/6 | 6BQ7A 7/- | 811 30/- | OC75 6/- |
| DK95 7/- | EZ37 12/6 | QV05-25 7/- | 6B17 8/6 | 813 25/- | OC76 6/- |
| DI145 15/- | EZ38 8/- | QV06-20 7/- | 6C100 20/- | 864A 13/8 | OC77 6/- |
| DL92 4/6 | HL1ADD | QV06-25 7/- | 6BW6 7/- | 872A 52/8 | OC78 6/- |
| DL94 5/9 | | R10 15/- | 6BW7 9/8 | 5651 7/8 | OC81 4/- |
| DL96 7/- | KT61 12/6 | R17 8/- | 6C4 2/9 | 5654 8/- | OC81D 4/- |
| DL10 12/6 | KT66 16/- | R18 7/6 | 6CB6 5/- | 5672 7/- | OC81M 5/8 |
| DL116 30/- | KT67 45/- | R19 7/- | 6CDB0 20/- | 5687 10/- | OC81DM 6/- |
| DL1819 30/8 | KT81 (C5) | RG5/500 | 6CH6 5/9 | 5691 25/- | OC81DM 6/- |
| DL170 5/- | KT81 (DEC) | S130 25/- | 6CL6 8/6 | 5749 10/- | OC82 6/- |
| EY86 6/- | KT81 (DEC) | S130 25/- | 6CW4 10/- | 5763 10/- | OC82D 6/- |
| EY87 6/- | KT88 27/6 | S141 3/6 | 6D4 15/- | 5842 65/- | OC83 6/- |
| EY88 6/- | KTW61 10/- | S141 3/6 | 6DK6 9/- | 5963 10/- | OC83 5/- |
| EY89 6/- | KTW62 10/- | STV280/40 | 6E23 13/8 | 6067 10/- | OC170 5/- |
| EY90 6/- | KTW62 10/- | STV280/40 | 6J34 2/6 | 6058 10/- | OC171 8/- |
| EY91 3/- | KTW62 10/- | STV280/40 | 6J6 3/- | 6059 18/- | OC200 7/8 |
| EY92 3/- | KTW62 10/- | STV280/40 | 6J70 4/9 | 6060 6/- | OC642 3/6 |
| EY93 3/- | KTW62 10/- | STV280/40 | 6K70 1/8 | 6061 12/- | XA101 3/6 |
| EY94 3/- | KTW62 10/- | STV280/40 | 6K80 2/- | 6062 14/- | XA111 3/6 |
| EY95 3/- | KTW62 10/- | STV280/40 | 6L60 7/- | 6063 7/- | XA112 4/6 |
| EY96 3/- | KTW62 10/- | STV280/40 | 6Q70 6/- | 6064 7/- | XA125 5/- |
| EY97 3/- | KTW62 10/- | STV280/40 | 6G77 5/- | 6065 9/- | XA141 7/- |
| EY98 3/- | KTW62 10/- | STV280/40 | 6H73 5/- | 6067 10/- | XA142 7/- |
| EY99 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY00 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY01 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY02 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY03 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY04 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY05 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY06 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY07 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY08 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY09 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY10 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY11 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY12 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY13 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY14 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY15 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY16 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY17 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY18 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY19 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY20 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY21 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY22 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY23 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY24 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY25 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY26 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY27 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY28 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY29 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY30 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY31 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY32 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY33 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY34 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY35 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY36 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY37 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY38 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY39 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY40 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY41 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY42 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY43 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY44 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY45 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY46 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY47 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY48 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY49 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY50 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY51 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY52 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY53 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY54 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY55 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY56 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY57 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY58 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY59 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY60 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY61 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY62 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY63 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY64 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY65 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY66 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY67 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY68 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY69 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY70 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY71 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY72 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY73 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY74 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY75 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY76 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY77 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY78 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY79 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY80 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY81 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY82 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY83 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY84 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY85 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY86 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY87 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY88 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY89 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY90 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY91 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY92 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY93 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY94 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY95 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY96 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY97 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY98 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY99 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |
| EY00 3/- | KTW62 10/- | STV280/40 | 6H73T 4/8 | 6090 25/- | XA143 8/- |

All valves brand new and boxed
 Special 24 Hour Express Mail Order Service
 Postage 6d. per Valve
 Mon.-Sat. 9 a.m.-5.45 p.m.
 Closed Sat. 1.30-2.30 p.m.
 Open Daily to Callers
 Tel. 01-769 0199/1649

CLASSIFIED ADVERTISEMENTS

DISPLAYED SITUATIONS VACANT AND WANTED: £5 5s per single col. inch.
LINE advertisements (run-on): 6/- per line (approx. 7 words), minimum two lines.
 Where an advertisement includes a box number (count as 2 words) there is an additional charge of 1/-.
SERIES DISCOUNT: 15% is allowed on orders for twelve monthly insertions provided a contract is placed in advance.
BOX NUMBERS: Replies should be addressed to the Box number in the advertisement, c/o Wireless World, Dorset House, Stamford Street, London, S.E.1.
 No responsibility accepted for errors.

Advertisements accepted up to **JANUARY 5** for the **FEBRUARY** issue, subject to space being available.

SITUATIONS VACANT

AN OVERSEAS CAREER with International Aeradio Limited.

TO meet the requirements of constant growth and expansion, we invite applications from technicians and engineers for an overseas career in North, West and East Africa, the Mediterranean area and the Arabian Gulf. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F., Radio Electrical Artificers in the Royal Navy or R.E.M.E. Army, or have other experience in the maintenance of H.F. and V.H.F. communications, R.T.T. and navigation aids, we should be interested to hear from you. Successful candidates would normally spend six weeks at our Radio Engineering School, Southall, Middlesex, before proceeding overseas, but in some cases staff with suitable qualifications and experience may be offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation. Bachelor or married is provided free; other benefits include generous U.K. leave and membership of an excellent pension and life assurance schemes.

Interested applicants, please, to Personnel Manager, WRITTEN applications, please, to Personnel Manager, International Aeradio Limited, Aeradio House, Hayes, 119 Rd., Southall, Middlesex.

EXPERIENCED Cinema Sound Engineer required for service and installation; good salary and conditions.—Box W.W. 1926. Wireless World.

EXPERIENCED enthusiasts required, London, W.1 for tape editing, mobile work, evenings, weekends, state experience and salary expected.—Box W.W. 1941. Wireless World.

TRAINED engineers required for interesting work on radio radar equipments at a flying unit in North Wales.—Apply: Short Bros. & Harland, Ltd., R.A.E. Llanberis, Merioneth, N. Wales. 162

RADIO Engineer/Mechanic, first-class communications work, required by large company engineers, 12 ms. service overseas, excellent opportunity.—Write age, experience. Box W.W. 1909. Wireless World.

A FULL-TIME technical experienced salesman required for retail sales; write giving details of age, previous experience, salary required to: The Manager, Henry's Radio, Ltd., 305, Edgware Rd., London, W.2. 167

HEARING aids (transistor) service engineer with view eventually to control small service and despatch dept., London area. Good salary and prospects for right man. Apply with details.—Box W.W. 69392. Wireless World.

TV Service Engineer and Trainee for London retail business of the highest standing; estd. over 40 years; good position and prospects for suitable applicants with high standards of service; state age and details of experience.—Box W.W. 73. Wireless World.

WEST London Aero Club invite "A" and "B" licensed engineers with capital and/or necessary equipment to commence Radio Workshop. Alternative propositions may be considered. Write full details to—Write, Waltham Airfield, near Maidenhead, Berks. 168

TEST Engineers, Micro Equipment. Several posts are vacant for intelligent persons in vigorous, young, expanding company. Salary range £750 to £1,200.—Full details education and experience to Research Officer, Flann Microwave Instruments Ltd., 9, Old Bridge St., Kingston-upon-Thames, Surrey. 1901

WORLD-WIDE News and Newspicture agency requires competent, versatile **TELECOMMUNICATIONS ENGINEERS** for extremely interesting work in Lincoln, Europe, Middle East and Africa. Applicants must have a sound knowledge of Radio/Electronics and general principles of line/radio telegraphy/telephony.—Apply in writing, giving all details of past experience, present salary, languages spoken, etc., to Mr. D. Till, Director of Communications, United Press International, 8, Bouverie St., E.C.3. 1937

WEST Sussex County Education Committee, Worthing College of Further Education, Broadwater Rd., Worthing, Sussex. Applications are invited for the post of **ELECTRICAL LABORATORY TECHNICIAN** to maintain and construct electronic equipment. Salary Scale N.J.C. T.3.—£960-£1,020 per annum. Commencing salary according to age and experience. Additional remuneration payable in respect of certain specialist qualifications. Superannuable post.—Application form obtainable from the Principal. 1935

NORTH-EAST ESSEX TECHNICAL COLLEGE, Shepven Rd., Colchester, Essex, Department of Electrical Engineering. An Assistant Lecturer, Grade B, in either Applied Electronic or Telecommunications is required. Applicants should have industrial and/or teaching experience, together with appropriate qualifications. Salary scale: £955-£1,625 p.a. plus degree allowance. Assistance with removal expenses may be given.—Application forms and further particulars are available from the Principal to be returned within 14 days of the appearance of this advertisement. 1934



The Civil Service

Professional and Technical appointments

RADIO AND ELECTRONIC ENGINEERS BOARD OF TRADE (CIVIL AVIATION)

Qualified engineers required as Assistant Signals Officers in the field of Civil Aviation for the provision and installation of advanced electronic equipment—including the latest type of radar, telecommunications, navigational aids, etc.

QUALIFICATIONS: Degree with 1st or 2nd class honours in Electrical Engineering or Physics, or have passed all examinations for M.I.E.E., A.M.I.E.R.E. or A.F.R.Ae.S.

AGE: 23 and normally under 35 on 31st December 1967 (extension for Forces and Overseas Civil Service).

SALARY (Inner London): £1,110-£2,052 depending on age and qualifications. Good prospects of promotion.

Pensionable appointments.
 (Reference S 85 ASO)

EXECUTIVE ENGINEERS AND ASSISTANT EXECUTIVE ENGINEERS POST OFFICE

Applications are invited for posts as **EXECUTIVE ENGINEERS** and **ASSISTANT EXECUTIVE ENGINEERS** in London and provinces for work on the development and design of communications systems and postal service equipment.

QUALIFICATIONS: Executive Engineers: Degree in Mechanical or Electrical Engineering, or Physics or Applied Physics, or have achieved Corporate Membership of the I.E.E., I.Mech.E., or I.E.R.E. Final year students may apply.

Assistant Executive Engineers: G.C.E. (or equivalent) pass in English language, and one of the following: H.N.D., in Electrical or Mechanical Engineering or Applied Physics; a pass in (or exemption from) Parts 1, 2 and 3 of the examinations of I.E.E., or I.Mech.E.; a pass in (or exemption from) Sections A and B of the I.E.R.E. examinations; a pass in (or exemption from) Parts 1 and 2 of the examination of the Council of Engineering Institutions, in subjects acceptable to one of the Institutions named above.

SALARIES (national): **Executive Engineer:** £906 (at 21)—£1,677 (at 34 or over)—£1,884. **Assistant Executive Engineer:** £734 (at 18 or under)—£1,097 (at 25 or over)—£1,631. Salaries increased for officers serving in London. Non-contributory pension. Promotion prospects.

AGE: Executive Engineer: At least 21 and under 35 on 31st December 1967. Some extensions for service in H.M. Forces or Overseas Civil Service. Assistant Executive Engineer: At least 17½ and under 27 on 31st December 1967.

Applications for both posts from well qualified older candidates will be considered.
 (Reference: S 353)

APPLICATION FORMS are obtainable from the Secretary, Civil Service Commission, Savile Row, London, W.1. Please quote appropriate reference.

 ★ **ELECTRONIC DESIGN & DEVELOPMENT ENGINEERS (ALL GRADES) SALARIES UP TO £2,800 P.A.** ★
 ★ **ELECTRONIC TEST & SERVICE ENGINEERS (ALL GRADES) SALARIES UP TO £1,600 p.a.** ★
 ★ **TECHNICAL SALES ENGINEERS (EXPERIENCED) SALARIES UP TO £2,500 p.a.** ★
 ★ **TECHNICAL AUTHORS (ALL GRADES) SALARIES UP TO £1,800 p.a.** ★
 ★ **ALSO** ★
 ★ **DRAUGHTSMEN, PRODUCTION ENGINEERS** ★
 ★ We have over 500 registered vacancies for above types of engineers in the Home Counties and South England ★
 ★ areas. If you have had at least 2 years' experience in British industry and require a job which offers first class ★
 ★ prospects, top salaries and interesting work. ★
 ★ Phone (any time day or night) or write to:— ★
 ★ **ELECTRONICS APPOINTMENTS LTD.,** ★
 ★ **Norman House,** ★
 ★ **105-109, Strand, W.C.2.** ★
 ★ **TEMPle Bar 5557-8.** ★
 ★*****



PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT

Careers for VIDEO ENGINEERS

COLOUR AND MONOCHROME

Service and Commissioning Engineers

CROYDON AREA

Additional engineers are required with thorough knowledge of professional television equipment for studio and industrial applications, Video recording and some knowledge of colour television techniques. Training in the last two fields can be arranged.

Electronic Test Engineers

WEYBRIDGE AREA

For work on colour equipment we seek services of experienced Video Engineers. Thorough understanding of transistorised pulse circuitry is essential.

Conditions of employment are attractive.

Apply in confidence to Plant Personnel Officer,

**Peto Scott Limited,
Addlestone Road,
Weybridge, Surrey.
Tel: Weybridge 45511.**

PETO SCOTT
sound and vision

Engineers! Join a Promotion-winning Team now

Gearing for 1968's big expansion programme of the Micro Switch and Meter Division has meant rapid promotion for many Honeywell engineers ... and has created some gold-plated opportunities for newcomers to our sales teams. Attractive positions exist in the London, Manchester and Birmingham areas, so if you are keen, qualified and looking for the rewards that match your talents read on:

Senior Outside Sales Engineers

If you have about three years selling experience, preferably in the Electro-mechanical or Electronic field, backed by an H.N.C. or equivalent you can now gain your full reward. Become an Outside Sales Engineer with our successful London or Birmingham Sales Force.

Senior Engineer

This is a key position and the successful occupant will be treated accordingly. He will be a qualified Engineer with experience in the design and/or application of Industrial Sequence Controls, including Solid State Devices. As Senior Engineer he will assist the Product manager and be responsible for planning new products with liaison between Sales and Factory from concept to manufacture. This London Head Office based position is permanent, pensionable and the successful applicant will be given assistance with relocation costs if necessary.

Outside Sales Engineers

We also need Sales Engineers in London, Birmingham, and Manchester and YOU can join one of these promotion-winning teams if you have around a year's selling experience plus an O.N.C. qualification or its equivalent. Honeywell recognise and reward ambition and such men whose outside experience may be limited, will still be strongly considered for these appointments.

Sales Engineers

Inside Sales Engineers are also wanted in London, Birmingham and Manchester, preferably with O.N.C. or its equivalent. These positions are ideal for the ambitious young man seeking a career in sales.

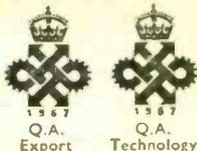
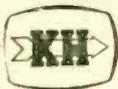
All positions offered carry attractive salaries and fringe benefits, and the promotion door at Honeywell is always open. You will also enjoy the prestige of working for one of the world's leading and pace-setting companies in the micro switch field.

Apply now, giving position, career details and work area preferred to:—

Employment Supervisor, Honeywell Controls Limited,
Great West Road, Brentford, Middlesex.

OR TELEPHONE 01-568 9191 EXT. 352
FOR IMMEDIATE DISCUSSION ON YOUR FUTURE

Honeywell



MARINE SERVICE ENGINEERS

We have vacancies in our Newcastle depot for Service Engineers. Applicants must have experience of Marine Radar and have had M.O.T. Radar Course and hold a first class P.M.G. or be able to demonstrate that they have at least equivalent knowledge and experience.

Apply to:

MR. N. M. PRESTON
SERVICE MANAGER

KELVIN HUGHES

A DIVISION OF SMITHS INDUSTRIES LIMITED

New North Road, Hainault, Ilford, Essex

Telephone: 01-500 1020

LDEP

industrial automation

TEST ENGINEERS

Several vacancies arise for engineers who wish to be engaged in testing a wide range of valve and semi-conductor industrial control equipment, including digital systems. A working knowledge of electrical/electronic circuitry is essential.

These are interesting permanent staff situations, and the salary paid will be commensurate with ability and experience.

The Company is situated in rural surroundings, and yet is close to several large towns. Housing is available at very moderate prices.

Applications for the above positions, stating age, qualifications and previous relevant experience, should be addressed to:—

Personnel Manager,

L.D.E.P. Ltd. Industrial Automation
RUGELEY, Staffs.



How to switch

from a good career in engineering to a better one servicing computers

To become a successful IBM Data Processing Customer Engineer, you need more than engineering qualifications. You need to be able to talk confidently and well to any level of customer management, and to have a pleasing personality in your work. As a DPCE, you work in direct contact with your customers, on some of the world's most advanced data processing equipment.

You must have a sound electronic and electro-mechanical background, such as ONC/HNC Electronic or Electrical, or Radar/Radio/Instrument Fitters course in the armed services.

You will get thorough training on data processing equipment throughout your career. Starting salaries depend on experience and aptitude, but will not be less than £1,100 a year. Salary increases are on merit—within 3 years you could be earning £1,750. Drive and initiative are always well rewarded at IBM; promotions are made on merit and from within the company.

If you are between 21 and 31, and would like this chance to become part of a rapidly expanding and exciting computer industry, write to IBM.

Send details of training, experience and age to Mr. D. Dennis, IBM United Kingdom Limited, 389 Chiswick High Road, London, W4, quoting reference DP/WW/2.9.

IBM

Government of UGANDA REQUIRES TELECOMMUNICATIONS ENGINEERS

for the Ministry of Internal Affairs, on contract for one tour of 21-27 months in the first instance. Salary, according to age and experience in the scale £1,347-£2,205 a year. Included is an allowance, normally TAX FREE, ranging from £600-£816 a year which will be paid by the British Government direct to an officer's bank account in Uganda. Gratuity 25% of total emoluments. Educational allowances. Uniform allowance £25 a year. Liberal leave on full salary. Accommodation provided at reasonable rental or hotel allowance in lieu. Contributory pension scheme available in certain circumstances.

Candidates, who will serve as Superintendents/Assistant Superintendents of Police (Radio), must possess a City and Guilds Final Certificate Course 49 or equivalent qualification with at least 6 years practical experience including installation and maintenance of fixed and mobile V.H.F. equipment (A.M. and F.M.); H.F. medium and low power S.S.B. and D.S.B. transmitters and receivers; Radio teleprinter equipment; Small diesel and petrol electric generating plants. Duties will include the supervision and instruction of local maintenance staff under training.

Apply to **CROWN AGENTS, M. Dept., 4 Millbank, London, S.W.1** for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M3D 62331 W1.

ST. BARTHOLOMEW'S HOSPITAL, LONDON, E.C.1.
An ELECTRONIC ENGINEER OR PHYSICIST is required to take charge of high voltage machines used for radiotherapy. These comprise a 15 MeV continuously evacuated electron accelerator and a 6 MeV Linear Accelerator operating basically on solid state units. For the successful applicant there will also be an opportunity to collaborate on research work. Applicants must have a degree. The salary will either be on the scale £855 to £1,658 or £1,833-£2,276 per annum according to qualifications and experience, plus £75 London Weighting. Applications should be sent to the Clerk to the Governors quoting ref. no. ASC 1271. 1936

FIELD SERVICE ENGINEER FOR PUBLIC EQUIPMENT AND AUDIO AMPLIFICATION EQUIPMENT

Covering London and Southern Counties. Experience Essential. Good Salary. Expense Allowance. Company Vehicle or Vehicle Allowance provided.

Write:

SERVICE MANAGER, MAGNETA (B.V.C.) LTD.,
Parsons Green Lane, London, S.W.6.

NEWCASTLE GENERAL HOSPITAL (1,060 beds), 2
Medical Physics Technicians Grade III (specialising in electronics) required for the Regional Neurological Centre to work in electronics laboratory on design and development of apparatus concerned with neurology and neurosurgery. There is considerable scope for initiative and the successful candidates will be expected to hold H.N.C. qualification, although consideration will be given to those with O.N.C. and experience in a similar field. Whitley Council conditions of service. Salary scale £980-£1,300.—Applications, with names and addresses of two referees, to Hospital Secretary, Newcastle General Hospital, Newcastle upon Tyne NE4 6BE, within two weeks. 1933

A NEW YEAR WITH NEW OPPORTUNITIES

MICROWAVE ASSOCIATES LIMITED

We are a young expanding Company in the field of Microwave generation, detection and control. During the last twelve months work has been carried out on many interesting projects in the radar and communications field including the development of all solid state microwave television links and of solid state switches for use in aircraft systems as well as much progress work on microwave sources.

Our Company continues to grow and if you are interested in joining a progressive team, we have the following vacancies:

COMMUNICATION ENGINEERS MICROWAVE SYSTEMS ENGINEERS TEST ENGINEERS
TECHNICIANS TECHNICAL ASSISTANTS

If you are interested in these vacancies or would like to join us in a capacity not mentioned please apply in writing, stating name, experience, qualifications, age and current salary, quoting reference A26 to:

**R. R. Williams, Personnel Manager,
Microwave Associates Limited,
Cradock Road, Luton, Beds.**

All applications treated in strictest confidence.

Research in Opto-Electronics

We are still building our team for work in Modern Optics, and need an experienced

Electronics Engineer

with enthusiasm for new fields of engineering. His chief duty will be to study applications of the basic research now in hand on pattern recognition and other optical information processing.

Please write to:—

**The Personnel Manager (Ref. 46),
Hawker Siddeley Dynamics Ltd.,
HATFIELD,
Herts.**



ROYAL HOLLOWAY COLLEGE

(University of London)

Englefield Green, Surrey.

SENIOR ELECTRONICS TECHNICIAN

required to assist with design and construction of equipment used in advanced teaching and research. This appointment offers the opportunity for a wide range of interesting and non-repetitive work. Salary on the scale £912-£1,150 plus qualifications allowance and London weighting. 37½-hour week. Four weeks holiday. Applications should be sent to the Secretary.

Ferranti IN SCOTLAND PUBLICATIONS GROUP

Publications Engineers

Vacancies exist, to be filled from the beginning of February 1968 for Technical Authors (Electronic), of grades up to experienced Seniors, for the preparation of technical publications covering design, operation and maintenance of the Company's entire range of products. Our Technical Publications Group is housed in pleasing surroundings on the south bank of the River Forth and claims to be the largest Group of its kind in the Electronics Industry in Britain. The Group is backed by a comprehensive publishing section.

Anyone (male or female) with an electronic background in airborne radars, ground radars, air navigational equipments or machine tool control, with the ability to write in a simple and concise manner will be given the opportunity of training in publications technology. All posts carry attractive salaries and conditions, together with the benefit of living in one of the more pleasant cities in the U.K.

Edinburgh is a city which caters for leisure time and is ideally situated as a centre for Summer Touring and Winter Sports. It abounds in facilities for rugby, football, golf, cricket, badminton, skating, sailing, etc., and has a ski slope and racing circuits on its outskirts. Theatres, Concert Halls and Eating Houses cater for all tastes, summer and winter. Such amenities are provided at a fraction of their cost compared with other cities—AND transport is no problem.

Interviews can be arranged in Edinburgh, London and Manchester, to suit.

Apply with details of career to
Staff Appointments Officer, Ferranti Ltd.,
Ferry Road, Edinburgh 5.



Computer Engineers

Due to continued expansion NCR require additional **ELECTRONIC** and **ELECTRO-MECHANICAL ENGINEERS** for Computer Maintenance. Posts are available for men wishing to become Site Engineers. Training Courses are arranged for suitably qualified men. H.N.C. Electronics, City & Guilds Final or equivalent standard required. Men from Forces with radar experience welcome. Knowledge of electronic or electro-mechanical equipment necessary. Good Pension and Bonus Plan in operation. Please write for Application Form to The Personnel Officer. NCR, 1000 North Circular Road, London, NW2, quoting Publication and month of issue.

Plan your future with

ELECTRONIC MAINTENANCE ENGINEERS

There are excellent opportunities in the Installation and Maintenance Division of E.M.I. Electronics Ltd., for engineers to carry out maintenance work on a wide variety of electronic equipment, including laboratory test gear, tape recorders, broadcast and studio T.V. equipment, and electronic automation equipment.

Candidates should be between 21 and 45, have had at least three years' experience of this type of work, and be willing to travel.

Good commencing salaries will be paid, and staff conditions include a contributory pension scheme and free life assurance. Grants towards re-location expenses will be made in suitable cases.

EMICAREERS



Applications, giving concise personal/career details to:
P. JONES · GROUP PERSONNEL DEPARTMENT · E.M.I. LTD
BLYTH RD · HAYES · MIDDLESEX · TEL: 01-573-3888 · EXT: 411

World wide News and News Picture Agency requires competent versatile

TELECOMMUNICATIONS ENGINEERS

for extremely interesting work in London, Europe, Middle East and Africa.

Applicants must have a sound knowledge of Radio/Electronics and general principles of Line/Radio Telegraphy/Telephony.

Apply in writing giving all details of past experience, present salary, languages spoken, etc., to:

Mr. D. Till,

Director of Communications,

UNITED PRESS INTERNATIONAL,
8 Bouverie Street, E.C.4.

UNIVERSITY OF LONDON Goldsmiths' College, New Cross, London, S.E.14. Applications are invited for the post of Technician in Audio-visual Aids. The work will be with an expanding unit and opportunities will exist for an interesting and progressive career. Applicants must be suitably qualified with experience in radio and tape-recorder servicing. Experience in CCTV and Film Projection equipment an advantage. Salary range: £715-£1,215 p.a. according to age and ability.—For further particulars write to the Registrar. [1951]

SIGNALS Command Air Radio Laboratories Ministry of Defence (A/R), R.A.F. Watton, TheWard, Norfolk. Telecommunications Engineers (2 posts graded S.S.O./S.O.) to work on the design and development of aerials, receiving and analysis equipment for the V.H.F., U.H.F., and S.H.F. frequency bands used in aircraft. Involves original laboratory work and some supervision of development contracts. A knowledge of solid state techniques an advantage. Qualifications: 1st or 2nd class honours degree or equivalent or higher qualification in appropriate subject and, for S.S.O., at least 3 years' post-graduate experience. Salary: S.O. £926-£1,574, S.S.O. (minimum age 26) £1,744-£2,155. Prospects of permanent pensionable appointments.—Application forms from Ministry of Defence, CE2 (A/R), Sentinel House, Southampton Row, London, W.C.1. [1950]

GATESHEAD & DISTRICT HOSPITAL MANAGEMENT COMMITTEE

SENIOR ELECTRONIC TECHNICIAN

Applications are invited for the above post, to carry out duties in the Gateshead district, N.W. Durham, Hexham district and Prudhoe groups of hospitals. Qualifications should preferably include the H.N.C. (Electronics or Light Current Electrical Engineering) or City & Guilds Telecommunications Engineering Certificate, or of similar academic level. The person to be appointed should have wide experience in the electronic field including telecommunication radio frequency transmission and reception, audio frequency systems, domestic and public entertainment, pulse generation, automatic control systems, and electro-medical apparatus. Hospital experience would be an advantage.

The Technician will be based at Gateshead and be responsible to the Group Engineer, Gateshead & District H.M.C. for organising a system of routine maintenance covering a wide variety of electronic equipment. National Health Service conditions of service. Salary within the scale £980-£1,300 p.a.

Applications, giving full details of age, education, experience, qualifications and present salary, together with names and addresses of three referees, should be sent to the Group Secretary, Gateshead & District Hospital Management Committee, Queen Elizabeth Hospital, Sheriff Hill, Gateshead, Co. Durham. NE9 6SU.

THE Royal Free Hospital requires an Electronics Engineer. The successful candidate will be part of a team of electronics engineers but will have special responsibility for the maintenance and modification of electronic diagnostic apparatus including electro-physiological and data processing equipment in the Department of Psychological Medicine at the Lawn Road Branch, where there are first-class computing facilities including a small on-line installation. Experience with either biological or pulse techniques would be an advantage but is not essential and the Department is prepared to consider a recent graduate or someone of comparable ability still in training and interested in the fields of medical automation, computer programming or electrophysiology. Detailed applications stating age, qualifications and experience to the Administrator, The Royal Free Hospital, Gray's Inn Rd., London, W.C.1. [1952]

SITUATIONS WANTED

MERCHANT NAVY Radio Officer seeks shore employment as Service Engineer willing to train for near position.—Please write Box W.W. 71. Wireless World.

BOOKS, INSTRUCTIONS, ETC.

MANUALS, circuits of all British ex-W.D. 1939-45 wireless equipment and instruments from original R.E.M.E. instructions: s.a.s. for list over 70 types.—W. H. Bailey, 167a, Moffat Road, Thornton Heath, Surrey. CR4-8PZ. 166

UNIVERSITY OF NEWCASTLE UPON TYNE

A technician is required for closed circuit television maintenance work in this expanding service. The duties will include routine servicing of a variety of television cameras, monitors and associated equipment, and service with a small mobile unit. Some new construction will be involved. Applicants must have a thorough knowledge of basic electronics; an understanding of optics and audio equipment will be an advantage.

The commencing salary will, for an appointee with appropriate qualifications, be at a suitable point on the University's full scale for Technicians (£683-£968 p.a.) and a supplementary allowance of £50 per annum will be paid to the holder of approved higher qualifications.

Applications, giving full details of age, education, qualifications, and experience, should be sent as soon as possible to the Director, Department of Photography, The University, Newcastle upon Tyne, 1.

Applicants should state when they will be available for interview.

OUTSTANDING OPPORTUNITIES FOR ABOVE AVERAGE DESIGN AND DEVELOPMENT ENGINEERS

To earn not less than £2,500 p.a.

Qualified Engineers are urgently required to work on advanced engineering contracts in the Home Counties and Provinces, with experience in one or more of the following fields:—

- (1) Analogue and Digital Equipments
- (2) Microwave and Communications
- (3) Radar and Navigational Aids
- (4) Instrumentation

This is a first-class opportunity to work on exciting projects at exceptional salary levels.

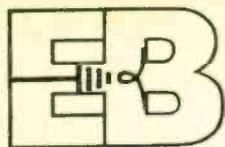


STRAND TECHNICAL CONTRACTORS LIMITED

NORMAN HOUSE, 105-109 STRAND, LONDON, W.C.2

01-836 5557

Please quote: EW1



BECKMAN MODEL J. Continuous Instrument Potentiometer 2" dia. 10K, 35/- Brand new Res. Tol +5% Lin Tol +0.15%.

BECKMAN MODEL A. 10 Turn Precision Wirewound Potentiometer available in the following values:—100 Ohms, 10K, 100K. Offered at 50/-, well below list price.

BECKMAN MODEL 7216. 10 Turn Precision Potentiometer 1/2 dia., 60/-.

MATCHING DUODIALS. Type 2606 up to 15 Turn, 1/2 Dial, 45/- only, nearly half list price.

SINE/COSINE POTENTIOMETER by Kelvin & Hughes, SCP4 33K, offered at a sixth of manufacturer's price, £12/10/-.

SCOOP INDUSTRIAL BUYERS OC25, £17/10/- per 100. Mullard OCBID £7/10 per 100.

VEEDER ROOT SIX DIGIT IMPULSE COUNTER with manual reset, 230 Volts A.C. 55/-, 110 volts D.C., 35/-, Finished in two-tone grey shrivel.

SUDECO PRECISION FOUR DIGIT IMPULSE COUNTER, with pre-selection for counting back to zero as soon as the pre-set number of impulses have been received, 24 V. D.C., 185 mA, £5/5/-, black finish.

"MINICUBE" BLOWER Sub-miniature, only 1" square, operates on 26V-400 c.p.s. input power, 1 or 2 pH. Output 2.2 CFM at free air Wt. 1 1/2 oz. Brand new, made by Saunders Associates, offered at third of manufacturer's price, £19/10/-.

DUAL SPEED VERNIER DRIVE, completely enclosed for panel mounting, accurate to 0.05 degree. Input to Output ratio 36 : 1. Universal coupling to allow for misalignment of shafts. Size 2.2" x 2.2" sq. by 3" dia. White on black engraved dial. Made by Acton Laboratories to the highest Ministry specification. Offered at a fraction of manufacturer's original cost, £12/10/-.

SPERRY PRECISION DC TACHOGENERATOR, Type L526. Brand new, in manufacturer's original packing. 5V/1,000 r.p.m. Size II, Mod. 2. £12/10/-.

G-V controls. Hermetically sealed thermal timing relays available in the following:—7.5 seconds at 28 V., 20 sec. at 6.3 V., 30 sec. at 28 V., 120 sec. at 28 V., 180 sec. at 28 V. All £1 each.

LEACH. Balanced Armature Relays, 3 Pole. D.T.—10 amp 24/28V D.C., 25/-.

CHOPPERS. S.P.D.T. 6 volt 400 cycles, octal base 7/6.

DELAY RELAY. Hermetically Sealed Thermo-static Delay Impervious to Atmospheric conditions and altitudes S.P.S.T. Normally open with a 30 second delay, 7/6.

ELECTRONIC BROKERS LIMITED,
8 BROADFIELDS AVE., EDGWARE, MDDX.
Tel.: 01-958 9842

WE PURCHASE

PLUGS AND SOCKETS, MOTORS, TRANSISTORS, VALVES AND KLYSTRONS, RESISTORS, CAPACITORS, POTENTIOMETERS, TEST EQUIPMENT, RELAYS, TRANSFORMERS, METERS, CABLES, ETC.

PROMPT PAYMENT AND COLLECTION
TURN YOUR CAPITAL INTO CASH

ELECTRONIC BROKERS LIMITED
8, BROADFIELDS AVENUE
EDGWARE, MIDDLESEX.

TEL. 01-958 9842

WESTREX COMPANY LIMITED

have vacancies for the following skilled personnel:

ELECTRONICS ENGINEER conversant with solid state audio amplifier and logic circuit design to co-ordinate development including construction and testing of prototypes.

TESTER/INSPECTORS for audio frequency type of work for Q.R. & C. Department.

ELECTRO MECHANICAL TESTER/INSPECTORS of teleprinters and high speed tape punches for Q.R. & C. Department. We also require applications of same calibre for field maintenance and installation work; vacancies exist in many major towns.

Please apply in writing stating the vacancy which interests you, giving full details of experience and career to date, to :

Secretary, Westrex Co., Ltd.,
152 Coles Green Road,
London, N.W.2.

TAPE RECORDING ETC.

SAVE on cost of Hi-Fi. See Audio Supply notice (advert No. 1943 Services Offered column). [1944
TAPE to disc transfer, using latest feedback disc cutters: EPs from 21/-; s.a.e. leaflet.—Derox High Bank, Hawk St., Carnforth, Lancs. [170
TAPE/Disc/Tape transfer editing, duplicating, if quality and durability matter (especially with LPs from your previous tapes), consult Britain's oldest transfer service. Fund raising records published for schools musical societies (tax free).—Sound News Productions, 10, Clifford St., London, W.1. Reg. 2745. [1945



Television

We are expanding our activities in the field of television-by-wire, and need an experienced development engineer who can undertake important work on both immediate and long-term projects, involving both transmitting and receiving systems and equipment.

Good Laboratory experience and proven ability are the main requirements for the appointment, which offers very good security and opportunities for promotion to an engineer of the right calibre. All enquiries will be treated in strict confidence, and should be addressed to

The General Manager, British Relay (Electronics) Ltd.,
1-7 Croft Street, Deptford, London, S.E.8.

THE MOTOR INDUSTRY RESEARCH ASSOCIATION

Electronic Instrument Engineer

An immediate vacancy exists for an experienced engineer capable of leading a small team engaged on the maintenance, calibration and installation of a wide range of electronic equipment.

In addition to having experience in the maintenance of normal test equipment (e.g., oscilloscopes, signal generators, etc.), the successful candidate will be expected rapidly to familiarise himself with the maintenance of analogue computers, multi-channel F.M. tape-recorders, gas analysis equipment, radio telephone and doppler radar equipment, and a wide range of specialised apparatus constructed in the Association's Laboratories.

This is a new post which calls for a man with both practical and organising ability. Salary will be commensurate with experience and qualifications.

Electronic Maintenance Technicians

Vacancies also exist for technicians familiar with practical maintenance work on complex electronic apparatus, particularly analogue computers and their peripheral apparatus.

Appointments will be made within the grades Technician II-IV at wages ranging from £16 10s. to £22 10s. per week.

Applications in writing to the Secretary, Motor Industry Research Association, Lindley, Near Nuneaton, Warwickshire.



20 Penywern Rd., Earls Court, London, S.W.5 Tel: 01-373 8721

This Private School provides full & part day training in the following professional subjects

RADIO & TELEVISION SERVICING RADAR THEORY & MAINTENANCE RADIO TELEGRAPHY

SERVICE & REPAIRS

REPAIRS.—Our modern service department equipped with the latest test equipment including a wow and flutter meter and multiblex stereo signal generator is able to repair Hi Fi and tape recording equipment to manufacturers' standard.—Teleonic, Ltd., 92, Tottenham Court Rd., London, W.1. 01-636 8177. [21

B.C.C.2. TV. RADIO. TAPE REC. SERVICE SPARES.
U.H.F./625, modify your set to B.C.C.2, 1955 to 1965 models covered, manufacturers complete kits and tuners, send for free list, Ferguson 625 IF amp chassis 39/6 (or less valves 19/6), circuit and instr. 3/6, p/p 4/6. Philips complete 625 conversion kit including circuit 70/-, p/p 6/-. GEC Sobell sound and vision dual 405/625 IF amp and output chassis 42/6, p/p 4/6. New UHF tuners including valves 29/6, or Philips transistorised 70/-, p/p 4/6. Fireball Tuners, new, tested, exclusive offer of special manufacturers' types suitable for KB, Ultra, Ferguson, HMV, etc., 75/-, new turret tuners, Brayhead 3001/3 58/6; Cylidon c 19/6; Brayhead 10, 16, 35Mc/s 19/6; KB 16, 38Mc/s 10/-; Ekco 16Mc/s 10/-, post 4/6, many others available. TV Signal Boosters, transistorised, Pye Labgear B1/B2 and u.h.f. battery 75/-, u.h.f. mains 97/6, u.h.f. mast-head 105/-, post free; L.O.P.T.s, scan coils, framed output transf. mains droppers, etc., for all popular makes CRTs, 14, 17, 19in from £4.3 (callers only). Tape recorder belts, heads, motors, etc. Salvaged components, large selection transformers, scan coils, turrets, etc. Enquiries invited, c.o.d. despatch available.—Manor Supplies, 64, Golders Manor Dr., London, N.W.11; callers 589B, High Rd., N. Finchley, N.12 (near Granville Rd.). Hil. 9118 (day). Spe. 4032 (eve). [60

BOROUGH POLYTECHNIC

Borough Road, London, S.E.1.

The Borough Polytechnic, situated in Southwark, has been nominated as one of the colleges in London that will be designated a "Polytechnic" under the terms of the 1966 White Paper. Large building extensions, now well advanced, will completely rehouse the Department of Electrical and Electronic Engineering.

Applications are invited for the following posts:—

A PRINCIPAL LECTURER

and

A SENIOR LECTURER

in

ELECTRONIC ENGINEERING

Applicants should hold a good honours degree in Electrical Engineering or in Physics and should be corporate members of an appropriate professional institution. They should have had relevant industrial or research experience and preferably teaching experience.

Whilst applications will be considered from candidates specialising in any branch of electronic engineering, it is particularly hoped to make one appointment in **Radio Communications** (Ref. E.11) and the other in **Digital Systems** (Ref. E.12).

Candidates with superior qualifications and experience will be considered for the **Principal Lectureship**, which is a post of considerable responsibility, both academically and administratively.

Present Salary Scales (currently under review) are:—

Principal Lecturer: £2,450 p.a. to £2,670 p.a.

Senior Lecturer: £2,210 p.a. to £2,450 p.a.

It is hoped that the persons appointed to these posts will engage in research work, for which opportunities and facilities can be made available.

Further particulars and application forms may be obtained from the Clerk to the Governing Body, with whom applications should be returned as soon as possible.

ARE YOU AN ENGINEER— OR HOPING TO BE ONE?

A missile systems expert is just one of the things you could become in today's Royal Navy.

Are you a professional engineer with a degree or Dip. Tech.? You can enter the Navy as an acting Sub-Lieutenant. If you don't have a degree but have been accepted for a university place, we'll give you an allowance of about £770 p.a. while you study—and naval training too. If you have "A" levels in pure and applied maths and physics but no university place, we'll give you a full engineering training and every chance of getting a degree.

Your naval training—like that of all our officers—would begin at our college in Dartmouth, Devon. You learn to take responsibility both for your men and for complex equipment. The ships and aircraft of today—and tomorrow—call for top engineers. We make sure they get them. As an Engineer Officer you will be encouraged to keep abreast of the latest developments, and will be given every opportunity for postgraduate studies. You could also have direct responsibility for equipment design.

You'll see the world. Your ship might go anywhere, in NATO trials, or in operations such as bringing relief to a hurricane-hit area. You'll have a high professional status and the salary to match. For the right man, the way to the top lies clear ahead—ability and intelligence are the qualifications for promotion.

For all details write to: Capt. J. H. F. Eberle RN, Officer Entry Section (W/W/F), Old Admiralty Building, London, S.W.1.

MISCELLANEOUS

METALWORK. all types cabinets, chassis, racks, etc. to your own specification, capacity available for small milling and capstan work up to 11in bar. PHILPOTT'S METALWORKS, Ltd., Chapman St., Loughborough. [17

ARTICLES FOR SALE

GOOD second-hand Ferrographs often available.—Reg. 2745 (London). [1942

VACUUM pumps, gauges, etc. recorders, general scientific and laboratory equipment, catalogue.—V. N. Barrett & Co., Ltd., 01-654 6470. [69

HEATHKIT TV Alignment Generator H.F.W.-1 calibrated and ready for use. £40.—Box W.W. 1928, Wireless World.

DARLINGTON DISTRICT HOSPITAL MANAGEMENT COMMITTEE

Senior Electronics Technician

Duties are in Darlington (base Hospital), South West Durham and adjacent Groups of Hospitals.

Ownership of a car will be an advantage. Wide experience in the electronic field including telecommunications, radio frequency transmission and reception, audio frequency systems, domestic and public entertainment, pulse generation, automatic control systems, and electro-medical apparatus.

Hospital experience an advantage.

Responsibility to the Group Engineer, Darlington District H.M.C. for a system of routine maintenance, covering a wide variety of electronic equipment.

Qualifications should preferably include the H.N.C. (Electronics or Light Current Electrical Engineering), or City & Guilds Telecommunications Engineering Certificate, or of similar academic level.

National Health Service Conditions of Service, with car allowance as appropriate.

Salary £980-£1,300 p.a.

Apply, giving age, education, experience, qualifications and present salary, with three referees to Group Secretary, Darlington District H.M.C., Darlington Memorial Hospital, Darlington, to arrive by 17th January, 1968

PHILIPS ELECTRICAL LIMITED

(Medical Apparatus Division)

HEARING AIDS

A vacancy has arisen in the Hearing Aid Service Department for a Supervisor/Technician. The person appointed, who must be an experienced technician will be responsible for the day-to-day administration of the department, the control of a small staff and able to deal with callers on Hearing Aid Service queries. Hours 8.45 a.m. to 5 p.m. Monday to Friday.

Applications should be addressed to

The Personnel Officer,
Philips Electrical Limited,
45, Nightingale Lane,
Batham, S.W.12.
KELvin 7760.

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

ASSISTANT EXPERIMENTAL OFFICER

required for interesting work in attractive conditions, situated in 280 acres of parkland 40 miles north of London. The work on the measurement and control of the environment in glasshouses will involve measurements of light, temperature and carbon dioxide concentration. Experience of modern methods of control desirable.

Qualifications: Pass Degree or H.N.C. if 22 years and over. G.C.E. in 5 subjects with two mathematic or scientific subjects at "A" level if under 22 years of age.

Salary: Starting at £568 p.a. at age 18 up to £1,017 p.a. at age 26 or over, rising to £1,243 p.a.

Prospects: Excellent prospects of promotion to Experimental Officer on a scale of £1,365 p.a. rising to £1,734 p.a.

Ref.: 67/ECD/21

FIVE DAY WEEK · SUPERANNUATION
CANTEEN

Application forms from: The Secretary,
N.I.A.E., Wrest Park, Silsoe, Bedford.

Government of ZAMBIA

REQUIRES

RADIO SPECIALISTS

on contract for one tour of 36 months in the first instance. Salary according to experience in scale rising from £1645 to £1855 gross per annum. A supplement of not less than £200 per annum is also payable direct to an officer's home bank account. Gratuity 25% of total salary drawn. Both gratuity and supplement are normally TAX FREE. Liberal leave on full salary or terminal payment in lieu. Free passages. Quarters at low rental. Children's education allowances. Outfit and plain clothes allowances. Contributory pension scheme available in certain circumstances.

Candidates, who will serve in the rank of Inspector of Police, must have completed an approved apprenticeship of five years

or hold a Service Trade Certificate or equivalent qualification and have had at least six years post-qualification experience in the installation and maintenance of modern low and medium power H.F. equipment, S.S.B. and I.S.B. equipment, and of V.H.F. equipment, including multiplex links. Knowledge of maintenance of teleprinters, diesel and petrol generators preferred. Duties include travel by road and air and training Zambian officers for City and Guilds.

Apply to CROWN AGENTS, M. Dept., 4 Millbank, London, S.W.1., for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M3D/61274.

PHILIPS ELECTRICAL LTD.

(Medical Apparatus Division)

45, Nightingale Lane, Balham, S.W.12

HEARING AID DEPT.

Technician required for the service and repair of Hearing Aids. Previous experience in this field desirable. Hours 8.45 to 5 p.m. 5-day week. Pension Scheme. Apply to Personnel Officer at the above address or telephone KELvin 7766 for an appointment.



**CELTIC ELECTRONICS
CHRISTCHURCH,
BRIDGE STREET,
CHRISTCHURCH, HAMPSHIRE**

We are Suppliers of
TUNING FORK BASED, FILTERS, TONE
GENERATORS, ENCODERS, DECODERS
and SINGLE ELEMENTS in the range 200
c/s — 4000 c/s.
QUARTZ CRYSTAL UNITS FROM 0.4
Mc/s — 120 Mc/s
Enquiries For QUARTZ FILTER UNITS
are Welcomed

Technical Assistant

A Technician is required to service and maintain advanced communications equipment and air traffic control displays. The equipment is situated in a trailer specially designed to give operational demonstrations to prospective users. Initial training on maintenance will be given.

Recent experience in the RAF or on military electronic engineering would be an advantage. It will be necessary to undertake overseas visits and a clean driving licence is essential.

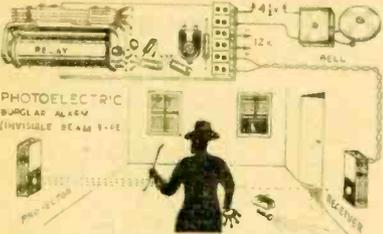
Age group 25 to 35 years but older applicants may be considered.



Apply, quoting Ref. NAV/21,
The Senior Personnel Officer,
The Decca Navigator Co. Ltd.,
247 Burlington Road,
New Malden,
Surrey.
Telephone 01-942 7711

PHOTOELECTRIC KIT

Build 12 EXCITING PHOTOELECTRIC DEVICES on a Printed Circuit Chassis
 CONTENTS: 2 P.C. Chassis Boards, Chemical Etching Manual, Infra-Red Sensitive Photocell, Latching Relay, 2 Transistors, Resis., Cond., Pot., Terminal Block, Elegant Case, Screws, etc. In fact, everything you need to build a simple but efficient Photo-Switch/Burglar Alarm/Counter, etc. (Project No. 1) which can be modified for modulated light operation (Projects Nos. 2 and 3).



Also Essential Data, Circuits and Plans for building 12 PHOTOELECTRIC PROJECTS. (1) Simple Photo-Switch. (2) Modulated Light Alarm. (3) Long Range Scary-Light Alarm. (4) Relay-less Alarm. (5) Warbling Tone Alarm. (6) Closed-Loop Photoelectric Alarm. (7) Projector Lamp Stabiliser. (8) Electronic Projector Modulator. (9) Mains Power Supply Unit. (10) Automatic Car Parking Lamp Controller. (11) Super Sensitive Relay-less Modulated Light Alarm. (12) Car Automatic Headlamp Dipper. Basic Kit: 39/6. Post and Packing 2/6 (U.K.).

OPTICAL KIT

Everything needed (except plywood) for building 1 Folded-Beam Projector and 1 Photocell Receiver to suit PHOTOELECTRIC PROJECTS. CONTENTS: 2 lenses, 2 mirrors, Infra-Red Filter, 2 45 deg. Blocks, Projector Lamp Holder and Bracket, Plans, etc. Optical Kit: 19/6. Postage and Packing 1/6. Send a S.A.E. for full details, a brief description and Photographs of all 52 Radio, Electronic and Photoelectric Projects. Assembled. Dept. Y.E.I.

EXPERIMENTAL ELECTRONIC ENG.
 333 York Rd., LONDON, S.W.11

MODEL E 7600/4 180-260V, 50W. Mullard Cardomatic Valve Tester complete with cards. Little used; £45 o.n.o.—Reply Box W.W. 1939. Wireless World.
SILICON BC109C's N.P.N. transistors. General purpose, very high gain, especially low noise. 4 11 pin. P. & P. 9c., c.w.o., c.o.d.—32, Philbeach Gdns. S.W.5. [179]

QUANTITIES of Barretter valves, CL33, CY31 and CIC, wanted, new and boxed; have for exchange new 6AQ5, EL84, 6BR7 and ECC83 valves, or will buy for cash.—Harrinray Photographic, 435, Green Lanes, London, N.4. 01-540 5241. [1910]

SOUTHERN'S Instruments 12 channel oscillograph unit, needs slight attention, with recording camera, trolley mounted, would suit technical college studying vibration effects, etc.; price £50, plus carriage.—J. Black, 44, Green Lane, Hendon, N.W.4. [1947]

MANCHESTER EDUCATION COMMITTEE. Tenders are invited for the purchase of second-hand audio-visual aids equipment.—Further details and forms of tender from Supplies Officer, Stores Department, New Cross, Manchester 4, returnable by December 22nd, 1967. [1946]

ULTRASONIC amplifiers by British maker, 35 and 70 watt models, 200 245v mains operation components include 2-EL34 and 1-ECC81 valves 2 BY100 diodes, 1 mains transformer tapped 200 220 240 250 230v, 0.85 amp, 1 mains transformer 220 240v-450v also O.P. trans. 6ft mains lead c/w Bulgin connector. Price (incl. carriage U.K.) £3/10 each.—J. Black, 44, Green Lane, Hendon, N.W.4. [1917]

ENTHUSIASTS Have you considered a career in Technical Authorship? If you have sound experience in electronics or communications and ability to write clear concise English we would train applicants as Technical Authors. The commencing salaries range from £1,300 to £1,700 depending on experience with the prospects of high future rewards and earnings.
Box No. 5039, c/6 Wireless World

PHILIPS ELECTRICAL LTD.

(Medical Apparatus Division)

45 Nightingale Lane,
 London, S.W.12

have vacancies for

X-RAY SERVICE ENGINEERS

for London and Birmingham area.

Suitable applicants of O.N.C. standard should have an electro-mechanical background with experience in electronics. A knowledge of closed circuit television would be an added advantage.

Applications in writing to the Personnel Officer at the above address or telephone **KELvin 7766**.

RADIO TECHNICIANS

A number of suitably qualified candidates are required for unestablished posts, leading to permanent and pensionable employment (in Cheltenham and other parts of the U.K. including London). There are also opportunities for service abroad.

Applicants must be 19 or over and be familiar with the use of Test Gear, and have had practical Radio/Electronic workshop experience. Preference will be given to candidates who can offer "O" level and GCSE passes in English language. Maths and/or Physics, or hold the City and Guilds Telecommunications Technical Intermediate Certificate or equivalent technical qualifications.

Pay according to age, e.g. at 19—£812 at 25—£1046 (highest age pay on entry) rising on 1.1.68 to at 19—£828, at 25—£1,076. Prospects of promotion to grades in salary range £1,159-£1,941. There are a few posts carrying higher salaries.

Annual leave allowance of 3 weeks 3 days rising to 4 weeks 2 days. Normal Civil Service sick leave regulations apply.

Application forms available from:—

Recruitment Officer (RT),
 Government Communications Headquarters,
 Oakley, Priors Road,
 Cheltenham, Glos.

TEST ENGINEERS

Due to continued expansion vacancies exist for Test Engineers of all grades to work on a wide variety of both digital and analogue equipments from simple circuits to complete digital systems.

If you are able to work to detailed specifications using standard measuring devices and can apply yourself logically and systematically to the diagnosis of faults in modern electronic equipment, we can offer you a permanent position within a salary scale ranging from £17 per week to £1,400 per annum.

Write or telephone:

Mr. R. P. Naish,
Gresham Lion Electronics Limited,
 Twickenham Road,
 HANWORTH, Middlesex.

Telephone: 01-894-5511 OR 01-894-9748
 (Evenings) for an informal chat.

FED UP WITH YOUR PRESENT JOB?

We require a number of junior engineers with drive and initiative for:—

Circuit design—development and prototype construction, etc.; Electro-mechanical drafting—printed circuit/chassis layouts, etc.; Production line test and inspection engineers; Production line fault finders.

Excellent prospects and full training given, day release considered. Salary up to £1,000 depending on experience and qualifications.

Send full details in writing of experience to date and present salary to:—

Solid State Controls Limited
 30/40 Dafling Road, London, W.6

ELECTRONIC ENGINEER (ARN 1)

To design test units and establish test methods for the electrical parts of control and measuring equipment, and to assist in the running of the section which develops and constructs these test units. Applicants should have practical industrial experience of D.C. and low frequency apparatus and components. O.N.C. is desirable but not essential. Salary of £1,200 p.a. or more depending on experience and qualifications.

ELECTRONIC TECHNICIAN (ARN 2)

To assist in the design and construction of test units for our test rooms. He should be able to check and prove these units, keep accurate records including simple circuit diagrams and make electrical measurements precisely. Experience of similar work on D.C. and low frequency equipment is required. He will be expected to work with the minimum of supervision. Salary £20 p.w. or more depending on experience.

In both instances apply to the
Recruitment Officer
RANK PULLIN CONTROLS
GREAT WEST ROAD,
BRENTFORD, MDDX.
 Tel: 01-560 1212, Ext 240

TECHNICAL ASSISTANT

Applications are invited from young electrical or electronic engineers with a live mind to work in the Group patents department of Pye of Cambridge Ltd.

The successful applicant will have a flair for describing technical equipment and be required to liaise between patent agents, inventors and legal advisers.

An attractive salary taking into account age and experience will be offered.

Please apply, giving full details of age, qualifications and experience to: The Personnel Manager, Pye of Cambridge Ltd., St. Andrew's Road, Cambridge.

CROWN AGENTS ENGINEERS

The Crown Agents' Engineering Departments, which embrace all disciplines, carry out a wide range of activities on behalf of their Oversea Principals, including the design, purchase and inspection of diverse plant, structures, machinery and equipment, in addition to providing advisory and consultancy services.

The Crown Agents is not a Department of the British Government; nor are its staff Civil Servants, although their salaries and conditions of service are based on those of the U.K. Civil Service.

The following appointment is available:

ASSISTANT ENGINEER (RADIO COMMUNICATION)

Candidates should be Corporate or Associate Members of the Institution of Electrical Engineers or have equivalent qualifications. Applicants who are not so qualified but who have H.N.C. or equivalent may be considered as Technical Officers.

They should have received training in Radio Communications Equipment in a reputable organization. A knowledge of Broadcasting and Television Equipment would be of advantage.

Duties, mainly those of a Purchasing Officer, will include the preparation of specifications and tenders, evaluation of tenders and preparation of advice to Crown Agents' Principals in respect of this equipment and may involve spending brief periods overseas.

Appointment will be on the following terms:

1. If under 50 years of age, on probation for 2 years for admission to the permanent and pensionable establishment.
2. If over 50, to the unestablished and non-pensionable establishment, OR
3. On contract for 3-5 years, with a 25% addition to the salary scales given below.

Preferred age-limits are 25-35. Candidates must be prepared to serve overseas.

SALARIES (Inner London)

Assistant Engineer £1,238 (age 25)-£1,864.

Technical Officers:

Grade I, £1,477-£1,812

Grade II, £1,303-£1,477

Grade III, £1,103-£1,303

Retrospective adjustment on 1/1/68, to:

Assistant Engineer £1,317-£1,979

Technical Officers:

Grade I, £1,565-£1,927

Grade II, £1,358-£1,565

Grade III, £1,151-£1,358

Please write for application form, quoting reference number M28/OFFICE/VI and title of post to: CROWN AGENTS, 'M' DEPT., 4 MILLBANK, LONDON, S.W.1. Candidates must be resident in the U.K., or anticipate being so in the near future.

EDITORS AND ENGINEERS RADIO HANDBOOK

New, 17th Edition, by W. Orr, 84/- P. & P. 4/6.

PRACTICAL WIRELESS SERVICE MANUAL. New ed. by Hellyer. 25/- P. & P. 1/3.

COMPUTERS FOR THE AMATEUR CONSTRUCTOR, by Warring. 20/- P. & P. 1/-.

PRACTICAL AERIAL HANDBOOK, by King. 35/- P. & P. 1/3.

SURPLUS CONVERSION HANDBOOK, by C.Q. 28/- P. & P. 1/-.

SIDEBAND HANDBOOK, by Stoner, pub. by C.Q. 24/- P. & P. 1/-.

V.H.F. FOR THE RADIO AMATEUR, by C.Q. 32/- P. & P. 1/-.

ELECTRONIQUES HOBBIES MANUAL by Standard Telephones. 10/6. P. & P. 1/-.

Q & A ON TRANSISTORS, by Brown. 2nd edition. 8/6. P. & P. 9d.

Where possible 24-hour service guaranteed.

UNIVERSAL BOOK CO.

(Leicester Square Tube Station)

WW-132 FOR FURTHER DETAILS

FOR Sale as new, Zenith Royal 3,000-1 transistor transoceanic portable; £120.—Box W.W. 1940, Wireless World.

A Better deal for cash customers. We do not provide interest free credit but offer a generous discount of 15% for cash. Equipment despatched brand new in sealed cartons on receipt of remittance with order. Agents for all leading makes. Demonstrations, service, guidance—Write or phone. Callers welcome. Open all day Saturday. Thursday half day.—Audio Services, Ltd., 82, East Barnet Rd., New Barnet, Herts. Tel. Barnet 6805. [20]

ARTICLES WANTED

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Lev. 4986. [63]

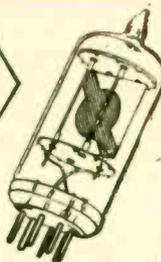
NEW GRAM AND SOUND EQUIPMENT

GLASGOW.—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343, Argyle St., Glasgow. C.2. [11]

EXCHANGES

EXCHANGE: Recording studio has a matched pair of Tannoy 15in d.c. loudspeakers it would like to exchange for a pair of Tannoy 12in d.c. units.—Box W.W. 1948, "Wireless World."

Quartz Crystal Units



For

ACCURACY

RELIABILITY

PRICE ECONOMY

you can
DEPEND
on

Write for
Illustrated
Brochure &
Price List

THE QUARTZ CRYSTAL CO. LTD.

Q.C.C. Works, Wellington Crescent,
New Malden, Surrey (MALden 0334 & 2988)

WW-133 FOR FURTHER DETAILS

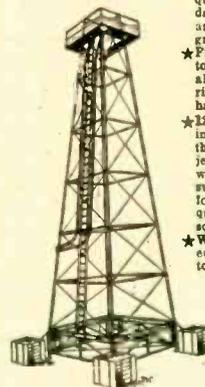
EXCLUSIVE OFFER

PERMANENT OR
TRANSPORTABLE STEEL
60-FOOT AERIAL TOWERS

As supplied to
British and other Governments

★ Unique design
★ Scientific Construction

having the following remarkable features.



- ★ Entirely self supporting, requiring no guys, stays, foundations, pickets or spikes or any attachment to the ground.
- ★ Fitted with step ladder to the top and balcony with railings all round (you can walk right round the top with both hands free).
- ★ 12 feet square at base tapering to 6 feet square at top, they are quite safe when subject to gale force winds and will accept 60 square feet superficial area on top at force of 60 m.p.h. They require ground area of 20 feet square.
- ★ Will support up to 2 tons of equipment on top, the whole tower can be completely lowered to the ground by 2 men in 20 minutes and raised in the same time.
- ★ Can be completely erected and dismantled by 3 men.
- ★ Breaks down for transport by 2 ton lorry into parts easily handled by 2 men, there are no small loose parts, no nuts or bolts to get lost or damaged; all screws and adjustments are fully protected from rust and so designed to be free from damage when transported or left loose on the ground.
- ★ Footproof—the Tower cannot be erected if not assembled correctly. No skilled labour is required and no special tools are necessary.
- ★ Can be raised and lowered, erected and dismantled and removed as many times as desired.
- ★ Everything necessary for the complete tower to be put into use and raised and lowered is provided; full drawings and instructions.

These fine Towers were made in England by B.L.O.G. and cost the Government £2,200 each. They are BRAND NEW and in maker's original packing. You can see one erected at our premises.

Cost £2,200

Price Brand New
£345

40-page list of over 1,000 different items in stock available—keep one by you.

| | |
|--|--------|
| ★ Uniselectors 10 Bank 25 Way | £1 15 |
| ★ 7 Track Tape Readers | £12 10 |
| ★ 7 Track Tape Patches | £12 10 |
| ★ 50 Enclosed Rack Cabinets | £25 0 |
| ★ T-200 Pannadaptors 450/470 Kc/s. | £30 0 |
| ★ A-1 Multi-core Cable Testers 2 Kv. | £40 0 |
| ★ Narda 500 w. Ultrasonic Cleaner | £85 0 |
| ★ Sliding Shelves rack mounting | £3 0 |
| ★ Magnetic Recording Wire, 1-lb. reel. | £2 10 |
| ★ 3M Video Recording Tape, 1lb. | £5 10 |
| ★ Marconi S.B. Receivers HR-22 2/32 mc/s. | £80 0 |
| ★ R.C.A. 420 Mc/s Yagi 5 el. Beams | £2 10 |
| ★ Model 15 Teletype Page Printers | £29 10 |
| ★ Model 14 Teletype Tape Readers | £25 0 |
| ★ Model 14 Teletype Repetitors | £25 0 |
| ★ R.C.A. 25 watt Projector; Loudspeakers, range 1 mile | £14 10 |
| ★ Metro-Vickers Vacuum Pumps 230 v. A.C. | £22 10 |
| ★ Precision Mains Filter Units | £2 10 |
| ★ E.M.I. Recording Bridges | £2 10 |
| ★ Avco Geler Counters | £7 10 |
| ★ Philco W.S. No. 43 Transmitters 350W | £75 0 |
| ★ E.M.I. 3794 Waveform Monitors on trolleys | £45 0 |
| ★ Motorola 6 v. Mobile Transmitters 30/40 Mc/s | £12 10 |
| ★ Pen-type Personal Dosimeters | £2 15 |
| ★ Monitor Type 56 and Power Units | £7 10 |
| ★ Marconi TF 1053 Noise Meters | £45 0 |
| ★ AN/URM-17 Spectrum Analysers 10/18000 Mc/s | P.U.R. |
| ★ AN/URM-33, 34, 35 Signal Generators 1000/8000 Mc/s. | P.U.R. |

Carriage extra at cost on all above.

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements—we can probably help—all enquiries answered.

**P. HARRIS
ORGANFORD — DORSET**
WESTBOURNE 85051

WW-134 FOR FURTHER DETAILS

OSMABET LTD.

WE MAKE TRANSFORMERS AMONGST OTHER THINGS.
AUTO TRANSFORMERS. 0-110-240-220-240 v. A.C. up to 1000 VA fully shielded. (Listed terminals) Lineage: 50 w. 22/6; 75 w. 27/6; 100 w. 32/6; 150 w. 37/6; 200 w. 55/-; 300 w. 70/-; 400 w. 85/-; 500 w. 120/-; 600 w. 135/-; 1,000 w. 180/-; 1,500 w. 212/-; 2,000 w. 217/-; 3,000 w. 221/-; 4,000 w. 225/-.

MAINS ISOLATION TRANSFORMERS. Input 200-240 v. A.C. 1:1 ratio, 100 w. 70/-; 200 w. 110/-; 500 w. 240/-.

MAINS TRANSFORMERS. Input 200-240 v. A.C. TX1 425-0; 425 v. 250 mA., 0.3 v. 4 a. et. 6.3 v. 4 a. et. 0-5-4; 3 v. 3 a. 110/-; TX2 250-0-250 v. 150 mA., 6.3 v. 4 a. et. 0-5-4; 3 v. 3 a. 60/-; TX4 300-0-300 v. 90 mA., 6.3 v. 2 a. et. 6.3 v. 1 a. 45/-; TX5 300-0-300 v. 120 mA., 6.3 v. 1 a., 6.3 v. 2 a. et. 6.3 v. 2 a. 60/-; TX7 40-0-40 v. 1 a. 50/-; TX8 230-0-230 v. 60 mA., 6.3 v. 1.5 a. 22/6. TX1M 250 v. 60 Ma., 6.3 v. 0.75 a. 6.3 v. 1.5 a. 15/-.

INSTRUMENT TRANSFORMERS. Prim. 200-240 v. A.C. 0MT4. Tapped sec. 5-20-30-40-60 v.; giving 5-10-15-20-25-30-40-55-70, 10-0-10, 20-0-20, 30-0-30 v. A.C. 1 a. 27/6; 2 a. 37/6. 0MT5. Tapped sec. 40-50-60-80-90-100-110 v.; giving 10-20-30-40-50-60-70-80-90-100-110, 10-0-10, 20-0-20, 30-0-30, 40-0-40, 50-0-50 v. A.C. 1 a. 40/-.

HEATER TRANSFORMERS. Prim. 200-250 v. A.C. 6.5 v. 1.5 a. 9/6; 6.3 v. 3 a. 15/-; 0.3 v. 6 a. 25/-; 12 v. 1.5 a. 15/-; 12 v. 2 a. 22/6; 12 v. 0.5 a. 7/6; 24 v. 3 a. 50/-; 24 v. 5 a. 70/-; 24 v. 8 a. 110/-; 24 v. 12 a. 140/-.

Comprehensive range of transformers and chokes stocked. Carriage extra. All transformers from 3/6 to 7/6 each.

TRANSFORMERS WOUND TO YOUR SPECIFICATION
POWER PACK, input 200/240 v. A.C. nominal output 12 v. D.C., capacitor smoothed, bridge rect., 500 mA., 37/6. P.P. 2/6.
BATTERY ELIMINATORS, input 200/240 v. A.C. output 9 v. D.C. 100 mA., PP 45/-; PP 15 mA. 17/6. leaded s.a.e.
BULK TAP ERASER, and head demagnetiser, 200/250 v. A.C., suitable any size spool, any type head, 35/- leaded s.a.e.
LOUDSPEAKERS, new stock, famous make, full range available, all new 200's, 1st. heavy duty 15 or 25 watt, 7 or 15 ohm 15/-; 105/-; 30 watt 15 ohm 188/- Carriage 5/6. Lists s.a.e.
AUTOCHANGERS, Garrard, Heartbridge, 1,000 100/-; 2000 110/-; 3000 130/-; BSR Super Sun U255 weartrides, 100/- All brand new, carriage 7/6 each.
CONDENSERS, electrolytic, 2,500/50 v. 5/6; 6000/15 3/6; 1000/25 2/6; 100/450 v. 3/6; 100 x 400/275 v. 3/6; 100 x 200/250 v. 4/6; (incl. postage 1/6).
FLUORESCENT LOW VOLTAGE LIGHTING, Input 6, 12, 24 v. D.C. Extensive range of fluorescent fittings and inverters. Lists s.a.e.
S.A.E. all enquiries please. Mail Order Only.
 46, KENZL WORTH ROAD, EDGWARE, MIDDX.
 Tel.: STD 0994 9314.

SLYDLOK FUSES 15 amp. 230 v. D.C. 440 v. A.C. 1/6 ea., 15/- per doz.

HEADPHONES, Balanced armature, DLR5. Brand New. 9/6 per. Moving coil type, with ear muffs for noise excluding. 12/6 per. Same fitted with moving coil mike, 17/6 per. Carbon hand mike, 7/6 each. P. & P. 2/- each item. No. 10 Assembly Headsets and Mic., moving coil 17/6 ea. P. & P. 2/6.

TANNOY LOUDSPEAKERS. Re-entrant type, ideal for public address, enclosed in waterproof wooden case, complete with steel baffle designed to produce directional reproduction at 5 watts. 7.5Ω. 27/6 each. Carr. 5/-.

SMALL GEARED MOTORS. 12-24 v. D.C. reversible, with gears attached 15/- ea.; with blower attachment, 12/6 ea.; with fan assembly, 12/6 ea.

TRANSMITTER. BC 625, part of T/R. SCR522. For spares only. Chassis only. Complete with valves except 832s and Relay. 21/- ea. Carr. U.K. 4/-.

SIEMENS HIGH SPEED RELAYS. H96B type, 50 150 ohms. 6/- ea.; Type H69D, 500-500 ohms. 6/- ea.; Type H96E, 1,700-1,700 ohms, 7/5 each. Carr. 1/-.

"TELE L" TYPE FIELD TELEPHONES. These telephones are fitted in strong steel case complete with Hand Gen. for calling each station. Supplied in new condition and tested. 70/- per pr. Carr. 7/6.

POST OFFICE TYPE RELAYS. 3,000 sers. 2 c/o. 2 m., slugged coil 140 ohms; 2 c/o. slugged coil 500 ohms. All at 6/- each. Carr. 1/-.

3,000 Type, by Ericsson Telephones, 2 1,000Ω 1 br. 2 mc. c/o plus 3 c/o's 12/6 ea., 2,000Ω 4 c/o's 10/- ea.; 500Ω 12 c/o's. 10/- ea. P. & P. 1/- ea.

MORSE KEYS. No. 8 assembly complete with leads, terminals and cover. 6/6 each. Carr. 2/-.

VIBRATORS. 6 v. 4 pin; 12 v. 4 pin; 12 v. 7 pin. Syn. All 6/- each. Carr. 1/-.

ELECTRO MAGNETIC COUNTERS. Register up to 9999, coil res. 300Ω 5/- each. Carr. 1/- Ex-equipment.

ELECTRIC PRIMING PUMPS. AMERICAN SURPLUS. 24 v. D.C. Overall size 7x2 1/2x2 1/2 in. G.P.H. Brand New. 37/6 each. Carr. 2/-.

P.O. TYPE DESK TELEPHONES. Type 162CB, no bell or ringing dial, black only. Brand new, boxed, 27/6. Carr. 2/6 each.

P.O. TYPE TELEPHONE HAND GENERATORS. 38 v. A.C. New 7/6. P. & P. 1/-.

MODULATION TRANSFORMERS. 150 watts, suitable for pair 813s, driving 313s. Size 6in. x 5in. x 3 1/2 in. Brand new, boxed. Price 27/6. Carr. 4/6.

MEGGER INSULATION TESTER 500 v. with Contest range from 0.1 ohm to infinity. Bakelite case with hand gen. £9 ea. Carr. 5/6. 2 ranges, ex-Hoover stock.

CUT OUT. 12 v. or 24 v. operation. Heavy duty silver contacts (5c 849). 7/6 ea. Carr. 1/6.

LIGHTWEIGHT HEADSET (part of '88" W. Set Equip.) complete with Boom mic., carbon made to highest Ministry Spec. Moving coil earpieces. Our price 35/- set. Carr. 3/- . Also Super Lightweight hand set. 17/6 ea. Carr. 2/-.

200 AMP. 24 v. D.C. GENERATORS. Type P3, ex-Air Ministry. £9/10/- ea. Carr. 10/6.

YURA MINIATURE RUSSIAN TRANSISTOR RADIOS. Med. wave, complete with rechargeable merc. batteries and 2 spare batteries and charger, leather case, only 65/- . P. & P. 2/-.

P.C.R. 12 V. VIBRATOR POWER PACKS. Brand new, 22/6 ea. P. & P. 5/-.

CONDENSERS. Paper, Sprague .1 mfd. 500 v., 5/- doz. .1 mfd. 1,500 v. 7/- doz. (incl. P. & P.).

HEAVY DUTY TERMINALS. Ex-equip. Black only, will take spade terminals and wander plug. 1/6 pr. 15/- doz. pairs. P. & P. 1/6 ea. doz.

11FT. WHIP AERIALS. 6 Section. Copperised steel and painted. Dia. 3/8-in. Complete with moulded base 2 1/2 x 3 1/2 in. 12/6 complete. P. & P. 2/6.

FATIGUE METERS. 24 v. D.C. Consisting of 6 x 496D Relays. 500-500Ω. 6 x 300Ω Electro Mag. counters, etc. £3/10/- ea. Carr. 4/6.

AUTO TRANSFORMERS (AMERICAN). 3kVA. 220/110 v. Hand rewinder provides 7 taps. Size 12 x 12 in. Wt. approx. 1/2 cwt. £12 and 10/- carriage.

S.A.E. all enquiries.



Tel. BIRKENHEAD 6067
Terms Cash with Order.

AMERICAN

TEST & COMMUNICATIONS EQUIPMENT

AN APN-9 Loran Receiver Indicators, suitable for navigation or Scope conversion, price from £5. S.A.E. for details.

AN/ARC-33 Transceivers 225/399.9 Mc/s.

AN/VRC-19 F.M. Transceivers. 152/174 Mc/s. £10.

AN/URC-4 & AN URC-11 "Handy-Talkies"

AN/ARN-6 & AN/ARN-44 Compass Receivers

AN/TRC-8 U.H.F. Radio Relay Sets.

AN/FPN-13 X band Radar Beacons.

CU-168/FRR 2/32 Mc/s Antenna Couplers.

AN/PSM-2A "Megger" Insulation Testers 500V 0-1,000 Mc/s.

AN URM-30 Test Set for AN/URC/45.

AN PSM-6 Multimeters 1K-20 kΩ/PV.

AN-URM-61 Signal Generator 1.8 4 Mc/s.

TS-47 Test Oscillator 40/500 Mc/s. £25

T-216/GR XTL. Controlled Signal Generator 225/399.9 Mc/s.

AN/UPM-11A X Band Range Calibrators.

AN/USM-24A Measuring Oscilloscopes.

TS-413C/U Signal Generators 75 Kc/40 Mc/s.

TS-297/UB Multimeters. £5/10/-.

TS-497/UR Signal Generator 2/400 Mc/s.

TS-147A/UP Radar Test Sets.

TS-917A/JCG (Stelma TDA-2) Telegraph Distortion Analysers.

ME-22/PCM Decibel Meters-45/+25 DBM Tektronix 541, 543 & 545 spare Tubes Type 5BHP2A. Price £14.

NEW GENERAL CATALOGUE
 AN/103 1/-

SUTTON ELECTRONICS

Salthouse, Nr. Holt, Norfolk. Cley 286

PHOTO ELECTRIC CONTROL SYSTEM

Comprises a light source unit with optional Infra Red filter and lens system to focus the light. Also a photo-electric Relay control unit. Both housed in metal cases for bench or wall mounting. Sensitivity control range on-off switch. Works from 230/240 v. A.C. Mains. Can be used as a simple on-off switch by breaking the beam of light (invisible infra Red filter is used) and as such it will operate as a burglar alarm, or will open doors, etc. Also in conjunction with a counter or other equipment it will perform many functions in the factory or warehouse.

Price **£9.19.6**

F.M. WIRELESS MICROPHONE

14-164 Mc/s. Transistorised. Operates from 9 v. battery. Complete with additional secret the step microphone. List £12/10/- ONLY

Price **£6.15.0**

These cannot be operated in F.K.

FM MULTIPLEX STEREO ADAPTOR.

Printed circuit board, 4 trans. 6 diodes 9 v. with full instructions

Price **£5.19.6**

BSR TAP HEADS BRAD. 2 TRACK

39/6 pair

BSR TAP HEADS MALL 4 TRACK 39/6 pair

REFLEX CONE TYPE WATERPROOF SPKR.

5 watt, 9 ohm, 200-16,000 c/s PA & Music Relay

Price **£4.5.0**

MULTIMETERS

32/- from

S.A.E. for full selection and bargains offers in multimeters, radios, Baby Akeron, Intervova, Walkie-Talkies, and rectifiers. All Post Free. C.O.D. 3/6.

DURHAM SUPPLIES

175E Durham Road, Bradford 8, Yorkshire

ALL GOODS GUARANTEED CONVERTOR/BATTERY CHARGER.

Input 12 v. D.C., output 240 v. 50 c/s. 170 watts max. Input 240 v. 50 c/s., output 12 v. 5 amp. D.C. Fully fused with indicator lamps. Size 9 1/2 x 10 x 4 1/2 in. Weight 19 lb. An extremely compact unit that will give many years reliable service, supplied with plug and leads. Only £4/10/- . P. & P. 15/-.

DEKATRON SCALER/TIMERS. Various models from £6 to £12. Also available Ratemeters from £14. Write for details.

TRANSISTORS—Not remakes.

| | | | |
|------------------|---------|-----------------|---------|
| ACY 19 Mul. | 4/- ea. | 25301 Tex. | 4/- ea. |
| BCZ 11 Mul. | 4/6 ea. | 25701 Tex. | 4/6 ea. |
| GET885 Mul. | 4/- ea. | 25702 Tex. | 4/6 ea. |
| 2N1305 Rca. | 4/6 ea. | V30/201P New. . | 4/6 ea. |
| MA393 | 3/6 ea. | V60/10P. New. . | 4/- ea. |
| 25018 Tex. | 7/- ea. | | |

VALVES

| | | | |
|------------|---------|----------------|---------|
| 6AK5 | 3/- ea. | DL92/94 | 3/- ea. |
| 6SN7 | 2/6 ea. | 12SN7/B36 | 2/- ea. |
| 12AT7 | 2/- ea. | 6CH6 | 3/6 ea. |
| E180F | 8/6 ea. | 6BR7 | 6/- ea. |
| 2D21 | 3/6 ea. | | |

COUNTER TUBES GCI OB. 12E ea. Trigger tubes CV2224/G1/371K 15/- ea. GTE175M 8/- ea. BROOKS CRYSTALS. 500kc/s: 2, 5, 10 mc/s., 10/- ea.

RELAYS

American miniature gold contacts, 4 pole co 48 v. Brand new boxed 6/6 ea.

Carpenters type 51A1/50. Brand new boxed 8/- ea.

3000 Series 5 k/ohms, 2 pole make, HD contacts 3/6 ea.

Siemens sealed HS, 48 v., spco type H96E. 3/- ea.

American miniature 4-pole co 12/24 v. 200 ohms, sealed 5/6 ea.

FRACTIONAL H.P. MOTORS. 240 v. 50 c/s.

Brand new. Ideal models, fans, etc. 8/6 ea.

TRANSFORMERS. All 200/250 inputs, tapped 0-6-12-18, 3 amp. 15/- ea. 7 amp. 30/- ea.

H.T. TRANSFORMERS, e.g., 450-0-450, 250 mA.

3 x 6.3-3 amp. 1 x 5 v. 2 amp. Potted Parmeko/Gardiners, as new 50/- ea. Write stating requirements.

NEW DIODES. Mullard genuine OAB1, 1/6 ea. CV448/425, 1/- ea.

METROSILS. Ideal pulse suppression 2/- ea.

EHT CONDENSERS. 7.5 kv. working, with clips. 0.1 mfd. 5/6 ea., 0.25 mfd. 8/6 ea.

Cash with order. Post paid over 10/-.

CHILTHEAD LTD., 22 Sun Street, Reading, Berks.

SWANCO PRODUCTS LTD.

G3NP AMATEUR RADIO SPECIALISTS G3PQQ

NEW EQUIPMENT

| Sommerkamp F-Series Equipment | | £ s. d. |
|---|-----|---------|
| FR-100B double conversion superheterodyne with crystal-controlled first mixer, 80-10 metres | 112 | 0 0 |
| FL-200B 88B/AM/CW transmitter, 240 watts PEP, complete with built-in power supply and antenna relay | 130 | 0 0 |
| FL-100B linear amplifier, 960 watts PEP | 90 | 0 0 |
| Sommerkamp FT-150 transceiver, 80-10 metres | 190 | 0 0 |

| Swan Line Equipment: | | £ s. d. |
|----------------------------------|-----|---------|
| Swan 500 BB transceiver | 238 | 0 0 |
| Swan 230-XC power supply/speaker | 45 | 0 0 |
| Swan 410 V.F.O. and adapter | 57 | 0 0 |

| Hallcrafters Equipment: | | £ s. d. |
|--------------------------------------|-----|---------|
| SX-146 88B receiver, 80-10 metres | 125 | 0 0 |
| HT-146 88B transmitter, 80-10 metres | 175 | 0 0 |
| SE-2000 Hurricane transceiver | 495 | 0 0 |
| P-2000 power supply | 195 | 0 0 |
| HA-1 electronic keyer | 39 | 0 0 |

| Edystone Radio Ltd.: | | £ s. d. |
|---|-----|---------|
| Edystone EA12, Amateur bands receiver, 160m.-10m. | 185 | 0 0 |
| Edystone 940, Communications receiver | 133 | 0 0 |
| Edystone 840C receiver | 68 | 0 0 |
| Edystone 885S receiver | 60 | 6 3 |
| Edystone EC10 receiver | 53 | 0 0 |

| Trio Communications Receivers: | | £ s. d. |
|--|----|---------|
| Trio JR-60, 14 tubes amateur communications receiver, 840 kc/s.-30 mc/s., plus 142-148 mc/s. | 61 | 19 8 |
| Trio JR-58, 9 tube communications receiver | 34 | 13 0 |
| Trio JR-58DE, 8 tube receiver | 36 | 15 0 |
| Trio JR-500SE, Crystal controlled double superhet | 61 | 19 0 |

| Lafayette Receivers: | | £ s. d. |
|---------------------------------|----|---------|
| HA-500, Amateur bands receiver | 44 | 2 0 |
| HA-700, Communications receiver | 37 | 16 0 |
| HA-350, Amateur bands receiver | 78 | 15 0 |

| K.W. Electronics Ltd.: | | £ s. d. |
|--|-----|---------|
| K.W.201, Amateur bands communications receiver, 160-10m. | 105 | 0 0 |
| K.W. "Vespa," Mk. II with P.S.U. | 128 | 0 0 |
| K.W.2000A and P.S.U. | 220 | 0 0 |

Full range of K.W. Equipment now in stock.

Full range of Drake Equipment available.

Full range of Heathkit Equipment available.

| Swanco/CSE Equipment: | | £ s. d. |
|--|----|---------|
| Swanco/CSE 2A10 solid state transmitter | 43 | 7 0 |
| Swanco/CSE 2AE solid state receiver | 44 | 0 0 |
| Swanco/CSE, Type II A.T.M.A. mobile/ixed/ portable antenna | 9 | 15 0 |
| Swanco/CSE microphone, type MM2 | 2 | 17 11 |
| Halson, Mobile antenna, new all weather all bands system | 6 | 17 8 |
| Extra coils (when more than one band required) | 3 | 17 6 |

| Echellord Communications 4 metre Equipment: | | £ s. d. |
|--|----|---------|
| Echellord B1/4 transmitter | 30 | 0 0 |
| Echellord M1/4 transmitter (mains or mobile) | 40 | 0 0 |
| Echellord C1/4 converter | 10 | 10 0 |

| Codar Radio Company | | £ s. d. |
|---------------------|----|---------|
| CR.70A receiver | 19 | 10 0 |
| FR.30 | 5 | 10 0 |
| PR.30X | 7 | 4 0 |
| R.Q.10 | 6 | 15 0 |
| R.Q.10X | 8 | 8 0 |
| CC.40 | 6 | 10 0 |
| CR.45K | 9 | 10 0 |

| Partridge Electronics | | £ s. d. |
|-----------------------|---|---------|
| Joystick std. | 4 | 15 0 |
| Joystick de-luxe | 5 | 19 6 |
| Type 3 tuner | 2 | 15 0 |
| Type 2A tuner | 3 | 12 6 |
| Type 4 tuner | 4 | 4 0 |
| Type 4RF tuner | 6 | 6 0 |

SECOND-HAND EQUIPMENT

Many items in stock including: LG-300, K.W. "Viceroy," K.W. "Vanguard," Geloiso 212, LG-50, AR88D, AR88LF, B.A.1, Mohkan, B-44MK11a, Heathkit Two-er, EC-10, etc. Your enquiries please.

Full H.P. facilities (credit sale on small items).

Full Service facilities—receivers reigned, transmitters serviced etc.

New Illustrated Catalogue, 7/6 post paid.

SWANCO PRODUCTS LTD.

Dept. W.1. 247 Humber Avenue
COVENTRY

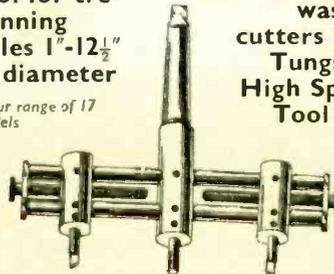
Telephone: Coventry 22714 Hours: Mon.-Sat. 9a.m.-6p.m.

ADJUSTABLE HOLE & WASHER CUTTERS

The right tool for trepanning holes 1"-12 1/2" in diameter

Adjustable hole and washer cutters 18% Tungsten High Speed Tool bits

In our range of 17 Models



Write for illustrated brochure of our full range with straight or Morse taper 1-4 or Bitsstock shank

All models available from stock
AKURATE ENGINEERING CO. LTD.
Cross Lane, Hornsey, London, N.8
TEL. FITZROY 2670

WW-135 FOR FURTHER DETAILS

VALVES

VALVE cartons by return at kept prices; send 1/- for all samples and list.—J. & A. Boxmakers, 75a, Godwin St., Bradford, 1. 110

VALVES WANTED

WE buy new valves, transistors and clean new components, large or small quantities, all details, quotation by return.—Walton's Wireless Stores, 55, Worcester St., Wolverhampton. 162

CAPACITY AVAILABLE

AIRTRONICS, Ltd., for coil winding, assembly and wiring of electronic equipment, transistorised sub-unit sheet metal work.—5a, Walerand Rd., London, S.E.13. Tel. 01-852 1706. 161

TRANSFORMERS

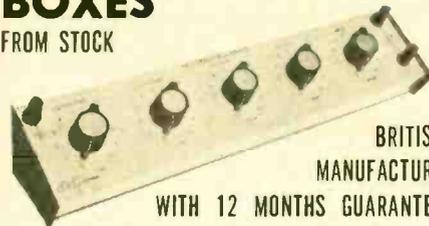
MAINS TRANSFORMERS
1VA TO 2.5 KVA

AUTO TRANSFORMERS
20 watts to 5,000 watts

Trade and Professional Enquiries Only
OLYMPIC TRANSFORMERS LTD.
224 HORSEY ROAD
LONDON, N.7
NOR 2914

JJ JUNIOR DECADE BOXES

FROM STOCK



BRITISH MANUFACTURE

WITH 12 MONTHS GUARANTEE

RESISTANCE BOXES • ACCURACY + 0.4%

| Suitable for use at high frequencies | | £ | s. | d. |
|--------------------------------------|--|-----|----|----|
| MODEL | | | | |
| J1 5 Decade 0 to 1,111,100 ohms | | £13 | 12 | 0 |
| J2 5 Decade 0 to 111,100 ohms | | £13 | 8 | 0 |
| J3 4 Decade 0 to 111,100 ohms | | £10 | 8 | 0 |
| J4 4 Decade 0 to 11,100 ohms | | £10 | 4 | 0 |
| J5 3 Decade 0 to 11,100 ohms | | £7 | 12 | 0 |
| J6 3 Decade 0 to 1,100 ohms | | £7 | 8 | 0 |

| CAPACITANCE BOXES ACCURACY ± 1% 500 V. DC Wkg. | | £ | s. | d. |
|--|--|-----|----|----|
| MODEL | | | | |
| JC1 100 pf to 0.111 µf | | £10 | 8 | 0 |
| JC2 30 to 10,140pf | | £11 | 4 | 0 |

J. J. LLOYD INSTRUMENTS LTD., Brook Ave., Warsash, Southampton

WW-136 FOR FURTHER DETAILS

MINIATURE KEY SWITCHES. (P.O. Lever Type 1000), centre off. 2 c/o each way. 7/6 ea.
RE-SETTABLE HIGH SPEED COUNTER (3 × 1 × 3/4 in.) 3 digit. 12/24/48 v. (state which), 32/6 ea. P.P. 2/6.
HIGH SPEED MAGNETIC COUNTERS (4 × 1 1/2 in.) 4 digit. 5/12v. 24/48v. (state which), 6/6 ea. P.P. 1/-.
TRON OSCILLOSCOPES. CD711S. £50 carr. 70/-; £43 £50, carr. 70/-; QD910 £75, carr. £5. All in first class condition. Complete with R.F. Als.
COPPER TIPS 3in. Rnd. 0/6 amp. 10/- ea. P.P. 2/6.
MINIMATE PRINTED CIRCUIT BOARD (8 1/2 × 5 1/2 in.) sheet, 5 for 10/-.

JULK COMPONENT OFFERS

| | |
|---|---------------|
| 100 Capacitors | 50pF to .5µF. |
| 250 Resistor (latest types) | 50pF to .5µF. |
| 250 Resistors and 1 watt. | |
| 150 Hi-Stab R2nd 1 watt. | |
| 25 Vitreous Wors. 1/2 and 1 watt. | |
| 12 Precision Rf. Resistors. 5% (several standards included) | |
| 12 Precision Capacitors 1 and 2% (several standards incl'd) | |
| 12 Electrolytics (miniature and standard sizes). | |
| ANY ITEM 10/- ANY 5 ITEMS £2 | |

VENNER LIGHTWEIGHT ACCUMULATORS (1 oz. 1 1/2 in. x 1/2 in.) 2 v. 1.5 a.h., 12/6 (with electrolyte and charging inst.).

CARPENTER POLARISED RELAY 1000 turns at 4000Ω 15/- (with base). ALL Types (G.E.C./SIEMENS/S.T.C. Sealed relays stocked).

MAINS RELAY (240 v. A.C.) 12 H.L. make contacts, 20/- ea. P.P. 2/6.

REED RELAYS (2 Herkons) S.T.C. 2426-a2-15, 2 make. 10-15 volt coil, 15/- ea.

"3000" TYPE RELAYS (Ex. New Equip.) 10 for 25/- (our choice) P.P. 5/-

RESOLVED COMPONENT INDICATOR (Solartron UP253-2A Condition new. £35 (with manual), cap. 5/-).

TELEPHONE HANDSET (Type 706) 17/6 ea., P.P. 2/6.

ZENER DIODES 3 to 50 volt. 5%. 1.5 watt. 3/6; 10 watt. 5/6 ea.

BLOWER/EXTRACTOR FANS (By PAPST Motors) 4 1/2 x 4 1/2 in. cast moulding. 450 C.F.M. Engineered to very fine limits. 50/- ea., P.P. 2/6.

THYRISTOR LAMP DIMMER/SPEED CONTROL KITS. 200 watt kit, 27/6, P.P. 2/6; 500 watt kit, 37/6, P.P. 2/6.

SILICON CONTROLLED RECTIFIERS (Thyristors) BTY87 (100r) 100 p.i.v. 12 amp., 15/- ea.; TBY91 (150r) 150 p.i.v. 16 amp., 20/-; CR525/10 100 p.i.v. 25 amp., 30/-; CR525/40 400 p.i.v. 25 amp., 60/-; CR51/20 200 p.i.v. 1 amp., 5/6; CR51/40 400 p.i.v. 1 amp., 7/6; CR53/40 400 p.i.v. 3 amp., 10/- ea.

SILICON OIODES RS220af 2/- ea., £1 doz.; RS240 3/- ea., 30/- doz.; RS280 4/- ea., 40/- doz.; IS103/BY100 4/- ea., 40/- doz.; RA5310af (avalanche) 6/- ea., 60/- doz.; IS413 5/- ea., 50/- doz.; RS610 10/- ea., RS640 20/- ea., RS612 40/- ea.; RS845 60/- ea.

PRODUCTION BATCH COUPLER (BURNDENPT) BE403. Condition: New £15 ea., P.P. 20/-.

OSCILLOSCOPES Cossor 1035, £17/10/-; 1049, £20; Solartron D300, £20, P.P. any unit £2/10/-.

E.M.I. MINIATURE RELAYS (24v. 1 c/o) 1/2 1/2 1/2 in. Vtc. 1/2 oz. 7/6 ea.

TELEPHONE OESK SETS (type 706), Brand new, 95/-, P.P. 5/-.

SILICON BRIDGE UNITS. GEX541 80 p.i.v. 10a., 37/6; E11BD-RC 100 p.i.v. 10a., 37/6; GA31-A (Germ). 200 p.i.v., 2a., 20/-.

SORENSEN VOLTAGE REGULATORS. Type LT-1000-25. £15 ea.

P.C. CONNECTORS (13 way in-line), 4/6 pair.

LARGE CAPACITY ELECTROLYTICS. 2,000 µF. 150v.; 4,000 µF. 90v. 7/6 ea., 6,300 µF. 63v.; 10,000 µF. 30v.; 16,000 µF. 15v.; 25,000 µF. 15v. 10/- ea. All 4 1/2 in. screw terminals. P.P. 1/- ea.

SPEAKER BARGAINS. E.M.I. 13 8in. with double Tweeters 15 ohm, 65/-, P.P. 5/-. As above less tweeters 3 or 15 ohm, 45/- ea., P.P. 5/-. FANE 12in. 20 watt (Dual Cone), 95/-, P.P. 5/-. PHASE SENSITIVE VOLTMETERS (Solartron UP250/253) £65.

TRANSFORMERS L.T. 50v. at 5 amp. 19-0-19v. 1/2 amp. 25/-, P.P. 5/-.

TRANSFORMERS H.T. 625-0-625v. at 110 m.a. 6.3v. at 2a., 6.3v. at 3a. ct. Parmeko Neptune series, 35/-, P.P. 5/-.

ELECTRIC SLOTMETERS (1 1/2) 25 amp. L.R. 240v. A.C. 85/- ea., P.P. 5/-.

QUARTERLY ELECTRIC CHECK METERS, 40 amp. 240v. A.C. 20/- ea., P.P. 5/-.

TRANSISTOR POWER SUPPLY. 2 × 12v. at 250 m.a. 240v. 50 c/s. input, 25/- ea., P.P. 5/- (made by E.M.I.).

STEP-DOWN TRANSFORMERS. PRI. 200/250v. Sec. 1. 115v. at 1.25 amps.; Sec. 2. 25v. at 5 amp., 25/- ea., P.P. 5/-.

PATRICK & KINNIE

81 PARK LANE, HORNCHURCH, ESSEX
Tel.: ROMFORD 44473.

MOTOLA INTEGRATED CIRCUITS

LATEST LOW PRICE DUAL IN LINE

| | | | | |
|--------|---|-----------------------|---|------|
| MC715P | — | DUAL 3-INPUT GATE | — | 19/6 |
| MC724P | — | QUAD 2-INPUT GATE | — | 17/6 |
| MC725P | — | DUAL 4-INPUT GATE | — | 17/6 |
| MC789P | — | HEX INVERTER | — | 19/6 |
| MC792P | — | TRIPLE 3-INPUT GATE | — | 19/6 |
| MC799P | — | DUAL BUFFER | — | 17/6 |
| MC788P | — | DUAL BUFFER (NON-INV) | — | 22/6 |
| MC723P | — | J-K FLIP FLOP | — | 17/6 |
| MC790P | — | DUAL J-K FLIP FLOP | — | 29/6 |

Postage and handling 2/-.

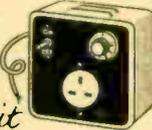
DELIVERY EX STOCK

Crosswire Electronics Ltd.

STAPLE HOUSE, 51 - 52, CHANCERY LANE, LONDON W.C.2.

WW-137 FOR FURTHER DETAILS

**HEAT
LIGHT
SPEED
CONTROL Unit**



LATEST ELECTRONIC BREAKTHROUGH. CUT YOUR ELECTRICITY BILLS BY HALF. FINGER-TIP CONTROL OF ALL ELECTRICAL APPLIANCES UP TO 3000 WATTS. **HEAT.** Vary the heat of your ELECTRIC FIRES, and save electricity. Ideal for ELECTRIC BLANKETS, household IRONS, simmer your ELECTRIC KETTLE. Excellent for SUN-RAY LAMPS. **LIGHT.** Control the brightness of all household LAMPS, from a glimmer to full brightness. Ideal for SPOT LAMPS, ARC LAMP, etc. Useful for FLOODLIGHTS. **SPEED.** Controls the speed of ANY ELECTRIC DRILL, for any application. Super for LATHE, GRINDERS, FOOD MIXERS, VACUUM CLEANERS, WASHING MACHINES, SPIN DRIERS, HEDGE CUTTERS WILL CONTROL ALL UNIVERSAL MOTORS UP TO 2 H.P. These units must not be confused with ordinary resistances and thermostats that waste power. Obtained in a strong metal case, in black or grey, size now 6x5 1/2 inches. SIMPLE TO USE. No specialised knowledge required. A unique electronic achievement, contains 7 transistors and thyristors and scores of micro miniature electronic components COMPLETELY SAFE AND APPROVED. Brand new and ready to use improved de-luxe model. Price 8 GNS. carriage and insurance 10/-. Trade enquiries invited. Free demonstration at our premises.

**RUN
TELEVISION-LIGHTING
DRILLS
ETC-ETC
from a
12 Volt CAR BATTERY**



A Superiorly designed POWER CONVERTER (de luxe model). A 12 volt INPUT gives a 200/240 volt OUTPUT. Enables you to run up to 220 watt AC/DC TELEVISION lighting and equipment. Thousands of uses. Indispensable to caravaners, Workshops and Garages. The unit is contained in a compact louvered steel case. Complete with connecting leads, battery clips and full instructions. Ready to connect up and use.
List price over £30. Our price whilst stocks last, £8/19/6. Carriage 12/6. C.F.O. C.O.D. 3/6 extra.
All orders to: Dept. P.W.8

GLOBE SCIENTIFIC LTD
24 CAWOODS YARD, MILL STREET,
MARSH LANE, LEEDS 9.

WW-138 FOR FURTHER DETAILS

CONRAD, RITBLAT & CO. OFFER

3 SMALL MODERN FACTORIES

NORTH OF LONDON

| | | |
|---|--|--|
| <p>WALTHAMSTOW ESSEX 2,000 sq. ft. rent £1,500 p.a. ex. NO PREMIUM</p> | <p>LETCHWORTH HERTS 4,000 sq. ft. rent £1,350 p.a. ex. NO PREMIUM</p> | <p>HARLOW ESSEX 2,000 sq. ft. rent £415 p.a. ex. PREMIUM £3,750</p> |
|---|--|--|

CONRAD, RITBLAT & Co.
MILNER HOUSE · LONDON W.1 · Tel. 01-935 4499 (20 LINES)

WW-139 FOR FURTHER DETAILS

B.P.A. ELECTRONICS can undertake immediately, short or long-term contracts for:— Electronic and Electro-Mechanical assembly and wiring. Coil winding (including toroidal), cable forming, vacuum impregnation and encapsulation, printed circuit board manufacture including layout and preparation of artwork. Inspection to A.I.D. or A.R.B. if required.—Boulton Paul Aircraft Ltd., Wolverhampton. Tel. Fordhouses 3191. [1938]

SERVICES OFFERED

JOIN Audio Supply Association 7 6 p.a. 65-page photographically illustrated, non-advertising Hi-Fi catalogue 5/-; equipment housing booklet 1/6; your best guides for safe buying.—10, Cliford St., London, W.1. [1943]

TUITION

KINGSTON-UPON-HULL Education Committee, College of Technology, Principal E. Jones, M.Sc., F.R.I.C.
FULL-TIME courses for P.M.G. certificates and the radar maintenance certificate, also in electrical and electronic engineering.—Information from College of Technology, Queen's Gardens, Kingston-upon-Hull. [18]

SERVO AND ELECTRONIC SALES LTD.
NOW OFFERING
RECONDITIONING SERVICE FOR INDUSTRIAL INSTRUMENTS
Moving Coil Multi-range Meters, Electrical and Electronic Test Equipment of all kinds. Estimates given for all repairs.
87 London Road, Croydon, Surrey Tel.: 01-888 1512
(Instrument Repairs and Counter Sales)
WE ARE SPECIALISTS SUPPLIERS IN ELECTRONICS, AUTOMATION AND ELECTROMECHANICS
Also at: 43 High St., Orpington, Kent Tel.: 31066 33976
MHI Road, Lydd, Kent Tel.: Lydd 252

WW-140 FOR FURTHER DETAILS

NEONS, PRINTED CIRCUIT BOARDS, INSTRUMENT CASES, MOULDED REED SWITCHES and PIDAM logic modules, CONTIL and BRIGHTLIFE products are all ex-stock. For details see December, 1967 and Feb. 1968 issues, advertisements. For further details use reader service card. New prices on new leaflet. All customers on mailing list will receive these automatically.
WEST HYDE DEVELOPMENTS LIMITED,
30 HIGH STREET, NORTHWOOD, MIDD.
Telephone: Northwood 24941

WW-141 FOR FURTHER DETAILS

FOR SALE—

4 Westminster Multiwinders, 10-way Automatic Interleave.
PRICE: £100 each and carriage. Can be viewed by arrangement.
Large range of
TRANSFORMER LAMINATIONS
in Radiometal, Mumetal & H.C.R. "C" and "E" cores—Case and Frame Assy's. Please send for list.

J. BLACK
44 Green Lane, Hendon, N.W.4
Tel.: 01-203 1855 & 3033

FAIRCHILD INTEGRATED CIRCUITS

* New low prices

These industrial microcircuits are designed for a wide variety of industrial and commercial equipment operating over a temperature range of +15 to +55 deg. C. The operating voltage range is 3.6 v. ±10%. These ICs are similar in size to TO5 can transistors and are epoxy encapsulated with 8 leads. Full details are sent with each order, showing typical applications. The 914 gate may be used to build multivibrators, Schmitt Triggers and linear amplifiers.

THE 923 IS A FULL COUNTING FLIP-FLOP.

- L 900 BUFFER - - - PRICE 9/6
- " L 914 DUAL GATE - - - PRICE 9/6
- " L 923 JK FLIP-FLOP - - - PRICE 12/6
- PLASTIC SPREADERS - - - 1/6

DELIVERY EX STOCK
 Terms: Cash with order.
 Approved Accounts Opened.
 Postage and Handling 2/-.

CROSSWIRE ELECTRONICS LTD.
STAPLE HOUSE,
51-52 CHANCERY LANE,
LONDON, W.C.2

WW-142 FOR FURTHER DETAILS

WE BUY

any type of radio, television, and electronic equipment, components, meters, plugs and sockets, valves, and transistors, cables electrical appliances, copper wire, screws, nuts, etc. The larger the quantity the better. We pay Prompt Cash.

Broadfields & Mayco Disposals,
 21 Lodge Lane, London, N.12

RING 445 2713
 445 0749
 958 7624
 958 9842

V.H.F. WIDE-BAND AMPLIFIERS

Specification: 40-230MHz: Gain 20DB-1.5DB Max. Output (1 carrier) 2 volts; Input/Output Impedance 75 ohms; 18in. Rack Mounting. Two-stage Distributed Circuit. Power Requirement: 100-250 volts 50 watts Built to Professional Standards. Brand New and Fully Guaranteed.
 For Sale at the Reduced Price of £30.0.0.
 Further details Box No. 5040, c/o "Wireless World."

DISCOUNT TRANSISTORS

Quantity prices (in brackets) for 5 OR MORE SAME TYPE. First grade, guaranteed.

| | | | |
|---------|-------------|--------|-----------|
| AD161/2 | 15/- (pair) | TIS61M | 4/- (3/6) |
| AF239 | 12/- (8/-) | 2N704 | 3/6 (3/-) |
| BC107 | 4/- (3/9) | 2N2926 | 3/- (2/6) |
| BC109 | 4/- (3/9) | 2N3702 | 4/- (3/6) |
| BC168 | 3/- (2/6) | 2N3703 | 4/- (3/6) |
| B-5000 | 10/- (9/-) | 2N3704 | 4/- (3/8) |
| IS44 | 3/6 (2/6) | 2N3705 | 4/- (3/6) |
| T13028 | 18/- (16/-) | 2N3707 | 5/- (4/6) |
| T1407 | 6/- (5/6) | 2N3983 | 6/- (5/6) |
| TIS60M | 4/- (3/8) | 2N4058 | 5/6 (5/-) |

INTEGRATED CIRCUIT CA3020 (R.C.A.) with circuit 33/-.

THERMISTOR S.T.C. R54 for W.W. Low Distortion Oscillator 21/-.

RECTIFIER 1S557 800piv, 500mA. 3/6 (3/-). Mail order only. Orders over 10/- U.K. post paid.

AMATRONIX LTD. (Dept. W.W.1), 396 SELSDON ROAD, CROYDON, SURREY.

LAWSON BRAND NEW TELEVISION TUBES

Complete fitting instructions are supplied with every tube. Terms: C.W.O. Carriage and insurance 10/-.

The continually increasing demand for tubes of the very highest performance and reliability is now being met by the new Lawson "Century 99" range of C.R.T.s.

"Century 99" are absolutely brand new tubes throughout manufactured by Britain's largest C.R.T. manufacturers. They are guaranteed to give absolutely superb performance with needle sharp definition screens of the very latest type giving maximum Contrast and Light output; together with high reliability and very long life.

"Century 99" are a complete range of tubes in all sizes for all British sets manufactured 1947-1967.



- 12" — £4 : 10 : 0
- 14" — £5 : 10 : 0
- 17" — £5 : 19 : 0
- 19" — £6 : 19 : 0
- 21" — £7 : 15 : 0

LAWSON TUBES

18 CHURCHDOWN ROAD
 MALVERN, WORCS.

Tel. MAL 2100

2 YEARS FULL REPLACEMENT GUARANTEE.

DEIMOS LTD

TAPE RECORDERS FOR RESEARCH, INDUSTRY AND PROFESSIONAL AUDIO
single and multichannel

8 CORWALL LANE, HILLINGDON, MDX.

HAYes 3561

WW-143 FOR FURTHER DETAILS

★ HAMMERITE HAMMER ENAMEL ★

AIR DRYING • JUST BRUSH ON
 1/2 pint 8/- p/p. 1/9, 1 pint 16/- p/p. 3/- Blue, silver, black, bronze (and others). NO PRIMERS NEEDED. Just try it. Brushed sample interesting but FREE. INDUSTRIALISTS !!! SAVE TIME AND EYES (2 pints will do a Min)

TRIAL TIN

(covers 5 sq. ft.)
3/9
 3d. post.

FINNIGAN SPECIALTY PAINTS (W) Mickley Square, Stocksfield, Northumberland. Tel: Stocksfield 2280

WW-144 FOR FURTHER DETAILS

GODLEYS

SHUDEHILL, MANCHESTER 4

Telephone: BLAckfriars 9432

Sole Manchester Distributors for world famous BRYAN AMPLIFIERS

Agents for Ampex, Akai, Ferrograph, Tandberg, Brenell, B & O, Vortexion, Truvox, Sony, Leak, Quad, Armstrong, Clarke & Smith, Lowther, Fisher, Goodmans, Wharfedale, Garrard, Goldring, Dual, Decca, Record Housing, Filtrube, G.K.D., etc.

Any combination of leading amplifiers and speakers demonstrated without the slightest obligation.

BUILDING A "SCOPE"

Indicator unit type 10Q53. One of the finest units to appear on the surplus market, modern manufacturer, 10.B.7.G. and 3.10, valves, built in E.H.T. unit producing 3kV. to a modern version of the 5in. V.C.R.517 tube, brilliance, focus, X and Y shift. Controls on front panel, circuit diagram supplied. Ideal for conversion to an oscilloscope. Size of unit 7in. x 7in. x 19in. long. Used but good condition 60/+, carriage 19/-. Circuit diagram sold separately, 3/9, Post Free.

New Catalogue No. 17. Government and manufacturers surplus. Also new components. 3/- post free.

RADIO CONTROL **ARTHUR SALLIS** 93 NORTH ROAD BRIGHTON SUSSEX
 Phone 65806 **EX GOVT ELECTRICAL SURPLUS**

RADIO officers see the world. Sea-going and shore appointments. Trainee vacancies during 1968. Grants available. Day and boarding students. Stamp for prospectus.—Wireless College, Colwyn Bay. [12]

I.E.R.E., City & Guilds and R.T.E.B. exams. Specialised ICS home-study course will ensure success. For details of wide range of exam. and diploma courses in radio, TV and electronics, also new practical courses with kits, write to: ICS (Dept. 522), Intertext House, London, SW11. [23]

STUDY radio, television and electronics with the world's largest home study organisation, I.E.R.E., City & Guilds, R.T.E.B. etc. Also practical courses with equipment. No books to buy. Write for free prospectus to ICS (Dept. 442), Intertext House, London, SW11. [24]

TV and Radio, City & Guilds, R.T.E.B. Certs., etc. on "satisfaction or refund of fee" terms, thousands of passes. For full details of exams and home training courses (including practical equipment) in all branches of radio, TV, electronics, etc., write for 132-page handbook—free, please state subject.—British Institute of Engineering Technology (Dept. 150K), Aldermaston Court, Aldermaston, Berks. [15]

FREE to ambitious engineers! 132-page Guide to B.Sc. (Eng.), A.M.I.E.R.E., A.M.S.E., A.M.I.M.I., City & Guilds, A.I.O.B., A.R.I.C.S., G.C.E., etc., on "Satisfaction or Refund" terms; thousands of passes—over 600 Home Study Courses in all branches of Engineering, Building, Radio, Electronics, etc.—Write: B.I.E.T. (Dept. 151K), Aldermaston Court, Aldermaston, Berks. [14]

WANTED—

Redundant or Surplus stocks of Transformer materials (Laminations, C. cores, Copper wire, etc.), Electronic Components (Transistors, Diodes, etc.), P.V.C. Wires and Cables, Bakelite sheet, etc., etc.

Good prices paid

J. BLACK

44 Green Lane, Hendon, N.W.4
Tel. 01-203 1855 and 3033

REDUNDANT OR SURPLUS RADIO — ELECTRONIC STOCKS WANTED OSMABET LTD.

46 KENILWORTH ROAD, EDGWARE, MIDDx.
TEL: STONEGROVE 9314

P.V.C. Adhesive Tapes

Widths 1/2"-1". Cores. 1" & 3". Colours. Black, white, red, green, blue, yellow. Large quantities always available. Sample 20 rolls and price list £1. Satisfaction guaranteed.

R. North & Co., 68, Wright Street, HULL.

WW—145 FOR FURTHER DETAILS

MARSHALL'S SEMICONDUCTOR CENTRE

Fully guaranteed devices at low prices

Table listing semiconductor components with prices. Columns include device type (e.g., 2/6 ca., 4/- ca.), part numbers (e.g., OC45, ACY17), and prices (e.g., 2N404, 2N1091).

NEW ADDITIONS TO OUR RANGE

Table listing new semiconductor additions with part numbers and prices (e.g., 4/6 NKT214, 2/4, 274).

NEWMARKET SILICON SILIND RANGE 7/6 ca.

Table listing Newmarket Silicon Silind components with part numbers and prices (e.g., 2N696, 2N497).

Post & Packing 1/- per order. Quantity discounts available

A. MARSHALL & SON (LONDON) LTD.,

28 Cricklewood Broadway, N.W.2.
Telephone: 01-452-0161 Dept: W.W.14

TEST EQUIPMENT — SURPLUS AND SECONDHAND

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc. in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [164]

RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

HRO Rk5s, etc., AR88, CR100, BRT400, G209, S640, etc., etc. in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [165]

TECHNICAL TRAINING

CITY & GUILDS (Electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, T.V., automation, etc., send for 132-page handbook—free.—B.I.E.T. (Dept. 152K), Aldermaston Court, Aldermaston, Berks. [115]

BECOME "Technically Qualified" in your spare time, guaranteed diploma and exam. home-study courses in radio, TV, servicing and maintenance. R.T.E.B., City & Guilds, etc., highly informative 120-page Guide—free—Chambers College (Dept. 837K), 148, Holborn, London, E.C.1. [16]

P.M.G. Certificates, City & Guilds and I.E.R.E. Examinations. Also many non-examination courses in Radio, TV and Electronics. Study at home with world famous I.O.S. Write for free Prospectus stating subject to—International Correspondence Schools (Dept. 443), Intertext House, Parkgate Rd., London, S.W.11. [125]

TRAIN TODAY FOR TOMORROW

Start training TODAY for one of the many first-class posts open to technically qualified men in the Radio and Electronics industry. ICS provide specialized training courses in all branches of Radio, Television and Electronics—one of these courses will help YOU to get a higher paid job. Why not fill in the coupon below and find out how?

- Courses include:
● RADIO/TV ENG. & SERVICING
● AUDIO FREQUENCY
● CLOSED CIRCUIT TV
● ELECTRONICS—many new courses
● ELECTRONIC MAINTENANCE
● INSTRUMENTATION AND SERVOMECHANISMS
● COMPUTERS
● PRACTICAL RADIO (with kits)
● NEW PROGRAMMED COURSE ON ELECTRONIC FUNDAMENTALS

- Guaranteed Coaching for:
● Inst. Electronic & Radio Eng's.
● C. & G. Telecom. Techns' Certs.
● C. & G. Supplementary Studies
● R.T.E.B. Radio T.V. Servicing Cert.
● Radio Amateur's Examination
● P.M.G. Certs. in Radiotelegraphy
● General Certificate of Education

Start today - the ICS way
INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 230 Parkgate Rd., London, S.W.11.
Please send FREE book on
Name
Address

GENUINE BRAND NEW PRODUCTS AT LESS THAN HALF PRICE

BRAND NEW BRITISH RECORDING TAPES—P.V.C. POLYESTER AND MYLAR, with fitted leaders in polythene and boxed, manufactured by reputable British firm, all 100% tested, not to be confused with sub-standard. Imported or usual tapes.

Table listing tape specifications: S.P., L.P., D.P. with various lengths and prices.

Brand new pre-recorded beginners and brush-up courses on tape, in FRENCH, GERMAN, ITALIAN, SPANISH. Full set course of 26 lessons recorded at 3 1/2 i.p.s. on Scotch & E.M.I. Course lasts 1 hr. and is complete with manual. Our price just 19/6, retail 59/6.

100% TESTED TRANSISTORS

Table listing various transistor types and prices (e.g., OC23, OC35, OC39).

TRANSISTORS, MATCHED SETS

1 OC24+2 OC45, per set, 10/-
1 GET874F sleeved Yellow OC44, per set, 10/-
1 GET873P sleeved White OC45 1st I.F., per set, 10/-
1 GET873P sleeved Blue OC45 2nd I.F., per set, 10/-
1 OC81D+2 OC81, per set, 9/6
1 OC82D+2 OC82, per set, 9/6
OC83 GET118/151, set of 3, 9/6

DIODES. OA81 4/-, OA95 4/-, OA182 4/-, OA202 4/-

SILICON DIODES

BYZ 12 (400 v. P.L.V., 6 amp.), 5/-
BYZ 13 (200 v. P.L.V., 6 amp.), 5/-
ELAC SPEAKERS, 7x4in. Price 12/6.

4 TRANSISTOR PUSH/PULL ULTRA Lin amplifier, 1 watt output, battery operated, designed for electronic instruments, microphones and public address. Many other uses. Price 15/6.

CABINET TO MATCH ABOVE, 10/-.

VOLUME CONTROLS, with switch, price 3/6.

TRANSISTORISED CAR RADIOS, normally £12/10/-.

Our price £9/9/6.

TELESCOPIC CAR AERIALS, 3 extensions, price 17/6

ALL GOODS SUPPLIED CARRY OUR MONEY BACK SATISFACTION GUARANTEE

Postage on all orders 1/-.

STARMAN, 28, Linkscroft Avenue, Ashford, Middlesex, Ashford S3020.

**TO INSERT AN
ADVERTISEMENT
IN THE
CLASSIFIED
SECTION
TELEPHONE
WIRELESS WORLD
WATERLOO 3333
EXT. 210**

R & R RADIO

51 Burnley Road, Rawtenstall
Rossendale, Lancs
Tel.: Rossendale 3152

BOXED VALVES

| | | | | | |
|-----------|-----|-----------|-----|-----------|-----|
| EF80..... | 4/- | PC84.... | 5/- | PY33.... | 7/6 |
| ECC82.... | 4/- | PCF80.... | 5/3 | 30P19.... | 7/6 |
| ECL80.... | 6/- | PL81.... | 5/- | 30P4.... | 7/6 |
| EB91.... | 2/- | PY81.... | 7/6 | UI91.... | 7/6 |
| EF85.... | 5/- | U301.... | 5/- | EY86.... | 5/6 |
| PL36.... | 7/6 | PCL83.... | 7/6 | | |

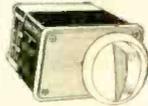
Postage on valves. One valve 9d, two or three 1/-, over three post paid.

TRANSISTORS

| | | | | | |
|-----------|-----|-----------|-----|-----------|------|
| AC128.... | 2/6 | ACY27.... | 4/- | ACY28.... | 4/- |
| ACY30.... | 5/- | OC45.... | 3/- | 2N697.... | 10/- |
| 2N706.... | 3/- | OC81.... | 3/- | OC82.... | 3/- |

V.H.F. indoor diodes c/w 6ft cable 6/- post paid.
Goods as advertised Sept. still available.

"SONOCOLOR" CINE RECORDING TAPE
Superior quality 5" reel, 900ft. L.P. with strobe markings, also cine light deflector-mirror. Suitable all tape recorders and OUR 4" - EACH cine projectors. List 28/- PRICE 14/- Post 2/6



**SMITHS PRECISION
SIX MINUTE DELAY
ACTION SWITCH**

Clockwork actuated
10/6 EACH (3 or more Post 2/6 post free).

Separate switching up to 6 mins. 15 amps. 250 volts. MADE FOR ROLLS WASHERS. Ideal photographic timer, sequence switching operations, etc., etc. Brand new units at a fraction of their value.

**SPECIAL PURCHASE
STELLA RECORD PLAYER**
Amplifier and Loudspeaker—all transistor—top performance of discs at 33 $\frac{1}{3}$, 45 and 78 r.p.m. LP xtal cartridge. Smart red or blue plastic cabinet. WORTH DOUBLE!



OUR PRICE £8.5.0 Post 5/-



**THE INSTANT BULK TAPE
ERASER AND RECORDING HEAD
DEMAGNETISER**

200 250 A.C. Leaflet S.A.E. **35/-** Post 2/6

TRANSISTOR BOOSTER—

DOUBLE YOUR VOLUME!

Black plastic cabinet speaker with 20ft. lead for transistor radio, intercom, mains radio, tape recorder. Size: 7 $\frac{1}{2}$ in. x 5 $\frac{1}{2}$ in. x 3in. **30/-** 2/6



SPECIAL OFFER! BRAND NEW B.A.S.F. TAPES
60 min. Cassette C60 (For Philips etc.) 17/6
7 in. L.P. 1,800 ft. (Cat. LGS35) 45/- Post 2/6—3 or 7 in. D.P. 2,400 ft. (Cat. LGS26) 70/- more post free.

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE RD., CROYDON. Tel: 01-684-1665

DINSDALE MK II AMPLIFIERS

Printed circuits and parts for mono and stereo versions. Special new power amp. printed board eliminates earth loop problems.

BAILEY 20 WATT AMPLIFIER. All parts available for this unit including Radiometal-cored Driver Transformer and recommended bi-filar wound Mains Transformer.

MULLARD 10W. A.B. TRANSISTOR AMPLIFIER. SPECIAL CLEARANCE.

Printed Circuit Boards to Mullard specification, fully drilled and fluxed. Price 4/- each or 7/- for two post free.

Layout Diagrams 9d. each. All other parts available. Please send S.A.E. for all Lists.

HART ELECTRONICS

321 Great Western Street, MANCHESTER 14

FOR SALE

E.M.I. RE.404 Studio Stereo/Mono Mixing Console transistorised throughout.

10 Channels (5 left and right).

Complete with presence filters. Tone Controls and provision for M.S. & A.B. working with spreader facility.

Fully isolated Monitor System incorporated. Manufactured in 1962.

Price £1,250.

Enquiries to:

CALAN ELECTRONICS LTD.

6 Croft Street, DALKEITH, Scotland.

Phone: DALKEITH 2344

RS **symbol of quality** **trade only**

for electronic components - by return

WW-147 FOR FURTHER DETAILS

BOOKS

"BASIC Mathematics for Radio and Electronics"
By P. M. Colebrook, B.Sc., D.I.C.A.C.G.I. Revised and enlarged by J. M. Head, M.A. (Cantab.), presents in readable form a complete course in basic mathematics from engineering students of all kinds and leads on to the more advanced branches of mathematics of increased importance to radio engineers. In this edition the chapter covering the application of mathematics to radio has been revised and enlarged while new subjects covered include Stability, Linear Differential Equations, Elementary Statistics, Short Cuts to Numerical Calculations and an Introduction to Matrices. Will be invaluable to those without previous knowledge of the subject. 17/6 net from all booksellers. By post 18/6 from Iliffe Books, Ltd., Dorset House, Stamford St., London, S.E.1.

"ULTRASONIC delay Lines" C. F. Brockelsby, B.Sc. A.R.C.S., A.M.I.E.E., J. R. Palfreeman, R. W. Gibson, B.Sc. (Eng.), Grad. I. Mech. E. The authors are members of a team which has been working on ultrasonic delay lines, since the early days, at the Mullard Research Laboratories. This is the first book to be written specifically on the subject which has important applications in radar, radio and television, electronic computers, pulse-forming networks, correlation techniques and multi-channel communication systems. The early chapters discuss basic principles and the various type of delay lines are then covered. The chapter on electronics for delay lines deals fully with the design of broad-band amplifiers, oscillators, etc., either with transistors or valves. The last two chapters are devoted to the delay line measurements and the many applications of delay lines. Among the five appendices there is one containing nearly 60 curves which give the characteristics of many delay line materials. The final appendix discusses one of the latest developments, ceramic transducers. 65/- net, 66/3 by post.

"WIRELESS Servicing Manual" W. T. Cocking, M.I.E.E. This is the tenth edition of a book which since 1936 has been known to radio servicemen everywhere as a reliable, thorough and comprehensive guide to solving most of the problems that arise in the repair, maintenance and adjustment of the modern radio receiver. In the present edition a major addition is a chapter devoted to transistors and transistor sets. The author of "Wireless Servicing Manual" is well known to a wide circle of readers as former editor of "Electronic Technology" and now of "Industrial Electronics." His crisp, lucid style makes this handbook of utmost value to the service man and amateur alike. 25/- net, 26/- by post from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

CURSONS TRANSISTORS

ALL GUARANTEED

- 1/- each. BAY31, BAY50, DK10, OA70, OA81.
- 2/- each. XA101, XA102, OC71, OC72, OC81, OC8D, OC44, OC45, GET16, FST3/1, ACY22.
- 3/- each. OC139, OC140, 2N706, 2N708, 2N2894, BY100, RA5310AF, 2N914, BSY26, BSY27, BSY95A, AFZ12, BFY18, BFY19, BFY26.
- 7/6 each. RA5508AF, CRS3/40, BLY10, BLY11, BUY10, BUY11, ADY22, ADY23, ADY24, OC26.

ZENER DIODES

3.9 v. to 26 v., $\frac{1}{2}$ w. 3/0 each; 1.5 w. 4/-; 7 w. 5/- ea.

**CURSONS,
78 BROAD STREET,
CANTERBURY, KENT.
S.A.E. LATEST NEW LIST**

LONDON SHOWROOM

with **OFFICES & WORKSHOP**

close **MARBLE ARCH**

approx. 2,500 sq. ft.

suitable for manufacturing & distribution

rent £2,000 p.a. ex

apply sole surveyors

CONRAD, RITBLAT & Co.
Millner House, London W.1 Tel 01-935 4499 (20 lines)

WW-148 FOR FURTHER DETAILS



**HORSTMANN 20 AMP
ELECTRIC TIME SWITCH
36HR SPRING RESERVE**

200/250 volts, 20 amp. contacts. ON/OFF twice every 24 hours at any manually pre-set times. By-pass override, 36 hour spring reserve, overcomes stopping in case of power cut. Can be supplied with Solar dial if required, on at dusk, off at dawn. Used but perfect. **LIMITED QUANTITY. 69/6.** P. & P. 4/6.

Waterproof metal case approx. 6in. x 3 $\frac{1}{2}$ in. x 3 $\frac{1}{2}$ in. 10/- extra.

HORSTMANN 15 DAY CLOCKWORK TIME SWITCH
Jewelled movement. Once ON/OFF every 24 hours at any manually pre-set times. Key and mounting bracket. Used but perfect. 5 amp model. Fully guaranteed. **35/-** P. & P. 4/6.

Box 365, **KINGSWOOD SUPPLIES (w.w.9)**
4, SALE PLACE, LONDON, W.2. Tel: 01-723 8189.



MANUFACTURERS OF THE WORLD'S FINEST SOLDERING INSTRUMENTS

CATALOGUE SURVEY No. 3 THE L.64.

THIS IS PERHAPS THE MOST POPULAR MODEL IN THE RANGE. ITS SHARP TEMPERATURE TOGETHER WITH ITS GOOD HEAT RESERVOIR AND RAPID RECOVERY TIME MAKE THIS MODEL THE PERFECT GENERAL PURPOSE INSTRUMENT—FITTED AS STANDARD WITH A $\frac{3}{16}$ " BIT, ITS VERSATILITY IS FURTHER INCREASED BY A FULL RANGE OF BITS GIVING TIP SIZES FROM $\frac{3}{32}$ " TO $\frac{1}{4}$ ". AGAIN, SPECIAL TEMPERATURES AND VOLTAGES CAN BE SUPPLIED TO ORDER AT NO EXTRA CHARGE.



Send for details to

HEAD OFFICE SALES & SERVICE

ADCOLA PRODUCTS LTD
ADCOLA HOUSE, GAUDEN ROAD,
LONDON, S.W.4.

Telephones: 01-622-0291/3

Telegrams: SOLJOINT, LONDON, S.W.4

AUSTRALIAN ASSOCIATES: ADCOLA PRODUCTS PTY. LTD., 673 WHITEHORSE ROAD, MONT ALBERT MELBOURNE
 AGENTS IN ALL LEADING COUNTRIES

This page
for 20 years

240 consecutive
issues

Advertisements

Wireless World

MAY, 1945

**WHEN YOU BUY SOLDER
WHETHER YOU BUY IT TO REPAIR A SET
TO MAKE ONE SET OR A THOUSAND SETS
IT WILL PAY YOU TO BUY THE BEST—
ERSIN MULTICORE**



The cost of making an average joint in radio equipment when using ERSIN MULTICORE, bought in its smallest package, is one-tenth of a farthing. Naturally, if you bought a ton of ERSIN MULTICORE, each joint would cost you less still. Just one faulty joint can, to put it mildly, cause you considerable annoyance. Isn't it worth while therefore to buy the best? Insist on getting ERSIN MULTICORE—the solder wire with 3 cores of non-corrosive extra active Ersin Flux.

our claim
of 1945 is
as sound
today

After advertising *inside* "WIRELESS WORLD" we moved to the outside back cover in May, 1945. Here is part of that advertisement. Since January, 1948 we've occupied this space in *every* issue. Probably a record for any manufacturer in any journal.

Although we've improved the product and made it in many different alloys, with finer gauges and different fluxes, our main claim is as sound today as it was 30 years ago. It pays to buy the best. Millions of miles of 3 and 5 core Ersin Multicore solder including non-corrosive fluxes is used in over 60 countries.

We also make solder-tape, preforms, washers, rings, pellets, discs and liquid fluxes ... and a complete range of alloys and chemicals for soldering printed circuits.

Our new Mark 2 Solderability Test Machine and Automatic Solderer make industry more efficient.

Arax Acid Core Solder assists in fabricating metals.



ERSIN

Multicore
5 CORE SOLDER

The 30-page seventh edition of "Modern Solders" is available free of charge to engineers applying on their Company's notepaper. Ask us to help you with your soldering problems.

Multicore Solders Ltd., Hemel Hempstead, Herts.
Telephone Hemel Hempstead 3636 Telex 82363

WW-002 FOR FURTHER DETAILS