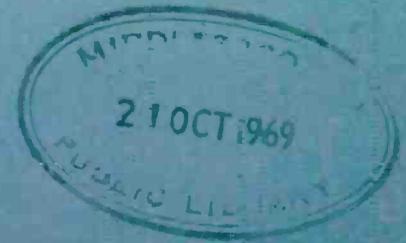


Wireless World

November 1969 Three Shillings

Integrated circuit tester
Electronics in civil aviation



UNITEC 1



SIMPLEX FORWARD CORRECTOR

**THE ADVANCED COMMUNICATIONS ANCILLARY
ENSURING READABLE TELEPRINTER COPY for**

- * **METEOROLOGICAL BROADCASTS**
- * **MARINE COMMUNICATIONS**
- * **OFF-SHORE DRILLING**
- * **FORESTRY**
- * **BANKING**

AND MANY SIMILAR APPLICATIONS

Standard Telephones and Cables Limited,
Communications Division, New Southgate, London N.11.
Telephone: 01-368 1200. Telex: 261912.

An **ITT** Associate

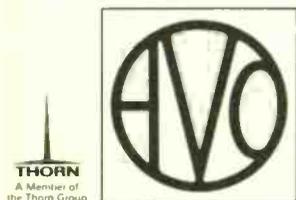
world-wide telecommunications and electronics

STC

why the MULTIMINOR is still the best mini-meter

- It's still an Avometer yet fits in the pocket/held easily in one hand
- Has a d.c. sensitivity of $10,000\Omega/V$
- Measures up to 25kV and 25A with optional accessories
- Accuracy conforms to B.S.S. 89/54.

Get your own Multimeter today (complete with plastic case, leads, instruction booklet and a full year's guarantee) from your local supplier, or ask for details direct from Avo.



Avo Limited
Avocet House, Dover, Kent
Telephone: Dover 2626
Telex: 96283

WW—006 FOR FURTHER DETAILS

prepare now for tomorrow's world

Today there is a huge demand for technologists such as electronics, nuclear and computer systems engineers, radio and television engineers, etc. In the future, there will be even more such important positions requiring just the up-to-date, advanced technical education which C.R.E.I., the Home Study Division of McGraw-Hill Book Co., can provide.

C.R.E.I. Study Programmes are directly related to the problems of industry including the latest technological developments and advanced ideas. Students claim that the individual tuition given by the C.R.E.I. panel of experts in each specialised field is comparable in technological content with that of technical colleges.

Why C.R.E.I. Courses are best

No standard text books are used — these are often considerably out-of-date when printed. C.R.E.I. Lesson Material contains information not published elsewhere and 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, Industry.

Take the first step to a better job now—enrol with C.R.E.I., the specialists in Technical Home Study Courses.

C.R.E.I. PROGRAMMES ARE AVAILABLE IN:

Electronic Engineering Technology * Industrial Electronics for Automation * Computer Systems Technology * Nuclear Engineering * Mathematics for Electronics Engineers * Television Engineering * Radar and Servo Engineering

City and Guilds of London Institute: Subject No. 49 and Advanced Studies No. 300.



Member of the
Association of British
Correspondence Colleges
C.R.E.I. (London), Walpole House,
173-176 Sloane Street, London S.W.1.
A subsidiary of McGraw-Hill Inc.

POST THIS COUPON TODAY FOR A BETTER FUTURE

To C.R.E.I. (London), Walpole House, 173-176 Sloane Street, London, S.W.1.
Please send me (for my information and entirely without obligation) full details of the Educational Programmes offered by your Institute.

My interest is City and Guilds please tick General

NAME _____

ADDRESS _____

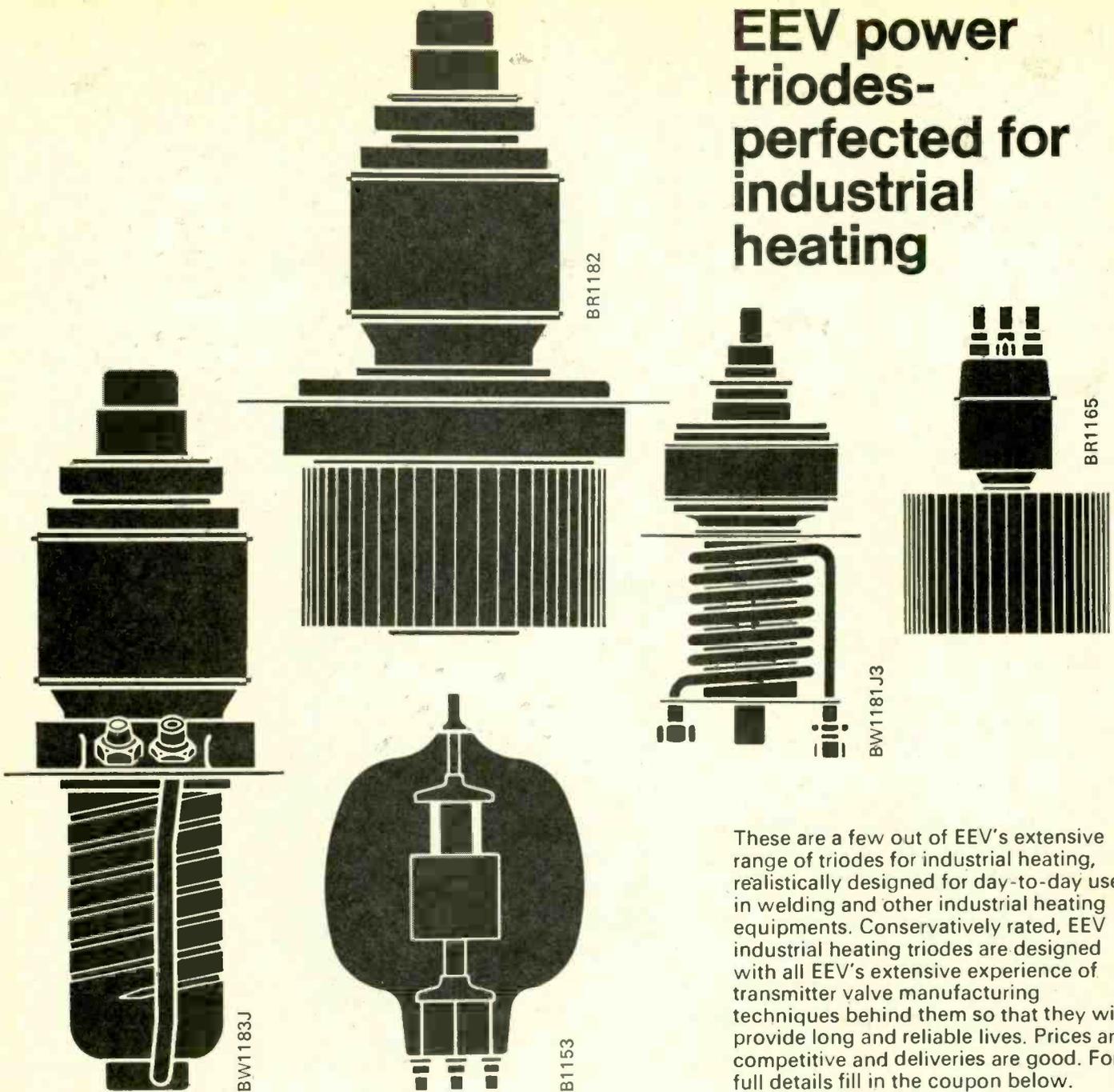
EDUCATIONAL BACKGROUND _____

ELECTRONICS EXPERIENCE _____

WW124

WW—007 FOR FURTHER DETAILS

EEV power triodes-perfected for industrial heating



These are a few out of EEV's extensive range of triodes for industrial heating, realistically designed for day-to-day use in welding and other industrial heating equipments. Conservatively rated, EEV industrial heating triodes are designed with all EEV's extensive experience of transmitter valve manufacturing techniques behind them so that they will provide long and reliable lives. Prices are competitive and deliveries are good. For full details fill in the coupon below.



English Electric Valve Co Ltd
 Chelmsford Essex England Telephone: 61 777
 Telex: 99103 Grams: Enelectico Chelmsford

Send for full details of EEV power triodes for industrial heating.

Please send me full data on your range of forced-air cooled power triodes for industrial heating. I am also looking for a triode with the following parameters:

Output power (kW) : _____ Anode voltage max. (kV) : _____ Frequency (MHz) : _____

NAME _____ POSITION _____

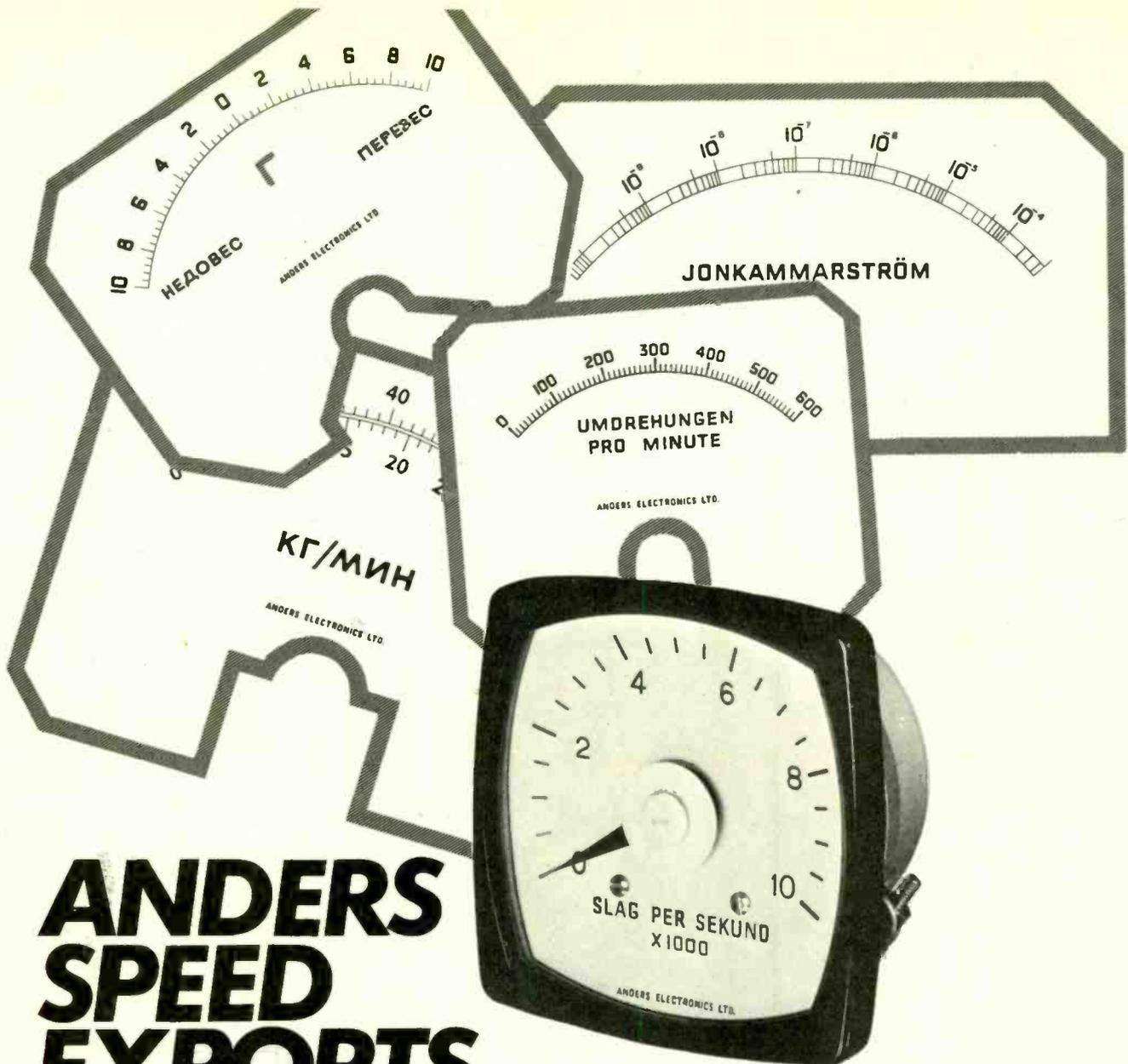
COMPANY _____

ADDRESS _____

TELEPHONE NUMBER _____ EXTENSION _____

WW-008 FOR FURTHER DETAILS

WW35



ANDERS SPEED EXPORTS

So you're doing your bit and making equipment for far-away places? And you're held up for meters? Like an 0.5mA calibrated in pulsfrekvens? Or a jonkamarström meter specially calibrated from 10^{-10} to 10^{-4} ? Or a straightforward (but impossible to locate) 100mA moving-coil job reading simply 0.35 КГ/МИН? Relax. No problem at all. Anders are legending most types of meters in all sorts of languages every day of the week—and as often as not calibrating them specially into the bargain. Hand lettering specialists are standing by for the one or two off. Fast, accurate techniques are here for the quantity orders. Ring us. You'll find we are as fast at this sort of thing as we are at supplying standard meters off the shelf . . . and, as you know (or should know), that's fast.

N.B. The variety of meters in our new catalogue is a revelation—and now we've got extensive new centralised premises for a better-than-ever 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.

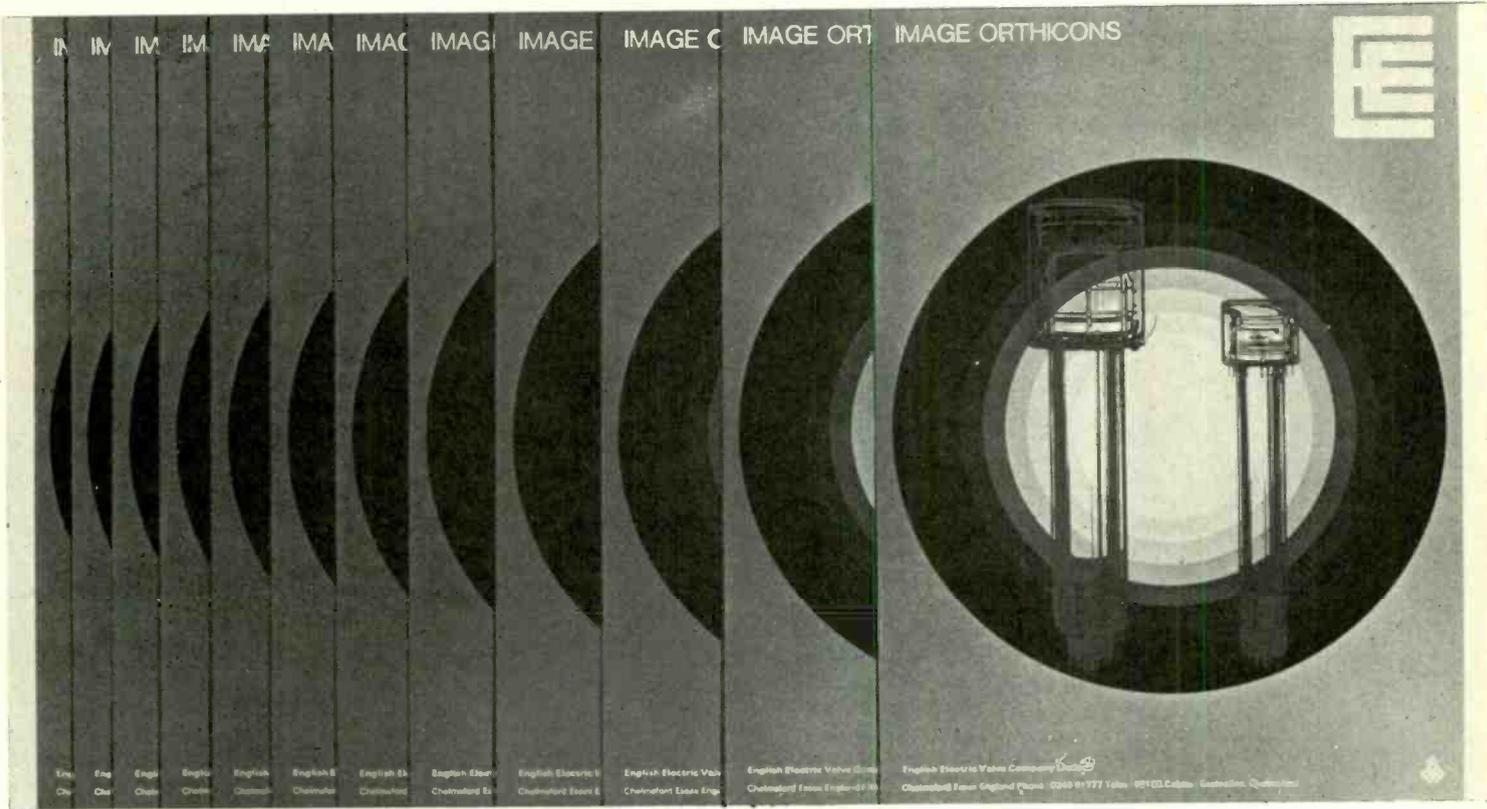
ANDERS METER SERVICE

Anders Electronics Ltd., 48-56 Bayham Place, Bayham Street, London, N.W.1. Telephone: 01-387 9092

WW—009 FOR FURTHER DETAILS

Image Orthicons— a new brochure from EEV

This new brochure gives a summary of the EEV range of Image Orthicons, applications and brief data. Full information, including characteristic curves and operational conditions together with outline diagrams, is available on request. But for an introduction to the range, send for a free copy of our new brochure.



English Electric Valve Co Ltd
 Chelmsford Essex England Telephone: 61777
 Telex: 99103 Grams: Enelectico Chelmsford



 Please send me a copy of your Image Orthicon brochure.

NAME

POSITION

COMPANY

ADDRESS

TELEPHONE NUMBER

EXTENSION

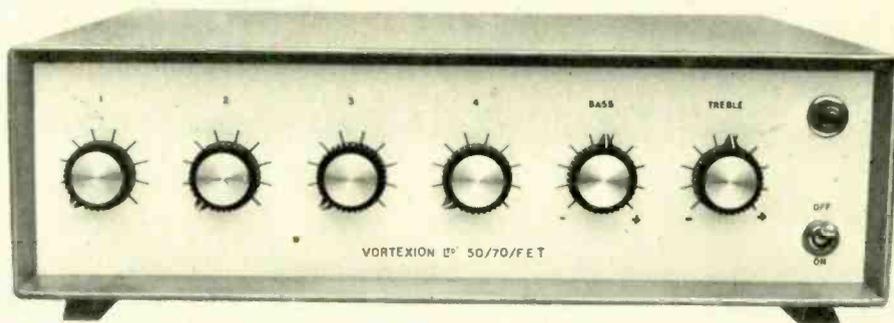
WW—010 FOR FURTHER DETAILS

WW36

Vortexion

This is a high fidelity amplifier (.3% intermodulation distortion) using the circuit of our 100% reliable—100 Watt Amplifier (no failures to date) with its elaborate protection against short and overload, etc. To this is allied our latest development of F.E.T. Mixer amplifier, again fully protected against overload and completely free from radio breakthrough. The mixer is arranged for 3-30/60Ω balanced line microphones, and a high impedance line or gram. input followed by bass and treble controls. Since the unit is completely free from the input rectification distortion of ordinary transistors, this unit gives that clean high quality that has tended to be lost with most solid state amplifiers.

THE VORTEXION 50/70 WATT ALL SILICON AMPLIFIER WITH BUILT-IN 4 WAY MIXER USING F.E.T.s.



Size 14" × 11½" × 4½"

100μV on 30/60 ohm mic. input.
100mV to 100 volts on gram/auxiliary
input 100KΩ.

Weight 20lb.

ELECTRONIC MIXERS. Various types of mixers available. 3-channel with accuracy within 1db Peak Programme Meter. 4-6-8-10 and 12-way mixers. Twin 2,3,4 and 5 channel stereo. Tropicalised controls. Built-in screened supplies. Balanced line mic. input. Outputs: 0.5v at 20K or alternative 1mW at 600 ohms, balanced, unbalanced or floating.

200 WATT AMPLIFIER. Can deliver its full audio power at any frequency in the range of 30 c/s-20Kc/s ± 1db. Less than 0.2% distortion at 1 Kc/s. Can be used to drive mechanical devices for which power is over 120 watt on continuous sine wave. Input 1 mW 600 ohms. Output 100-120v or 200-240v. Additional matching transformers for other impedances are available.

30/50 WATT AMPLIFIER. With 4 mixed inputs, and bass and treble tone controls. Can deliver 50 watts of speech and music or over 30 watts on continuous sine wave. Main amplifier has a response of 30 c/s-20Kc/s ± 1db. 0.15% distortion. Outputs 4, 7.5, 15 ohms and 100 volt line. Models are available with two, three or four mixed inputs for low impedance balanced line microphones, pick-up or guitar.

CP50 AMPLIFIER. An all silicon transistor 50 watt amplifier for mains and 12 volt battery operation, charging its own battery and automatically going to battery if mains fail. Protected inputs, and overload and short circuit protected outputs for 8 ohms-15 ohms and 100 volt line. Bass and treble controls fitted. Models available with 1 gram and 2 low mic. inputs. 1 gram and 3 low mic. inputs or 4 low mic. inputs.

100 WATT ALL SILICON AMPLIFIER. A high quality amplifier with 8 ohms-15 ohms and 100 volt line output for A.C. Mains. Protection is given for short and open circuit output over driving and over temperature. Input 0.4v on 100K ohms.

20/30 WATT MIXER AMPLIFIER. High fidelity all silicon model with F.E.T. input stages to reduce intermodulation distortion to a fraction of normal transistor input circuits. The response is level 20 to 20,000 cps within 2 db and over 30 times damping factor. At 20 watts output there is less than 0.2% intermodulation even over the microphone stage at full gain with the treble and bass controls set level. Standard model 1-low mic. balanced input and Hi Z gram.

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, S.W.19

Telephone: 01-542 2814 and 01-542-6242/3/4

Telegrams: "Vortexion London S.W.19"

WW—011 FOR FURTHER DETAILS

QUAD 50 is a single channel 50 Watt amplifier designed for Broadcast, Recording and other applications in the Audio industry, completely proof against misuse and giving the highest quality of reproduction.



INPUTS - 0.5 Vrms unbalanced with provision for an optional plug-in transformer for bridging 600 ohms lines.
OUTPUTS - isolated providing 50 watts into almost any impedance from 4 to 200 ohms.
DIMENSIONS - 12 $\frac{3}{4}$ " x 6 $\frac{1}{4}$ " x 4 $\frac{1}{2}$ "

Complete the coupon and post today.

QUAD
for the
closest approach
to the
original sound

Please send me full details of the QUAD 50 Amplifier

NAME

POSITION

COMPANY

ADDRESS

.....

(BLOCK CAPITALS)

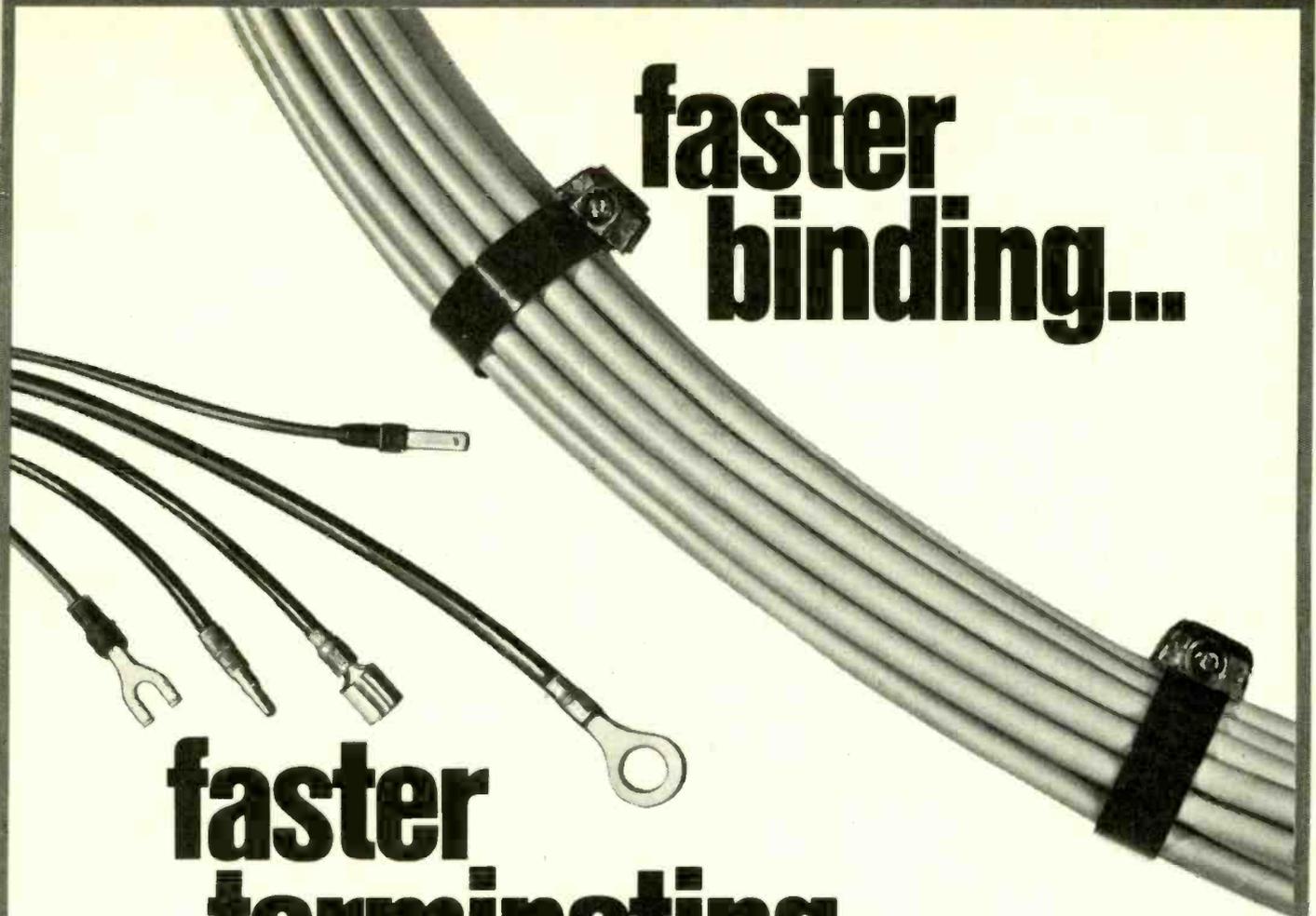
ACOUSTICAL MANUFACTURING CO. LTD.,
HUNTINGDON. Telephone: Huntingdon (0480) 2561/2

w w

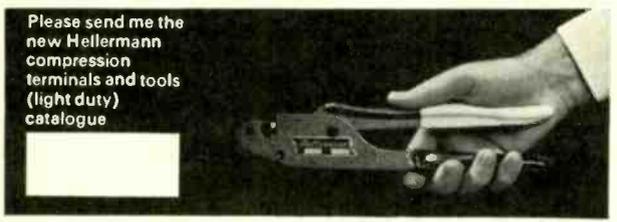
WW-012 FOR FURTHER DETAILS

faster binding...

faster terminating...



Please send me full-colour broadsheet on the Tyton system



Please send me the new Hellermann compression terminals and tools (light duty) catalogue

Name _____

Company _____

Address _____

www11



WORLD LEADERS IN CABLE ACCESSORIES
HELLERMANN ELECTRIC

A division of Bowthorpe-Hellermann Ltd.,
Gatwick Road, Crawley, Sussex.
Tel: 28888

A member of the Bowthorpe Holdings Group of Companies

The Tyton® cable binding system is unique. Binds cables half as fast again as comparable systems. Exclusive double extrusion locking ensures consistent fixing and high pull-out force. Only one size of strapping and closures needed for each tool for simplified stocking. Off-the-reel strapping means *no wasted lengths*—use 1000 ties a week and you could save hundreds a year. Strapping and accessories come in self-extinguishing nylon capable of withstanding 100°C continuously. Accessories include rivet and pin fixing saddles and closures, one-hole fixing clips etc.

Hellermann compression terminals and tools are designed to end terminating snags. Tools are available in hand, pneumatic or foot-operated types. All feature straight-line die motion, full stroke ratchet-controlled mechanism for consistent results, and colour-coded bodies and handles for quick, simple matching of terminal types and sizes. They cover all AWG sizes from 22 to 6 (·20 to 18·3 mm²). Terminals come in four basic types and in dozens of different sizes and patterns.

There's just one thing that links the vast Hellermann range of cable accessories ...

Hellermann are determined to save you money!

WW—013 FOR FURTHER DETAILS

WG THERMOSTATIC SOLDERING IRONS

Two new and unique thermostatic soldering irons with closely controlled bit temperatures to suit all types of soldering. WG thermostatically controlled soldering irons cannot overheat enabling high wattage elements to be used and making soldering infinitely more efficient than ever before. Inexpensively priced these irons represent a major advance in heat controlled soldering.



MODEL WG50. For use on very small to medium size electronic circuits. Power rating 50 watts. Voltages available 12v., 24v., 100/120v., 210/250v. Five bit sizes from $\frac{1}{16}$ " to $\frac{1}{4}$ ".

59/6



MODEL WG150. For use on all circuits requiring a large number of joints. Power rating 150 watts. Voltages available 100/120v., 210/250v. Four bit sizes from $\frac{3}{16}$ " to $\frac{7}{16}$ ".

89/6

W. GREENWOOD ELECTRONIC LTD.

21, Germain Street, Chesham, Bucks. Tel: Chesham 4808/9

WW—014 FOR FURTHER DETAILS



A Technical Knockout

Titles are hard to win at Morganite. But we have a Champion in the Type 81E Cermet Trimming Potentiometer.

After several rounds with our Quality Control personnel, the Champion emerged unscathed. Unfortunately,

the other contender could not stay the distance. He survived an examination of tiny component parts at 500 times life size (that's like spotting blemishes on a 60 ft. matchstick) but he suffered a technical K.O. during the final rounds

of electrical tests.

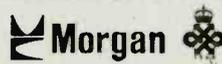
The Champion took them in his stride and now challenges all comers.

If you have an application for a 0.5w single turn trimming potentiometer, (Bantam Weight) back a proven title holder – it pays !

MORGANITE RESISTORS LIMITED

Bede Industrial Estate, Jarrow, County Durham.

Telephone: Jarrow 897771 Telex: 53353



WW—015 FOR FURTHER DETAILS

www.americanradiohistory.com

The

Genevac[®]

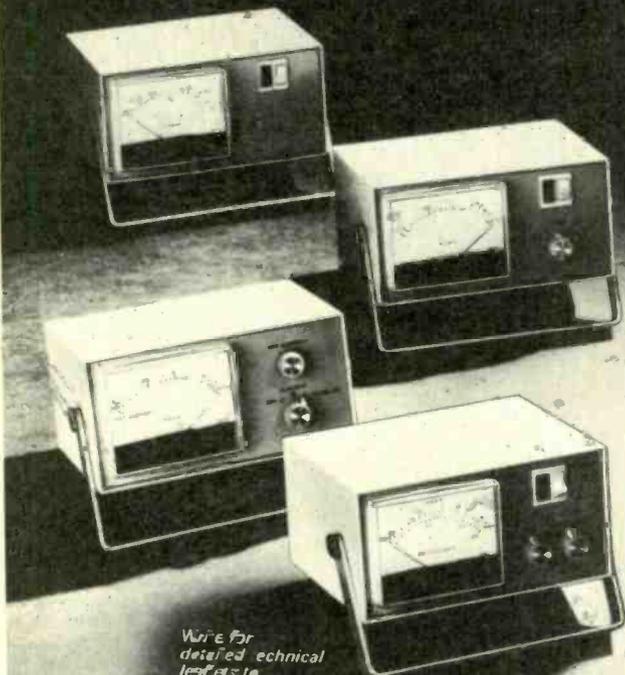
VACUUM GAUGES

The Genevac Gauge Range: three types of pressure measurement device suitable for sophisticated applications in science and industry. All feature ins and readout, recorder output and interchangeable gauge heads. Electrical & stabilised power supply makes the gauges insensitive to mains voltage fluctuation thus eliminating an external 'set volts' control.

Thermocouple Gauges and Gauge Heads: for pressure measurement in the medium high vacuum range 1 torr to 10^{-3} torr. Two types, mains or battery powered.

Pirani Gauge and Gauge Head: for pressure measurement in the medium high vacuum range 1 torr to 10^{-3} torr. Two scale readout.

Penning Gauge and Gauge Head: for pressure measurement in the high vacuum range of 3×10^{-3} torr to 10^{-6} torr. Panel mounting accessories available.



Write for detailed technical leaflets

WILLM PRODUCTS DIVISION

General Engineering Co. (Radcliffe) Ltd.

15220, Millers Road, Radcliffe, Manchester

Phone: 061 275 2771, 2772, 2773. Telex: 31290 Genvac.



ORYX

are trumps!

MODEL SR1
Instant solder remover
Ideal for printed circuit work
and integrated circuits.
79/6

MODEL SR2
with non recoil
action
82/6

MINIATURE SOLDER POT
60/-

For rapid tinning of small tags and components.

MODEL ST-60
90/-

'Hot' wire stripper for P.T.F.E. insulation.
24 v operation.

MODEL 6A
27/6

The smallest low voltage soldering iron, ideal for Printed Circuit work.
6v.6 watts.

MODEL WG50
59/6

Thermostatically controlled miniature soldering iron. 50 watts.
5 bit sizes $\frac{1}{16}$ " - $\frac{1}{4}$ "
Available for 12v, 24v, 110v and 210/250v. operation

MODEL M1
35/-

A miniature mains voltage soldering iron
10 watts. 5 bit sizes $\frac{1}{16}$ " - $\frac{1}{4}$ "
210/250v operation

Full details of these and other instruments from the Sole U.K. and Export distributors.

W. GREENWOOD ELECTRONIC LTD.

21, GERMAIN STREET, CHESHAM, BUCKS
TELEPHONE: CHESHAM 4808/9.

the variable
transformer
range from
the company
with 35 years
experience...

Claude Lyons Regulac[®]



With every Claude Lyons Regulac comes the benefit of 35 years' experience in variable transformers. Regulacs come in hundreds of models from small single units for laboratory or instrument use to large ganged assemblies for high-power 3-phase operation at outputs from 210VA to 28.8 kVA and above.

The range includes portable, dual-output and oil-immersed models plus many high-frequency and special types—and is constantly being extended.

[®] Registered trade mark of Claude Lyons Limited

Regulacs provide smooth, continuous adjustment of voltage output from zero to line voltage and above, either hand-operated or motor-driven. No device is more useful, versatile and reliable for the control of AC voltage.



For full details write to Publicity Department, Hoddesdon
Claude Lyons Limited
Hoddesdon, Herts. Hoddesdon 67161 Telex 22724
76 Old Hall St., Liverpool L3 9PX. 051-2271761 Telex 62181

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.

ELECTRICAL ENG.

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

CIVIL ENG.

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

RADIO ENG.

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

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.

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., B.Sc. (Eng.), A.M.S.E., R.T.E.B., A.M.I.P.E.,
 A.M.I.M.I., A.R.I.B.A., A.I.O.B., P.M.G., 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.

164 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 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 COUPON NOW!

TO B.I.E.T., 446A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE.

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

LEVELL VOLTMETERS

measure μ V's from

1Hz to 450MHz

TRANSISTOR A.C. MICROVOLTMETERS

Response from 1Hz to 3MHz with amplifier output available. Two versions differ only in meter size and bandwidth switch on type TM3B.

TYPE TM3A
£49

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather case £4/10/-
A.C. Power Unit £7/10/-



TYPE TM3B
£63

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £5.
A.C. Power Unit £7/10/-

VOLTMETER RANGES

15 μ V, 50 μ V, 150 μ V 500V f.s.d.
Accuracy $\pm 1\% \pm 1\%$ f.s.d. $\pm 1\mu$ V at 1kHz.

dB RANGES

-100dB to +50dB in 10dB steps. Scale
-20dB to +6dB. 0dB = 1mW into 600 Ω .

FREQUENCY RESPONSE

Above 500 μ V: ± 3 dB from 1Hz to 3MHz.
 ± 0.3 dB from 4Hz to 1MHz.
On 500 μ V: ± 3 dB from 2Hz to 3MHz.
On 150 μ V: ± 3 dB from 4Hz to 1MHz.
On 50 μ V: ± 3 dB from 7Hz to 500kHz.
On 15 μ V: ± 3 dB from 20Hz to 200kHz.

AMPLIFIER OUTPUT

150mV at f.s.d. on all ranges. Will drive a load of 200k Ω and 50pF without loss.

POWER SUPPLY

One type PP9 battery, life 1000 hours; or, A.C. mains when Power Unit is fitted.



BROADBAND VOLTMETERS

As A.C. Microvoltmeters plus H.F. probe to extend response to 450MHz. Two versions differ only in meter size and L.F. bandwidth switch on type TM6B.

TYPE TM6A
£85

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £4/10/-
A.C. Power Unit £7/10/-



TYPE TM6B
£99

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £5.
A.C. Power Unit £7/10/-

H.F. VOLTAGE RANGES

1mV, 3mV, 10mV 3V f.s.d. Square law scales. Accuracy $\pm 4\%$ of reading $\pm 1\%$ of f.s.d. at 30MHz.

H.F. dB RANGES

-50dB, -40dB, -30dB +20dB.
Scale -10dB to +3dB. 0dB = 1mW into 50 Ω .

H.F. RESPONSE

± 0.7 dB from 1MHz to 50MHz
 ± 3 dB from 300kHz to 400MHz.
 ± 6 dB from 400MHz to 450MHz.

L.F. RANGES

As TM3A and TM3B except for the omission of 15 μ V and 150 μ V.

POWER SUPPLY

One type PP9 battery, life 1000 hours on L.F. ranges and 400 hours on H.F. ranges; or, A.C. mains when Levell Power Unit is fitted.

LEVELL

PORTABLE INSTRUMENTS

Fully detailed leaflets are available on our complete range of portable instruments

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

WW-020 FOR FURTHER DETAILS

THIS NEW ARROW CT RANGE OF COMMERCIAL SUB-MINIATURE SWITCHES OFFER

Big savings



plus 2A 250V AC operation.

The first of a new range of low-cost, compact switches, which will be found to be invaluable when weight and space saving, together with good product styling, are prime considerations.

Combining the highest standards of quality and reliability, this range of switches opens up new horizons for designers of commercial equipment. Competitive in price and of attractive appearance these sub-miniature switches are available with two or three position single pole change over circuits, are rated at 5A 29V DC, 2A 250V AC, and measure only 0.551" x 0.375" and 0.93" to the top of the sleeve.

Write or telephone for full details and/or a sample of this latest Arrow switch—it's a little beauty.

ARROW

ARROW ELECTRIC SWITCHES LTD.

BRENT ROAD, SOUTHALL, MIDDLESEX. PHONE: 01-574 2442 Telex: 23332 Cables: ARROWHART LONDON
Scottish office: 13 Murray Place, Stirling. Phone: 0786 3823

subsidiary of 

WW-021 FOR FURTHER DETAILS

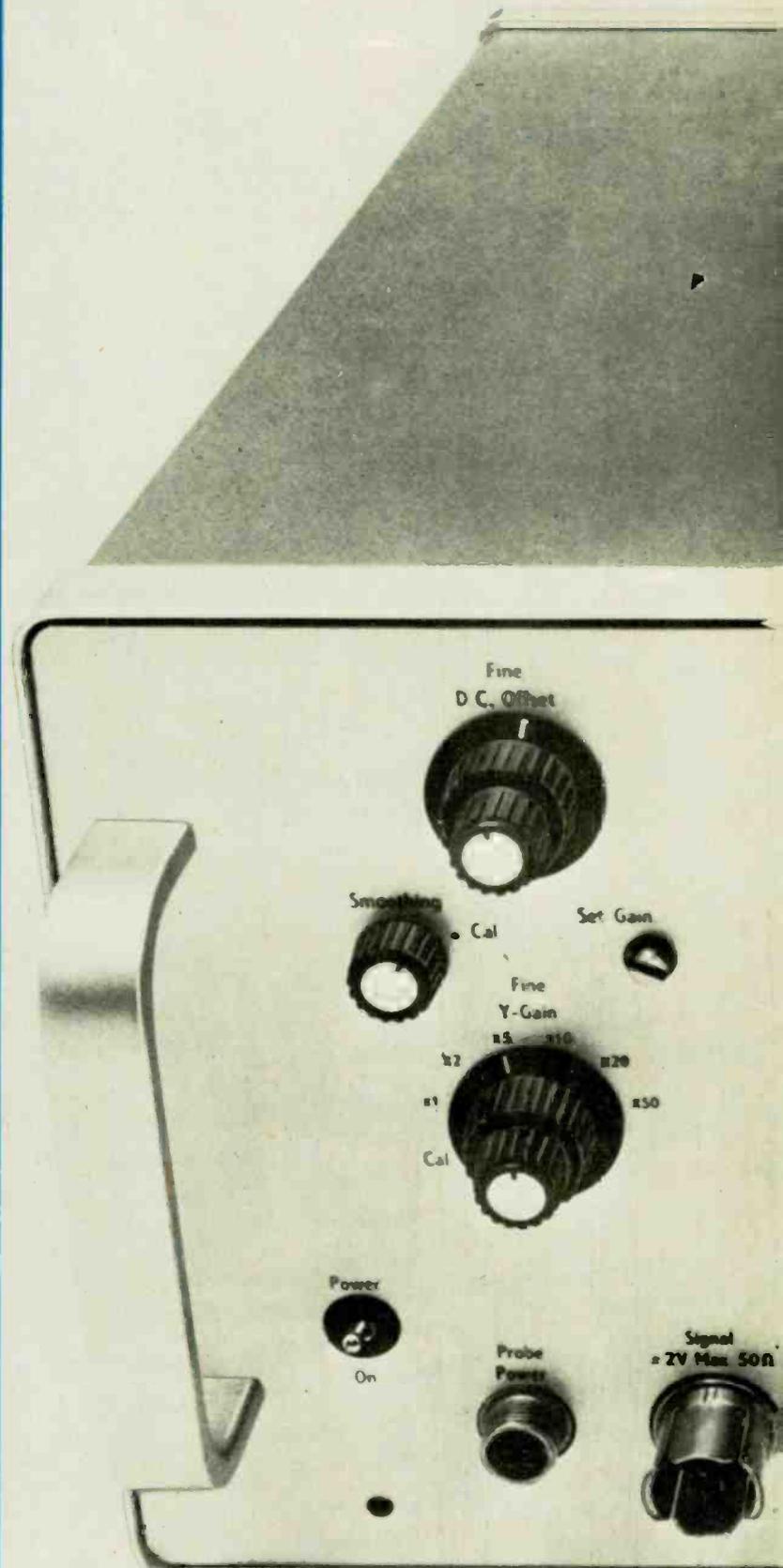
from the new Bradley, new life for ageing oscilloscopes

The way things are going in computer logic and pulse measurement, even relatively new oscilloscopes are old before their time. Yet you may feel that investing in faster instruments to examine the even faster computer phenomena of today represents too large an outlay. For you, Bradley introduces the 158 Oscilloscope Adaptor. It'll put new life into oscilloscopes, because it enables waveforms at frequencies up to 1000 MHz to be displayed on any general purpose oscilloscope. So you can expect quite a lot more from your present equipment. Bradleys will see to that.

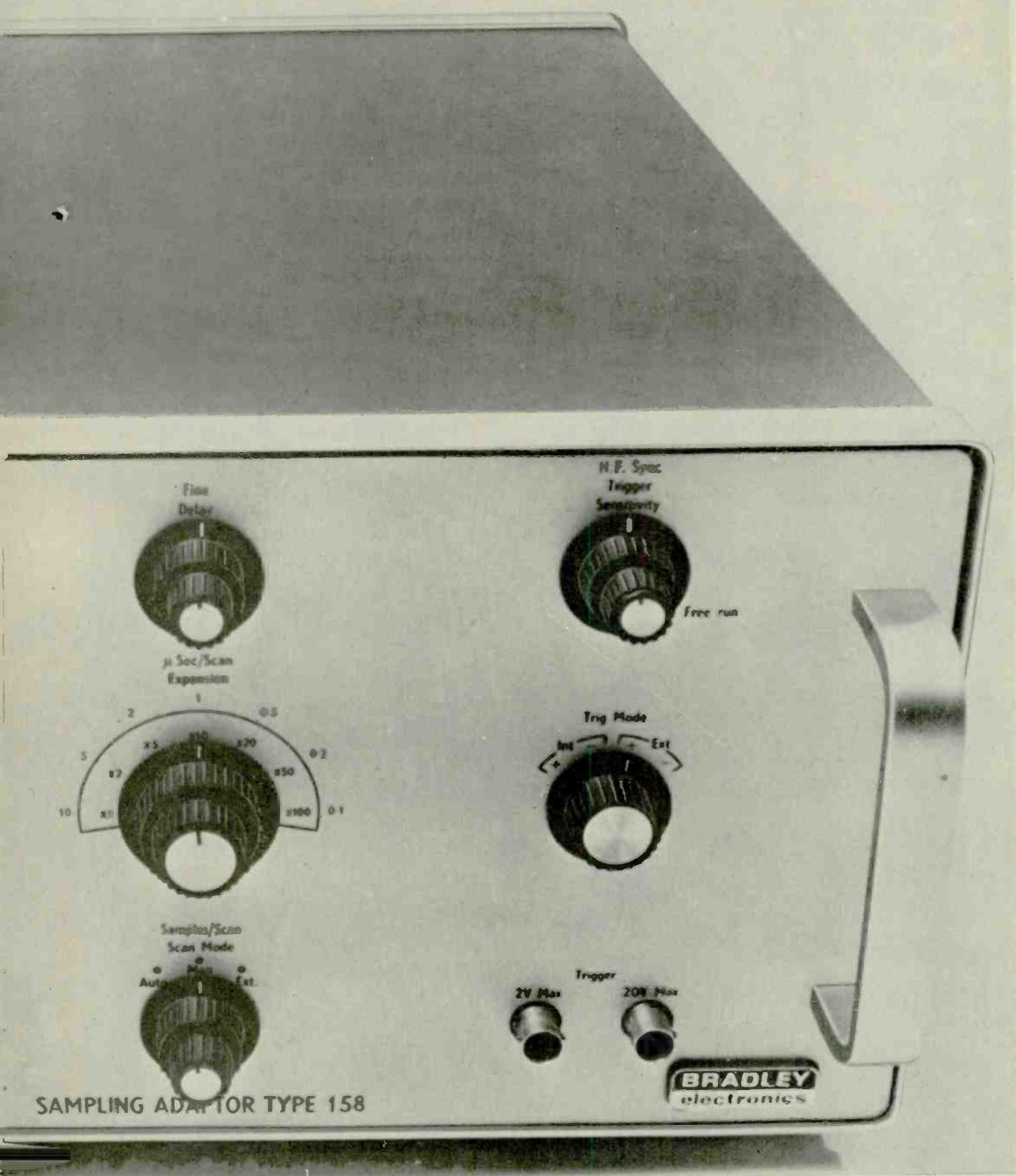
G. & E. BRADLEY LTD.
Electral House,
Neasden Lane,
London, N.W.10.
Tel: 01-450 7811 Telex: 25583

**EXPECT MORE
FROM THE NEW
BRADLEY**

BRADLEY
electronics



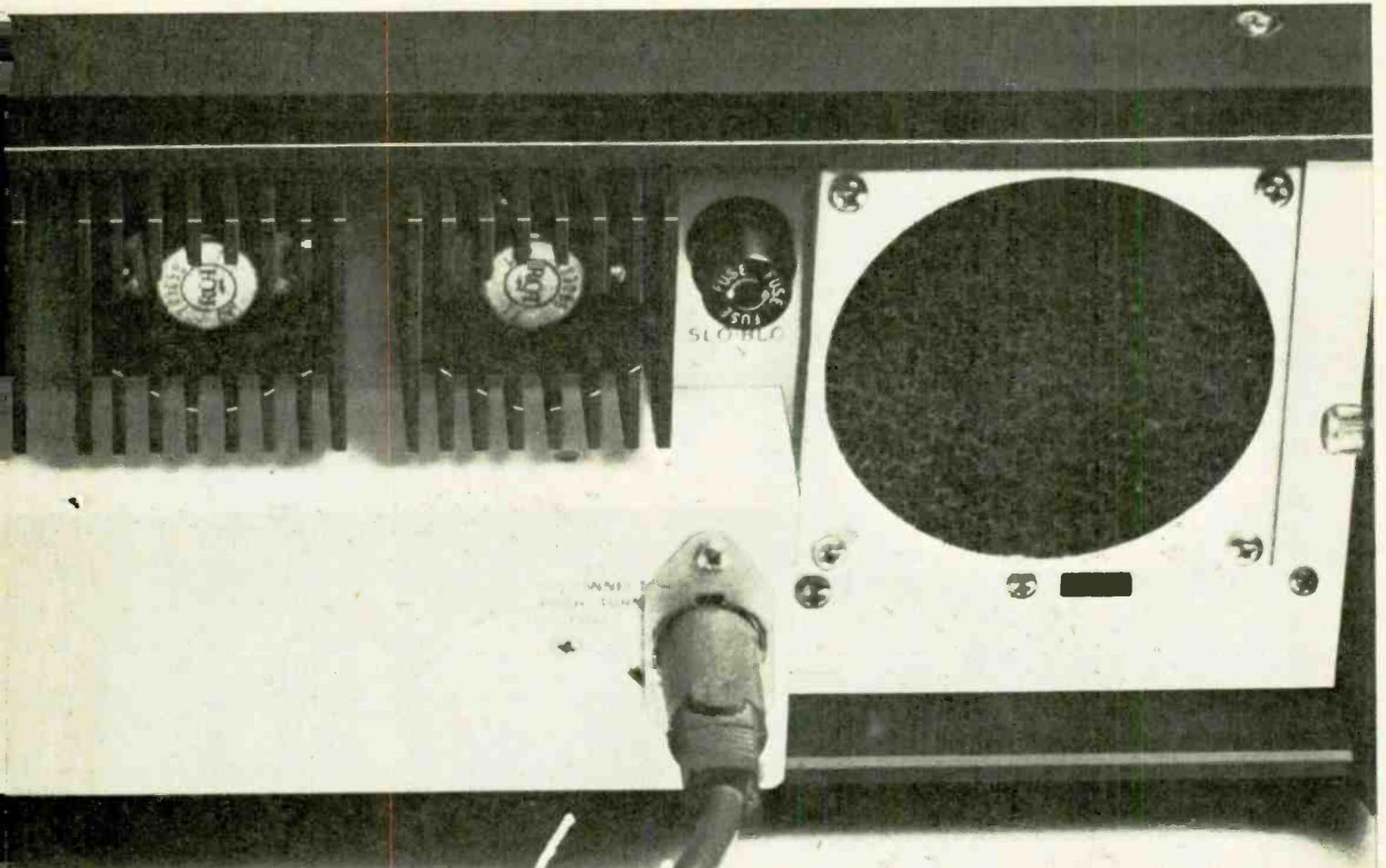
WW-022 FOR FURTHER DETAILS



SAMPLING ADAPTOR TYPE 158

BRADLEY
electronics

WW—023 FOR FURTHER DETAILS



calibrated
and ready to plug in

BRADLEY TECHNICAL SERVICES

BRADLEY
ELECTRONICS

STANDARD LABORATORY
G & F BRADLEY LTD
ELECTRONIC ENGINEERS

Certificate of Calibration

1st, 1969
Serial no. 01
Page 1 of 2

In accordance with the conditions of the approval
direct record of the measurements made. Copy
and by the issuing laboratory. The certificate may
prior written approval of the Director, B.C.S., and

l e
Head

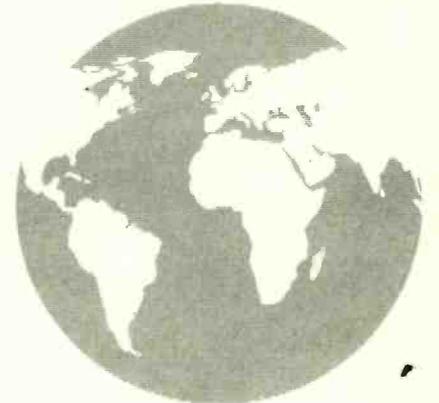
BRADLEY

G & F BRADLEY LTD, LONDON
CALIBRATION REPORT

INSTRUMENT COUNTER TIMER
MANFR MONSANTO
FULL CALIBRATION
RANGES CHECKED
EQUIPMENT USED Oscilloscope

WW-024 FOR FURTHER DETAILS

PYE SPANS THE WORLD



Pye Telecommunications is the world's largest exporter of radiotelephone equipment. Pye Radiotelephones are used all over the world to ensure *instant* contact. Pye research development and quality control really *do* keep in touch with tomorrow.

rely on

the vital contact



Pye 'Pocketfone' Personal Radiotelephone
New battery economy circuit · Extremely light-weight and compact · Reception free from noise and interference · Minimum of controls · Transmit button automatically extends antenna · Hearing aid socket · Easily accessible batteries.



Pye 'Bantam' Portable VHF Radiotelephone
Fully transistorised transmitter and receiver · Very high performance receiver · Crystal filter selectivity · 0.5W transmitter output · 250mW audio power · Long endurance with rechargeable or dry batteries · Can be used with external antenna to give greater range · Weatherproof.



Pye VHF Radiotelephone Fixed Station
Solid-state receiver and transmitter · 10-15W R.F. output · Field-effect transistors used in receiver · Suitable for all climates · Electronic squelch · Designed to meet all relevant specifications.



Pye UHF Radiotelephone Fixed Station
Solid state receiver and transmitter · 8-10W R.F. output · Very high R.F. selectivity using field-effect transistors · Very low noise factor · Electronic squelch · A. C. or 24V d.c. operation · Suitable for all climates · Designed to meet all relevant specifications.



Pye 'Westminster' Remote Mounted Radiotelephone
Completely solid state · 5-8W R.F. output · 1-10 channels with solid state switching · Illuminated channel indicator · Suitable for all climates · Meets all relevant specifications.



Pye 'Westminster' Front Mounted Radiotelephone
Completely solid state · 5-8W R.F. output · 1-10 channels with solid state switching · Suitable for all climates · Meets all relevant specifications.



Pye Single-Sideband Radiotelephone
125W (p.e.p.) R.F. output · Fully transistorised receiver · C.W. facilities provided · Sideband selection by crystal filter · Carrier insertion for a.m. compatibility · Fixed or mobile application · Advanced transmitter design.



Pye 'Pioneer' Radiotelephone
Fully transistorised · For use with automatic, CB manual, or magneto exchanges · Weatherproof cabinet · Unattended operation over long periods · Facility for fitting privacy equipment · Optional single antenna operation.



Pye 5-Circuit UHF Radiotelephone
Compact 5-circuit radio terminal · Fully transistorised · Channelling equipment · Frequency-shift signalling · Continuous unattended operation in all parts of the world · Twelve standard plans for terminals and repeaters.

PYE
equipment gives you instant-contact with mobility

PYE TELECOMMUNICATIONS LTD. Cambridge England Telephone: Cambridge (0223) 61222 Telegrams: Pyetelecom Cambridge Telex: 81166

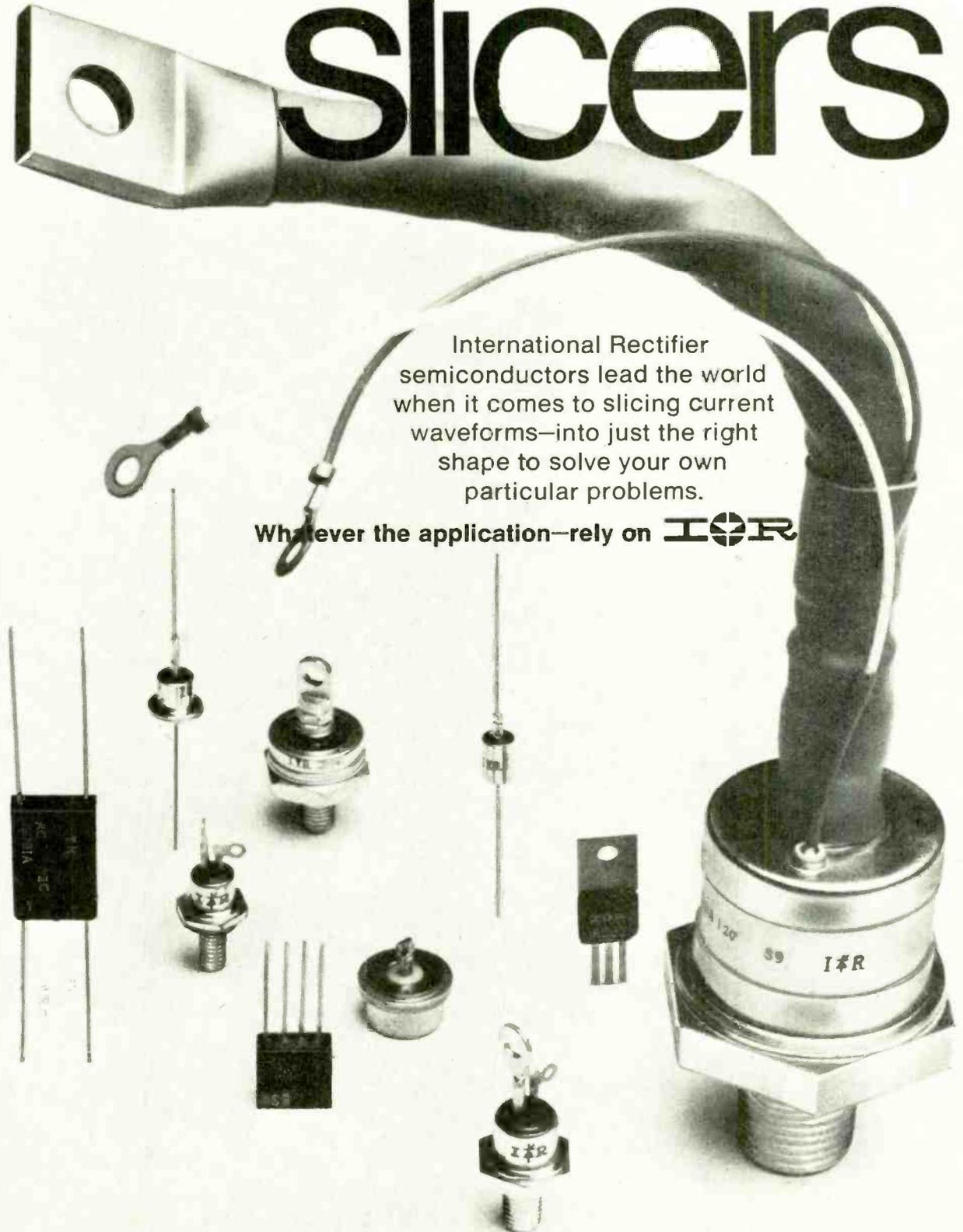


WW-025 FOR FURTHER DETAILS

IOR the current slicers

International Rectifier
semiconductors lead the world
when it comes to slicing current
waveforms—into just the right
shape to solve your own
particular problems.

Whatever the application—rely on **IOR**

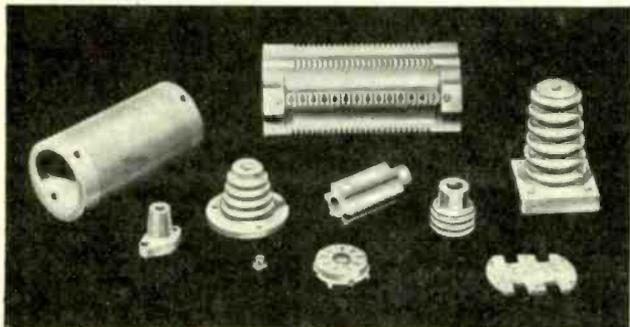


WW—026 FOR FURTHER DETAILS

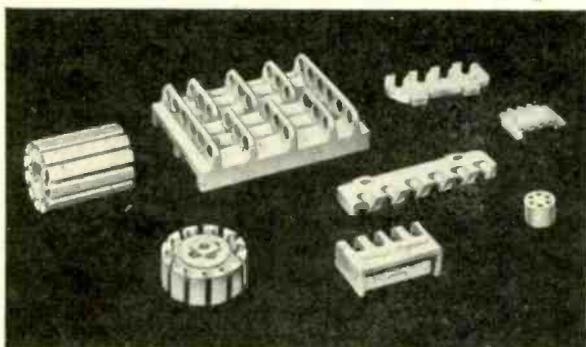
www.americanradiohistory.com

Bullers CERAMICS

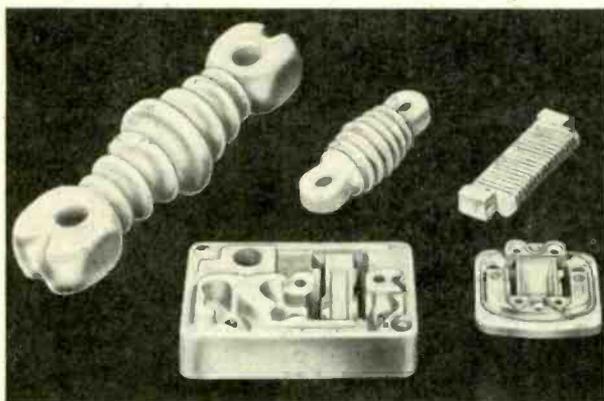
for the **ELECTRONIC INDUSTRY**
(and Electrical Appliance Manufacture)



Frequelex—for high-frequency insulation.



Refractories for high-temperature insulation.



Bullers porcelain for general insulation purposes.

Meticulous care in manufacture, high quality material, with particular attention applied to *dimensional precision and accuracy*, explain the efficiency and ease of assembly when using Bullers die pressed products.

Write today for detailed particulars.

BULLERS LIMITED

Milton, Stoke-on-Trent, Staffs.

Phone: Stoke-on-Trent 54321 (5 lines)

Telegrams & Cables: Bullers, Stoke-on-Trent

WW—027 FOR FURTHER DETAILS

NKT

FOR

CUSTOM HYBRIDS

If you have read as far as this, you either know what "custom hybrids" are, or want to know what they might be.

For the uninitiated, a "hybrid" is a modern form of microcircuit (integrated circuit) which produces the performance of a bulky, conventional-component, printed-circuit-board assembly inside a small sealed package by hybrid assembly techniques, combining printing of components with attaching separate discrete devices.

Electronic equipment manufacturers are changing over from printed-circuit-boards to hybrid microcircuits. Larger ones are trying to produce their own hybrids. Smaller ones tend to look to a specialist custom-hybrid manufacturer, like NKT, for units custom-built to their exact specifications.

A survey of customers to whom NKT have supplied custom-hybrids over the last two years indicates that the commonest reasons for them "going hybrid" have been:

1. They had to have smaller circuits.
2. They had only short runs, expensive in engineering.
3. They had high assembly labour costs relative to materials.
4. They had to use high-cost special-selection components to achieve close overall circuit performance.
5. They had long runs of identical packages.
6. They had to find improved environmental stability.
7. They had a need for greater reliability.
8. They had a problem in getting skilled assembly labour.
9. They had to reduce production costs.
10. They had a cost problem in multiple-component stock holding.

You may have equipment design problems such as these to which custom hybrids can provide an answer.

Why not write in on your company letter heading to our Marketing Manager for NKT's CUSTOM HYBRID BROADSHEET No. 5, and a free copy of our "CUSTOM HYBRID GUIDANCE MANUAL".

NKT—Newmarket Transistors Ltd.,

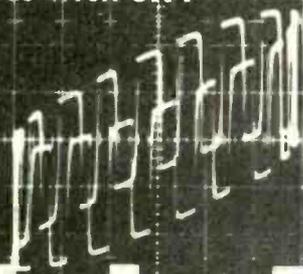
Exning Road,
Newmarket, Suffolk.

Tel. Newmarket (0638) 3381. Telex 81358

STAND C63, INSTITUTE OF ELECTRONICS SHOW,
BELLE VUE, MANCHESTER. 29 SEPT.—3 OCT.

WW—028 FOR FURTHER DETAILS

Dynamco's 72 Service
Scopes with 6KV



Competitive Scope



Bright Display?

There's no comparison!

Dynamco's 72 Scope Features

- AC/DC or Battery
- DC to 15MHz
- Stable Trigger
- All Solid State
- Plug-on X & Y Units

- Single or Dual Trace
- Easy to use
- And the display unit may be used separately for monitor purposes.
- Weighs under 18 lbs. and occupies less than 0.4 cubic feet.

See for yourself — ring
Chertsey 2636 and ask for
Barrie Newman.

Dynamco Ltd
Hanworth Lane
Chertsey Surrey
World Wide Sales & Service



DYNAMCO



FIT AND FORGET

A.P.T. POWER UNITS

the power pack people

A.P.T. ELECTRONIC INDUSTRIES LIMITED

Chertsey Road, Byfleet, Surrey. Tel: Byfleet 41131-2-3-4

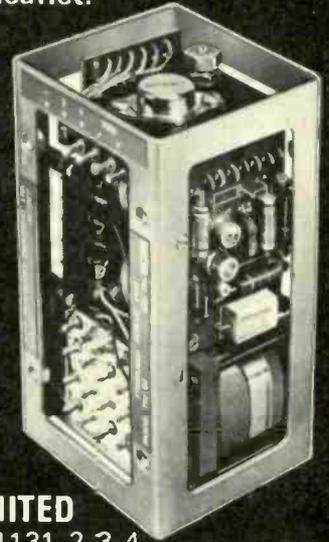
D.C. POWER UNIT MODEL TSU-0500

Stabilised output 0.5A at
preset voltage in range
6-30V.

Very small size 14.3 x
7.8 x 7.0cm high
(5 $\frac{5}{8}$ " x 3 $\frac{1}{4}$ " x 2 $\frac{3}{4}$ ").

Price £19.0s.0d. net
ex-works, prompt delivery.

For further details send
for fully descriptive
leaflet.



WW-030 FOR FURTHER DETAILS

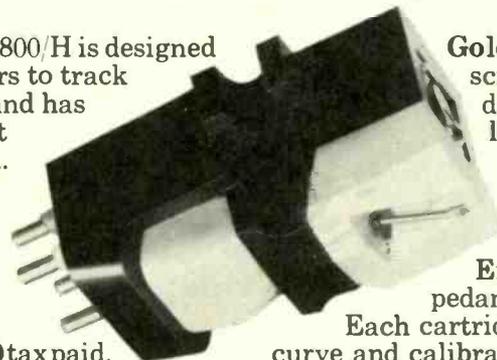
You're on the right track- with Goldring 800 magnetic cartridges

Goldring 800 magnetic cartridges track unerringly. Because that's the way we make them. They're designed to translate even the most delicate information stored in the groove back into an identical electrical signal. We call it the sound of true transduction.

Hear it for yourself. You'll know you're on the right track.

Goldring 800/H... the 800/H is designed for inexpensive changers to track between 2 $\frac{1}{2}$ -3 $\frac{1}{2}$ grams and has a high output of at least 8mV. £10.13.6 tax paid.

Goldring 800
... the 800 is designed for standard arms and changers where the requirements of high fidelity and robustness usually conflict. £13.0.0 tax paid.



Goldring 800 E... is designed for transcription arms and a micro-elliptical diamond is fitted to a finer cantilever, end damped against natural tube resonance £18.17.1 tax paid.

Goldring 800 Super E... the 800 Super E is for those to whom perfection is barely good enough.

Extraordinarily low mechanical impedance for superb tracking capabilities.

Each cartridge is supplied with its individual curve and calibration certificate. £26.0.0 tax paid.



Send for details and complete range of Goldring Hi-Fi equipment

Goldring Manufacturing Co. (Great Britain) Ltd.

486-488 High Road, Leytonstone, London, E.11. Tel: C1-539 8343.

WW-031 FOR FURTHER DETAILS

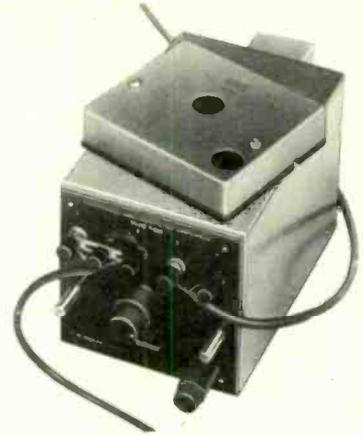


**PRECISION VERNIER POTENTIOMETER
TYPE 5590C**

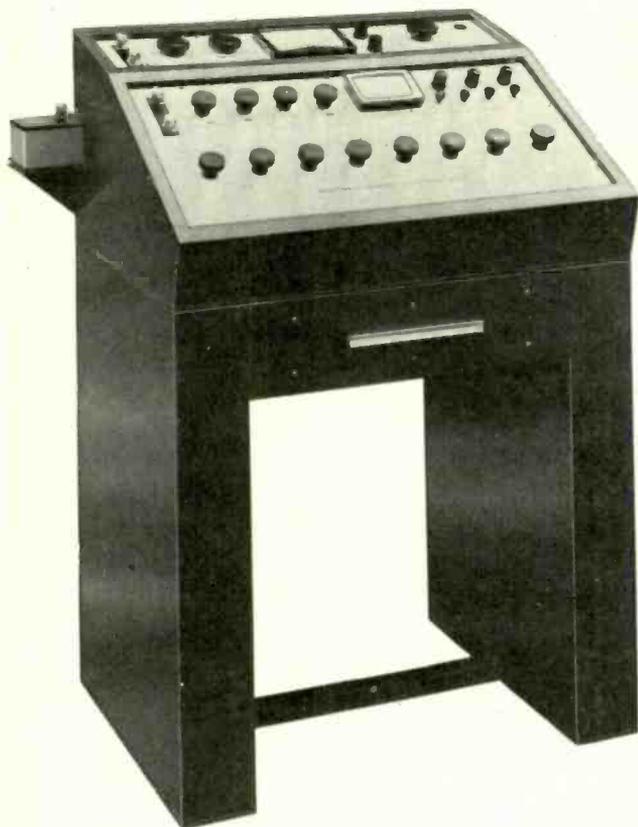
This is a single range 5 dial potentiometer readable to 7 decimal places, with 8 figures above one volt and 7 figures below. It retains all the advantages of the double potentiometer without continual cross-calibration. Range: 0 to 1.8010110V in steps of 0.1 μ V. Calibrated Accuracy: \pm 0.0005% of reading +0.1 μ V. Leaflet 208F./3514.

**PHOTOCELL
GALVANOMETER
AMPLIFIER
TYPE 5214**

This amplifier is primarily intended for use with an indicating galvanometer for the most sensitive null detection in d.c. bridge and potentiometer work of the highest precision. The amplification is such that a robust type of indicating galvanometer can be used and no very special precautions need be taken to eliminate vibration. Leaflet 175./2043.



FOUR FROM... TINSLEY



**HIGH SENSITIVITY
PORTABLE GALVANOMETER
TYPE M.R. 4/45**

Optical magnifier gives effective scale distance of 1.5 meters in an instrument about 22cm in length. The case has a completely removable cover and detachable screen. Double light beam giving 2 separate spots, centre zero scale and fine zero adjuster. Considerable space saving—with an increase in sensitivity. Leaflet 175/2021A.

**INDUCTIVELY COUPLED DOUBLE RATIO BRIDGE
TYPE 5650**

For platinum resistance thermometry, this Bridge operates at 400 Hz and is readable to 8 figures with an accuracy of ratio measurement to 1 in 10⁷. The desk console contains the Oscillator, Mains Operated Charging Unit, Selective Amplifier, Double Inductive Ratio (8 decades), Lead Compensating Unit and a set of Resistance Standards. Leaflet 139D.

TINSLEY

H. TINSLEY & CO LTD · WERNDÉE HALL
SOUTH NORWOOD · LONDON SE25 · 01-654 6046

the choice in over 50 different countries!

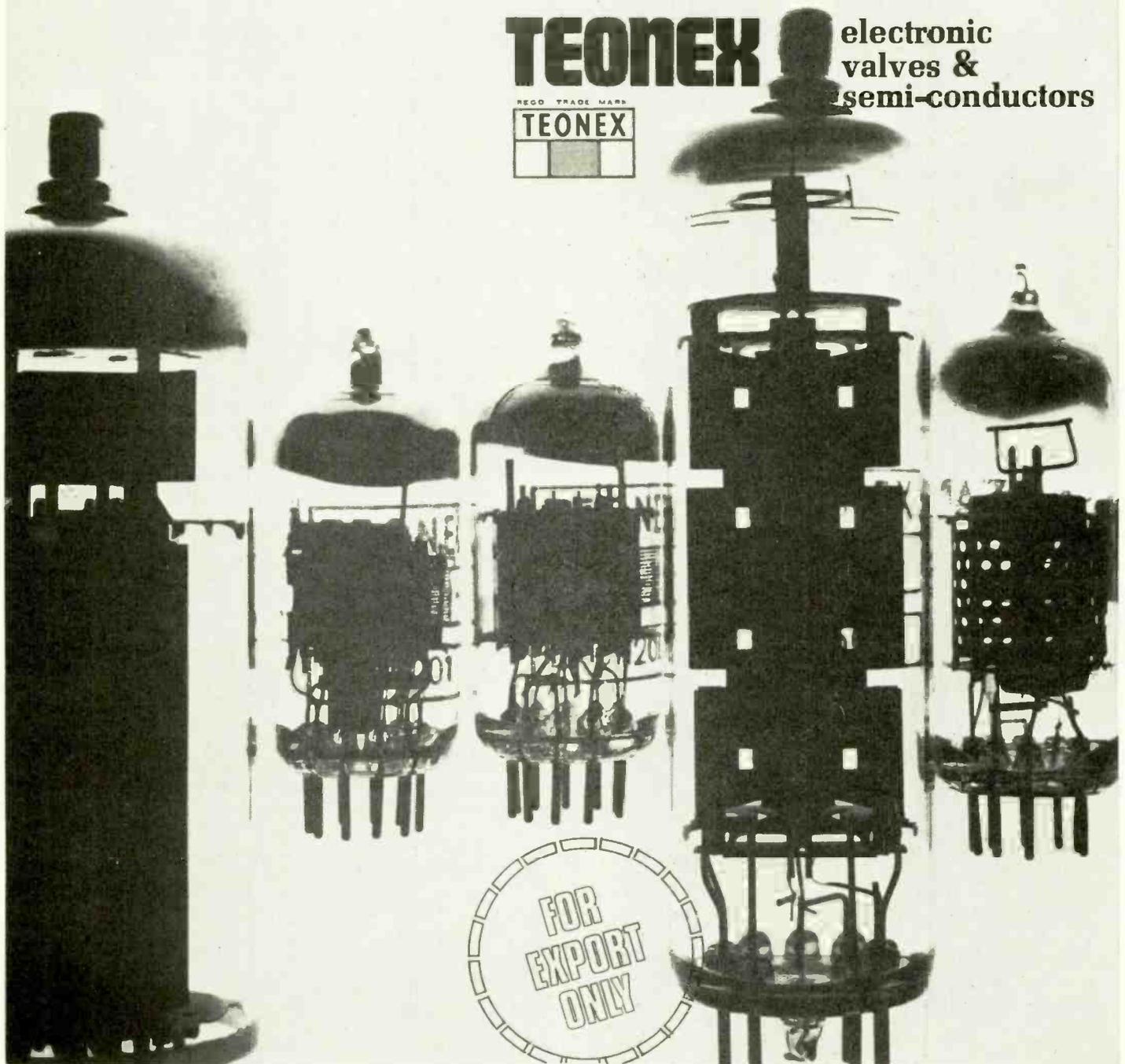
Teonex electronic valves and semi-conductors are supplied all the world over where quality and reliability count.

Teonex offer a comprehensive range of receiving, professional and special quality valves. Whether you require a device to Mil specifications for government work or a commercial device for replacement in a television set, Teonex products are equally suitable.

For technical specifications and price lists, please write to Teonex Limited
2a Westbourne Grove Mews
London W.11 · England
Cables: Tosupply London W.11.

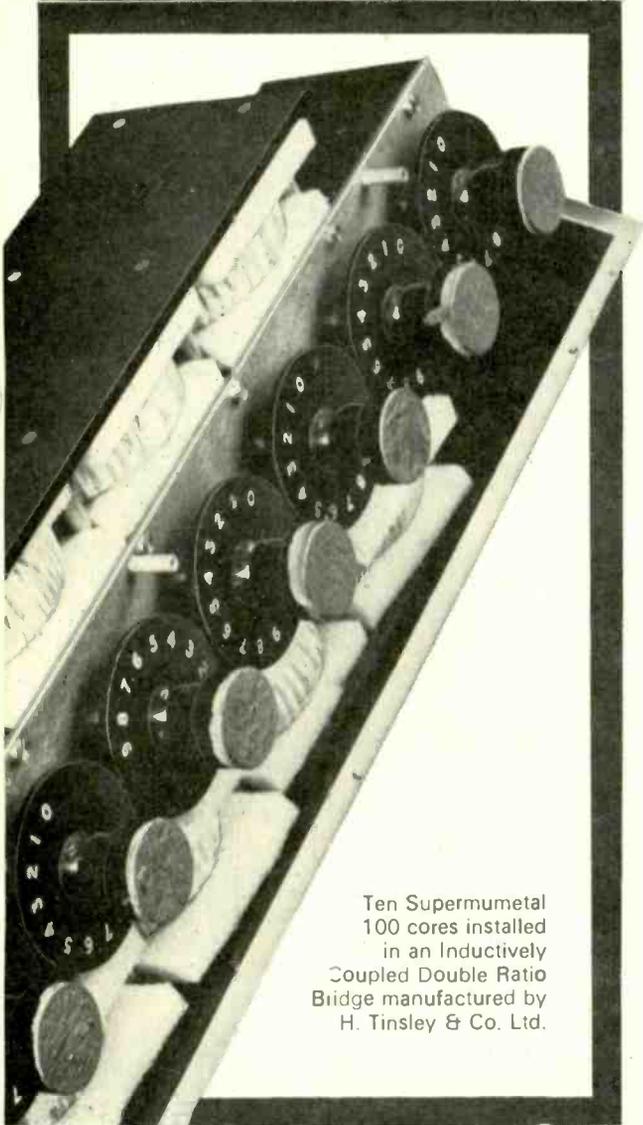
TEONEX electronic
valves &
semi-conductors

REGD TRADE MARK
TEONEX



WW—033 FOR FURTHER DETAILS

Telcon
soft magnetic
materials give
today's circuits
tomorrow's
performance



Ten Supermumetal
100 cores installed
in an Inductively
Coupled Double Ratio
Bridge manufactured by
H. Tinsley & Co. Ltd.



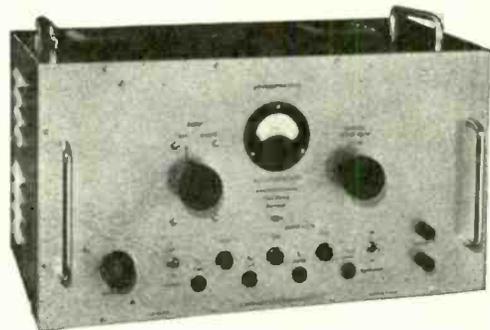
Please send
for further
details of
Telcon
soft magnetic
materials.

look ahead with
T
M **TELCON**

TELCON METALS LTD., Manor Royal, Crawley, Sussex.
Telephone: Crawley 28800 Member of the **BICC** Group of Companies.

WW-034 FOR FURTHER DETAILS

TWO FROM TINSLEY



PATCHET A.C. STABILISER TYPE 5105B

For very high precision measurements in a.c. potentiometry.
The unit is simple and automatically protected from damage.
Stabilisation ratio 1000/1 and response time of about 0.03 sec.,
total harmonic distortion less than 1%. Leaflet 215.



PRECISION NON INDUCTIVE STANDARD RESISTOR TYPE 5576 M

This is one of a group of four Grade 1 a.c./d.c.
oil filled resistors, for use with a.c. at power
frequencies or up to 1,000 Hz. The range of
resistance available is from 10,000 ohms to
0.0001 ohm. The resistance material is a
Cu-Ni-Mn alloy. Leaflet 11.

TINSLEY

H TINSLEY & CO LTD · WERNDÉE HALL
SOUTH NORWOOD · LONDON SE25 · 01-654 6046

WW-035 FOR FURTHER DETAILS

SOLE U.K. DISTRIBUTORS OF

SEW PANEL METERS

- LOW COST ● QUICK DELIVERY
- OVER 200 RANGES IN STOCK
- OTHER RANGES TO ORDER

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.

CLEAR PLASTIC METERS

Type MR.85P. 4 1/2in. x 4 1/2in. fronts.



10mA	52/-
50mA	52/-
100mA	52/-
500mA	52/-
1 amp.	52/-
5 amp.	52/-
15 amp.	52/-
30 amp.	52/-
20V. D.C.	52/-
50V. D.C.	52/-
150V. D.C.	52/-
300V. D.C.	52/-
15V. A.C.	52/-
300V. A.C.	52/-
8 Meter 1mA	57/8
VU meter	72/-
1 amp. A.C.*	52/-
5 amp. A.C.*	52/-
10 amp. A.C.*	52/-
20 amp. A.C.*	52/-
30 amp. A.C.*	52/-

Type MR.52P. 2 1/2in. square fronts.

50μA	82/-
50-500μA	52/-
100μA	52/-
100-1000μA	47/8
500μA	45/-
1mA	40/-
5mA	40/-
10mA	40/-
50mA	40/-
100mA	40/-
500mA	40/-
1 amp.	40/-
5 amp.	40/-
10V. D.C.	40/-
20V. D.C.	40/-
50V. D.C.	40/-
300V. D.C.	40/-
15V. A.C.	40/-
300V. A.C.	40/-
8 Meter 1mA	42/-
VU Meter	82/-
1 amp. A.C.*	40/-
5 amp. A.C.*	40/-
10 amp. A.C.*	40/-
20 amp. A.C.*	40/-
30 amp. A.C.*	40/-

Type MR.38P. 1 21/32in. square fronts.



150mA	27/8
200mA	27/8
300mA	27/8
500mA	27/8
750mA	27/8
1mA	27/8
2 amp.	27/8
5 amp.	27/8
10mA	27/8
50mA	27/8
100mA	27/8
20V. D.C.	27/8
100V. D.C.	27/8
150V. D.C.	27/8
300V. D.C.	27/8
500V. D.C.	27/8
750V. D.C.	27/8
15V. A.C.	27/8
300V. A.C.	27/8
150V. A.C.	27/8
300V. A.C.	27/8
500V. A.C.	27/8
8 meter 1mA	32/-
VU meter	42/-

Type MR.45P. 2in. square fronts.

50μA	45/-
50-500μA	42/-
100μA	42/-
100-1000μA	37/8
500μA	32/-
1mA	30/-
5mA	30/-
10mA	30/-
50mA	30/-
100mA	30/-
500mA	30/-
1 amp.	30/-
5 amp.	30/-
10V. D.C.	30/-
20V. D.C.	30/-
50V. D.C.	30/-
300V. D.C.	30/-
15V. A.C.	30/-
300V. A.C.	30/-
150V. A.C.	30/-
300V. A.C.	30/-
500V. A.C.	30/-
8 meter 1mA	37/8
VU meter	45/-
1 amp. A.C.*	30/-
5 amp. A.C.*	30/-
10 amp. A.C.*	30/-
20 amp. A.C.*	30/-
30 amp. A.C.*	30/-

Type MR.65P. 3 1/2in. x 3 1/2in. fronts.

50μA	67/8
50-500μA	55/-
100μA	55/-
100-1000μA	52/-
500μA	47/8
1mA	42/-
5mA	42/-
10mA	42/-
50mA	42/-
100mA	42/-
500mA	42/-
1 amp.	42/-
5 amp.	42/-
10 amp.	42/-
15 amp.	42/-
20 amp.	42/-
30 amp.	42/-
50 amp.	42/-
10V. D.C.	42/-
20V. D.C.	42/-
50V. D.C.	42/-
150V. D.C.	42/-
300V. D.C.	42/-
15V. A.C.	42/-
150V. A.C.	42/-
300V. A.C.	42/-
500V. A.C.	42/-
8 meter 1mA	47/8
VU meter	67/8
50mA A.C.*	42/-
100mA A.C.*	42/-
200mA A.C.*	42/-
500mA A.C.*	42/-
1 amp. A.C.*	42/-
5 amp. A.C.*	42/-
10 amp. A.C.*	42/-
20 amp. A.C.*	42/-
30 amp. A.C.*	42/-

BAKELITE PANEL METERS

Type MR.65. 3 1/2in. square fronts.



100mA	35/-
500mA	35/-
1 amp.	35/-
5 amp.	35/-
15 amp.	35/-
30 amp.	35/-
50 amp.	35/-
5V. D.C.	35/-
10V. D.C.	35/-
20V. D.C.	35/-
50V. D.C.	35/-
150V. D.C.	35/-
300V. D.C.	35/-
30V. A.C.*	35/-
150V. A.C.*	35/-
300V. A.C.*	35/-
1 amp. A.C.*	35/-
5 amp. A.C.*	35/-
10 amp. A.C.*	35/-
20 amp. A.C.*	35/-
30 amp. A.C.*	35/-
VU meter	62/-

*MOVING IRON - ALL OTHERS MOVING COIL



EDGWISE METERS

Type PE.70. 3 17/32in. x 1 15/32in. x 2 1/2in. deep.

50μA	60/-
50-500μA	57/8
100μA	57/8
100-1000μA	45/-
500μA	42/-
1mA	35/-
5mA	35/-
10mA	35/-
50mA	35/-
100mA	35/-
500μA	52/-
1mA	47/8
300V. A.C.	47/8
VU meter	65/-

PLEASE ADD POSTAGE

SEND FOR ILLUSTRATED BROCHURE ON SEW PANEL METERS - DISCOUNTS FOR QUANTITIES

U.K. DISTRIBUTORS OF TMK MULTIMETERS



MODEL MD-120

This range of Multimeters, manufactured by Tachikawa Radio Instrument Co. of Japan, offers excellent value for money combined with quality and accuracy of measurement.

- IMMEDIATE DELIVERY
- DISCOUNTS FOR QUANTITIES
- TRADE ENQUIRIES INVITED

MODEL MD-120

Features Mirror Scale, Low Loss Switch and Robust Movement.
Sensitivity 20kΩ/Volt D.C. 10kΩ/Volt A.C.
D.C. Volts: 30, 60, 300, 600, 3,000V.
A.C. Volts: 6, 120, 1,200V.
D.C. Current: 60μA, 12, 300mA.
Resistance: 60K, 6 MEGΩ.
Decibels: -20 to +63db.
Rugged High Impact Plastic Case, size 3 1/2in. x 4 1/2in. x 1in.

£4.12.6 p/p 2/6

MODEL PL-436

Features Mirror Scale and Wood Grain Finish Front Panel.
Sensitivity: 20KΩ/Volt D.C. 8KΩ/Volt A.C.
D.C. Volts: 0.6, 3, 12, 30, 120, 600V.
A.C. Volts: 3, 30, 120, 600V.
D.C. Current: 50, 600μA, 60, 600mA.
Resistance: 10K, 100K, 1MEG, 10MEGΩ.
Decibels: -20 to +65db.
Rugged High Impact Plastic Case with Handle size 5 1/2in. x 4 1/2in. x 2 1/2in.

£6.19.6 p/p 2/6

MODEL 500

Features Mirror Scale and Buzzer Short Circuit Check.
Sensitivity: 30kΩ/Volt D.C. 15kΩ/Volt A.C.
D.C. Volts: 0.25, 1, 2.5, 10, 25, 100, 250, 500, 1,000V.
A.C. Volts: 2.5, 10, 25, 100, 250, 500, 1,000V.
D.C. Current: 50μA, 5, 30, 500mA, 12 amp.
Resistance: 60K, 6MEG, 60MEGΩ.
Decibels: -20 to +65db.
Handsome Dustproof Black Plastic Case size 3 5/16in. x 6 1/16in. x 2 1/2in.

£8.17.6 p/p 2/6

- ★ ALL MODELS FITTED OVERLOAD PROTECTION & SUPPLIED WITH BATTERIES, PRODS & INSTRUCTIONS

MODEL 5025

Features 57 Ranges, Giant 5 1/2in. Meter, Polarity Reverse Switch.
Sensitivity: 50kΩ/Volt D.C. 5kΩ/Volt A.C.
D.C. Volts: 125, 25, 125, 2.5, 5, 10, 25, 50, 125, 250, 500, 1,000V.
A.C. Volts: 1.5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V.
D.C. Current: 25, 50μA, 2.5, 5, 25, 50, 250, 500mA, 5, 10 amp.
Resistance: 2K, 10K, 100K, 1MEG, 10MEGΩ.
Decibels: -20 to +85db.
Plastic Case with Carrying Handle size 6 1/2in. x 2 1/2in. x 5 1/2in.

£12.10.0 p/p 3/6



MODEL 5025

MODEL 100,000 O.P.V. LAB TESTER

Features Unique Range Selector, 6 1/2in. Scale, Buzzer Short Circuit Check.
Sensitivity: 100,000 OPV D.C. 5kΩ/Volt A.C.
D.C. Volts: 5, 2.5, 10, 50, 250, 1,000V.
A.C. Volts: 3, 10, 50, 250, 500, 1,000V.
D.C. Current: 10, 100μA, 10, 100, 600mA, 2.5, 10 amp.
Resistance: 1K, 10K, 100K, 10MEG, 100MEGΩ.
Decibels: -10 to +49db.
Plastic Case with Carrying Handle size 7 1/2in. x 6 1/2in. x 3 1/2in.

£18.18.0 p/p 5/-



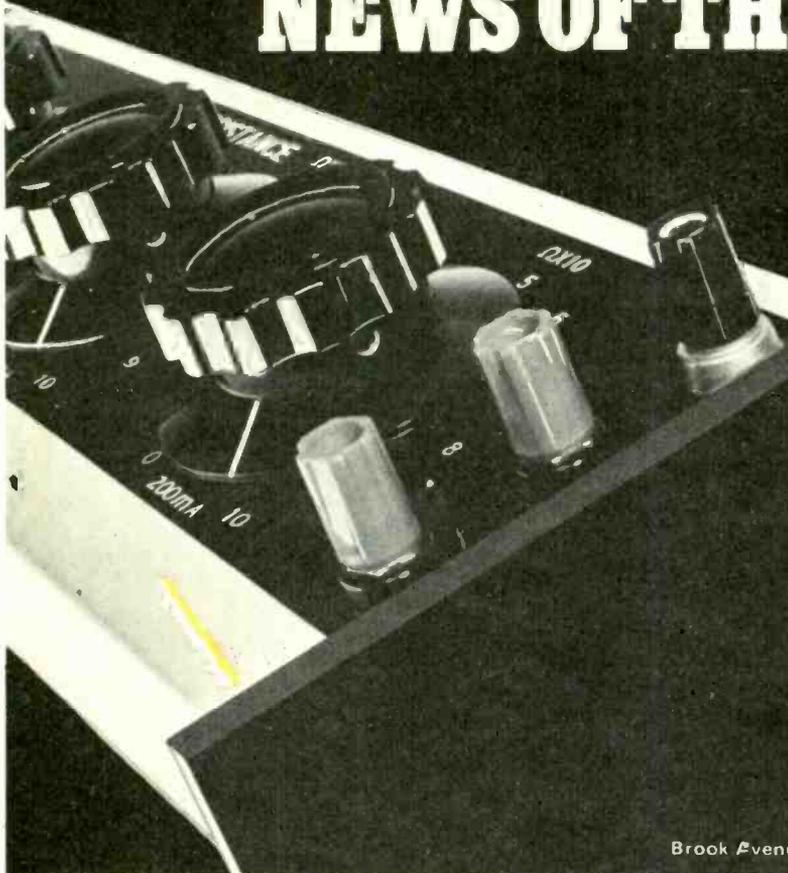
'LAB' MODEL

BARNET FACTORS LTD

4 LISLE STREET, LONDON, W.C.2
Telephone: 01-437 2723
Hours of business: 9 a.m. to 6 p.m. Monday to Saturday.

WW-036 FOR FURTHER DETAILS

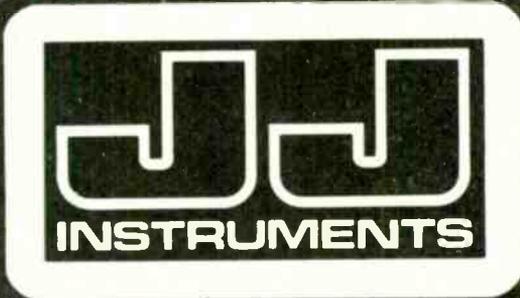
NEWS OF THE DECADE...



Capacitance
50pf to 1.1115 μ f with infinite resolution.
Accuracy = 1% or \pm 0.5% on all decades.

Inductance
Air Spaced In-H to 1H + 5%

Resistance
0.1 Ω to 1.1111 M Ω Average
accuracy \pm 0.1% Resistance elements
suitable for use up to 1MHz.



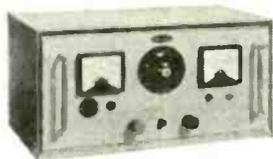
All ranges available from stock.
Write for descriptive leaflet
or demonstration.

J.J. Lloyd Instruments Limited

Brook Avenue, Warsash, Southampton SO3 6HP Tel: Locks Heath 4221

WW-038 FOR FURTHER DETAILS

SMOOTHED POWER UNITS WITH THE ACCUMULATOR PERFORMANCE.



Type
250YRU/30/20

Versatile power units providing all the usual voltages and currents normally required for development, servicing and production testing of practically all domestic and industrial equipment, up to a loading of 600W DC or AC.

APPLICATIONS

- ★ Production testing and servicing of battery operated equipment.
- ★ Testing fuel pumps—DC motors—relays—windscreen wipers—car radios—and other types of battery equipment.
- ★ Multiple outputs.
- ★ Continuously variable DC voltage.
- ★ Continuously variable AC voltage.

FEATURES

- ★ Output stabilised to accumulator performance.
- ★ Very low ripple.
- ★ Incorporating silicon rectifiers.
- ★ All models incorporating surge current limiting.
- ★ Low voltage outputs completely isolated from mains.
- ★ Quick delivery.

Type 250YRU/30/20. Output 1, 0-30V 20A DC. Output 2, 0-60V 10A AC. Output 3, 0-250V 4A AC. Price £131-5-0. Input 200/250V 40/60 Hz. Also available for 60V, 120V, 240V outputs.

VALRADIO LTD.

Dept. WPU4, BROWELL'S LANE, FELTHAM, MIDDLESEX, ENGLAND

Telephone: 01-890 4242

WW-042 FOR FURTHER DETAILS

M. R. SUPPLIES (London) LTD., (Established 1935)

Universally recognised as suppliers of UP-TO-DATE MATERIAL, which does the job properly. Instant delivery. Satisfaction assured. Prices nett.

FAN FLOW EXTRACTOR FANS. Undoubtedly today's greatest bargain for domestic or industrial use. For 200/250 volts A.C. 7,000 cu. ft. per hour. Easily installed, fitted weatherproof louvers which open when motor is switched on and close when off. Only 8 1/2 in. dia. Our nett price only £8/2/6 (despatch 7/6).

DESK OR TABLE FAN. An ideal fan for the hot weather, lightweight polythene, weighs only 1 1/2 lbs. Resilient 7 in. blade can be touched without injury. Finish: Two-tone Black and White, Red and White, Blue and White. 25 watts, 450 c.f.m. Complete with switch and flex. Only £4/2/6 (des. 5/-).

SYNCHRONOUS TIME SWITCHES. (Another one of our popular specialties) 200/240 v. 50c., for accurate pre-set switching operations. Sangamo S.254, providing up to 3 on-off operations per 24 hours at any chosen times, with day-omitting device (fuse optional). Capacity 20-amps. Completely housed & in. dia. 3 1/2 in. deep. £6/4/6 (des. 4/6).

ELECTRIC FANS (Papat), for extracting or blowing. The most exceptional offer we have yet made. 200/250 v. A.C. Induction motor—silent running. 2,800 r.p.m. duty 100 C.F.M. Only 4 1/2 in. square and 2 1/2 in. deep. Ideal for domestic or industrial use. Easy mounting. £3/5/- (des. 3/6).

SMALL GEARED MOTORS. In addition to our well-known range (List G.M.169), we offer small open type B.F. Units 200/250 v. A.C., 1, 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 68/6 (des. 3/-).

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 projection lamp cooling, light duty extractors, etc., still only 28/6 (des. 4/6).

AIR BLOWERS. Highly efficient units fitted induction totally enclosed motor 230/260 v. 50 c. 1 ph. Model 8D.26, 60 CFM (free air) to 11.5 CFM at 15 WG (size approx. 3 1/2 x 6 x 7in. Outlets 2 1/2 in. square, £8/10/- (des. 5/-). Model 8D27, 120 CFM (free air) to 40 CFM at 1.2 WG, 8 x 7 x 9in. outlet 2 1/2 in. sq., £11/15/6 (des. 5/-). Model 8D28, 260 CFM (free air) to 127 CFM at 1.5 WG, 11 x 8 x 9in., outlet 3in. sq., £13/17/6 (des. U.K. 7/6).

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 second hands. Central one-hole fixing. Dia. 2 1/2 in. Depth behind dial only 1 1/2 in. With back dust cover, 39/6 (des. 2/-). Set of three brass hands in good plain style. For 6 7/8 in. dia. 2/6 (des. 2/-).

SYNCHRONOUS TIMER MOTORS (Sangamo). 200/250 v. 50 c/s. 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 42/- (des. 2/-). Also high-torque model (G.E.C.), 2 1/2 in. x 2in. x 1 1/2 in. 6 r.p.m., 57/6 (des. 2/-).

SMITHS TIMER MOTORS. Synchronous, self-starting 200/250 volts, 1 ph., 50 c. Clockwise. 4 r.p.m. only. Only 25/- (des. 2/-).

MINIATURE D.C. MOTORS. 6/12 volts D.C. Ideal model makers. 4,000/9,000 r.p.m. no load. 1 1/2 in. x 1 1/2 in. diameter. Flange fixing. Only 9/6 (des. 1/6).

OFFICIAL STOCKIST: "PARVALUX" Electric Motors (List G.M.169)

EXTRACTOR FANS. Ring mounted all metal construction. T/E induction motor, silent operation, 8in. blade, 10in. max. dia., 400 CFM, £6/2/6 (des. 5/-). Same model 10in. blade, 12in. max. dia., 500 CFM, £6/12/6 (des. 6/-).

IMMEDIATE DELIVERY of Stuart Centrifugal Pumps, including stainless steel (most models).

M. R. SUPPLIES (LONDON) LTD., 68 New Oxford Street, London, W.C.1
(Telephone: 01-636 2958)

Best Reception with TRIO



Model 9R-59DE

BUILT IN MECHANICAL FILTER 8-TUBE COMMUNICATION RECEIVER

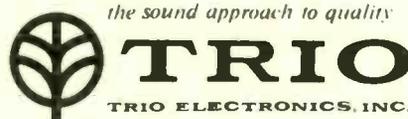
- * Illuminated dials permit easy tuning and band spread readings.
- * Continuous coverage from 550KHz to 30MHz and direct reading dial on amateur bands.
- * Close calibration accuracy with an excellent anti-backlash mechanism.
- * A mechanical filter enabling superb selectivity with ordinary IF transformers.
- * One RF and two audio stages of amplification, insuring high sensitivity and selectivity.
- * A Product Detector making possible clear SSB reception.

SPECIFICATIONS:

- * Frequency Ranges: Band A 550-1600KHz,
B 1.6-4.8MHz,
C 4.8-14.5MHz,
D 10.5-30MHz.
- * Sensitivity: $2\mu\text{V}$ for 10dB S/N Ratio (at 10MHz)
- * Selectivity: $\pm 5\text{KHz}$ at -50dB
- * Power Consumption: 45 watts
- * Audio Power Output: 1.5 watts
- * Tube & Diode Complement: 6BA6 \times 3, 6BE6 \times 2,
6AQ8 \times 2, IN60 \times 2, SW-05S \times 2, SW-05 \times 2,
6AQ5
- * Dimensions: Width 15", Height 7", Depth 10".

Model JR-500SE CRYSTAL CONTROL TYPE DOUBLE CONVERSION COMMUNICATION RECEIVER

- * Superior stability performance is obtained by the use of a crystal controlled first local oscillator and also, a VFO type 2nd oscillator.
- * Frequency Range: 3.5MHz-29.7MHz (7 Bands)
- * Hi-Sensitivity: $1.5\mu\text{V}$ for 10dB S/N Ratio (at 14MHz)
- * Hi-Selectivity: $\pm 2\text{KHz}$ at -6dB $\pm 6\text{KHz}$ at -60dB
- * Dimensions: Width 13", Height 7", Depth 10".



the sound approach to quality

TO: B.H. Morris & Co., (Radio) Ltd. WW

Send me information on TRIO COMMUNICATION RECEIVERS & name of nearest TRIO retailer.

NAME: _____

AGE: _____

ADDRESS: _____

TRIO KENWOOD ELECTRONICS S.A. 160 Ave., Brugmann, Bruxelles 6, Belgium

Sole Agent for the U.K. B. H. MORRIS & CO., (RADIO) LTD. 84/88, Nelson Street, Tower Hamlets, London E. 1. Phone: 01-790 4824

WW-039 FOR FURTHER DETAILS

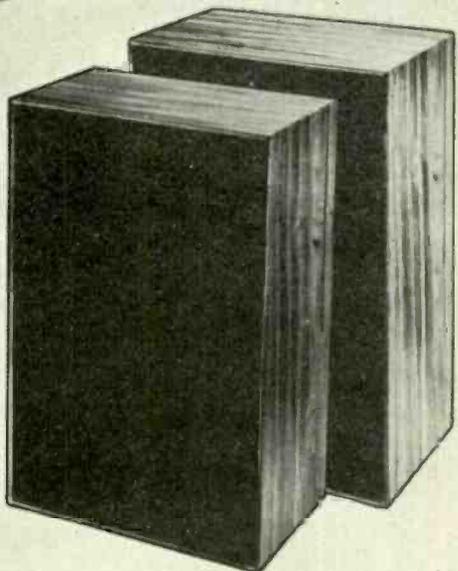
Heathkit Present The 'Compact' Sound of the 70's



'COMPACT' AD27



'COMPACT' AD17



AMBASSADOR SPEAKERS

See what's New in the world of sound from Heathkit at the Audio and Cine Fair, 1969, Olympia, London.

Daystrom Ltd. will be exhibiting the latest Heathkit Hi-Fi Stereo Amplifiers, Tuner-Amplifiers, F.M. Tuners, Stereo 'Compacts', Loudspeakers etc. A selection of these will be on demonstration in the Audio Studio on our stand.

New models include two stereo 'compacts', models AD-17 and AD-27. The AD-17 comprises a BSR MA65 turntable with Shure M44-MB magnetic cartridge and a 10 watt (rms) per channel stereo amplifier all mounted on a teak or walnut plinth. The AD-27 is similar but uses the MA70 turntable and includes an FM stereo tuner. In this case the 'plinth' is better described as a small cabinet. It has a 'roller shutter' lid and is available in teak or walnut.

A new loudspeaker has been added to the Heathkit range. The 'Ambassador' is a first class hi-fi loudspeaker. The cabinet comes ready assembled and finished in teak or walnut to match other current Heathkit equipment. It uses three loudspeaker units—a 12" bass unit, a 5" mid range and a small tweeter.

See these New models and many more . . . in the Heathkit 1970 CATALOGUE.

its FREE on request!



DAYSTROM LTD,
Gloucester, GL2-6EE
Tel Glos 29451 Telex 43216

To DAYSTROM LTD, GLOUCESTER GL2-6EE
 Please send me details of the new Heathkit HiFi models
NAME
ADDRESS

WW.11A



Armstrong
the high fidelity sound

**A STEREO
TUNER-AMPLIFIER
for the
BUDGET SYSTEM**



127 STEREO TUNER-AMPLIFIER £43-13-9
OPTIONAL CASE As illustrated £3-17-0

If you want high fidelity in the highest class don't buy the 127 Tuner-Amplifier; it isn't meant for you. But if you want a good quality system that is a great deal better than the average radiogram, and your power requirements, as well as your budget, are of modest proportions, then this is meant for you.

The 10 watts power output, 5 from each channel, won't fill a hall, but it is more than adequate for most domestic purposes. The AM-FM Tuner incorporated is doubly attractive because, as well as covering the medium wave-band, it has a performance on FM which is good enough to give excellent results on stereo radio once you add the optional M5 stereo radio decoder.

There are of course the usual facilities; pickup and tape inputs, tape recording outputs, bass and treble tone controls.

As we said at the outset, if you are after top-class hi-fi you don't want the 127, what you want is the Armstrong Series 500 model.

For details and technical specifications of all models, plus list of stockists, post coupon or write, mentioning 11WW69.

ARMSTRONG AUDIO LTD., WARLTERS ROAD N.7
Telephone 01-607 3213

name

address

11WW69

WW-041 FOR FURTHER DETAILS

**The most
advanced
microwave
devices
are here.**

Schottky Barrier Diodes

*Ga As Mixers *Ga As Detectors *LID. Reversible Ceramic
Oscillators

*Ga As Gunn Diodes *Si Avalanche (Impatt) Diodes
*Welded Ceramic S3

Backward Diodes

*Ge Planar Detectors *LID, Coaxial

Microwave Transistors

*Si 1 watt Power amplifiers *Si Low Noise, 5dB receiver

Tuning Varactor Diodes

*Si VHF & HF plastic, High Q *Si Hermetic, Wide
Capacitance Range

Varactor Multiplier Diodes

*160 GHZ, Si welded Ceramic

P-I-N Diodes *Switches

*Limiters *Modulators *Stick, Coaxial, Epoxy and Pill

Point Contact Diodes

*Mixers *Detectors *Coaxial, Single Ended Ceramic

Microwave Integrated Circuits

*Microstrip SUB-SYSTEMS incorporating microwave
semiconductors

**AEI
SEMICONDUCTORS**

**Write for your
copy of abridged
catalogue to:**

AEI Semiconductors Ltd.
Carholme Road, Lincoln
Telephone:
Lincoln 26435



WW-037 FOR FURTHER DETAILS

WORLD FAMOUS **IMO** (ELECTRONICS) LTD. VARIABLE VOLTAGE CONTROLS



VARIABLE TRANSFORMERS

- ★ Output 0-260V
 - ★ Input 230V 50/60CPS
 - ★ Shrouded for Bench or Panel mounting
- Inset shows latest pattern Brush gear ensuring smooth continuous adjustment.



£5.10.0 1 amp 2.5 amp £6.15.0 8 amp £14.10.0 12 amp £21.0.0
 5 amp £9.15.0 10 amp £18.10.0 20 amp £37.0.0

CONSTANT VOLTAGE TRANSFORMER.

Maintain spot-on test gear readings with Automatic Mains stabilizer.

- Specification:
- ★ Output 240V
 - ★ Accuracy ± 1%
 - ★ Input 190-260V
 - ★ Capacity 250 watts
 - ★ Corrected wave

£12.10.0 C & P 20/-



20 AMP LT SUPPLY UNIT

- ★ Input 240V
- ★ Output 20 amps at 24V fully adjustable
- ★ Size 16" x 12" x 20" high
- ★ Weight 50 lbs.

£35.0.0



SOLID STATE VARIABLE CONTROL

- ★ Output 25-240V
- ★ Input 240V 50 CPS
- ★ 5 amp & 10 amp models
- ★ Completely sealed

5 amp model **£8.7.6**
 10 amp model **£13.15.0**



UNIVERSAL MICRO SWITCH



MLC-3
 5 amp C/O
1/6
 each in quantity

10 amp C/O PUSH-BUTTON MICRO-SWITCH

panel mounting.
 Buttons in Red, Green, White & Black
 Type SS-1. **4/8** each per 1,000



IMMEDIATE DESPATCH
 FULL SPARES AND SERVICE AVAILABLE

PROCESS TIMERS-MICRO SWITCHES

- ★ SYNCHRONOUS MOTOR & CLUTCH
- ★ 10 MILLION OPERATIONS
- ★ Instantaneous & Timed out 3 AMP contacts
- ★ Repeat Accuracy ± 1%
- ★ Dial ranges 0-10 secs up to 0-28 hrs. May also be used as impulse start

£11
 dependent on quantity



SYS
 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.

£5
 dependent on quantity



STP
 TIMER

- ★ 1 MILLION OPS.
 - ★ 5 Amp c/o Sub-miniature Micro-switch
- 2/6** each per 1,000



"ACTUAL SIZE"
S5G
 MICRO SWITCH

- ★ Light force wire operated Micro-switch
- ★ Designed for even more economical coin-op mechanism

approx. **4/-** each per 1,000



CC5-R
 MICRO SWITCH

PROXIMITY SWITCHES, LIMIT SWITCHES AND LIQUID LEVEL CONTROLS
 MANUFACTURERS AND IMPORTERS FOR MINISTRY OF DEFENCE, G.P.O.

OMRON PRECISION CONTROLS

DIVISION OF IMO PRECISION CONTROLS LTD.

(Dept. WW9) 313 EDGWARE ROAD, LONDON, W2. TEL: 01-723 2231

WW-043 FOR FURTHER DETAILS

NKT

FOR GERMANIUM TRANSISTORS

One in five transistor sockets in this country are still calling for germanium transistors at a time when most semiconductor manufacturers have stopped producing them.

NKT has been expanding its germanium facilities to take the load and can readily supply most of the devices in current demand.

Apart from a comprehensive standard "NKT"-range of house coded devices, NKT specialises in the supply of:

- (a) **CV Germanium Transistors** such as CV 5309, 5327, 5791, 5929, 7001, 7002, 7005, 7006, 7007, 7008, 7012, 7074, 7083, 7084, 7085, 7086, 7376, 7436, 7437, 7438, 7439, 8004, 8126, 8386, 8559, 8640, 8765, 8794, 8801, 8802, 8810, 8837, 8838, 9190, 9308, 10809, 10992, 10995, 11175.
- "2N" Germanium Transistors** such as 2N 404, 1302, 1303, 1304, 1305, 1306, 1307, 1308, 1309.
- (c) **"Old-European" Standard Germanium Transistors** such as OC 28, 29, 35, 36, 42, 44, 45, 70, 71, 72, 74, 75, 76, 77, 80, 81, 82, 83, 84.
- (d) **"New European" Standard Germanium Transistors** such as AC 128, 176; ACY 17, 18, 19, 20, 21, 22, 30, 39, 40, 41; AD 140, 149; AF 114, 115, 116, 117.
- (e) **Other Manufacturer House-code Germanium Transistors** such as TK 23, 30, 31, 40, 42, 45, 46, 47, 48, 49.

YOU may be in trouble over continuing supplies of germanium transistors such as these.

Why not contact **NKT Sales Office** with your requirement.

NKT—Newmarket Transistors Ltd.,

Exning Road,

Newmarket, Suffolk.

Tel. Newmarket (0638) 3381. Telex 81358

WW—044 FOR FURTHER DETAILS

Valradio DC to AC TRANSVERTORS

(transistorised DC Invertors/Convertors)

Carry out your field tests using standard AC equipment.

A VALRADIO TRANSVERTOR will enable you to use all types of test instruments in the field or in motor vehicles.

Standard models are available for loads of 20W to 1000W for battery inputs of 12V & 24V and equally important to you most types are available from stock.

Prices range from £5 to £170.

The range is covered by three basic groups, having distinct characteristics.

T series—Square wave, frequency tolerance $\pm 3\text{Hz}$

Q series—Square wave, frequency tolerance $\pm \frac{1}{2}\text{Hz}$

S series—Sine wave, frequency tolerance $\pm \frac{1}{2}\text{Hz}$

Typical model B12/200S input 12V output 115-230V 200W.

Price £67-12-0



Type B12/200S

Send for full information and technical details:

VALRADIO LTD., Dept. W.C.4,
Browell's Lane, Feltham, Middlesex, England. Tel.: 01-890 4242

WW—045 FOR FURTHER DETAILS

POWER AT ANY FREQUENCY?

Our model PPA1K power supply will provide 1 kW of AC power at any frequency within the range 40 Hz to 10 kHz

A large selection of units from stock over the range 120W to 160 kW

- low distortion
- high frequency stability
- continuously variable output voltage
- single-phase or three-phase

LTV
LING ALTEC

LTV Ling Altec Limited

Baldock Road, Royston, Herts, England

Telephone: Royston 2424. Telex: 81174

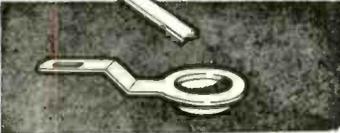
WW—046 FOR FURTHER DETAILS



PRECISION PRESSINGS

Accurate components at competitive prices

produced by progressive tooling and multiform methods



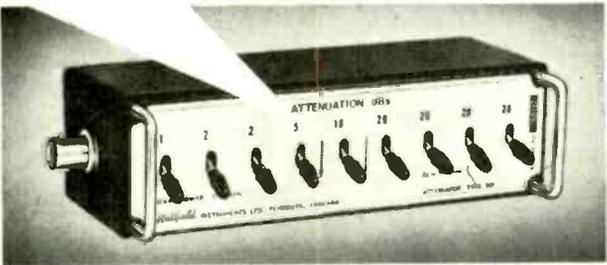
JOHN SMITH LTD.

209 SPON LANE · WEST BROMWICH · STAFFS. TEL. 021-553 2516 (3 LINES)
WOODS LANE · GRADLEY HEATH · WARLEY · WORCS. TEL. CR 69283 (3 LINES)

WW-047 FOR FURTHER DETAILS

INSTANT SELECTION

from 1 to 100 dB ATTENUATION



The Hatfield range of Switched Attenuators, Type 687, offer precise switched attenuation from 1—100 dB in 1 dB steps and are housed in neat, die-cast aluminium boxes only 5½ x 1½ x 2½ in.

The range comprises:

Type	Connections	Impedance
687A	BNC	50 ohms
687B	BNC	75 ohms
687C*	BNC	50 ohms
687D*	BNC	75 ohms
687E	BNC	600 ohms Unbalanced
687F*	BNC	600 ohms Unbalanced
687G	Terminals	600 ohms Balanced
687H*	Terminals	600 ohms Balanced

* with gold-plated switch contacts.

Full details on request.
HATFIELD INSTRUMENTS LTD.
Dept. WW, Burrington Way, Plymouth, Devon.
Telephone: Plymouth (0752) 72773/5. Telegrams: Sigjen Plymouth. Telex: 45592

HATFIELD BALUN

WW-048 FOR FURTHER DETAILS

Farnell

New Constant Voltage/ Constant Current 'L' Series



Our experience in the manufacture of stabilised bench power supplies and knowledge of the latest market requirements have prompted a re-design of the well established 'L' Series. Consideration has been given to the more advanced needs of the research and development engineer, but equally the basic features of a general purpose laboratory power supply, suitable for student use, have been retained.

Units Available	Prices
L.30A 0-50 Volts at ½ Amp.	£35
L.30B 0-30 Volts at 1 Amp.	£35
L.30C 0-10 Volts at 3 Amps (with adjustable over-voltage protection circuit)	£48
L.30A/T } L.30B/T }	twin versions of L.30A and B above £70

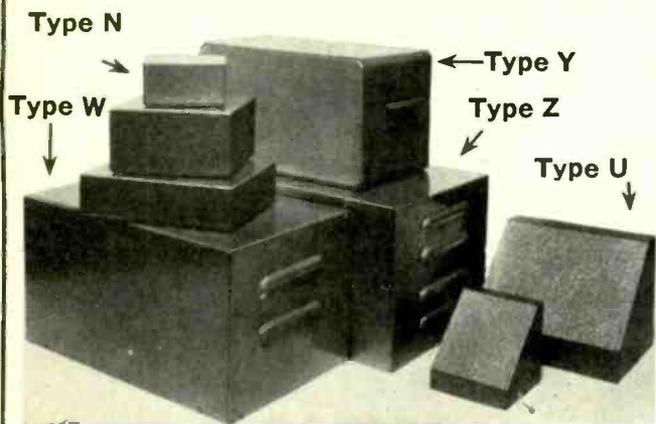
Features

- * Continuous variability of voltage and current settings
- * Constant voltage or constant current operation
- * Programmable output
- * Extremely stable output against load/line variations
- * Separate on/off switching of mains input and DC output
- * Adjustable current limiting facility on all units
- * Variable SCR over voltage protection circuit on L.30C.
- * Clean functional design with precise monitoring of voltage and current by clear scale meter.

FARNELL INSTRUMENTS LTD.,
Sandbeck Way, Wetherby, Yorkshire
Telephone: 0937 3541/6

WW-049 FOR FURTHER DETAILS

CHASSIS and CASES



CASES

ALUMINIUM, SILVER HAMMERED FINISH

Type	Size	Price	Type	Size	Price
N	8 x 6 x 2*	18/-	W	12 x 7 x 7*	37/6
N	6 x 6 x 3	17/6	W	15 x 9 x 8	48/6
N	4 x 4 x 2	11/-	Y	8 x 6 x 6	29/-
U	4 x 4 x 4	11/-	Y	12 x 7 x 7	45/-
U	5½ x 4½ x 4½	17/-	Y	13 x 7 x 9	50/6
U	8 x 6 x 6	23/-	Y	15 x 9 x 7	53/6
U	9½ x 7½ x 3½	24/-	Z	17 x 10 x 9	72/6
U	15 x 9 x 9	49/-	Z	19 x 10 x 8½	78/-
W	8 x 6 x 6	23/-			

*Height
Plus post and packing.

Type N has a removable bottom, Type U removable bottom or back, Type W removable front, Type Y all-screwed construction, Type Z removable back and front.

BLANK CHASSIS

FOUR-SIDED 16 SWG ALUMINIUM

Size	Price	Base	Size	Price	Base
6 x 4 x 2"	6/3	2/11	10 x 8 x 2½"	12/-	5/6
7 x 4 x 1½"	6/-	3/2	12 x 7 x 2½"	12/-	5/11
7 x 5 x 2"	7/6	3/5	12 x 9 x 2½"	13/9	7/-
8 x 4 x 2"	7/-	3/4	13 x 8 x 2½"	13/9	6/11
8½ x 5½ x 2"	8/-	3/9	14 x 7 x 3"	14/6	6/6
9 x 7 x 2"	9/3	4/10	14 x 10 x 2½"	16/-	8/7
10 x 4 x 2½"	9/-	3/9	15 x 10 x 2½"	16/6	9/1
12 x 4 x 2½"	10/-	4/3	17 x 10 x 3"	19/6	10/1
12 x 5 x 3"	12/-	4/9			

TO FIT OUR CASES

Size	Price	Base	Size	Price	Base
7 x 5½ x 1½"	7/-	3/9	12 x 6½ x 2"	10/9	5/11
7 x 5½ x 2"	7/9	3/9	14 x 8½ x 2"	13/6	7/11
11 x 6½ x 1½"	10/-	5/6	15½ x 9½ x 2½"	17/-	9/6
11 x 6½ x 2"	10/-	5/6	17½ x 9½ x 2½"	18/6	10/6

WITH BASES

Size	Price	Size	Price
5 x 4 x 2½"	9/3	3½ x 3½ x 2½"	6/6
4 x 2½ x 1½"	6/-	3 x 2 x 1"	5/6
3½ x 3½ x 2½"	7/3	6½ x 2½ x 1½"	8/3

Plus post & packing.

PANELS: Any size up to 3ft. at 6/- sq. ft. 16 s.w.g. (18 s.w.g. 5/3). Plus post and packing.

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.

WW-050 FOR FURTHER DETAILS

Adamin

MODEL 15

MICRO SOLDERING INSTRUMENT



● EXTREME VERSATILITY

Range of 8 interchangeable bits, from ¼in. (.047in.) to ¾in., including long-life PERMATIPS.

● ULTRA-SMALL SIZE

Length 7½in. Weight ½ oz. Max. handle dia. ⅞in.

● 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

28 Sydenham Road, Croydon, CR9 2LL

Tel: 01-688 8589 & 4559

WW-051 FOR FURTHER DETAILS

There are a couple of things you should know about the Welbrook All Silicon Stereo Amplifier

DISTORTION

0.1% at all output levels

PRICE

£42. 0. 0d.

A new and unique method of equalising impedances in the output stage enables only Welbrook to offer such true high fidelity reproduction at such low cost.

This technical breakthrough brings you the Welbrook W20 Stereo Amplifier, with no distortion rise at any level, for only £42. 0. 0d. This is a truly remarkable bargain among high quality stereo amplifiers, using Class B operation.

Performance:

Power Output:

24 watts R.M.S. (12 watts per channel) into 4 ohms load.

20 watts R.M.S. (10watts per channel) into 8 ohms load.

14 watts R.M.S. (7 watts per channel) into 15 ohms load.

Total Harmonic Distortion:

Typically 0.1% for 10 watts per channel into 8 ohms load at 1 KHZ with no increase at low levels.

Hum and Noise:

With volume control at minimum 80 dB. With volume control at maximum-55 dB.

Frequency Response:

-1 dB at 30 HZ and 15 KHZ.

Inputs: Pickup:

R.I.A.A. characteristic, sensitivity adjustable up to 3 MV to suit crystal; ceramic or magnetic cartridges.

Tuner:

Flat characteristic-sensitivity 100 MV-input impedance 100 K ohms.

Tape:

Flat characteristic-sensitivity 100 MV-input impedance 100 K ohms.

Outputs:

Loudspeakers output to suit 4, 8 and 15 ohms. Tape output for recording-200 MV for rated input sensitivities-minimum external impedance 10 K ohms.

Tone Controls Bass:

Ganged control giving ± 14 dB at 30 HZ

Treble:

Ganged control giving ± 14 dB at 15 KHZ

Balance Control:

Facility to reduce output from either channel continuously from maximum output to zero.

Dimensions:

14 1/2" wide x 9" deep x 4" high (cabinet)

Price:

Recommended retail price; £42. 0. 0d. including cabinet.

For full details of the Welbrook Stereo Amplifier post the coupon to:

**WELBROOK ENGINEERING & ELECTRONICS LIMITED,
BROOKS STREET, STOCKPORT, CHESHIRE, SK1 3HT**



To: Welbrook Engineering & Electronics Limited;
Please send me full details of the Welbrook Stereo Amplifier.

NAME

ADDRESS

(WW1)

WW-056 FOR FURTHER DETAILS

Get across loud and clear with AKG microphones!



AKG C-451
Quality condenser microphone with new CK1 capsule (interchangeable with other AKG microphones). Other capsules are available built into wind-shield with 'rifle' tube attachment. Supplied with battery power unit and/or mains unit which can feed two microphones.



AKG D-109
Dynamic miniature microphone—the smallest Lavalier on the market. High-quality reproduction compares well with others costing several times more. With 60 or 200 Ohm impedance. 3 metres cable. Use it wherever a mike is to be heard but not seen—interviewing, films, conferences, etc.



AKG D-224
Advanced studio microphone, employing two-way cardioid principle—the latest in microphone technology—in slim, elegant form. High-quality dynamic microphone ideal for all broadcasting and studio work. Incorporates bass attenuation switch and pivoted stand attachment.

Find out more about AKG mikes from

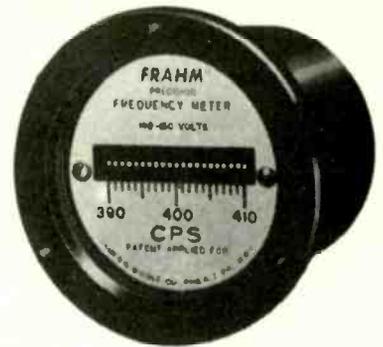


Politeohna (London) Ltd. 182-184 Campden Hill Road, London, W.8. 24 Hr. Telephone: 01-727 0711 Telex: 23894

AKG microphones

WW—057 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. 48/56 BAYHAM PLACE, BAYHAM STREET LONDON NW1 TEL: 01-387 9092.

WW—058 FOR FURTHER DETAILS

TELEPRINTERS · PERFORATORS REPERFORATORS · TAPEREADERS DATA PROCESSING EQUIPMENT



Codes: Int. No. 2 Mercury/Pegasus, Elliot 803, Binary and special purpose Codes.



2-5-6-7-8- TRACK AND MULTIWIRE EQUIPMENT

TELEGRAPH AUTOMATION AND COMPUTER PERIPHERAL ACCESSORIES DATEL MODEM TERMINALS, TELEPRINTER SWITCHBOARDS

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; Diversity; Frequency Shift, Keying Equipment; Line Transformers and Noise 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; Miscellaneous Accessories, Teleprinter and Teletype Spares.

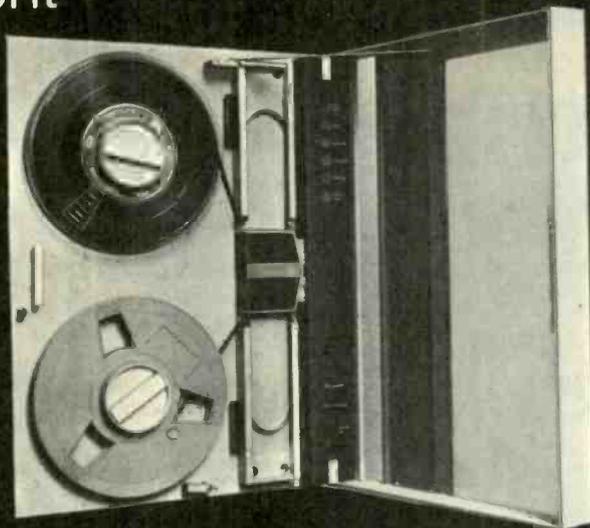


W. BATEY & COMPANY

Gaiety Works, Akeman Street, Tring, Herts.
Tel.: Tring 3476 (3 lines) Cables: RAHMO TRING
STD: 0442 82 TELEX 82362

WW—059 FOR FURTHER DETAILS

the increment
from this
Digital
Recorder
is the
reliability



The T5000 is probably the most reliable digital magnetic tape recorder in fully computer-compatible format you can find anywhere. It has 12 months PROVEN OPERATION behind it.

We didn't want to say too much about the T5000 until we were SURE of its performance. We've had it working internationally with discerning and demanding users. Now we're sure. You will find the T5000 a valuable contribution to your operation.

The T5000 fits easily into any system without headache — your interface problems have been anticipated right at the design stage.

BRIEFLY:

Reliability Proven All solid-state modular construction. No relays. All logic is I.C.

Simple to Operate Simple tape path.

Automatic loading into vacuum columns.

Ideal Tape Handling Vacuum columns give optimum tape packing. Proportional servo dynamic braking.

Precision Tape Drive Electronic damping eliminates any incremental capstan drive resonances.

Packing Density: 200, 556 or 800 b.p.i.

Feed Modes a. Incremental on command.

b. 37.5 i.p.s. (other speeds to special order)

Increment Rate a. 0-300 characters/sec at 556 and 200 b.p.i.

b. 0-500 characters/sec at 800 b.p.i.

(1200 characters/sec to special order)

Start Time 2 mSec at 37.5 i.p.s.

RACAL

A MEMBER OF THE RACAL GROUP OF COMPANIES

Get the full facts now from Britain's Analogue, Digital and Communications Magnetic Recording specialists:

RACAL-THERMIONIC LIMITED

Hythe, Southampton, England.

Telephone HYTHE 3265 : Telex 47600

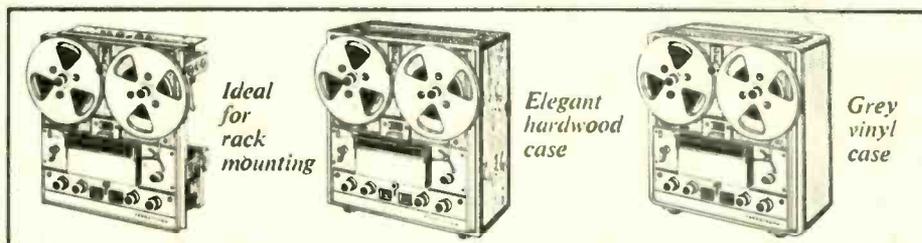
Ferrograph Series 7 - a lifetime of recording

Ferrograph Tape Recorders have been famous ever since 1949. A lifetime's experience of making fine recorders goes into every one of Ferrograph's brilliant new Series 7.

And there is a lifetime's recording in every Ferrograph instrument. Many of the earliest Ferrographs are giving perfect service today—twenty years later. You can be sure your Ferrograph will do the same for you. It will give dependable service for many, many years to come. It will keep its value. It will need the minimum of service. Spare parts will remain available for a lifetime's recording. That's how Ferrograph got its name.

Available in Mono, and in Stereo with and without end amplifiers; combining a unique range of 30 recording facilities, including:

- All silicon solid-state electronics with FET input stages and wide input overload margins.
- Vertical or horizontal operation.
- Unit construction: The 3 individual units i.e. tape deck, power unit and amplifier complex are mounted on a single frame easily removable from cabinet for service or installation in other cabinets or racks.
- 3 motors (no belts). 3 tape speeds.
- Variable speed spooling control for easy indexing and editing.
- Electrical deck operation allowing pre-setting for time-switch starting without need for machine to be previously powered.
- Provision for instantaneous stop/start by electrical remote control.
- Single lever-knob deck operation with pause position.
- Independent press-to-record button for safety and to permit click-free recording and insertions.
- 8½" reel capacity.
- Endless loop cassette facility.
- Internal loud speakers (2)—1 each channel on stereo, 2 phased on mono.
- 4 digit, one-press re-set, gear-driven index counter.
- 2 inputs per channel with independent mixing (ability to mix 4 inputs into one channel on stereo machine).
- Signal level meter for each channel operative on playback as well as record.
- Tape/original switching through to output stages.
- Re-record facility on stereo models for multi-play, echo effects etc, without external connections.
- Meters switchable to read 100 kHz bias and erase supply with accessible preset adjustment.
- Three outputs per channel i.e. (1) line out—level response. (2) line out—after tone controls. (3) power output—8-15 ohms.
- Power output 10W per channel.
- Independent tone controls giving full lift and cut to both bass and treble each channel.
- Retractable carrying handle permitting carrying by one or two persons.



U.K. Retail prices from £175 incl. P.T.

Please see next page for list of Ferrograph Stockists



FERROGRAPH

The Ferrograph Co Ltd, Mercury House, 195 Knightsbridge, SW7

Telephone: 01-589 4485

Listen for yourself

To *know* the Ferrograph Series 7 you must look at it, listen to it, for yourself. You will find it in stock at many of the best tape-recording and Hi-Fi specialists in the country, including the following:

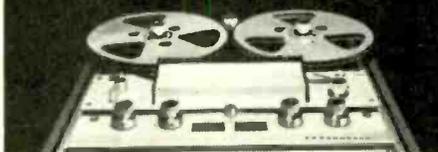
Ferrograph stockists

- London Dealers**
C. C. Goodwin (Sales) Ltd.,
7 The Broadway,
Wood Green, N.22
- Francis of Streatham,**
Tape Recorder Specialists,
169-173 Streatham High Road,
S.W.16
- Hampstead High Fidelity,**
91a Heath Street, N.W.3
- Imhofs,**
112-116 New Oxford St.,
W.C.1
- Larga of Holborn,**
76/77 High Holborn,
W.C.1
- Nusound,**
242/4 Pentonville Road,
N.1
- Nusound,**
82 High Holborn,
W.C.1
- Nusound,**
228 Bishopsgate,
E.C.2
- Nusound,**
360 Kilburn High Road,
N.W.6
- Nusound,**
36 Lewisham High St.,
S.E.13
- Nusound,**
2 Maryland Station,
E.15
- The Recorder Co.,**
186-188 West End Lane,
W. Hampstead, N.W.6
- R. E. W. (Earlsfield) Ltd.,**
266-268 Upper Tooting Road,
S.W.17
- R. E. W. (Earlsfield) Ltd.,**
146 Charing Cross Road,
W.C.2
- Teleonic Ltd.,**
92 Tottenham Court Road, W.1
- Teletape Ltd.,**
33 Edgware Road,
W.2
- Teletape Ltd.,**
84/88 Shaftesbury Avenue,
W.1
- Aberdeen**
Aberdeen Radio Company,
12 Hadden Street
- Aberdeen Sound Centre Ltd.,**
25A Belmont St.
- Banstead**
Raylec Limited,
43 Buff Parade,
High Street
- Birmingham**
Chas. H. Young Ltd.,
170-172 Corporation Street,
Birmingham 4
- C. H. (Hi-Fidelity) Ltd.,**
167-169 Bromsgrove Street,
Birmingham 5
- Cine-Equipments Ltd.,**
Audio Visual Department,
9A Dale End,
Birmingham 4
- Blackburn**
Holdings Audio Centre,
39-41 Mincing Lane
- Blackpool**
F. Benfell Limited,
17 Cheapside,
(Abingdon Street)
- Bolton**
Harker & Howarth,
Churchgate
- Boscombe**
Tape Recorders (Bournemouth) Ltd.,
874 Christchurch Road
- Bournemouth**
Forrester's,
National Radio Supplies Ltd.,
70-72 Holdenhurst Road
- Brighton**
Avery's
77 St. James's Street
- Lanes Radio Ltd.,**
11 Gardner St.
- Bristol**
Audio Bristol,
Park Street Avenue,
Bristol 1
- Bristol & West Recording Service Ltd.,**
6 Park Row,
Bristol 1
- Tape Recorder & Hi-Fi Centres Ltd.,**
82 Stokes Croft
- Bromley**
Bromley Sound,
32 Letchworth Drive
- Bury**
J. Smith & Son (The Rock) Ltd.,
184 The Rock
- Cambridge**
University Audio,
J. & 2 Peas Hill
- Canterbury**
Canterbury Hi-Fi Centre,
26 St. Dunstan's St.
- Cardiff**
The Roath Radio & Television Co.,
23/27 Morgan Arcade,
Cardiff CF1 2AF
- Sound Film Services**
(Cinema Liaison Ltd.),
27 Charles St.
- Tape Recorder & Hi-Fi Centres Ltd.,**
Oxford Arcade,
The Hayes
- Castle Douglas**
John Mitchell,
141 King Street
- Coventry**
Coventry Hi-Fi Centre,
13 City Arcade
- Coventry Tape Recorder Services,**
33 King William Street
- Crewe**
Charlesworths of Crewe Ltd.,
28 Hightown
- Darlington**
McKenna & Brown Ltd.,
11 Bond Gate
- Derby**
Bucklands of Derby,
41-49 London Road
- Doncaster**
Tom Jaques Ltd.,
Sound & Electronic Engineers,
16 Wood Street
- Dorchester**
Suttons,
Hardye Arcade
- Edinburgh**
J. B. Fulton Associates Ltd.,
16 Howe St.,
Edinburgh 3
- J. J. Mitchell (Cameras) Ltd.,**
Haymarket Corner,
Edinburgh 11
- Epping**
Chew & Osborne Ltd.,
148 High Street
- Farnham**
Lloyd of Keyworth Ltd.,
26/28 Downing St.
- Glasgow**
McCormack Ltd.,
33 Bath Street
- Goodmayes**
Unique Radio Ltd.,
The Facade,
High Road
- Gravesend**
Bennett & Brown (Gravesend) Ltd.,
58, 60b & 60c Wrotham Road
- Grimby**
Lincolnshire Instrument Co.,
Hi-Fi House,
69-71 Cartergate
- Guildford**
Marrow Sound Ltd.,
229 Epsom Road,
Marrow
- P. J. Equipments Ltd.,**
3 Onslow Street
- High Wycombe**
Hughes Photographic & Hi-Fi
Specialists,
7 High Street
- Huddersfield**
Woods,
The Music Shop,
New Street
- Ilford**
Nusound,
87-100 Ilford Lane
- Kingetter**
Paul Taylor & Partners Ltd.,
1 Silver Street
- Leeds**
Beckett Film Services Ltd.,
Audio-Visual Specialists,
46-48 The Headrow,
Leeds LS1 8EL
- Valiance Audio Lab.,**
20 New Market St.
- Leicester**
United Film Service,
13 King Street
- Liverpool**
Beaver Radio (L'pool) Ltd.,
20-22 Whitechapel
- Lowestoft**
Hughes (Lowestoft) Ltd.,
62 London Road North
- Maidstone**
Sloman & Pettitt,
Pudding Lane
- Mansfield**
Syd Booth,
11 Queen St.
- Manchester**
Lancs. High Fidelity Ltd.,
248 Wilmslow Road, Manchester 14
- Middlesbrough**
McKenna & Brown Ltd.,
Linthorpe Road
- Newcastle**
Clement Wain Limited
Redlion Square
- Newcastle-upon-Tyne**
Turners (Newcastle-upon-Tyne) Ltd.,
Camera House,
Pink Lane
- Norwich**
Suttons,
16-18 Exchange Street
- Nottingham**
The Audio Centre,
28-30 Pelham Street
- Peter Anson Electronics,**
165 Arkwright Street
- Nottingham Tape Recorders Ltd.,**
11 Burton Street
- Oxford**
Westwoods,
46 George Street,
Oxford
- Plymouth**
Albert E. Ford Ltd.,
84 Cornwall Street
- Portsmouth**
H. R. Knight Ltd.,
71 Tangier Road
- Ramsgate**
Tom Joyce,
147 Boundary Road
- Redcar**
McKenna & Brown Ltd.,
135 High Street
- Reigate**
Alan Laurenson & Co.,
9 Bell Street
- Salisbury**
Suttons Music Centre
Blue Boar Row
- Sheffield**
Sheffield Sound Centre,
101 Ecclesall Road
- Solihull**
C. H. (Hi-Fidelity) Ltd.,
12 Drury Lane
- Southampton**
Hamilton Electronics (Southampton) Ltd.,
35 London Road
- Suttons,**
421 Shirley Road
- South Shields**
Savilles',
5-7 Keppel Street
- Stafford**
Tom Reekie Ltd.,
10 Bridge Street
- Stockport**
W. J. & M. Baylis Ltd.,
611 Gorton Road,
Reddish
- Stockton on Tees**
Bond & Mason,
Radio—TV—Hi-Fi—Electrical,
94 Church Road
- Stoke on Trent**
Wilson Radio Ltd.,
30-32 Liverpool Road
- Sudbury**
The Record Shop,
King Street
- Sunderland**
Saxons (Sunderland) Ltd., Photo-
graphic Dealers,
20-22 Waterloo Place
- Swansea**
Holt,
Radio, TV, Hi-Fi, Audio Electronics,
Picton Arcade,
Oxford Street
- Teddington**
Daytronic Ltd.,
119A High Street
- Truro**
Fords (Prop E. J. E. Vivian)
9 Pydar Street
- Wealdstone**
K. J. Enterprises,
17 The Bridge
- Wilmslow**
The Hi-Fi & Tape Recorder Lounge,
Green Lane
- Woking**
D. H. Hughes & Sons Ltd.,
29 High Street,
Knaphill
- Wolverhampton**
M. R. Warner & Son Ltd.,
26 Chapel Ash
- Worthing**
Bowers & Wilkins Ltd.,
1 Becket Buildings,
Littlehampton Road

If none of these is near enough to you, in case of difficulty, or for free literature, send us the coupon, or give us a ring on 01-589 4485

FERROGRAPH

the tape recorder with
the hearing-is-believing sound



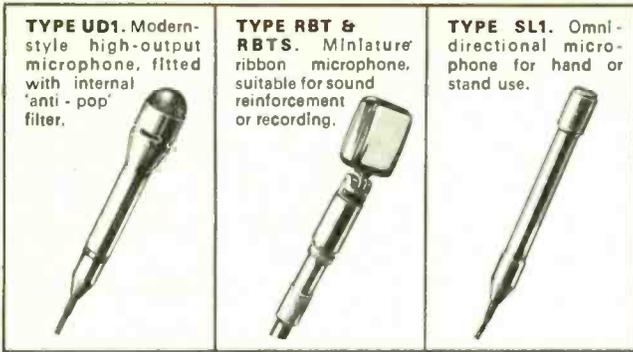
To The Ferrograph Co. Ltd., Mercury House, 195 Knightsbridge, London SW7

Please send me a free brochure on the Ferrograph Series 7
 or the new Ferrograph Manual for which I enclose £1

NAME.....
ADDRESS.....

WW

WW-064 FOR FURTHER DETAILS



Today's acoustical-performance standards are the highest ever. Nice to know Reslo makes equipment to match.

Precision-made amplifiers, loudspeakers, hi-fi radio tuners, full P.A. systems, accessories ...and microphones - magnificent. This is the Reslo range of products, designed to top the sky - high acoustical-performance standards of today. Shown above are some of Reslo's most in - demand microphones, three stylish, clean-sound units that truly speak for themselves...



Please send me your free brochure giving full details.

Name

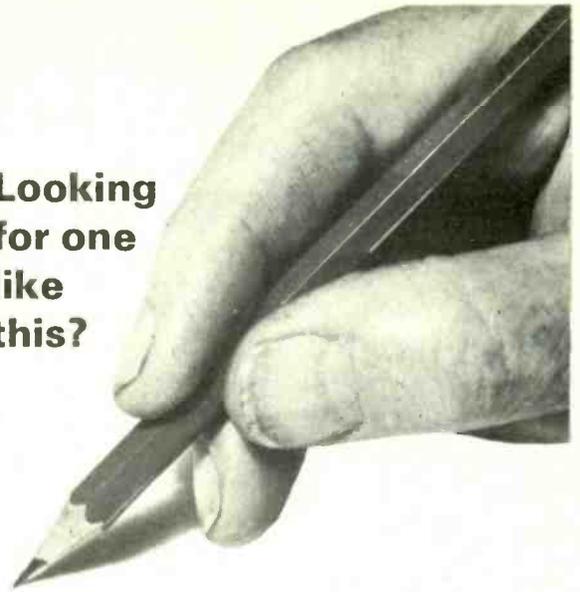
Address

RESLO MIKES,
ROMFORD,
ESSEX.



WW-065 FOR FURTHER DETAILS

Looking for one like this?



4 mm., tubular, wire ended, length 11.5 mm. Just one of the many Vitality Instrument and Indicator Lamps, 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 types and ratings detailed in Vitality Catalogue 69 may well be.

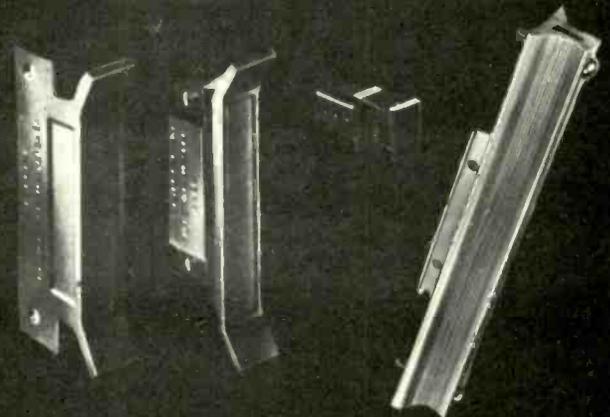
* Many a product owes its success to the intelligent addition of an indicator light*

VITALITY BULBS

VITALITY BULBS LTD., MINIATURE AND SUB-MINIATURE LAMP SPECIALISTS
BEETONS WAY, BURY ST. EDMUNDS, SUFFOLK. TEL: 0284 2071.
Member of the General Instrument Group.

WW-066 FOR FURTHER DETAILS

we've got lots of handles to our name



many in a complete colour range too!

If you would like to know more about our range of P.C. Card Handles, please write to:

VERO ELECTRONICS LTD.

Industrial Estate, Chandler's Ford, SO5 3ZR
Tel: Chandler's Ford 2921 Telex: 47551

Branches and Agents throughout the World

WW-067 FOR FURTHER DETAILS

PARTS AND COMPONENTS FOR TELECOMMUNICATION ENGINEERING AND ELECTRONICS

EXPORT—IMPORT

RC-Elements

- Resistors
- Capacitors
- Potentiometers

Electromechanical Components

- Connectors, sockets
- Switches
- Relays
- Pilot lamps
- Rotary buttons

Electroacoustic Components

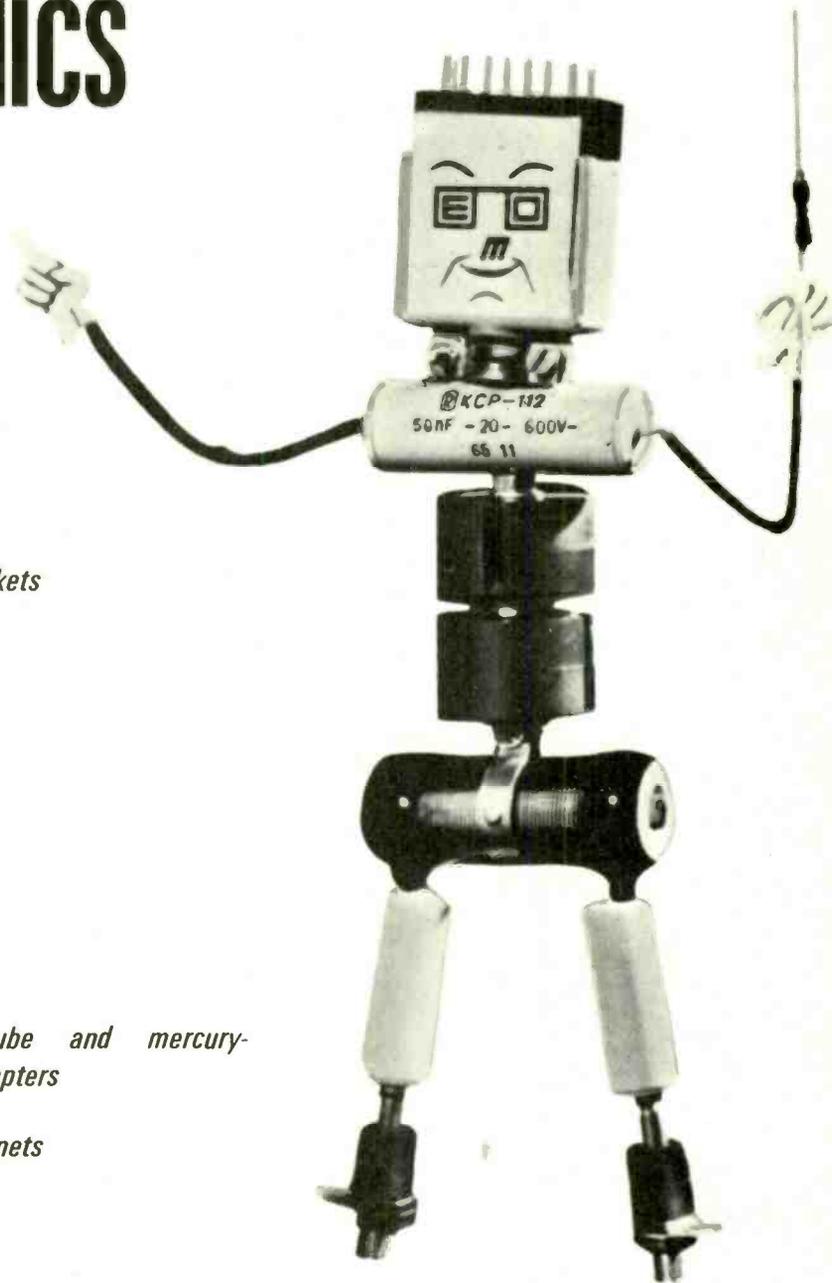
- Microphones
- Earphones
- Loudspeakers

Miscellaneous Parts and Components

- Transformers
- Fluorescent tube and mercury-
vapour lamp adapters
- Ferrites
- Permanent magnets
- Aerials

IMPORT

- Vacuum tubes, special lamps
- Semiconductor devices
- Integrated circuits



EMO
ELEKTROMODUL

BUDAPEST

ELEKTROMODUL

Hungarian Trading Company for Electrotechnical Components

BUDAPEST, XIII., VISEGRADI UTCA 47 a-b
Telephone: 495-340; 495-940. Telex: 3648; 3649

WW—068 FOR FURTHER DETAILS

Celestion PA

Loudspeakers for all Public Address Systems

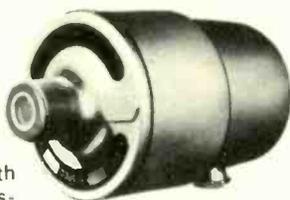


Re-entrant Horns

These Horns are capable of delivering a highly concentrated beam of sound over long distances. They are recommended for recreation centres, noisy factories and workshops and all indoor and outdoor locations where a high noise level has to be overcome.

Driver Units

Pressure type units are available with or without tapped 100V line transformers. The following 'built-in' features are on all models—High Sensitivity, Weatherproof, Phase Equalising Throat and Self-centring Diaphragm Assembly.



Re-entrant Loudspeakers

Rola Celestion re-entrant loudspeakers are designed for use wherever conditions demand compactness, toughness, high efficiency and unfailing service. They are rainproof and built to withstand prolonged exposure to vibration and adverse conditions.

Loudspeaker in Glass Fibre

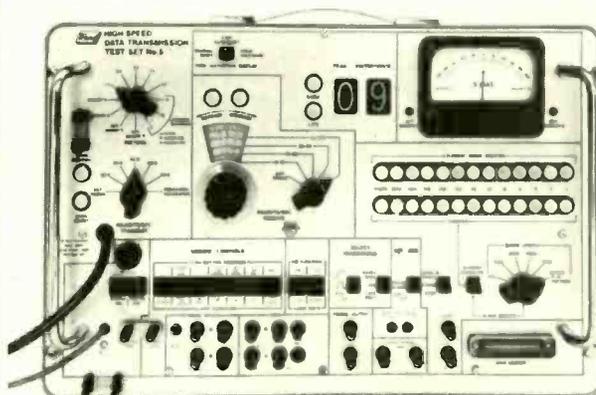
The Celestion Glass Fibre Loudspeaker is a compact robust and watertight unit, precision built for use on open boat decks, docks, chemical plants, plating shops, etc. where protection from the weather or corrosive atmosphere is vital.



Rola Celestion Ltd.
THAMES DITTON, SURREY
TELEPHONE 01-398 3402 TELEX 266 135

WW—069 FOR FURTHER DETAILS

LOOKING FOR HIGH SPEED TESTING OF YOUR DATA TRANSMISSION SYSTEMS?



Here's the answer

THE NEW HIGH SPEED DATA TRANSMISSION TEST SET NO.5 FROM TREND

With this portable, mains operated, unit you can carry out high speed testing of your data transmission equipment and links, checking peak telegraph distortion and bias distortion at a received data input rate of 128 Kilo bits per second. Error counting can be achieved at speeds of up to 1.6 Mega bits per second.

The Test Set No. 5 comprises a data transmitter, a data receiver and measuring circuits contained in a strong, internally screened ABS case. The case can be removed and the Test Set then rack mounted if desired.

Trend have fully detailed leaflets on this and their full range of transmission test equipment which is available on request.



Trend Electronics Limited

St. John's Works, Tylers Green, High Wycombe, Bucks.
Telephone No.: Tylers Green 322 & 654 Telex 83621 & 83625

WW—070 FOR FURTHER DETAILS

Some notes on Bridge Measurement by WAYNE KERR

Number 4 The Electric Field

The first three issues of these notes have described the basic principles of the Transformer Ratio Arm Bridge and have shown how high impedance components, such as small capacitors, can be accurately measured at the end of very long lengths of screened cable. The use of the bridge neutral connection enables the capacitance of the connecting cables to be isolated from the component being measured, the balance point of the bridge being unaffected by the presence of the screened cables. In this issue the use of the neutral connection to control the electric field surrounding an electrode forming part of a parallel plate or coaxial capacitor is described.

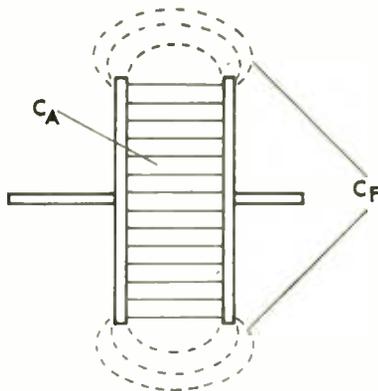


Figure 1

If a parallel plate capacitor is drawn, together with the associated electrostatic field, it will be apparent that the measured capacitance of this arrangement can be considered as the sum of two components; (C_A), the value for the centre part of the field in which the lines of force are linear, and (C_F), the value for the non-linear fringe field. Figure 1 illustrates these fields.

The electrical value for such a capacitor is exceedingly difficult to calculate, owing to the complicated nature of the fringe field, and so it has become common practice to use plates which are large in diameter and also placed closely together, in order to reduce to a minimum the effect of the fringe field. Furthermore, a difficulty arises in the determination of the permittivity of a substance comprising the dielectric. This is a simple ratio of the capacitance of the plates with the material placed between them to the capacitance of the plates in free space. In theory, an infinitely large disc of material would be necessary in order to carry out such a measurement and avoid errors due to lines of force in the fringe field traversing the edge of the disc.

The transformer ratio arm bridge offers a practical solution to these difficulties and Figure 2 shows how these errors can be eliminated by the use of the bridge neutral connection.

The right hand circular electrode is surrounded by an annular guard ring and is separated from it by a thin ring of insulating material.

When the system is balanced, both the central electrode and the guard ring are at the same potential and the bridge will only measure the capacitance formed by the central part of the field (C_B).

Further consideration of this arrangement shows that the thickness of the insulation in the annular gap becomes a limiting factor in the accuracy of the measurement—a wide gap would start to produce locally curved lines of force proportional to the width of the insulation. Fortunately, a technique developed recently enables an insulating layer to be produced only a few microns thick substantially removing this difficulty.

So far, the discussion of the transformer ratio arm bridge and its application to capacitance measurement has neglected a fundamental necessity, the creation of a precise standard of capacitance. The techniques already described can be used to design a basic standard, dependent only on the determination of the exact mechanical dimensions and the velocity of light for its achievement.

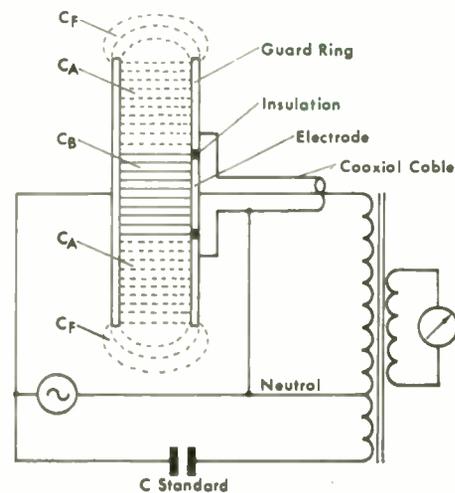


Figure 2

The ability to measure the capacitance between two electrodes precisely without correction being necessary for the effect of the fringe field creates new possibilities in metrology as well as electronics. Bridges can be constructed to measure reciprocal capacitance, and as the distance between linear-field electrodes varies as $1/C$, a voltage output can be given from the bridge directly proportional to this distance.

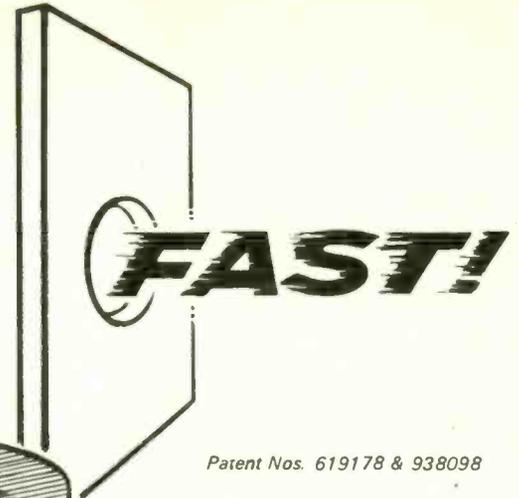
THE WAYNE KERR COMPANY LIMITED
NEW MALDEN • SURREY • ENGLAND

Telephone: 01-942 2202
Cables: Waynkerr Malden
Telex 262333

WW-071 FOR FURTHER DETAILS

"Q-MAX" SHEET METAL PUNCHES

. . . burr free holes



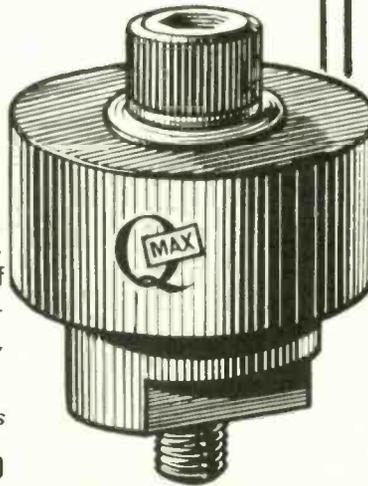
Patent Nos. 619178 & 938098

- 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



30 SIZES

ROUND: $\frac{3}{16}$ to 3 in.

SQUARE: $\frac{11}{16}$ and 1 in.

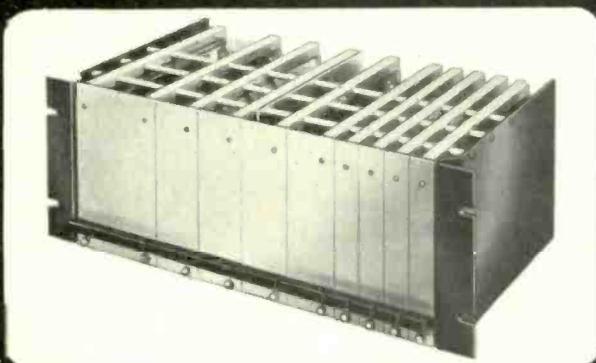
RECTANGULAR: $\frac{21}{32} \times \frac{15}{16}$ in.

Full List on application.

"Q-MAX" (electronics) LTD. Napier House, High Holborn, London, W.C.1.

WW—072 FOR FURTHER DETAILS

vero modular racks and card frames are very accommodating



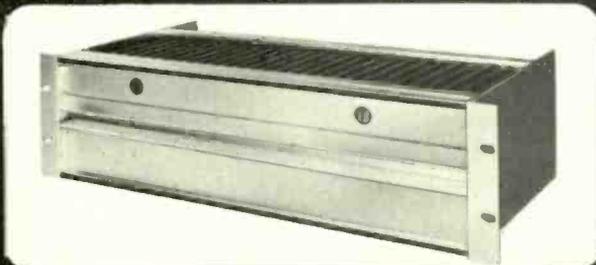
MODULAR RACK UNITS:-

Permitting 1,000's of variations using basic standard components. Module widths available are 1", 2", 4", 6", 8" and 16" in panel heights of 5 $\frac{1}{4}$ ", 7" and 8 $\frac{3}{4}$ " with depths of 7 $\frac{1}{4}$ " and 10 $\frac{1}{4}$ ".

CARD FRAMES:-

The Card Spacing can be arranged to a minimum of 0.5" pitch. A simplified method of edge connector mounting also provides for rapid assembly coupled with precise card alignment.

These are only a small part of Vero's systemised products which are all compatible to each other. Send now for full details of our complete packaging systems.



VERO ELECTRONICS LTD.

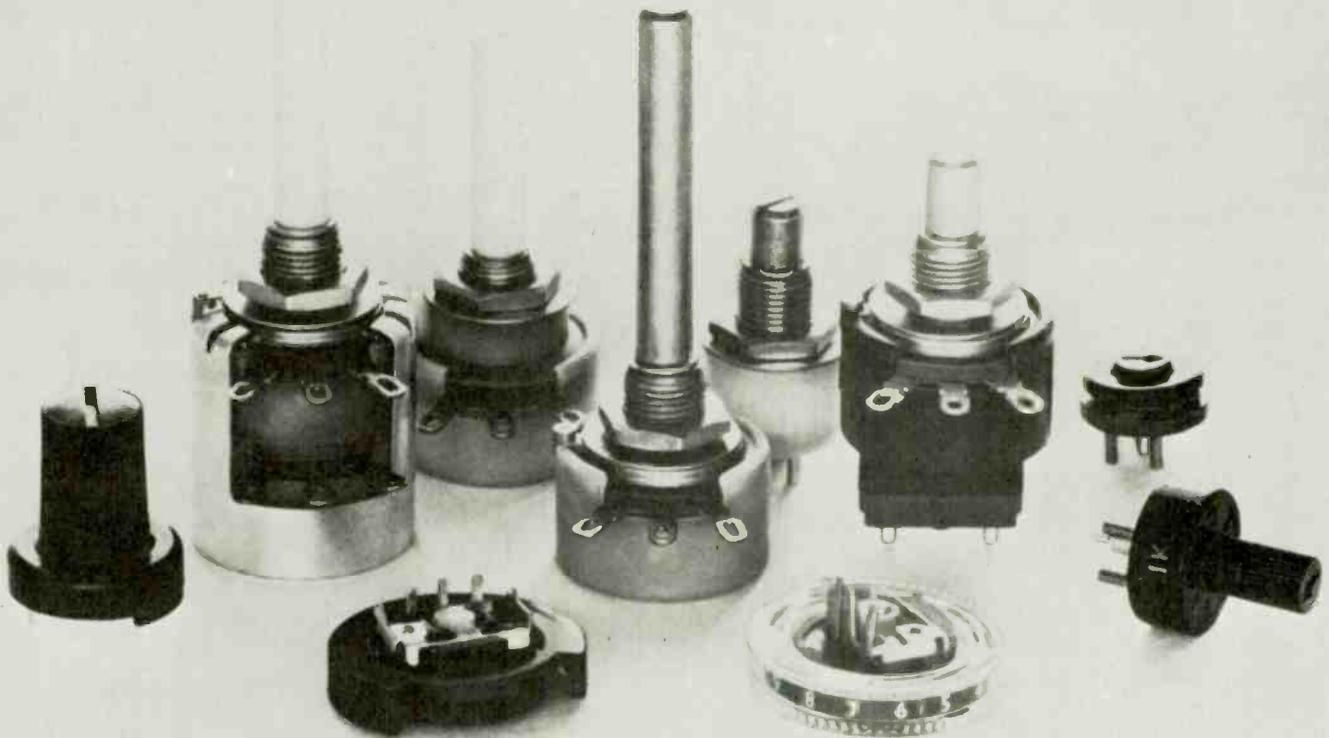
Industrial Estate, Chandlers Ford SO5 3ZR
Tel: Chandlers Ford 2921 Telex: 47551



Branches and Agents throughout the World

WW—073 FOR FURTHER DETAILS

New Weapons for the war against noise



We hate noise. We make filters to suppress it wherever it occurs. And now we are killing it at source with a new range of weapons . . . moulded track potentiometers. *Quiet* controls that retain low noise levels through a long operational life (upwards of 100,000 cycles).

There are over two dozen types in the range. Each has a hot moulded track element of large cross-sectional area, giving low current densities, high voltage ratings; eliminating local high spots and over-heating; eradicating wear.

An integral moulding of base, track and terminals gets rid of solders, rivets, welds; provides increased reliability and excellent humidity characteristics.

Standard or miniature designs, pre-set or switched for P.C.B. or chassis mounting are available in sealed and edge operated units. All are designed to meet the requirements of Specification DEF-5122 and are available with linear, logarithmic or special function laws.



All the lethal facts are in the brochure. Send for your copy today.

ERIE ELECTRONICS LIMITED,
Erie Controls Division,
Great Yarmouth,
Norfolk.

Tel: 0493 4911. Telex: 97421.

ERIE MOULDED TRACK POTENTIOMETERS

WW—074 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



WW—075 FOR FURTHER DETAILS



We put 23,340 cigarettes

in our Budget combination storage unit!

Think what you could put in it!

Storage. Lots of it, for a thousand things you stock: replacement parts; light bulbs; cameras; anything up to 7" x 8" x 10 1/2". Safety drawer-stops as 'standard'. Smooth guide runners thro'out. All in a compact 3ft 6in. high, 2ft 11in. wide, 1ft deep area. Ready assembled, in stove enamelled green or grey. With 18 handy, 6 large, 8 king-sized drawers. At £17 5s. worth every penny! See the rest of the N. C. Brown range!



£17 5s. carriage free on mainland

N.C. BROWN LTD. pacesetters in storage equipment

Send your FREE BROCHURE or Send (how many) Budget Storage Units @ £17 5s. in green or grey

NAME _____ ADDRESS _____

Dept. WW Eagle Steelworks, Haywood, Lanes. Tel: 69018
London: 25-27 Newton St., W.C.2. Tel: 01-406 7931

WW—076 FOR FURTHER DETAILS

IT TAKES A SHORT TIME TO TELL A LONG STORY



CALAN TRACE SHIFTER C501D

- ★ A TRACE (9,600 MILLIMETRES LONG ON A 5 INCH TUBE!)
- ★ A THREE DIMENSIONAL DISPLAY!
- ★ VERTICAL COMPARISON OF SUCCESSIVE SCANS!

Add these facilities to your oscilloscope. They will help you to examine the functional waveforms of heart or combustion engine or for that matter any other long waveform phenomena.

Price £78 Export and Agency Enquiries Invited.

Calan Electronics Limited,

6 Croft Street, Dalkeith, Scotland
Tel. 031-663-2344

WW—077 FOR FURTHER DETAILS

'WATTS' THE NAME FOR RECORD MAINTENANCE



HI-FI PARASTAT (Reg'd.) Pat. App. 58216/67.



Gramophone Record Maintenance and Stylus Cleaning Kit

Designed for use on NEW records or records in new condition which are to be played with pick-ups requiring very low tracking pressures. The 30,000 finely pointed tips of the HI-Fi Parastat Brush positively explore every detail in the record groove to provide the high degree of record cleanliness necessary when

using ultra lightweight pick-ups tracking at 2 grammes or less. The cover pad in the lid of the case is provided for the purpose of cleaning and activating the brush which when enclosed within the case is kept at the correct level of humidity required to control all static at the working surface. Perfectly clean records must be played with a perfectly clean stylus and an integral part of the kit is the new Watts Stylus Cleaner which provides a safe and efficient method of cleaning the stylus.

STYLUS CLEANER

Available separately complete with instructions.



Price 5/- Plus 1/3 P.T.

Supplied complete with instructions, 1 oz. New Formula dispenser, Distilled Water dispenser, spare pad cover and ribbons. Price 42/6 plus 1/3 P.T. Replacements: 1 oz. New Formula dispenser 4/6 Distilled Water Dispenser 4/- Pad Cover and Ribbons 1/9.

'PARASTAT' Reg'd. Manual Model Mk.IIA

A dual purpose record maintenance device. Keeps new records in perfect condition. Restores fidelity to older discs. Complete with 1 oz. New Formula dispenser and instructions. Price 45/-.

Replacements: Pad Covers 2/- each. Brush 12/6. Sponge Cover Pad 1/-, 1 oz. New Formula Dispenser 4/6.

HUMID MOP. Recommended for use in conjunction with the Manual Parastat and Preener. Cleans and conditions the bristles and velvet pads. Ensures correct degree of humidity at the time of use. Complete with spare sponges and instructions. Price 4/6. Replacements: Set of Sponges 2/6.

'PARASTATIK' Reg'd. DISC PREENER (Patent No. 982599)

Keeps new records like new. Expressly designed for use with records which have not had previous antistatic treatment. Complete with instructions. Price 6/9. Replacements: Packet of 4 wicks 2/-.

The original 'DUST BUG' Reg'd. (Patent No. 817598)

Automatic Record Cleaner. Easily fitted to any transcription type turntable. Provides a simple and effective method of removing static and dust while the record is being played. Surface noise and record and stylus wear is reduced, resulting in cleaner reproduction. Complete with 1/2 oz. New Formula Dispenser and instructions. Price 18/9 plus 4/5 P.T. Replacements: Nylon Bristle and Plush Pad 1/9. 1/2 oz. New Formula Dispenser 2/6.

A GUIDE TO THE BETTER CARE OF L.P. AND STEREO RECORDS

Completely revised. 48 pages, fully illustrated, providing all necessary information on Record Care. 2/6 Post Free.

All obtainable from your local specialist or direct:

To CECIL E. WATTS LTD. DARBY HSE, SUNBURY ON THAMES, MIDD.

Please send (Post Free U.K. and Commonwealth)

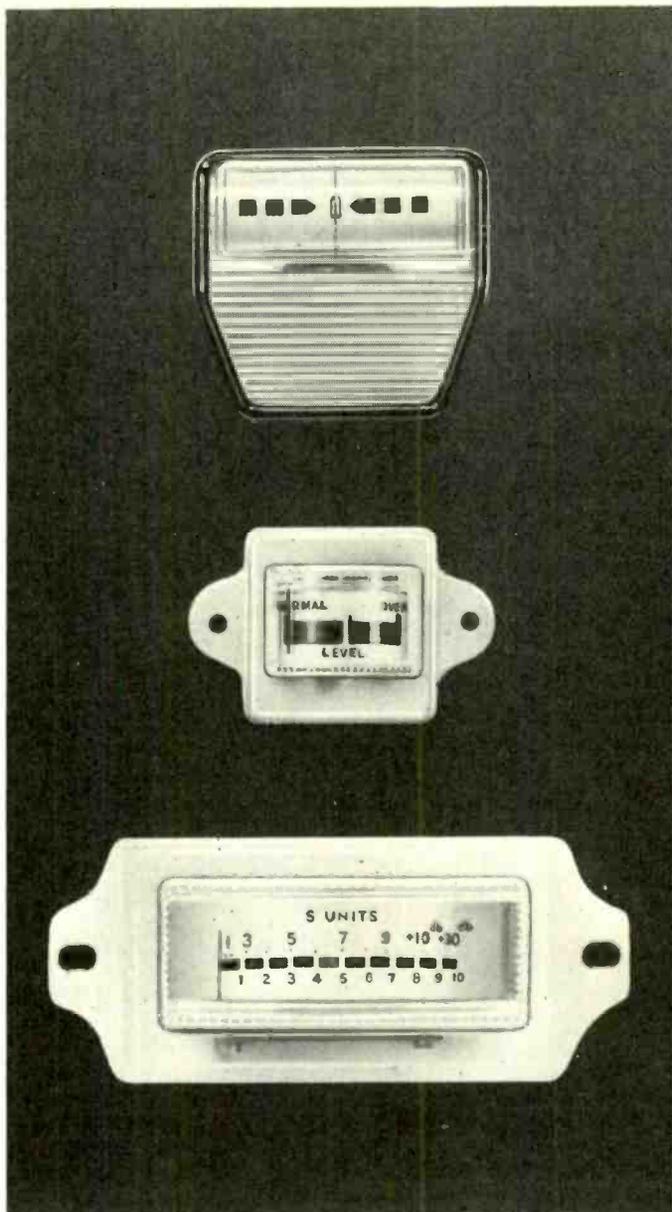
..... Disc Preeners @ 6/9 Hi-Fi Parastats @ 42/6 plus 1/3 P.T.
 Dust Bugs @ 18/9 plus 4/5 P.T. Manual Parastats @ 45/-
 48 page Booklets @ 2/6 Stylus Cleaners @ 5/- plus 1/3 P.T.

Replacement Parts:

I enclose cheque/P.O. value £..... (Do not send postage stamps)

Name

Address

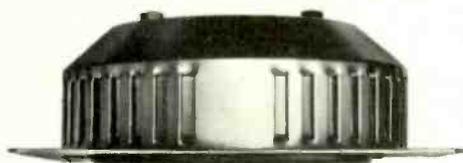


LEVEL METERS...

For a wide range of applications in professional radio, recording, instrumentation, and domestic equipment. For further information contact, IMPECTRON LTD., 23-31, King Street, London, W.3, Telephone: 01-992 5388

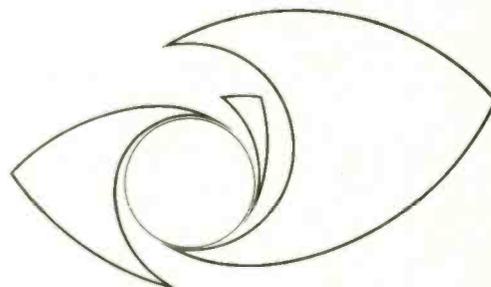


AUDIO & DESIGN "HYPERTONE" LOUDSPEAKER



- ★ Titanium Hyperbolic Radiating Element provides the highest standard of definition ever achieved.
- ★ Beryllium Copper Suspension provides low distortion bass.
- ★ Massive 6 lb. Ceramic Magnet for easier Power handling.

- ★ Modular approach allows flexibility of design.
- ★ Enthusiasts please note, the HYPERTONE reproduces everything.
- ★ Frequency Response: Total integrated power within 4db—25 c/s to 22 Kc/s.
- ★ Impedance at 400 c/s, 8 ohms or 15 ohms.
- ★ Power handling 15 watts R.M.S.



HYPERTONE

Suggested Retail Price £18.15.0

Write for further details and nearest Stockist:—

KEITH MONKS (AUDIO) LTD.

54 ROUNTON ROAD,
 CHURCH CROOKHAM,
 Nr. ALDERSHOT, HANTS.
 Tel: FLEET (02514) 3566

WRITE FOR DEMONSTRATION AT THE AUDIO FAIR STAND 88.

WW—080 FOR FURTHER DETAILS

Wilkinsons

EST. 1921

for RELAYS

P.O. TYPE 3000 AND 600

BUILT TO YOUR SPECIFICATION

Contacts up to 8 changeover

- ★ QUICK DELIVERY
- ★ KEEN PRICES



STANDARD LEVER KEYS

3 POSITION

Type 4C lock/4C lock 17/6 each.
 Type stop/6C 15/6 each.
 Type 2C 2M non-lock/2C 2M non-lock 14/6 each.
 Type 4C non-lock/6C lock 20/- each.
 Handles 8d. each.

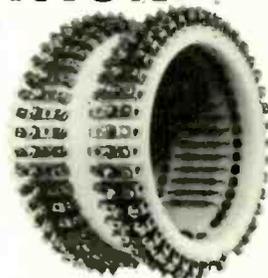
A large selection of field relays in stock.

L. WILKINSON (CROYDON) LTD.
 Longley House, Longley Rd., Croydon, Surrey.
 Tel. 01-684 0236

WW—081 FOR FURTHER DETAILS

ENCAPSULATION —

low tool cost method of cylindrical coils and potting. Enquiries also for:—



REED RELAYS
SOLENOIDS
COIL WINDING
TRANSFORMERS
 to 8 K.V.A.

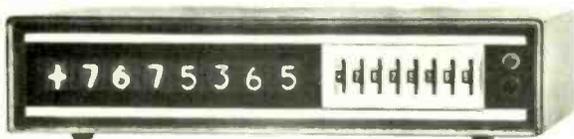
40-way relay "O" range

R. A. WEBBER LTD.

9 Knapps Lane, Bristol 5. 0272 657228

WW—082 FOR FURTHER DETAILS

ELESTA



SOLID STATE DIGITAL COUNTERS

A comprehensive range of compact counters specially designed for industrial application

- BATCH COUNTING AND MULTIPLE PRESELECTING OF QUANTITIES
 - TIME INTERVAL AND FREQUENCY MEASUREMENT
 - RATE AND RATIO MEASUREMENT (rpm, ft/sec, gallons/min, etc)
 - PROCESS CONTROL AND PROGRAMMING
 - NUMERICAL MACHINE CONTROL SYSTEMS
- Leine & Linde rotary digitisers ● Elesta bidirectional counters

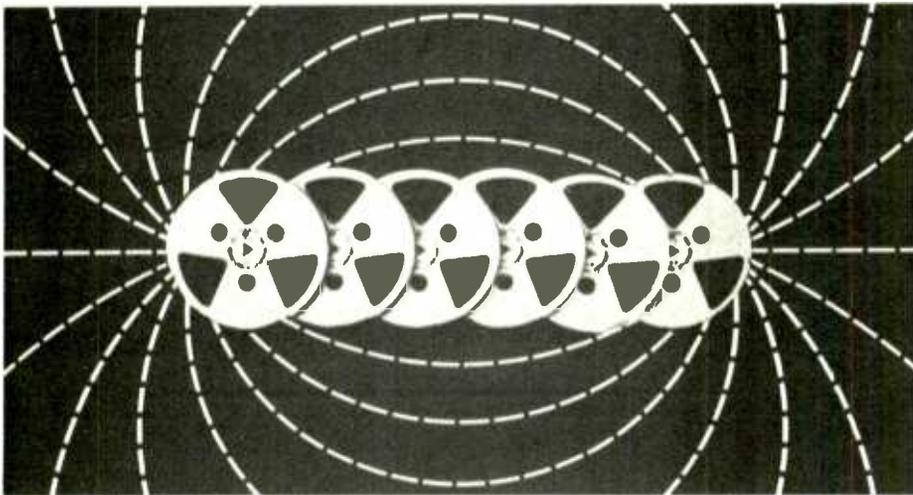
BRITEC LIMITED

17 Charing Cross Rd., London WC2. Tel: 01-930 3070. Telex 915854

WW—083 FOR FURTHER DETAILS

Residual magnetism may endanger your tapes every time you play them:

For only 75/- the Ferrograph Defluxer protects them.

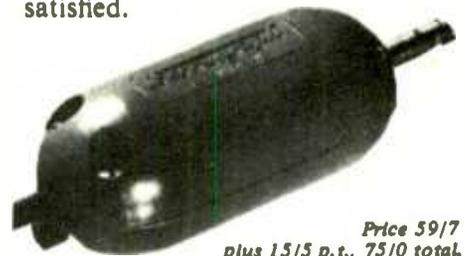


No professional studio would ever record without defluxing the heads and tape guides; so it is sensible that you, too, should follow this procedure at home. Once you have made a recording, or bought a pre-recorded tape, you must ensure that your sound is protected.

Electrical pulses, or magnetic materials such as are in loudspeakers nearby, can cause magnetization of the heads and guides which increases background noise and reduces high-frequency response.

Prevent any possibility of ruining your tapes. This unique

Ferrograph Defluxer is simple and quick, and can be used with practically any make of tape recorder. Once you start using it, your valuable, often irreplaceable tapes are protected against magnetization: surely it is worth just 75/- protection money! Call at your Ferrograph dealer, or send this coupon with your cheque/P.O. for a Defluxer. Money back guarantee if not satisfied.



Price 59/7
plus 15/5 p.t., 75/0 total.

Ferrograph

A member of the Willmot Breeden Group

To: The Ferrograph Co Ltd
Mercury House
195 Knightsbridge London SW7
Telephone: 01-589 4485

Please send me a Ferrograph Defluxer, complete with easy instructions for use.

I enclose cheque/P.O. for £3-15s, crossed and made payable to the Ferrograph Co Ltd.

Name _____

Address _____

(BLOCK CAPITALS)

ww

WW-084 FOR FURTHER DETAILS

SIMPLY SUPERB! the new brenell...

MODEL ST STEREO

Probably the most important new recorder of the year!

The new ST400/200 recorders are different from all previous Brenells. All transistorized electronics; shelf-mounting cabinet; simplified controls. Sound quality is even better than ever—as good as you can hear. Three-motor deck performance and reliability; quality components throughout. All usual facilities are available.

ST400/200 recorders are designed to give you exactly what you expect from a Brenell today.

Only the price is less than you may expect... £145 recommended. You pay no import duties... no high selling costs... only for a top-quality recorder, well made. It's a fine formula!

- Mono or stereo operation
- Choice of 2 or 4-track models
- 3 outer-rotor motors
- 3 tape speeds
- 2 recording level meters
- Full input/output and control facilities

A range of Brenell mono and stereo recorders is available, together with Brenell-deck and tape-link.



brenell

BRENELL ENGINEERING COMPANY LTD. 231/5 Liverpool Road, London, N.1. Telephone: 01-607 8271

GD 730

WW—085 FOR FURTHER DETAILS

TRANSIPACK[®] EMERGENCY

- STATIC NO-BREAK POWER SUPPLIES
- FREQUENCY CHANGERS
- INVERTERS

BEST
PERFORMANCE

DESIGN

DELIVERY

SIZES
up to 200 kVA



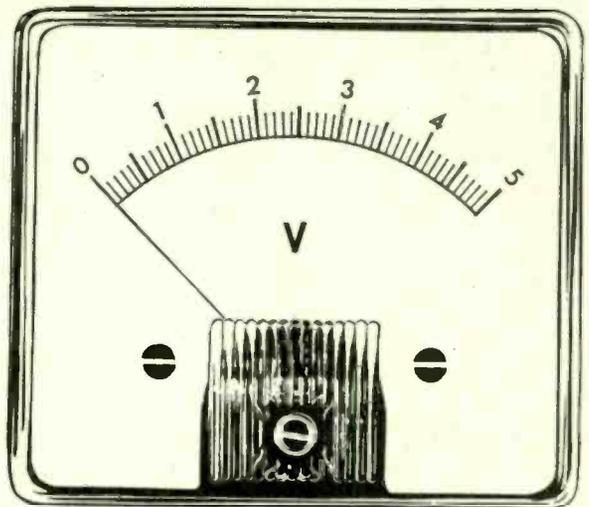
**INDUSTRIAL
INSTRUMENTS
LIMITED**

STANLEY RD., BROMLEY, KENT
Tel: 01-460 9212
Grams: Transipack Bromley

Transipack Factory:
PONSWOOD INDUSTRIAL ESTATE
THEAKLEN DRIVE
St. LEONARDS ON SEA, SUSSEX
Tel: Hastings 7344

WW—086 FOR FURTHER DETAILS

METER PROBLEMS?



A very wide range of modern design instruments is available for 10/14 days' delivery.

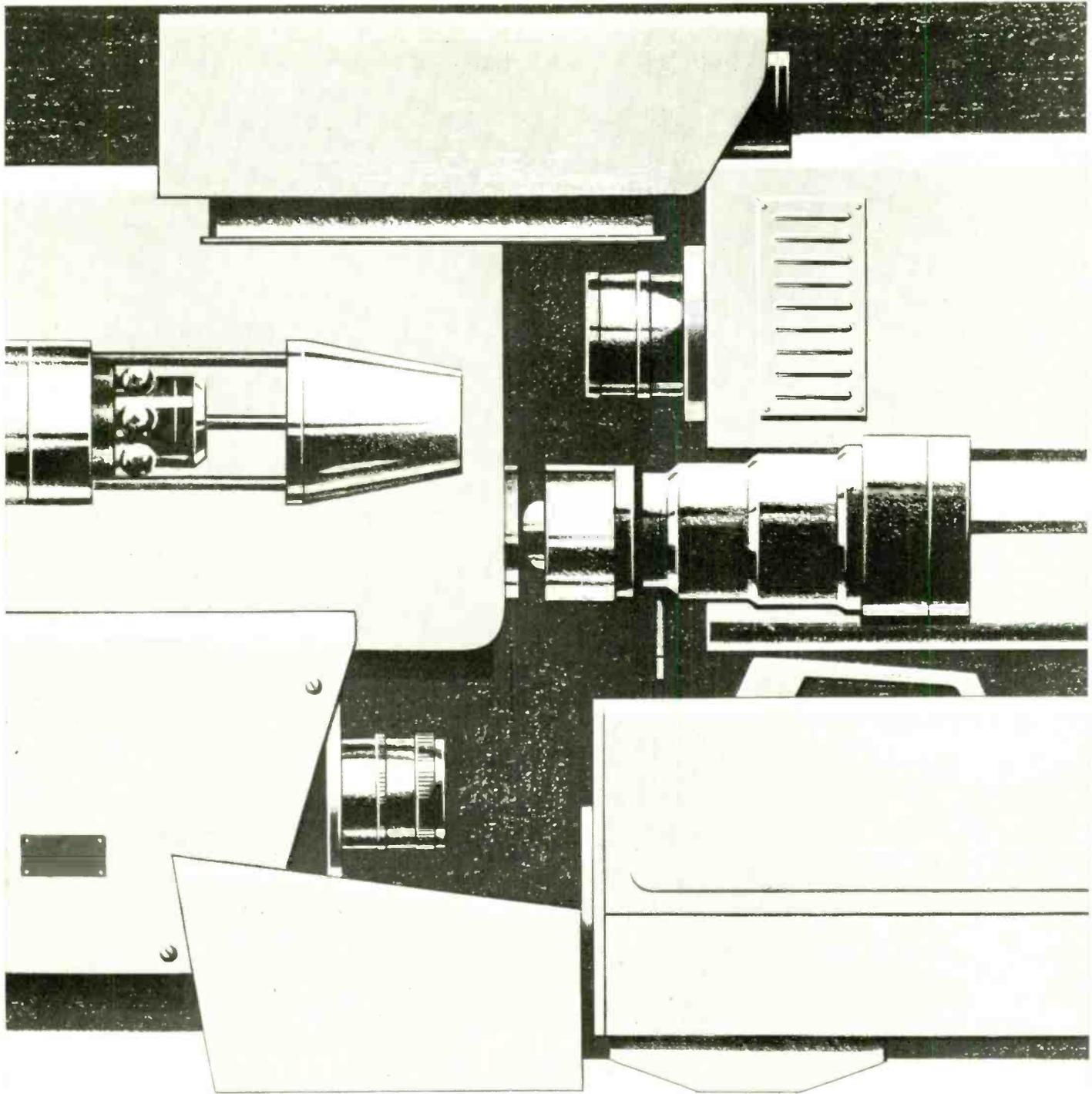
Full information from:

HARRIS ELECTRONICS (London)

138 GRAYS INN ROAD, W.C.1

Phone: 01/837/7937

WW—087 FOR FURTHER DETAILS



Cameras a plenty... but how quickly can you find the right low cost tube?

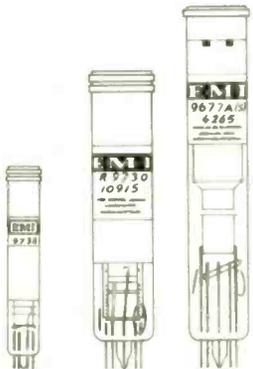
There is a growing range of closed-circuit equipment available, ranging from the simple black and white camera to sophisticated full-colour facilities. The time inevitably arrives when a replacement vidicon tube is needed quickly. This is the service **EMI** sets out to provide. Our vidicon range provides a type for virtually every camera, where reliability, good resolution and high sensitivity are required. Send for the **EMI** Vidicon replacement chart. Then, when you need a tube, simply contact your distributor or **EMI**.



EMI ELECTRONICS LTD., VALVE DIVISION, HAYES, MIDDLESEX. TEL: 01-573 3888 EXT. 2078

EDMUNDSONS ELECTRONICS LTD.,
60 - 74, MARKET PARADE, RYE LANE, PECKHAM, LONDON, S.E.15.
TEL: (01) - 639 9731
HAWNT & CO. LTD.,
112 - 114, PRITCHETT STREET, BIRMINGHAM, 6.
TEL: (021) - 359 4301
SOUTH WALES WIRELESS INSTALLATION CO. LTD.,
121, CITY ROAD, CARDIFF.
TEL: (0222) - 23636

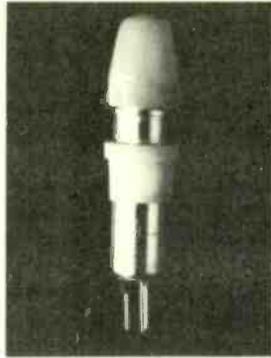
SMITH & COOKSON LTD.,
49 - 57, BRIDGEWATER STREET, LIVERPOOL 1,
TEL: (051) - ROYAL 3154
THE NEEHAM ENGINEERING CO. LTD.,
P.O. 8, 23, TOWNHEAD STREET, SHEFFIELD S1 1YB
TEL: (0742) - 27161
J. GLEASON & CO. LTD.,
NEWBIGGIN LANE, WESTERHOPE, NEWCASTLE UPON TYNE, NE5 1PM
TEL: (0632) - 860955



WW-088 FOR FURTHER DETAILS

OXLEY[®]

TRANSISTOR SWITCHED INDICATOR LAMPS



The Oxley Transistor-switched Indicator Lamp has been designed to indicate the state of logic or counting circuitry, and will find wide applications in computer read-outs and electronic instrument displays.

The Transistor-switched Indicator Lamp is based on the highly successful 'Barb' cone lock Indicator Lamp, and contains its own driver stage which enables the Lamp to be controlled direct from I.C. logic or other low current signals.

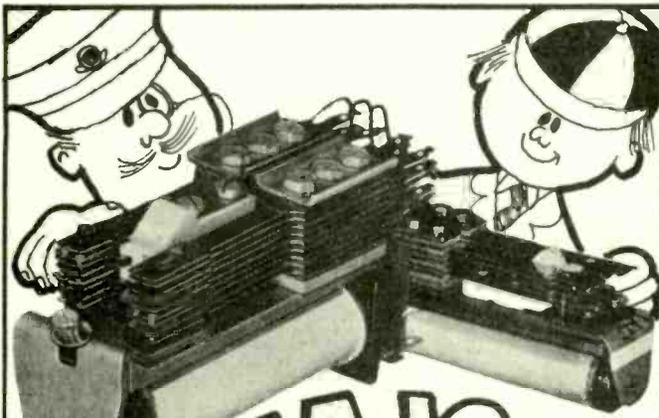
The design incorporates the following outstanding features:—

- ★ rapid fixing from the front of the panel
- ★ ideal for close grouping
- ★ removable lens cap, available in seven colours, facilitates bulb replacement
- ★ virtually unbreakable lens cap
- ★ available for 6V, 12V, or 28V supply
- ★ units available for positive or negative logic
- ★ frontal appearance matches our existing range of lamps.

OXLEY DEVELOPMENTS COMPANY LTD.
 Priory Park, Ulverston, North Lancs, England.
 Tel: Ulverston 2621 Telex: 6541 Cables: Oxley Ulverston

OXLEY[®] 

WW—089 FOR FURTHER DETAILS



MAJOR TO MINOR

DEPENDABLE IS THE NAME!

Major 3000, minor 600, comb type relays. Dependable will give you a planned delivery to match your Manufacturing schedules. Tell us what you want, and we'll see that you will get it! Contact us now and get the sort of answer you want to hear.

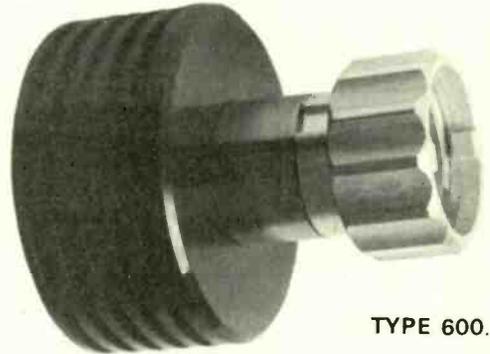
DEPENDABLE RELAY (CONTROLS) LTD
 157 Regents Park Road, London, N.W.1. 01-722 8161

WW—090 FOR FURTHER DETAILS

trio

COAXIAL TERMINATIONS

DC—2.5 GHz.
 2, 5 & 12 WATT.

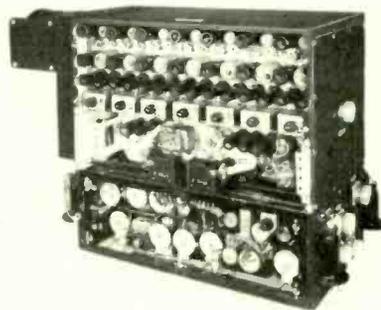


TYPE 600.

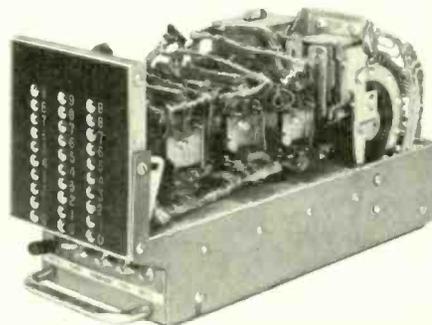
Series 600, 2, 5 and 12 watt Terminations are low reflection loads for terminating 50 ohm coaxial systems in their characteristic impedance. The frequency range is D.C. to 2.5 K mc/s with the V.S.W.R. of the termination less than 1.03 (.97) over the entire range for models fitted with E.I.D. $\frac{3}{4}$, Dezifix B, GR 874 or GR 900 connectors. In all 16 types of connector can be supplied.

TRIO INSTRUMENTS LTD.,
 BURNHAM ROAD,
 DARTFORD, KENT. Telephone: Farningham 2082.

WW—091 FOR FURTHER DETAILS



Ballistics Computers by Westinghouse.
 Nine servo amplifiers with associated motors.
 Brand new in sealed containers.
 £95, delivered.



Automatic Numbering Machine by Western Union.
 Four Uniselectors and 30 neons.
 Ideal amateur computer.
 Application leaflet. £12.10s. post free.

PUNCHES, READERS, VERIFIERS AND TELEPRINTERS
 AT REALISTIC PRICES TO EDUCATIONISTS. MOBILE
 SHOWROOM CALLS ON REQUEST.

COMPUTER TRAINING PRODUCTS

2 Lordship Lane, LETCHWORTH, HERTS. Tel: 4536 0462/6

WW—092 FOR FURTHER DETAILS

WAYNE KERR

0.01% Autobalance Bridge



WIDE RANGE a.f. bridge for precise measurements of single components or any LCR combination – including negative resistance.

AUTOBALANCE circuits give continuous readout, even of changing values.

ANALOG OUTPUTS from in-phase and quadrature channels for operating recorders.

COMPARATOR facilities and continuously variable backing-off controls permit discrimination to 10 parts per million.

SIMPLICITY of operation: a flexible lead arrangement gives 2, 3 or 4-terminal connections.

AUTOMATIC compensation for lead impedance.

RANGES

C	100 attofarads	—	1 Farad
G	1 picomho	—	10 kilomhos
L	10 nanohenrys	—	100 megahenrys
R	100 micro-ohms	—	1 tera-ohm

DISCRIMINATION

Up to 6 figures on all ranges.

FREQUENCY

Internal: 10,000 radians/sec (1592Hz)

1 kHz to order.

External: 200Hz—20kHz

OUTPUTS (both channels)

0—100mV

B331

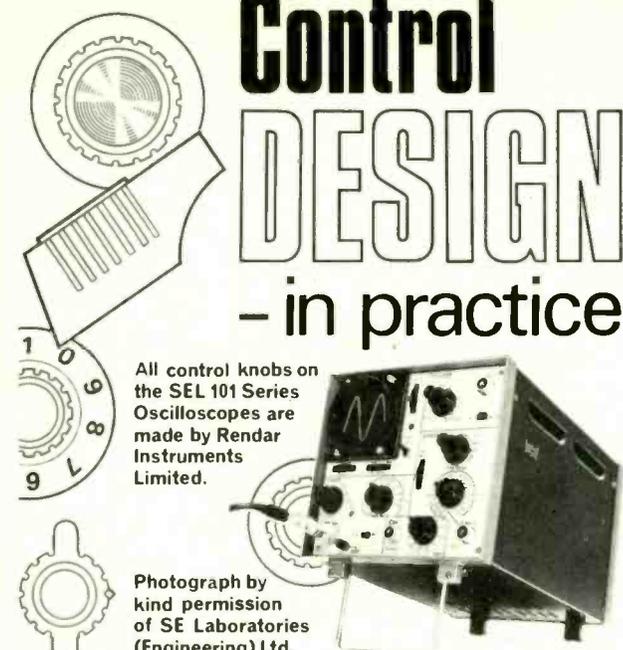
£1,200

THE WAYNE KERR COMPANY LIMITED
NEW MALDEN SURREY ENGLAND

Telephone 01-942 2202
Cables Waynkerr, Malden
Telex 262333

WW—093 FOR FURTHER DETAILS

Control DESIGN - in practice



All control knobs on the SEL 101 Series Oscilloscopes are made by Rendar Instruments Limited.

Photograph by kind permission of SE Laboratories (Engineering) Ltd.

Rendar control knobs are designed for fast, precise indication. Made in a variety of styles with wings, skirts, concentric and many other features, they are supplied in a range of materials, colours and finishes (including plated) to suit all needs.

Further information available from:

RENDAR
INSTRUMENTS LTD
BURGESS HILL, SUSSEX, ENGLAND
TELEPHONES: BURGESS HILL 2642-4
CABLES: RENDAR, BURGESS HILL

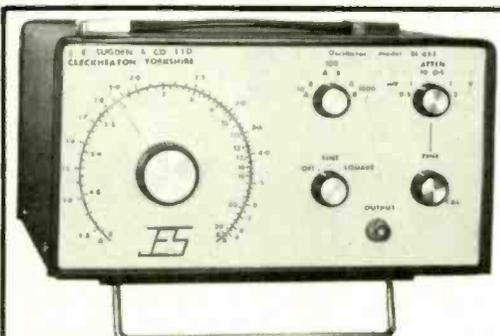
WW-094 FOR FURTHER DETAILS



FREQUENCY CHANGER FOR 110VA
60 HZ, 110V, 220V OUTPUT

R. GILFILLAN AND CO. LTD., SOUTHDOWNVIEW ROAD,
WORTHING, SUSSEX. Tel. (0903) 31587.

WW-096 FOR FURTHER DETAILS



Si451 Millivoltmeter

- ★ 20 ranges also with variable control permitting easy reading of **relative** frequency response

£30.0.0

also available

Si452 Distortion Measuring Unit

- ★ low cost distortion measurement down to .01% with comprehensive facilities including L.F. cut switch, etc.

£25.0.0

J. E. SUGDEN & CO. LTD., BRADFORD ROAD, CLECKHEATON, YORKS.

Tel: Cleckheaton (DWR62) 2501

WW-098 FOR FURTHER DETAILS

SPECIALIST SWITCHES are again giving the fastest switch service in the world

FROM THEIR NEW AND LARGER PREMISES IN CHARD, SOMERSET

Specialist Switches make **Rotary and Lever switches, types H, DH, HC, and LO, to specification.** There is one limitation (standard 2 in. long spindles), but this is not important when you are getting the **fastest switch service in the world.**

Delivery of 1-20 switches: 24 hours.

Up to 50 or so: 72 hours.

If you want around 250 or so: 7-10 days.

Please note our address:
SPECIALIST SWITCHES
P.O. Box 3,
CHARD, SOMERSET

Write for design charts and prices or
TELEPHONE-CHARD 3439

WW-095 FOR FURTHER DETAILS



—AVONCEL—
TM40 TROLLEY

EDITIONS FOR ALL MAKES AND MODELS OF OSCILLOSCOPES

£25 EACH PLUS £1 CARRIAGE

PRICE INCLUDES DRAWER; CARRYING-UNIT; POWER-BOARD AND 2 BRAKED CASTORS.

AVON COMMUNICATIONS AND ELECTRONICS LTD.
318 BOURNEMOUTH (HURN) AIRPORT, CHRISTCHURCH, HAMPSHIRE
TEL. NORTHBOURNE 3774. TELEG. AVONCEL, CHRISTCHURCH

WW-097 FOR FURTHER DETAILS

JES AUDIO INSTRUMENTATION

Illustrated the Si453 Audio Oscillator

SPECIAL FEATURES:

- ★ very low distortion content—less than .05%
- ★ an output conforming to RIAA recording characteristic
- ★ battery operation for no ripple or hum loop
- ★ square wave output of fast rise time

£35.0.0



SME

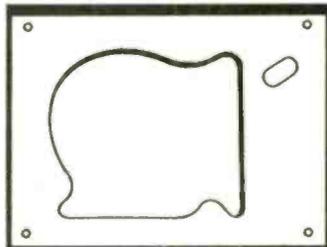
MODEL 2000

PLINTH SYSTEM

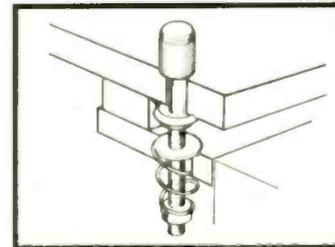
Designed to house SME precision pick-up arms in combination with leading makes of turntable, the Model 2000 Plinth System combines high-quality workmanship with ease of assembly. The basic unit is finished in selected veneers of teak, straight grained walnut, or rosewood. A one-piece hinged lid in heavy acrylic is reinforced with a polished stainless steel trim.

Write for details to:

SME LIMITED · STEYNING · SUSSEX · ENGLAND



Motor boards in matching veneers are ready cut and drilled for screw-driver assembly with the appropriate pick-up arm and turntable. The range, which will be added to from time to time, includes a blank board which can be cut to special order.



Four-point spring suspension adjustable for height and damping protects the motor board from acoustic feedback and external vibration.

WW—099 FOR FURTHER DETAILS



D54 Solid State Dual-Trace Oscilloscope

The D54 is an all solid state dual-trace 10MHz portable oscilloscope. Wide time base range, broad bandwidth characteristics and calibrated deflection factors make the D54 well suited for general-purpose laboratory work and production line testing applications.

Look at the features:

- 10 MHz Bandwidth at 10mV/cm
- All Solid State Design
- Small Size—Lightweight
- FET Inputs
- 22 Calibrated Sweep Speeds
- Chopped and Alternate Switching
- 6 x 10cm Viewing Area
- Versatile Triggering—including T.V. Line and Frame Sync.
- All these and more for only £150.0.0. (U.K. price inclusive of delivery)

Write or phone for details TODAY!!!

TELEQUIPMENT 

Telequipment Ltd., 313 Chase Road, Southgate, London, N.14. Telephone: 01-882 1166. Telex No. 262004
For Overseas enquiries write to: Tektronix Limited, P.O. Box 48, Guernsey, C.I. A member of the Tektronix Group

WW—100 FOR FURTHER DETAILS

Wireless World

Electronics, Television, Radio, Audio

Fifty-ninth year of publication

November 1969

Volume 75 Number 1409

Contents

- 499 **Domestic Broadcasting**
- 500 **A Design in Retrospect** by *J. Dinsdale*
- 506 **Cassette System for ¼-in Tape**
- 507 **Simple I.C. Tester** by *D. E. O'N. Waddington*
- 509 **Conferences & Exhibitions**
- 510 **Amateur Radio Show**
- 511 **Electronics in Civil Aviation**
- 513 **Stuttgart Radio & TV Show**
- 516 **News of the Month**
- 518 **Letters to the Editor**
- 520 **Personalities**
- 521 **Active Filters—4** by *F. E. J. Girling and E. F. Good*
- 525 **R.F. Amplifier for F.M. Tuner**
- 525 **Books Received**
- 526 **Living with Hi-Fi** by *Heather Dinsdale*
- 528 **Transistor Distortion Characteristics** by *J. L. Linsley Hood*
- 529 **Announcements**
- 530 **Circuit Ideas**
- 531 **Wireless World Logic Display Aid—7**
- 535 **More Letters to the Editor**
- 536 **Test Your Knowledge questions and answers** devised by *L. Ibbotson*
- 537 **World of Amateur Radio**
- 538 **New Products**
- 543 **November Meetings**
- 544 **Literature Received**
- 544 **H.F. Predictions**
- 546 **Real & Imaginary** by "Vector"
- A115 **SITUATIONS VACANT**
- A136 **INDEX TO ADVERTISERS**



This month's cover symbolizes the report on electronics in civil aviation which will be found on p. 511.

OUR NEXT ISSUE

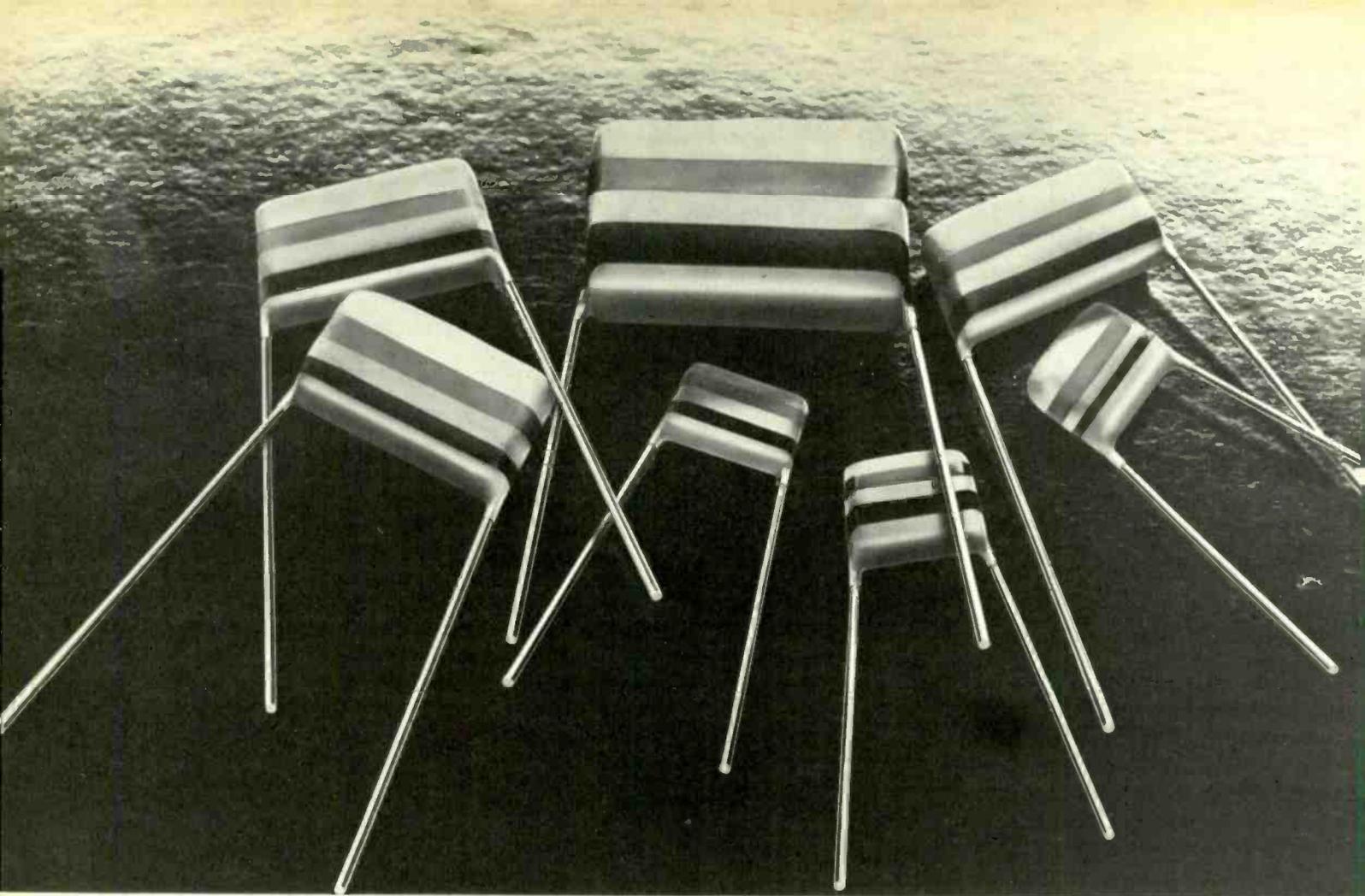
Pickup Survey—a critical review of the various types of transducer available.

A **Thermistor Hygrometer** using a single i.c. operational amplifier is described.

Review of the London Audio Fair.

I.P.C. Electrical-Electronic Press Ltd
Managing Director: Kenneth Tett
Editorial Director: George H. Mansell
Advertisement Director: George Fowkes
Dorset House, Stamford Street, London, SE1
© I.P.C. Business Press Ltd, 1969
Brief extracts or comments are allowed provided acknowledgement to the journal is given.

PUBLISHED MONTHLY (3rd Monday of preceding month). Telephone: 01-928 3333 (70 lines). Telegrams/Telex: Wiworld Hliffpres 25137 London. Cables: "Ethaworld, London, S.E.1." Annual Subscriptions: Home: £2 15s 0d. Overseas; 1 year £2 15s 0d. (Canada and U.S.A.; \$6.75). 3 years £7 0s 0d. (Canada and U.S.A.; \$17.50). Second-Class mail privileges authorised at New York N.Y. Subscribers are requested to notify a change of address four weeks in advance and to return wrapper bearing previous address. BRANCH OFFICES: **BIRMINGHAM**: 201, Lynton House, Walsall Road, 22b. Telephone: 021-356 4838. **BRISTOL**: 11, Elmdale Road, Clifton, 8. Telephone: OBR2 21204/5. **GLASGOW**: 2-3 Clairmont Gardens, C.3. Telephone: 041-332 3792. **MANCHESTER**: Statham House, Talbot Road, Stretford, M32 0EP. Telephone: 061-872 4211. **NEW YORK OFFICE U.S.A.**: 300 East 42nd Street, New York 10017. Telephone: 867-3900.



How we set the trend in plastic film capacitors

Ten years ago, Mullard introduced the C296 series of plastic film capacitors to replace the paper components then used exclusively in consumer applications in the UK. The film used is polyethylene-terephthalate generically known as polyester. This revolutionary film transformed the British capacitor market. It enabled Mullard to reduce component size by as much as 15% compared with paper types. Working voltages were up to 400V d.c. Insulation resistances greater than 50,000M Ω at 20°C were achieved for the first time in commercial quantities. The polyester film itself was non-hygroscopic and chemically inert. It was wound with aluminium using an extended foil technique to give minimal self-inductance. And the finished capacitors were encapsulated in hard, water repellent lacquer, which was unaffected by temperatures up to 150°C.

New techniques New manufacturing techniques were then introduced in plastic film capacitors, which allowed a metallised layer to be deposited on the film. This reduced our capacitor

sizes by up to a further 50%. About this time, the general acceptance of printed circuits created a strong demand for various components in different shapes, with particular dimensions to close tolerances. And because we at Mullard anticipated this trend we now produce the C280 miniature metallised film capacitors. These small devices have radial terminations in the standard I.E.C. 0.1 inch grid spacing, making them the economic answer to the problems of improving packing densities and reducing assembly production times. Due to their distinctive colour coding, small size and wide capacitance range the demand for these capacitors is far in advance of all others. The 400V units have a more recent polyester film (polycarbonate) which reduces losses at frequencies of 20kHz and above. This also applies to the C281 series with their axial leads and moulded encapsulation.

Development Work of course continues, and encouraging results are being achieved with capacitors for a.c. power handling, for example for interference suppression and power factor correction, using polypropylene films.

Higher demand The demand for discrete passive components has increased enormously during the last ten years. And today there is a

continual demand for polyester capacitors in the range 0.001 μ F to 10 μ F for most applications in the domestic field.

Worth it? Right from the beginning we've anticipated the changing requirements, tested new materials and techniques so that we can be sure the product will give consistent service. This also enables us to relate quality with the best possible price. Something which applies across our very wide capacitor range including electrolytic, variable and ceramic types. Mullard electronic components find applications as unexpected as astronomy and zoology, giving us experience in many technologies. Experience our customers now take for granted.

Mullard components for consumer electronics

Mullard Limited
Consumer Electronics Division
Mullard House Torrington Place
London WC1

Wireless World

Domestic Broadcasting

Editor-in-chief:

W. T. COCKING, F.I.E.E.

Editor:

H. W. BARNARD

Technical Editor:

T. E. IVALL

Assistant Editors:

B. S. CRANK

J. H. WEADEN

Editorial Assistant:

J. GREENBANK, B.A.

Drawing Office:

H. J. COOKE

Production:

D. R. BRAY

Advertisements:

 G. BENTON ROWELL (*Manager*)

J. R. EYTON-JONES

 R. PARSONS (*Classified Advertisement Manager*)

Telephone: 01-928 3333 Ext. 538

It is now 20 years since the Copenhagen Plan for medium- and long-wave broadcasting in Europe was implemented and the present chaotic state in the medium-wave band begs description.

There are those who consider that the situation in the medium-wave band is beyond redemption and that only a v.h.f. national network can provide a worthwhile service (see 'Letters' p.518). While we would whole-heartedly agree with this view on the grounds of the quality of service v.h.f. provides we would like to see a bolder plan introduced by the broadcasting authorities in this country for the efficient use of the medium-wave band. We are not necessarily pleading for a new European plan—the U.K. would probably be worse off as the result of such a reallocation—but, are the potentialities of this band being fully exploited? Have we moved very far since the introduction of the B.B.C.'s Regional Scheme in, was it 1936? We believe the aerials at Brookmans Park, London, are very little different from those originally used!

Talking of aerials. Readers may have seen in the lay press references to the scheme put up by Hughie Green for 100 local radio stations in the medium-wave band. At first sight this seemed ludicrous in the present congested state of the band but the scheme, which was rejected by the Post Office, depended, to some extent at least, on the use of directional aerials serving a very limited area of up to five miles radius with a low-power (2 kW) transmitter. While the use of such aerials would certainly avoid the stations causing interference with other transmitters sharing the frequencies it would not eliminate interference from Continental stations. Incidentally, Mr. Green's scheme was based on a survey conducted by a German company. A British company declined to carry out the work because the kind of publicity arising from the proposed scheme would impair its relationships with "two of its most important customers, the Post Office and the B.B.C."

In our August leader we considered, somewhat philosophically, the utilization of the radio spectrum, suggesting that the channels should be "tailored" to the information they are to carry. Some readers took us to task for this; commenting that our attention should have been directed to the B.B.C.'s use of its existing resources. One reader, who listed the 16 frequencies used by the B.B.C. in the medium- and long-wave bands, asked why the technique of synchronizing transmissions (as was done during the 1939-45 war to prevent them being used for homing by enemy aircraft) is not more widely used. Synchronization does, of course, necessitate national *network* operation and therefore precludes any "regional" variations. Such a network, or networks, provided by the B.B.C. could, and should, be supplemented by low-power local stations of the type envisaged by Mr. Green—whether they be commercially operated or as a non-commercial enterprise by a local authority.

It may not generally be known that the B.B.C. has been experimenting with compatible single-sideband transmissions in an endeavour to improve the signal-to-noise ratio in the medium-wave band. When the results of the experiments have been assessed maybe we shall hear of a scheme as bold as the television changeover from 405 to 625 lines.

A Design in Retrospect

by J. Dinsdale, M.A.

The designs for high-quality audio amplifiers published in 1961 and 1965 gave rise to several hundred letters from readers. In this article those letters referred to the designer have been analysed to establish the most popular topics of interest, and some of the more interesting suggestions and comments are examined in detail.

When Dick Tobey and I published our first articles in 1961^{1,2} describing the design of a transformerless high-quality audio amplifier using transistors, we did not expect to awaken more than a passing interest among a few enthusiasts. It was therefore with a mixture of surprise and delight that we received (and duly answered) over 100 letters from readers of *Wireless World*. Of these letters, the majority were either from engineers who were not conversant with transistor techniques (especially the use of complementary transistors and the application of a.c. and d.c. feedback) or from constructors wishing to know where certain components might be obtained. There were also a few letters from more perceptive readers who offered some useful advice and criticism, and these proved to be of great value later on in developing the mk.II system.

The circuit had originally been developed from a servo-amplifier, which was found to have an exceptionally good frequency response and low distortion. The idea of using the so-called quasi-complementary class B stage, in which complementary driver transistors are followed by an output pair of transistors of a single type had first been proposed by H. C. Lin in 1956³. The circuit which Tobey and I devised took advantage of Lin's concepts, but incorporated a modified form of feedback which gave lower distortion while maintaining satisfactory gain and phase margins for the whole amplifier. Tobey and I were both very keen on sound reproduction at that time (mid-1959) and we were anxious to exploit the then very new devices called semiconductors, which were

only just becoming available to home constructors in the U.K. at reasonable prices. I was then listening (single channel) via a Williamson amplifier with Partridge output transformer feeding a 12-in Magnavox loudspeaker in a bass reflex enclosure. My pickup at that time was a Collaro Studio 'P', later to be replaced by the Decca ffss mk.I which, when used with the S.M.E. 3009 series 1 arm and Garrard 301 turntable, gave results which at that time I considered to be little short of miraculous. However, the size and weight of the Williamson amplifier, and the heat produced by the valve heaters, made the prospect of constructing another identical amplifier for stereo distinctly unattractive. So when we found that a transistor servo amplifier, which we had developed for the inertial navigation system of a guided missile, sounded very nearly as good as the Williamson, could be assembled on a printed circuit board 5 inches square, and required only 40V d.c. at less than 1A peak current to give 10W into a loudspeaker load, we decided to modify the design to make it as good as possible for high-quality sound reproduction.

The performance of the transformerless quasi-complementary circuit developed by Tobey and myself appeared to be far superior (on paper) to the circuits then available (which employed transformers) and listening tests seemed to confirm this.

The two articles published at the end of 1961 described a class B quasi-complementary transformerless power amplifier and a pre-amplifier with comprehensive input, filter and tone-control facilities. The techniques used are commonplace nowadays, but they attracted considerable interest when published. Features in the power amplifier which were novel at that time included the quasi-complementary output stage and the use of a thermal feedback loop (utilizing the variation with temperature of the voltage across a diode junction) to stabilize the operating point of the output stage (and hence crossover distortion) against changes in ambient temperature. The method of earthing the equipment for single-channel operation was discussed, with particular reference to the

high asymmetrical currents which flow in the output stage of a class B amplifier. The article also suggested how to select suitable transistors in the light of cut-off frequency, gain and noise.

The pre-amplifier employed two transistors, and gave an adequate performance without being particularly elegant. The method of equalizing the playback characteristic on disc replay utilized the self-inductance of the magnetic pickup in order to avoid designing a high-impedance input circuit. This method was subsequently found to be both difficult to apply with a single channel, and distinctly undesirable for two-channel operation because it caused excessive cross-channel interference. The tone controls used a Baxandall-type circuit, and the output fed directly into the power amplifier. The point was made that by applying the feedback networks for both the tone controls and the filters around the same stage, the characteristics of the two controls interacted in a beneficial way to increase the slope of the h.f. filter when the treble control was set to maximum boost. The stereo balance control operated by varying the feedback ratio around the second stage. This provided only 6dB variation between channels, a figure subsequently found to be inadequate, and also tended to interfere with the operation of the tone controls. The complete system had been in operation since October 1959, some two years before publication, and we hoped that most of the obvious defects had been eliminated.

The mk.II design was constructed during 1963, and details were published early in 1965^{4,5}. The reason for publishing the new version was to improve the areas of weakness in the previous design, and to provide full details of the construction, which our correspondence had shown were badly needed. It also gave an opportunity of discussing some of the more interesting points in the design. The principal area of difference was in the pre-amplifier, which had been largely re-designed. The range of input circuits was closer to that then available from valve amplifiers, and the method of equalization for disc replay had been made completely independent of the inductance of the pickup. The tone controls and filters were much the same as before, but the balance control now utilized a log/antilog twin-gang potentiometer to give an infinite

Jack Dinsdale, aged 31, graduated in mechanical sciences at Trinity College, Cambridge and subsequently took a post-graduate diploma in advanced engineering at The College of Aeronautics, Cranfield. He spent several years with Elliott Automation and recently became senior research engineer with the Unit for Precision Engineering at the College of Aeronautics where he is responsible for the application of electronic control and digital computing techniques to machine tools and measuring machines.

Table 1. Performance of Mk. II system

Output power	10W r.m.s. per channel
Frequency response	±3dB from 35Hz to 20kHz
Total harmonic distortion	0.3% at 1kHz and 10 watts
Signal-to-noise ratio	70dB at 10W
Power requirements	40V at 800mA (max.) or 150mA (average)
Controls	Input selector (microgroove, standard, radio, microphone, tape replay), treble, bass, filter, volume, balance, function (stereo, reverse stereo, mono)
Channel separation	Radio: -80dB at 10kHz Mic: -50dB at 10kHz
Output impedance	Less than 0.25Ω

range of control while keeping the attenuation at the central position to a minimum. The particular problem of earthing the stereo system was discussed at length, but the most elegant method was suggested in subsequent correspondence⁶. The power amplifier circuit was little changed. The principal additions were a resistor to improve earthing and an a.c. centre-tapped coupling for the loudspeaker load to minimize the "plop" sound, which is caused when the circuit is switched on, by the coupling capacitor charging up via the loudspeaker.

The second article on the mk.II design gave full details of metalwork, printed circuits, wiring, and general hints on construction. There was also a comprehensive list of transistor alternatives, and details of the typical d.c. working points of all the transistors to aid fault-finding. The network for equalization to the R.I.A.A. disc replay characteristic was given, together with the method of calculating component values. Several correspondents have queried the derivation of these values, and a formal analysis has been included as the appendix to the present article. Two methods of dealing with crystal pickups were described: normal loading and velocity loading. Both have their disadvantages, and a number of readers commented on these. The correspondence on this subject has been summarized later in the article. Table 1 shows the performance of the complete mk.II system, and table 2 the main areas of the difference between the mk.I and mk.II designs. Table 3 shows a breakdown of the principal topics raised by correspondents after publication of the two sets of articles. A number of letters raised several points, so this table does not reflect the total number of letters received. Topics have been included only as initially raised; subsequent correspondence has been omitted.

Component availability

Many of the letters received, especially after the 1961 articles, referred to component

availability; the majority requested information on the n-p-n transistor, originally the 2N388A. The articles had not specified where this component could be obtained. This was an unfortunate omission as germanium n-p-n transistors with a V_{CB} of 45V are not easily obtained, even now. There were a few alternatives, such as the 2N2613 (RCA) and the AC127Z (Mullard), none of which was quite as good as the 2N388A for its sustained gain over the specified working range of collector current. A number of writers proposed using alternatives especially the OC139 or OC140, as these were the only British germanium n-p-n transistors then commonly available. Unfortunately, the value of V_{CB} for the OC139 and OC140 is only 25V, and it is possible for the full h.t. of 40V to appear across the transistor. A number of disappointed constructors did in fact write saying that they had blown up OC139s in the circuit.

Several constructors attempted to use a silicon n-p-n transistor, allied with a germanium p-n-p transistor, for the complementary pair, but the characteristics of the dissimilar materials only serve to upset the symmetry of the amplifier. In addition, the thermal loop via the diode, which compensates for changes in ambient temperature, relies on all the transistors possessing similar values of V_{BE} , and the effect of using a silicon transistor is to prevent this temperature compensation from operating correctly. If a silicon n-p-n transistor is to be used, then the complementary p-n-p transistor should also be silicon, to preserve the symmetry of the circuit. When the mk.II circuit was published it was equally difficult to obtain silicon p-n-p transistors.

Component tolerancing

The components used in most circuits, and the audio amplifier is no exception, may be divided into three categories when it comes to tolerancing.

These are:—

(i) Components whose values are by no means critical, where ±50% is more than adequate. This applies to most electrolytic capacitors, resistors used to suppress switch clicks, etc.

(ii) Components whose value determines d.c. operating points: ±10% is normally adequate.

(iii) Components whose value sets a precise parameter, for example equalization of recording characteristics, roll-off frequencies, etc. Here, the tolerance should strictly be determined from the maximum acceptable departure from the desired characteristic.

In this design I decided to recommend ±2% for the components in category (iii)

Table 3. Principal topics of correspondence

Topic	Number of Times Mentioned in Letters	
	1961	1965
1. Suppliers of n-p-n transistors	16	—
2. Matching and equalization of magnetic pickups	4	5
3. Matching and equalization of crystal pickups	1	11
4. Power supplies	3	5
5. Suppliers of printed boards	8	5
6. Transistor equivalents	3	12
7. Queries on circuit and fault finding	18	23
8. Earthing problems	1	9
9. Balance control	2	—
10. Mixing circuits	2	—
11. Mono/stereo switching	1	1
12. General component queries	4	—
13. Loudspeaker coupling	1	5
14. General component availability	—	9
15. Modifications for tape recording	—	5

as a compromise between faithfulness to the R.I.A.A. equalization curve, and reasonable price and availability. It is also worth noting that any inherent accuracy of equalization is nullified by the action of tone controls. Nevertheless I received a number of letters complaining that the performance of an amplifier departed by 5dB from the R.I.A.A. curve (one of these from a man who had used ±20% capacitors) and other letters saying that a design which had to rely on ±2% components could not possibly be a viable proposition. I think that here one literally pays one's money and takes one's choice, and I would recommend ±2% tolerance where stated for those readers interested in achieving the published sensitivity (optional) or the standard equalization curves (desirable). Incidentally although the Mullard polyester capacitors specified in the equalization circuits are rated at ±10% from 0°C to 85°C, intensive tests on these established that over the normal domestic ambient temperature range of 15° to 25°C, the values remained within ±2% of nominal.

All other resistors were specified as ±5% even though in many cases ±10% would have been adequate, on account of the high degree of negative feedback. The use of 5% resistors was principally to facilitate postal fault diagnosis, by ensuring that the d.c. operating conditions in all models of the amplifier would be closely controlled.

Tape recorder modifications

Many correspondents requested information concerning the use of the amplifier with domestic tape recorders. First of all, how should the amplifier be connected to the "record" input socket? This connection is normally best taken from the collector of the second transistor via a suitable coupling capacitor, the value depending on the input impedance of the tape recorder. The signal will be equalized at this point, and at a level of 30–50mV r.m.s.; all controls are bypassed since one normally relies on those of the tape recorder itself. If the input impedance of the recorder is 1MΩ (a typical figure) then the coupling capacitor should be of value 0.5μF.

The earthing can also lead to trouble, and it may be found worthwhile to avoid possible earth-loops by disconnecting the tape recorder mains earth and using that of the pre-amplifier. This approach is satisfactory provided that the tape recorder is individually earthed again when it is disconnected from the pre-amplifier.

Table 2. Summary of differences between Mk. I and Mk. II designs

Switch Position	Function	Mk. I version		Mk. II version	
		Sensitivity (10W at 1kHz)	Input Impedance kΩ	Sensitivity (10W at 1kHz)	Input Impedance kΩ
1	Microgroove pickup	(mag.)	5mV	6	4mV
		(crystal)	100mV	100	400mV
2	Standard pickup	(mag.)	8mV	7.5	8mV
		(crystal)	150mV	100	800mV
3	Radio	150mV	100	80mV	92
4	Microphone	1.5mV	1	5mV	92
5	Tape replay	2.5mV	1	3mV	92

In addition, the Mk. II version gave slightly improved figures for frequency response, distortion and channel separation.

The other tape recorder queries mainly concerned input to the pre-amplifier. Although equalization for 7½ i.p.s. from a low output tape head was provided in my design, I really expected users to take the output from the replay pre-amplifier on the recorder itself into the radio or auxiliary sockets on the pre-amplifier. I was therefore surprised to learn that many users required information on equalization for tape speeds of 1⅞, 3⅓, 7½ and 15 i.p.s. at various sensitivities. The C.C.I.R. standard of 70µs for 7½ i.p.s. was used in the published design. For the two lower speeds the time constants become 140µs and 280µs, and the value of the feedback capacitor must be proportionately increased in each case. If the resistor in series with the feedback capacitor is changed, to alter the sensitivity, the capacitor value will need adjusting to preserve the correct time constant.

Disc replay equalization

There has been much discussion in recent years in *Wireless World* and elsewhere, on the importance of accurate equalization of the disc replay characteristic, and the best means of achieving this. As far as magnetic pickups are concerned, the most appropriate way of dealing with these is to present the device with the manufacturer's recommended load impedance (normally 47 kΩ) and then to apply the R.I.A.A. replay characteristic by means of negative feedback. Provided that the high input impedance is achieved by feedback techniques, so that the base of the input transistor can be connected to ground via the pickup itself (and a suitable blocking capacitor), and the gain demanded from the stage is not excessive, this will result in low distortion and a good signal-to-noise ratio. It must be remembered here first, that if a transistor has a gain of (say) 100, then the amplifier stage containing this transistor should not be expected to give a gain greater than 10; and secondly that the R.I.A.A. characteristic requires nearly 10 times more power gain (18dB extra voltage gain) at 20Hz than at 1kHz where sensitivity is normally specified.

In the mk. II design the input impedance is 47kΩ closely, and the stage voltage gain in the 'LP' position is 12 at 1kHz rising to about 110 at 20Hz. This bears

favourably with the minimum specified gain of 100 for both Tr_1 and Tr_2 . Many correspondents have written to me complaining of a lack of bass in the 'LP' position. I have examined two such cases, and both were caused by low-gain transistors in Tr_1 and Tr_2 positions; the stage was just not capable of providing the extra 18dB at 20Hz. A final word of caution on this subject: it is always advisable to check the output waveform on an oscilloscope when measuring frequency response curves. There is otherwise the danger of starting the test at 1kHz, and failing to notice that the additional gain at lower frequencies is causing the waveform to square off and hence give an incorrect reading. The correct method of conducting this test is to present the input of the pre-amplifier with the *inverse* of the R.I.A.A. playback characteristic, and then to check the output for a flat response at the appropriate level.

Turning to amplitude-sensitive pickups (the piezo-electric types such as crystal and ceramic) many letters have implied a basic misunderstanding of how these devices operate. Curve A in Fig. 1 shows the amplitude of movement of the recording (cutting) stylus when recording a flat signal at all frequencies. Curve B shows the output of a velocity-sensitive (magnetic) pickup tracking the signal of curve A; the output is proportional to the rate of change of magnetic flux linkage, and will thus increase with frequency. Application of the R.I.A.A. playback equalization (shown in curve C) to curve B will give a flat response. The output of a perfect amplitude-sensitive pickup would be expected to mirror curve A, but the output of crystal and ceramic pickups is purposely modified by the mechanical characteristics of the mounting in such a way as to compensate for the recording characteristic and provide a reasonably flat output under no-load conditions. However, the performance of these pickups has, in my experience proved somewhat disappointing and I have obtained far better response curves from correctly equalized magnetic pickups. The equivalent electrical circuit of a crystal or ceramic pickup may be approximated by a constant voltage generator in series with a capacitor, as

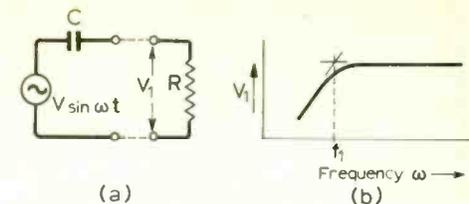


Fig. 2. (a) Equivalent circuit and (b) response of crystal pickup.

shown in Fig. 2(a). When this is loaded by a resistor, as must occur when it is connected to the input of the pre-amplifier the resultant response is as shown in Fig. 2(b), the turnover frequency f_1 being given by the expression

$$f_1 = \frac{1}{2\pi CR}$$

The value of C is fixed by the design of the pickup itself, and may lie in the range 200-2000pF, and the value of R is the apparent input impedance of the pre-amplifier as seen by the pickup.

There are three methods of loading a crystal pickup, as shown in Fig. 3:

(i) Employ a very high load-resistance (1 to 4 MΩ) with no further electrical equalization since this is performed approximately by the mechanical circuit of the pickup. This will place f_1 below the audible frequency spectrum.

(ii) Load the pickup with a relatively low resistance and equalize by using a feedback circuit composed of a series capacitor and resistor with the same time constant as the pickup capacitance and loading resistor.

(iii) Load the pickup by the more complex circuit described in my letter to *Wireless World* which provides, in combination with the mechanical circuit of the pickup, an output closely resembling that from a magnetic pickup. This may now be equalized exactly as for velocity-sensitive devices.

Since the inbuilt mechanical equalization is not affected by electrical loading, the output of a crystal pickup when loaded by a low resistance as in method (ii) will only approximate to the output of a velocity-sensitive device and equalization of this output by the conventional R.I.A.A. network will only approximate to an ideal response.

My choice of velocity-loading for crystal pickups was made because it permitted a single position 'LP' on the input switch, instead of two positions 'LP Magnetic' and 'LP Crystal'. In addition a number of high quality ceramic pickups require a loading impedance greater than 1MΩ to achieve a bass response to 40Hz using method (i) and my circuit is not ideally suited to this. Subsequent work has confirmed that resistive loading followed by equalization via method (ii) above is marginally best. Method (iii) is the easiest to implement with my published design, as in this case the feedback network is the same as that used for magnetic pickups. I would however emphasize that the optimum velocity-loading network varies for each pickup, and is ideally associated with the pickup itself (mounted in the arm at the

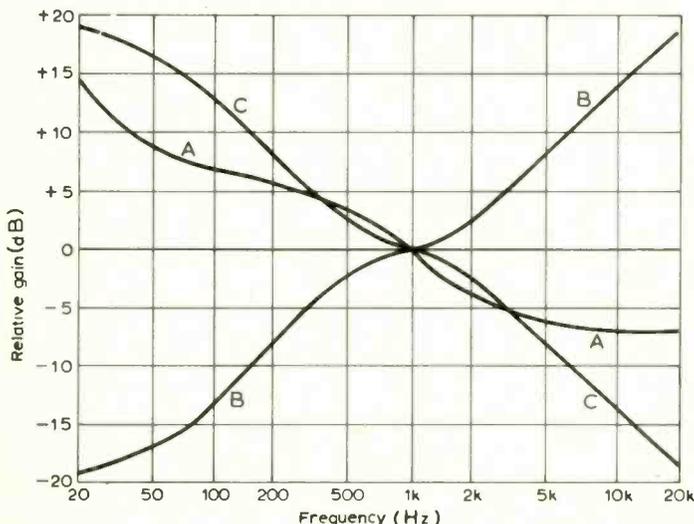


Fig. 1. Recording/playback curves.

cartridge terminals) rather than in the amplifier. It is possible to adopt more complex equalization networks, as advocated for example by Mr. J. L. Linsley Hood⁸, but my personal experience suggests that it is better to purchase a good magnetic pickup.

In spite of using the exact values of components for equalizing replay characteristics, the true response curves will not be obtained unless the treble and bass controls are set to a true 'flat' position, which may not coincide with the geometrical centre of rotation, or indeed may not be the same for both sections of a twin-ganged control. For this reason, several correspondents asked for the values of resistors for a switched control, and these are given in Fig. 4. The preferred switch is the Radiospares 2-pole 6-way midget wavechange switch, which is about the same diameter as the potentiometers it replaces.

Stereo switching

It was found convenient to carry out mode switching, i.e. stereo / reverse stereo / mono, at the output of the pre-amplifiers. The 'reverse stereo' position permits channels to be reversed so as to use the loudspeakers with the best bass response in the most appropriate channel (where non-identical speakers are employed); it can also be used to transpose the 'positions' of instruments from left to right, and reverse the 'direction' of trains and other stereo demonstration gimmicks. However, a number of readers have pointed out that by combining the two channels at this point for mono operation, the balance control must be set truly mid-way for correct cancelling of the out-of-phase component of the signal, and also the signal-to-noise ratio is degraded by 6dB. These are certainly valid points, but the switching problems involved if the channels are paralleled earlier in the pre-amplifier make any alternatives undesirable.

Input switching

It is clearly a disadvantage to run the leads from the input sockets right up to the front panel for switching. A better arrangement would be to place the input switching wafer at the extreme rear of the unit, with wiring directly from the input sockets. The 'feedback switching' wafer should be placed at the front of the unit as at present, and the switch should of course have a long shaft.

Power, sensitivity and distortion

On occasion, correspondents have asked whether the output power can be increased. The power available from a transformerless class B output stage depends on the applied voltage and the loudspeaker impedance. More specifically it is given by

$$P = \frac{(V-v)^2}{8R}$$

where P =output power (r.m.s. watts), V =supply volts, v =volts lost in output transistors, etc., and R =load impedance.

Thus for a given load impedance, the only way to increase the power is to increase the supply voltage. This is possible only if the transistors and other components will stand

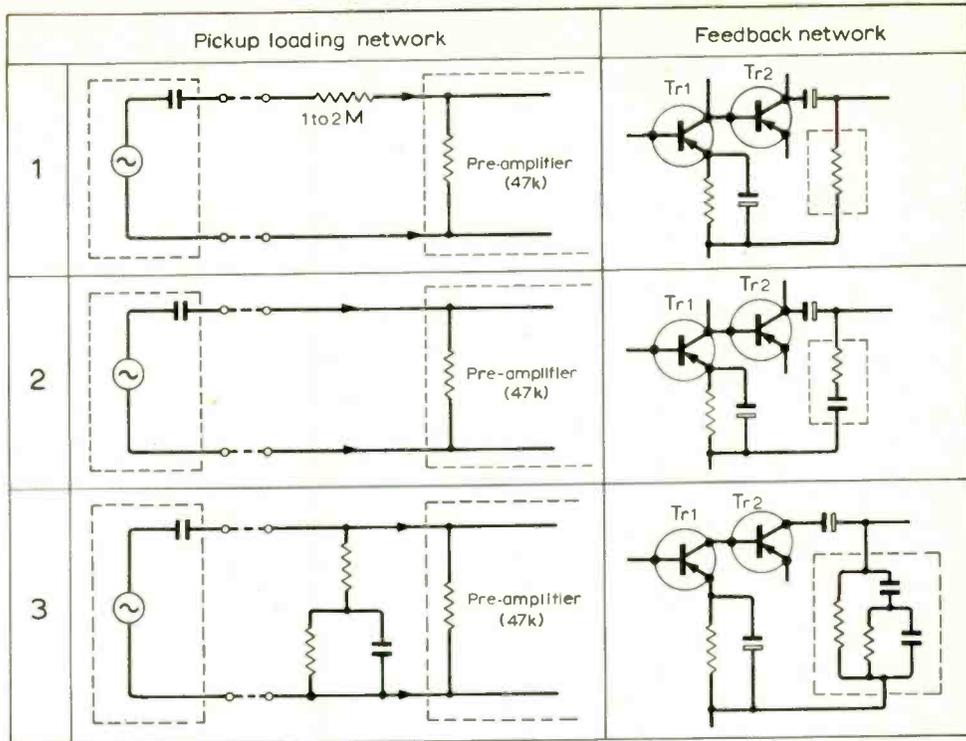


Fig. 3. Methods of loading crystal pickups. In 2 and 3 the time constants of the loading and feedback networks must be matched.

the increased voltage without breakdown. Alternatively, the load impedance may be reduced (e.g. from 15 to 8Ω). In this event the additional power is supplied by increased currents in the output and driver stages, and this is liable to result in increased crossover distortion.

The sensitivity of the power amplifier is given closely by the expression

$$\frac{R_f + R_e}{R_e}$$

where R_f is the feedback resistor from the amplifier output to the emitter of the first transistor and R_e is the value of the un-bypassed emitter resistor of the first stage. (In the mk. II circuit, the sensitivity is

$$\frac{3900 + 39}{39}$$

i.e. 100.) The sensitivity of the pre-amplifier is given by

$$\frac{(R_f + R_e)}{A R_e}$$

where R_f is the impedance of the appropriate feedback network, R_e is the un-bypassed emitter resistor of the first stage, and A is the attenuation of the input network (if any). If (as some readers have enquired) it is necessary to increase the sensitivity, this may be carried out in either the power amplifier or pre-amplifier or both. However attempts to do this may result in increased distortion, worsening of the signal-to-noise ratio, and impairment of the frequency response.

Several readers wrote to say they were experiencing severe distortion, and subsequent investigation showed that they were using a 3-Ω loudspeaker with the 15-Ω design. As a result, the output and driver

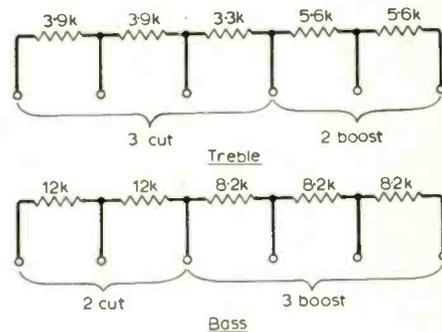


Fig. 4. Switched tone control networks.

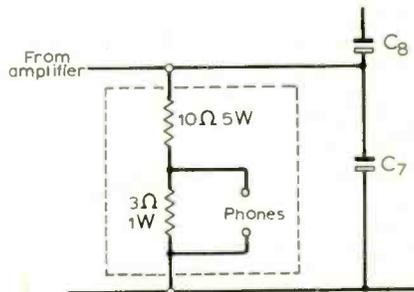


Fig. 5. Loading network for high-sensitivity earphones.

stages were supplying a higher current than the design permits, and crossover distortion was excessive. I do not recommend reducing the load to below 8Ω (when using the 40-V design) if distortion is to be kept reasonably low. It is worth noting that the component of crossover distortion remains fairly constant regardless of output power level, and as a result the distortion increases from 0.2% at 10W to 0.5% at 0.5W (both figures measured at 1kHz). At higher frequencies the distortion is still larger. If the amplifier is to be used to drive earphones, which normally require a very low power, it is worth loading

the output with a resistor network in order to ensure that the amplifier itself operates at a power level of a few watts. Fig. 5 shows a suitable network for this purpose. If load impedances of less than 15Ω are to be used, the values of the coupling capacitors C_7 and C_8 should be increased in order to maintain a satisfactory bass response. As a rule of thumb, $1000\mu F$ should be used with 15Ω load-speakers, increasing to $2000\mu F$ for 8Ω speakers.

The use of two electrolytics (C_7 and C_8) is recommended for reducing the 'plop' sound when switching on both mono and stereo systems; a single pair of electrolytics shared by the earthy ends of both speakers is not recommended because it introduces audible cross-talk and distortion in stereo systems owing to the finite impedance (frequency-variable) of these components. It is worth noting that there will be audible hum when two electrolytics are used per amplifier unless a choke (e.g. $50mH$) is used in the power supply to provide additional smoothing.

If the power amplifier is to be run either as a separate unit or with a different pre-amplifier, it is important to ensure that the input is loaded to ground by an impedance of under $10k\Omega$. Failure to do this will not only reduce the signal-to-noise ratio but will prevent the series feedback from operating correctly.

One potential source of catastrophic failure in the power amplifier is the biasing diode, setting the quiescent current of the output stage. If this diode fails, or the bases of the driver transistors are open-circuited for any other reason, then the output transistors will both be turned hard on and will fail in less than one second. It is for this reason that the resistor in series with the diode should not be replaced by a potentiometer, as these are notorious for intermittent loss of contact. A good alternative would be to use a fixed resistor with a trimming potentiometer in parallel. Failure of the potentiometer would not then be catastrophic. It is possible to use in place of the diode a suitable transistor as a 'super diode', i.e. with its collector and base strapped together.

More than one reader has commented on

the increase of supply current with signal frequency; this is however quite normal with this amplifier. It arises because the output transistors (OC35s, etc.) have a very low cut-off frequency f_T of about $5kHz$. The supply current rises with frequency for two allied reasons: firstly as the gain of the output transistors decreases, the very high feedback around the amplifier automatically increases their base currents to maintain the correct amplifier gain; secondly, the non-conducting transistor does not cut off until just after the conducting transistor has started to turn on, and so there is a short period during which current flows through both transistors. In spite of the above situation, the performance of the complete amplifier remains within the quoted limits. Obviously, distortion increases with frequency, but total harmonic distortion is still below 1% at $15kHz$. Furthermore, the percentage of the audio power spectrum which lies above $5kHz$ in music is very low, so the performance of music remains at a satisfactory distortion level.

Interested readers are referred to the note "Dinsdale Amplifier Mod"⁹.

Transistor alternatives

It was perhaps inevitable that, from the beginning, queries would be raised regarding alternative transistors. In many instances there were a number of well-known alternatives; but it was with care that the 1961 articles specified the polarity, gain and voltage rating of each device. In spite of this, many correspondents enquired whether quite unsuitable transistors could be used; some complained that they had used these, and not unnaturally the devices had failed, often carrying more of the circuit with them because of the overall d.c. feedback. For the benefit of those about to embark on this design a list of currently available transistor alternatives is given in table 4, but this is by no means exhaustive. An important point concerns the complementary drive pair (Tr_3/Tr_4). It is vital that both of these devices and the diode are of the same material (germanium or silicon). If a silicon pair is used, then two silicon diodes in series with the resistor should be employed.

Instability

A number of writers complained of insta-

bility. Without exception, the effect, which occurred only when pre-amplifier and power amplifier were connected together, took one of two forms:

- (i) supersonic oscillation from 30 to $50kHz$.
- (ii) subsonic oscillation at below $2Hz$.

The first of these is generally caused by feedback from the output of the power amplifier (loudspeaker terminal) to the input to the pre-amplifier between which two points the phase difference is such as to give positive feedback. If this oscillation (which tends to start as the volume control is advanced and is exacerbated by treble boost) is allowed to continue, it will rapidly lead to thermal breakdown of the output transistors and the destruction of high-frequency loudspeakers (especially ribbons). The remedy is to use screened input leads (a sound precaution anyway) and to ensure that the pre-amplifier and power amplifier are well screened within the unit itself. It is worth noting that all complaints of this nature stemmed from equipment in which one of these points had not been complied with. The subsonic oscillation occurs in the pre-amplifier, and is due to the high-pass filter via the resistor coupling the emitters of the first and last transistors. Faulty decoupling capacitors will lead to this low-frequency motor-boating.

Noise testing

The input transistor of the pre-amplifier, Tr_1 , requires its base to be loaded to ground via not more than $10k\Omega$ in order to maintain the correct function of the emitter feedback. If this condition is not fulfilled, a serious degradation of signal-to-noise ratio occurs. Normally the base is loaded via the impedance of the microphone, pickup or tape head in use (or by padding resistors if these are in circuit). In fact resistive and inductive loading give an audible difference to the character of the background noise; some observers have suggested that the "pink" noise resulting from inductive loading is more pleasing than the "white" noise due to resistive loading. However, this illustrates the obvious need to provide the appropriate loading resistor (or transducer) at the input terminal before noise tests are carried out. Failure to do this gives a misleading picture, which a number of constructors were quick to discover, especially as open-circuit high-gain input terminals have on occasion been known to pick up local radio interference. Thus the magnetic pickup terminal (for example) should be loaded to ground by about $2k\Omega$ (a typical pickup impedance) for testing signal-to-noise ratio.

In general the interposing of resistor networks between a signal source and the input transistor will degrade the signal-to-noise ratio. This is because the signal and noise are attenuated in equal manner, and in addition the resistors themselves will generate noise. However, where the signal has to be attenuated (as for example with high-output crystal pickups) it is worth while ensuring that the apparent source impedance presented to the input transistor is optimized to about $1k\Omega$. Table 5 shows the results of an experiment which illustrates this latter point, about which, incidentally, there has been much correspondence, including letters published in *Wireless World*. The signal-to-noise ratio is

Table 4. Transistor alternatives

	Transistor Number	Type	Gain (Typical)	Max. Working Voltage	Typical Types
Pre-amplifier	1	p-n-p, small-signal, low-noise	60 at $I_c = 1mA$	10	OC44 OC75 AC107 SN2613 (Selected for low noise)
	2				
	3				
Power amplifier	1	p-n-p, small-signal, low-noise, high frequency	60 at $I_c = 1mA$	6	OC44 2N2613
	2	p-n-p, sustained gain, over wide, current range	30 at $I_c = 100mA$	40	OC77 ACY17
	3*				
	4*	n-p-n, sustained gain, over wide, current range	30 at $I_c = 100mA$	40	NKT227 2N385A 2N388A
	5 & 6	p-n-p, good turn-off characteristic	30 at $I_c = 3A$	40	2N1605A OC28 OC29 NKT401 AD140 OC35 OC36 2N2147†

*Drivers. †See modifications for 2N2147 (ref. 9).

Table 5. The effect of input loading on noise level

R_1 Ω	R_2 Ω	Signal/noise ratio (dB)
100k	1k	60
1.2M	12k	55
4.7M	47k	40
10M	100k	21

largely dependent on the voltage amplifying transistors, especially Tr_1 and Tr_2 in the pre-amplifier and Tr_1 in the power amplifier. The use of low-noise devices in these positions cannot be emphasized enough, with the added proviso that Tr_1 in the power amplifier must also be a high frequency (15MHz) device to enable the feedback to operate correctly.

Earthing

The 1961 articles did not emphasize sufficiently the need for avoiding earth-loops, to judge from the correspondence on this subject. The currents flowing in the output valves of the then conventional valve amplifiers were small, and the effects of incorrect earthing were negligible. The precautions necessary to avoid distortion due to the high asymmetrical currents flowing in the output of a transistor amplifier were mentioned in both articles, but correspondence still arrives complaining of troubles due to this cause. Rather than repeat the necessary precautions here, I would refer readers who are in doubt to the original articles and to the correspondence in *Wireless World*. Two readers wrote describing the pick-up of radio/TV interference giving an audible signal. These phenomena were never entirely solved, as they ceased in both cases on re-wiring the systems, and could not be reinduced. They may have been due to a semi-dry joint acting as a detector diode.

Immediately after publication of the mk. II design in 1965, there was a considerable correspondence discussing methods of avoiding an earth loop. It was clear that the method proposed by Mr. C. Artus⁶ was far more elegant than that originally published, and I have now adopted this method. Most of the alternative earthing schemes proposed by readers failed to appreciate the need to prevent the asymmetrically-distorted output waveform from appearing in series with the input signals, and were therefore not valid solutions to the problem. However one method which several readers proposed was to design the complete power amplifier and pre-amplifier circuits symmetrically on either side of an earth 'tree-trunk'. This method avoids earth-loops, but it introduces other problems in the areas of overall screening between channels, screening between power amplifier and pre-amplifier in each channel, and wiring to the front panel controls. In addition, the complete board tends to be some 12 inches square, and this is not easy to accommodate in a cabinet. I still believe the Artus solution to be the most elegant.

Stabilized power supply

The power supply specified in both sets of articles consisted simply of an unstabilized capacitor-loaded bridge-rectified supply. The mk.II version included additional choke-capacitor smoothing. The disadvantages of this type of supply are first that the output voltage falls with prolonged loud sounds, and

secondly that with this fall in voltage there is a corresponding rise in hum level. The drop in output voltage can lead to premature "squaring off" of the waveform, and hence gross distortion and may also affect the "character" of the sound in an unmusical way. The increase of hum, which admittedly occurs only with loud sounds and is thus not immediately audible itself, produces a most unpleasant effect by modulating the output at 100Hz. This effect is particularly noticeable with organ music. The remedy is to use a stabilized or semi-stabilized supply.

Pilot lamps and mains switching

The use of a d.c. pilot lamp has been criticized on the grounds of false economy. Nevertheless I have measured an improvement of 10dB in hum level resulting from using a d.c. lamp. The use of a neon mains indicator introduces a "buzz", and steps must be taken to eliminate this with suitable r.f. chokes.

A further source of hum is the a.c. mains switch ganged to the volume control; if this switch can be positioned as far as possible from the pre-amplifier circuitry, so much the better. Placing the mains switch external to the amplifier is satisfactory, provided there is little chance of switching the amplifier on or off with the volume control at maximum rotation. Alternatively it might be possible to place the switch at the rear of the unit, with a long shaft connecting it to the front panel.

Fault diagnosis

Nearly half the letters I received described a set of symptoms and requested a diagnosis. I had carried out many tests during development of the circuit and had also helped personally in the construction and commissioning of over twenty amplifiers, so many of the symptoms were familiar, and could be identified. I always invited correspondents to let me know if my recommendations were successful, and many of them kindly replied giving me this information. This in turn helped others.

The greatest difficulty however occurred with letters describing modifications which were either proposed or which had been carried out and did not work, or which used different components to those specified. This situation frequently applied when commercial kits based loosely on the original design had been used. The kits or equipment often used cheaper components, and alternative transistors which were not suitable. In all of these cases, once the situation was established, it was possible to replace the faulty components with those originally specified, and in most cases the equipment then met the original specification.

I am always loath to recommend modifications especially where this involves personal expenditure by constructors, unless I have

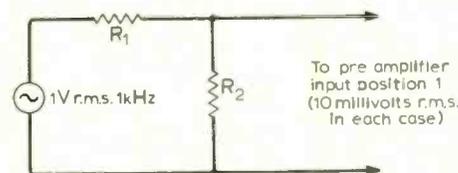


Fig. 6. Test circuit to investigate effect of input loading on noise level.

personally checked and tested the proposed alterations. As may be imagined I do not have the time or money to check all of these queries personally, especially as many involved proprietary equipment which it was desired to connect to my amplifier. In general, I feel that an author cannot normally be expected to comment with authority on modifications to his design; at the same time, I welcome letters describing modifications which have been carried out successfully.

Use with commercial equipment

The 1965 article referred to the difficulty of designing equipment which will work equally well with every pickup, tape deck, microphone, tuner, and loudspeaker marketed. Sensitivities and impedances (which are often complex and non-linear) are by no means standardized, and one can choose only a reasonable compromise; this is, after all, what the manufacturers of commercial amplifiers do. Perhaps one should increase the number of input sockets and switched alternatives, but this would put the price out of the home constructor bracket.

Nevertheless, a number of letters either enquired whether a particular tape head (for example) would work with the amplifier, or else complained that a certain device did not work satisfactorily. In these latter cases, inspection of the manufacturer's literature (where available) was generally enough to explain why either the gain or input impedance of the amplifier were not suitable for the device in question. To offer alternative input circuits was a temptation that had to be resisted, because I could not guarantee that all the other performance characteristics of the amplifier would be maintained, without building and testing the proposed new circuit myself.

Conclusions

It is now ten years since the "Tobey-Dinsdale Amplifier" was developed. It is still advertised in both kit and made-up form, and a number of commercial equipments have been based on the original circuit. A conservative estimate based on the supply of kits and transistors by two well-known companies suggests that over ten thousand of these amplifiers have been manufactured. It is not now the best available. Recent tests have shown that the quasi-complementary class B output stage produces audible crossover distortion, especially at low signal levels, and this in turn leads to aural fatigue. Nevertheless, I would like to believe that the amplifier, appearing when it did, fulfilled a need by providing an incentive for more able designers than myself to identify and tackle the principal obstacles in the design of a high-quality amplifier. This they have now done, and many amplifiers now on the market give an excellent performance.

Can anything be learned from a retrospective study such as this? I hope that if I have the opportunity again to write an article describing a circuit I will try to remember the following points:

- (i) All components should be precisely defined, and a number of commercial sources should be given.
- (ii) Alternative components should be given whenever possible (especially semiconductors).
- (iii) Suppliers of printed circuit boards and metalwork should be named.

(iv) It is obviously impossible to satisfy everyone; however if the design can give a number of options which between them cover all anticipated uses, then constructors can make the appropriate choice.

Of course one tries to design a system which will give perfect reproduction of music, and I personally regard distortion figures, frequency response curves, and all the other scientific and pseudo-scientific terms as a tiresome but necessary means to the ideal end. But when I heard a visitor to the 1965 London Audio Fair say to his companion, "The trouble is all this music—it's a pity I can't sit down and listen to the hi-fi", I decided to forget about pleasing everybody.

I will also try to remember that when writing to an author with queries, all relevant information should be given and the enclosure of a stamped addressed envelope is appreciated. And finally, if the author's suggestions prove to be successful, then writing to tell him so will make him feel far happier and it may make it easier for him to diagnose similar faults on other people's equipment.

References

1. R. Tobey and J. Dinsdale, "Transistor Audio Power Amplifier", *Wireless World*, November 1961.
2. R. Tobey and J. Dinsdale, "Transistor High Fidelity Pre-Amplifier", *Wireless World*, December 1961.
3. H. C. Lin, "Quasi-Complementary Transistor Amplifier", *Electronics*, September 1956.
4. J. Dinsdale, "Transistor High-Quality Audio Amplifier, pt.1", *Wireless World*, January 1965.*
5. J. Dinsdale, "Transistor High-Quality Audio Amplifier, pt.2", *Wireless World*, February 1965.*
6. C. Artus, Letters to the Editor, *Wireless World*, February 1965.
7. J. Dinsdale, Letters to the Editor, *Wireless World*, February 1966.
8. J. L. Linsley Hood, "Modular Pre-amplifier Design", *Wireless World*, July 1969.
9. J. Dinsdale, "Dinsdale Amplifier Mod", *Wireless World*, May 1969.

*A reprint of these two articles is available from Dorset House, Stamford Street, London SE1, price 5s.

Cassette System for 1/4-in Tape

Tape Systems Ltd, of Egham, Surrey, have developed a mechanically simple yet robust tape transport system for use with cassettes employing 1/4-in tape. Together these comprise the Packette System—Packette being the trade name of the new cassette.

Besides employing 1/4-in tape with its inherent advantage over 1/2-in tape with respect to mechanical strength, recording quality, alignment with the tape heads, and ease of manufacture, the Packette is edge driven. This action is achieved by building the pinch wheel into each Packette. There are both reel-to-reel and continuous-loop types.

The tape deck has a chassis of nylon-reinforced plastic and few moving parts. It can be operated in any position and be fitted with a variety of a.c./d.c. motors and

Appendix

Derivation of component values for R.I.A.A. disc equalization

$$\begin{aligned} \text{Network impedance} &= R_1 \left[\frac{1}{pC_1} + \left(\frac{R_2/pC_2}{R_2 + 1/pC_2} \right) \right] \\ &= \frac{R_1 \left[\frac{1}{pC_1} + \left(\frac{R_2/pC_2}{R_2 + 1/pC_2} \right) \right]}{R_1[1 + pR_2(C_1 + C_2)]} \\ &= \frac{R_1(1 + pT_2)}{(1 + pT_1)(1 + pT_3)} \end{aligned}$$

where $T_1 = \frac{1}{2}(b + \sqrt{b^2 - a})$

$T_2 = R_2(C_1 + C_2)$

$T_3 = \frac{1}{2}(b - \sqrt{b^2 - a})$

and $b = C_1R_1 + C_1R_2 + C_2R_2$

$a = 4C_1R_1C_2R_2$

For the case where $T_1 = 3180 \mu s$
 $T_2 = 318 \mu s$
 $T_3 = 75 \mu s$

It may be shown that:

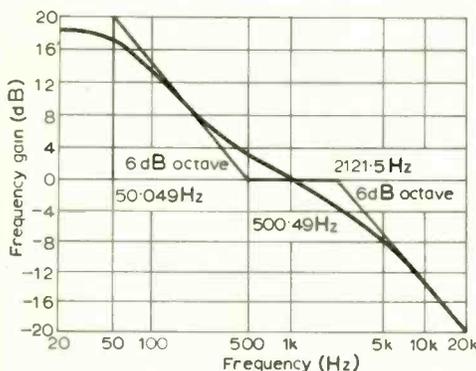
$C_1R_1 = .2940$

$C_2R_2 = 81.2$

$C_1R_2 = 237$

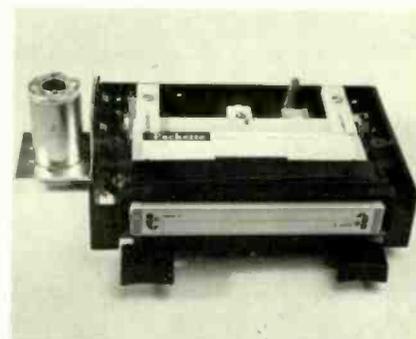
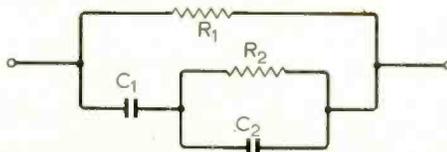
(C in microfarads, R in ohms)

From these expressions the values of components for the equalization networks may be derived starting with a suitable value of R_2 to set the sensitivity.



Standard R.I.A.A. curve for microgroove disc relay
 $f_1 = 50.049 \text{ Hz } (3180 \mu s), f_2 = 500.49 \text{ Hz } (318 \mu s)$ and $f_3 = 2121.5 \text{ Hz } (75 \mu s)$.

Equalization network



The plastic chassis loaded with a tape Packette and fitted with a drive motor.

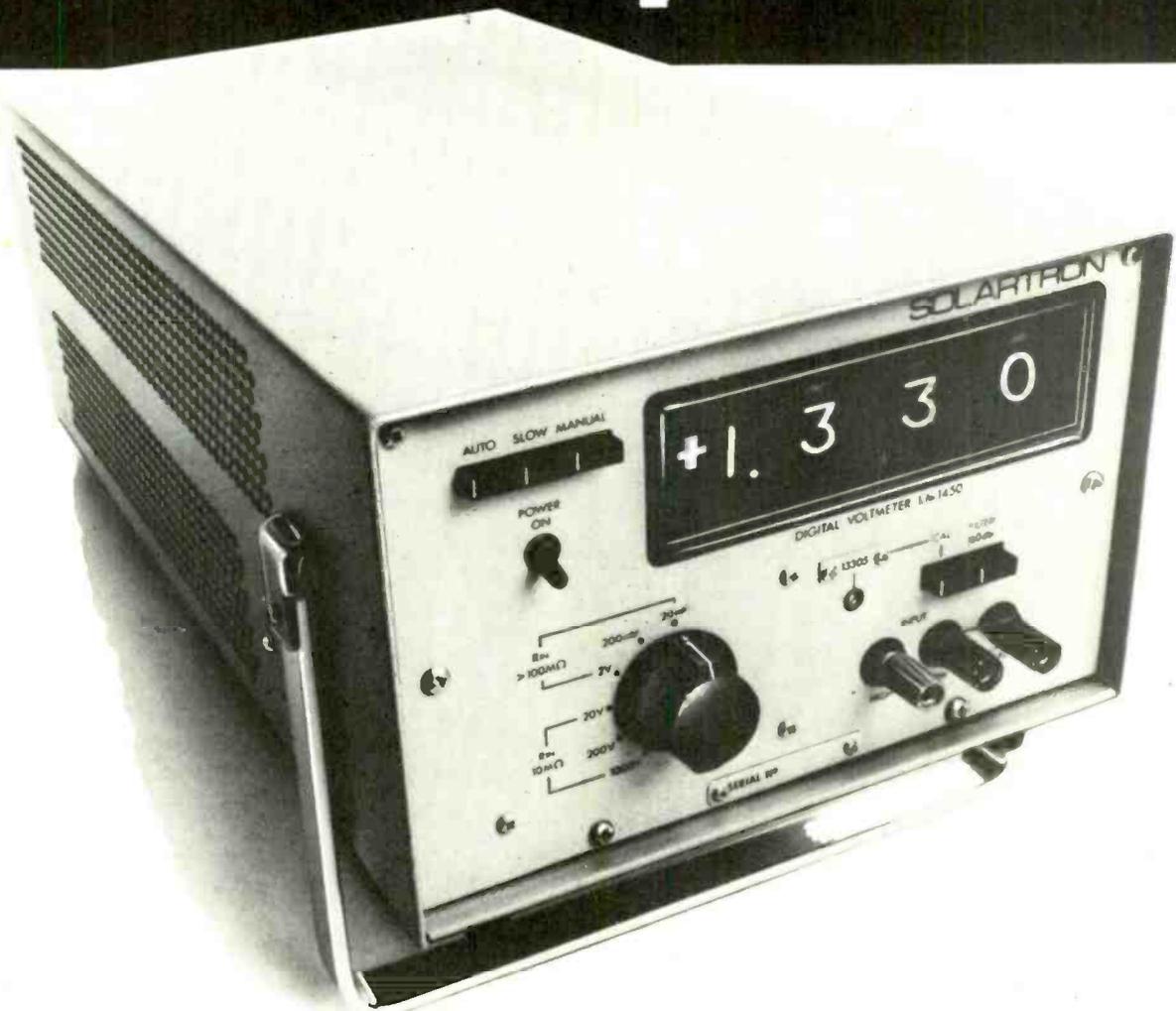
tape heads to meet many instrumentation and audio requirements. The same deck can be driven at speeds down to 15/16 i.p.s. and wow and flutter can be as low as 0.1% at 1 1/2 i.p.s. Modified Marriott heads are employed for audio use—a composite erase record/play head-block has been developed for double track use such as in language laboratories where recordings are made on one track whilst a second track is in play-back.

The single drive motor employed runs at constant speed in the same direction for all operations—tape speed and direction changes are achieved by simple mechanical modules.

Of course there is no fundamental reason why traditional tape speeds should be employed in a new system—there simply has to be correct equalization for any speed chosen.

A Packette system has been developed for use in a language laboratory, and models are available from E. J. Arnold & Sons Ltd, Butterley Street, Leeds LS10 1AX.

Now speed, stability & accuracy costs only £290



£290 buys you our LM 1450.
A great price for great
performance.

Fifty measurements per
second, ultra stability without
zero control, 0.05% reading
 $\pm 0.05\%$ full-scale, $10\mu\text{v}$
sensitivity and 140 dB common

mode rejection of interference.
Small wonder the LM 1450 is
satisfying customers right
round the world.

And when we streamlined its
price we streamlined its looks.
When you make a change for
the better, why do it by halves?

Phone Farnborough 44433 or
write for full details.

SOLARTRON
A Schlumberger Company

A force to reckon with

The Solartron Electronic Group Ltd Farnborough Hants England Tel: 44433

WW-101 FOR FURTHER DETAILS

EMITAPE Afonic

low-noise recording tape

quiet as a mouse!



don't buy any tape – buy **EMITAPE**

THE RANGE OF EMITAPE AFONIC LOW-NOISE TAPE

88

STANDARD PLAY

The best general purpose tape, giving maximum durability at all professional speeds. Pre-stretched polyester base film of super strength.

99

LONG PLAY

50% longer recording time – specially designed for multi-track recorders – pre-stretched polyester base film of super strength.

100

DOUBLE PLAY

Twice the recording time for a given size of spool – the perfect film for low speed, multi-track recorders – superfex polyester base film.

300

TRIPLE PLAY

Maximum playing time on spools up to 5" dia. – extended dynamic range – specially suitable for battery operated recorders – extra tensile polyester base.

EMITAPE IS AN EMI GROUP PRODUCT



WW—102 FOR FURTHER DETAILS

Electronics in Civil Aviation

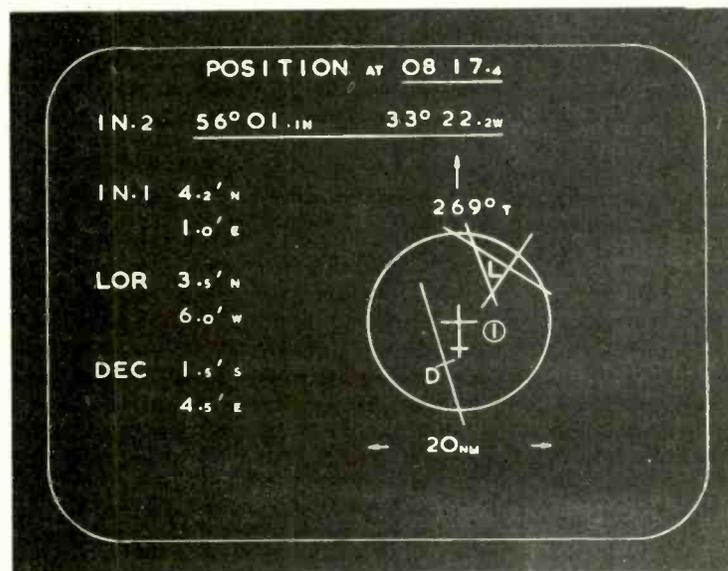
An impression of the current state of civil avionics obtained at a recent London conference

The devil we know is better than the devil we don't—and so say nearly all of us. This message was repeated over and over again in various ways by speakers discussing diverse aspects of electronics in civil aviation at the Royal Festival Hall, London, September 15th to 19th.

On the face of it one would think that it would not be beyond the capability of the electronics industry to provide civil aviation with all they need in the way of control, measurement and computing equipment. In fact if the electronics engineers were given their head and if the aviation boys took things at their face value a whole host of new electronic aviation aids would soon appear but, if this happened, chaos, collision and catastrophe would be the order of the day.

Revolutionary equipment could well, on paper at least, do away with all the known limitations of existing systems but such equipment would certainly introduce a number of unknown features which would lead to hazardous situations simply because these features are unknown. This has been proved in the past, as was pointed out in a paper by J. Benjamin of the Royal Aircraft Establishment, in military aviation where strategic necessity has led to radical change, sometimes with disastrous consequences.

Another important factor to be taken into account when



A possible solution to the problem of clearly presenting navigation information to the crew was suggested by J. G. Carr and F. S. Stringer and is shown above. The c.r.t. display shows the outputs of four navigation systems—two inertial navigators, Loran and Decca. The display graphically shows the positional information from the four equipments and shows how the outputs of three of the equipments differ from the one selected, which happens to be inertial navigator No. 2.

considering change in civil aviation is that airborne equipment of the type we are considering requires large, very expensive, ground installations for support. Any change would mean that all the ground installations throughout the world would have to be replaced.

There is no question that a vast improvement must take place in the facilities available to civil aviation. However, this will be achieved by evolution and not revolution. Figures given by E. Davies, of Marconi, in a paper on surveillance radar showed that in the twelve months ended July 1968 the total aircraft movements (take offs or landings) at Heathrow, Gatwick, Luton and Stanstead was 400,000. During the same period another 700,000 movements were contributed by 26 other airports in the London area. The average movements for the period worked out at 125 per hour with peaks in the region of 250 movements per hour. According to P. G. Masefield, chairman of the British Airport Authority, the number of movements by 1980 will triple. This means 20 runways will have to run at a constant rate of 40 movements per hour.

To handle the necessary amount of traffic "all weather" operation will become essential and automatic landing will become routine even in extremely adverse weather conditions.

Civil aviation therefore has to find ways of handling all these aircraft in all sorts of weather. This will mean across-the-board improvements in airborne and ground installations with the lion's share of the problem on the heads of electronics engineers.

Automatic landing

The problem here is not one of accuracy, existing systems are perfectly adequate in this respect; it is not one of reliability, because reliability can be had at a price; it is the overall integrity of the system. Integrity is a word that was much bandied about at the conference. In this context it means that a system will operate correctly when required and that it will be known to be operating within its specified limits at any particular time and may therefore be trusted.

Consider a typical automatic landing installation. The well known, and established, instrument landing system (i.l.s.), operating in conjunction with heading information is responsible for bringing the aircraft in line with, and just over the threshold of, the runway. Being a radio system relying on radiated beams it is sensitive to interference and, on a number of airfields, it just cannot be installed because of the terrain.

In the later stages of the landing radio altimeters on board the aircraft play an important part. These can be sensitive to multi-path reflections and aircraft attitude.

The automatic pilot and automatic throttle used to carry out the landing contains tens of thousands of electronic components, scores of motors, servo systems, amplifiers, integrator and feedback loops. How can one be sure that this complex system is 100% serviceable? Is it sufficient to fit three

of them and take the majority decision as being the right one? In this context the words fail-safe, fail-soft, fail-operative, fail-obvious, probability, comparator, monitor, duplex, triplex and duplicate monitored were repeated over and over again.

In most of the areas mentioned no real solutions to these problems exist as yet. In a paper by W. Hilton, of Sperry Gyroscope, a fail-obvious comparator for airborne systems was described which gave a warning if the monitored equipment or the comparator itself failed. With this system, if the comparator failed, the monitored equipment must also be considered to be unserviceable because the pilot, even if he knows that it is the comparator at fault, has no way of ensuring that the monitored equipment itself has not failed also. Even if the idea is extended indefinitely—a monitor to monitor the monitor, to monitor the monitor . . . there can still be no absolute certainty. The accepted thing is that the probability shall be that a system shall not fail more than once in 10^7 landings.

Will the designers have to take into account freak conditions? For instance an aircraft returning to an airfield at which a visual landing is impossible due to bad weather and when, for some reason, a diversion airfield is not available. In a case such as this a pilot would want to know the degree of unserviceability of his equipment in order to determine whether an automatic landing is a justifiable risk. Probably the only way of doing this would be to employ a large number of equipment measuring sensors controlled by a digital computer.

With the i.l.s. the picture is a brighter one. Some time ago the R.A.E. designed c.p.i.l.s. (correlation protected instrument landing system) which is now being developed and will be produced by the Plessey Company.

The system employs hyperbolic phase fields and correlation detection to generate guidance misalignment signals with inherent integrity and, with suitable choice of transmitter modulation, the system is compatible with existing v.h.f. instrument landing systems. The only additional airborne equipment consists of a microwave aerial and mixer unit which may be fed directly into the existing i.l.s. The idea therefore conforms to the rule of evolution rather than change, it provides the pilot with a choice of v.h.f. or microwave i.l.s., and overcomes many of the v.h.f. i.l.s. interference and site problems.

Air traffic control

The other area of great difficulty is in air traffic control. It is thought that large digital computers will be able to perform the necessary predictions and calculations for the safety of all aircraft in the controlled area. This will include handling emergency situations and taking into account the presence of military aircraft which, according to E. Davies, may suddenly change flight level at rates of up to 60,000 ft per minute.

The problem is in getting adequate information on all movements in the area so that the computers can be kept up to date on a rapidly changing situation.

In this field many improvements are required to radar systems. Airfield radar can be divided into two types; primary radar which is responsible for general surveillance and tracking, and secondary radar which consists of an airborne transponder that gives information on the aircraft carrying it when interrogated by a ground installation.

Primary radar needs to be of higher resolution to separate targets which are close together; higher scan rates must be achieved so that any new target may be quickly spotted; and dwell time on any particular target must be increased so that stationary clutter can be minimized and additional doppler information (velocity etc.) can be derived.

All these requirements are in obvious conflict and M. A. Radford, of Marconi, suggested that the solution may lie in the use of multiple receiver and electronic scanning techniques.

Secondary radar suffers from a variety of defects. One of these is difficulty in siting the aerial on the aircraft and even when two aerials are carried, contact is not certain due to the

screening effect of the airframe. With present equipments the only information transmitted is aircraft identity and height.

Secondary radar however is rapidly increasing in importance and will eventually oust the primary radar from its premier position. C. Ullyatt, of R.R.E., says that primary radar will probably be used mainly to handle those aircraft which for some reason cannot take part in the secondary radar system, and for keeping track of airfield ground movements. Mr. Ullyatt gave a paper describing a new transponder which followed the law of evolution. Basically it consists of an auxiliary unit which can be fitted to, and addressed through, the existing transponder. The new equipment would be capable of transmitting a great deal of information and during an emergency could transmit the state of the aircraft systems to the ground.

Navigation

Extremely accurate navigation is essential to enable aircraft to operate in the fairly close proximity required if the number of movements predicted for the future is to be met. J. G. Carr and F. S. Stringer, of the R.A.E. (Mr. Stringer described hyperbolic navigation systems in our August issue), suggested at the conference that two or more current navigation aids could be operated under the direction of a management digital computer and explained how a Comet-4 was being modified to do research along these lines. In this system a highly accurate point position fixing aid is used with a long-term reference system so that the limitations of both are overcome.

Mr. Stringer suggested that the Kalman filtering technique could be used to great advantage now that digital computers of adequate capacity are available. Although such a technique is not liable to become economically attractive until storage becomes cheaper.

With the Kalman technique, a mathematical error model of each of the sensors is stored in the computer, the parameters of these models are adjusted throughout the flight every time a position comparison is made so that as time progresses the model becomes a closer approximation to the truth. The computer uses these stored values of error parameters to correct the navigation information to produce position data that is more accurate than any of the sensors could have achieved separately. In effect the navigation system is being continuously calibrated during the flight, and the longer the flight the more accurate the system becomes.

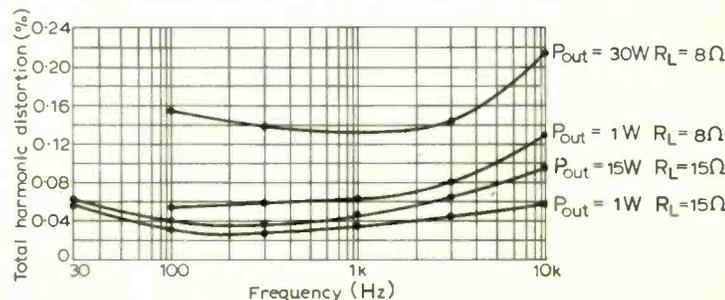
Civil aviation is rapidly approaching a point when far reaching decisions on electronic equipment for the next decade will have to be taken. We can only hope that the evolution of suitable equipment will not be overtaken by the demands on the airlines for more airborne seats.

Correction

"Low-cost 15W Amplifier" Oct. 1969.

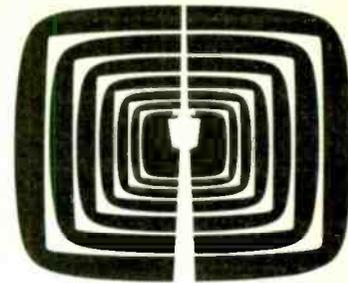
The common emitter resistor R_6 in Fig. 1 should be $4.7k\Omega$ not $47k\Omega$.

Fig. 4, showing curves of t.h.d. against frequency for different powers and loads, was incorrectly annotated. The correct specifications are shown below.



Stuttgart

Radio and TV show



Some highlights from the last German national exhibition

Good German citizens, and a good many non-Germans, flocked in their thousands to see the 26th German radio exhibition, the *Deutsche Funkausstellung*, which was held at Killesberg, just outside Stuttgart, from August 29th to September 7th. On the first three days, the Friday, Saturday and Sunday, 245,000 people attended the exhibition. Total attendance over the ten days that the exhibition was open was 703,000 which created an all-time record and exceeded all expectations.

Colour TV and hi-fi equipment were the principal attractions at the exhibition, coupled with a huge television studio, run by the first and second programme authorities A.R.D. and Z.D.F., which seated 1,400 people per performance. A clever idea here for people who could not get inside the studio was a travelling trolley to convey them past the long observation window so that they all had a good view but were unable to loiter. High-quality speakers conveyed the sound to them.

One of several large halls, in fact the major area of Hall No. 1, was occupied by various exhibits and demonstrations of the Bundespost, the German equivalent of our Post Office, who included among them an historical exhibit of television apparatus. There was the 30-line Nipkow mirror helix, an old 441-line receiver, and a 180-line or 441-line camera that was used during the Olympic Games in 1936, where Walter Bruch (now Prof. Dr. Bruch) inventor of the PAL colour system, was employed as a camera operator.

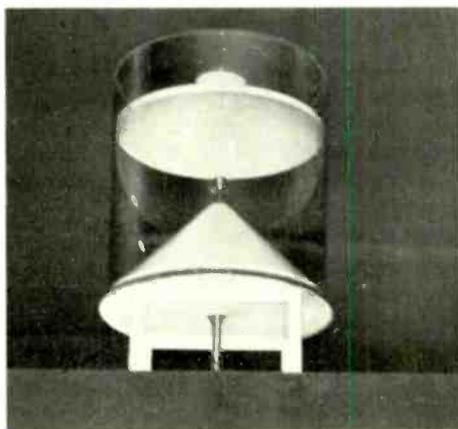
Probably the most significant exhibit, however, was the 12-GHz television broadcasting equipment, which was actually a working model, comprising transmitter, aerial, receiver dish and translator to Band IV and V channels. At present there are three television services available in Germany, and all the channels in Bands I, III, IV and V are apparently fully occupied by them.

To make room for additional services, which will include an educational one, the Bundespost has been experimenting with still higher frequencies, around 12 GHz, actually between 2.5 and 2.7cm as was reported in *Wireless World* in July this year.

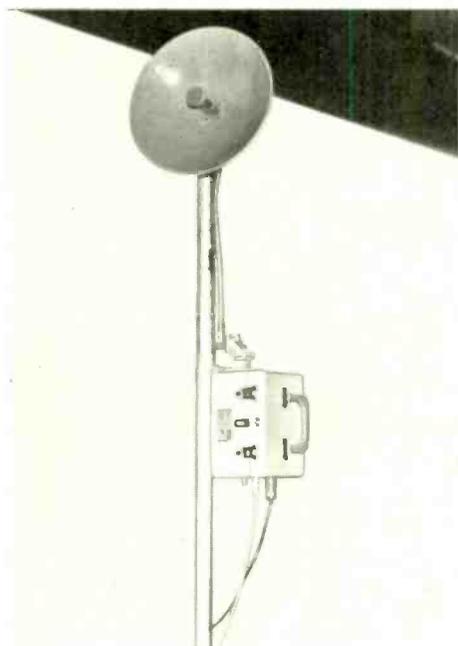
The exhibit showed the kind of equipment that would be used. The transmitter employs a conical aerial, with a reflector, which can be seen in the accompanying photograph, and has a circular radiation pattern in a horizontal plane. The reflector

receives energy from a vertical horn projecting from the apex of the cone. Weather protection is provided by a transparent cover which encloses the whole aerial.

For reception a parabolic aerial is employed, as in the photograph, which is mounted on a mast together with a translator



Transmitting aerial for the experimental television service on 12GHz.



Receiving paraboloid, with translator on the mast, for the 12GHz service.

or to convert the microwave frequency range to, say, u.h.f., so that it can be applied to a normal domestic receiver.

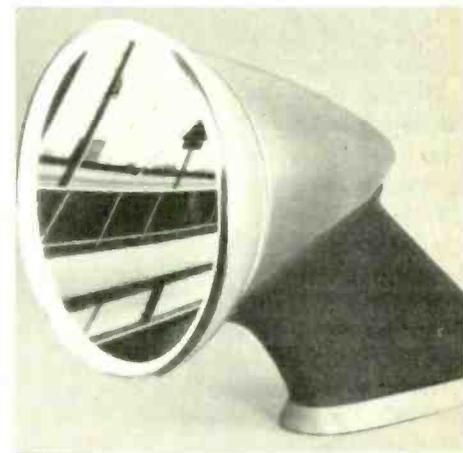
In the experimental model shown the receiving aerial would cost about DM.200 (approximately £20), but the translator was estimated to cost about DM.8,000, which would render the system too expensive for any but the largest blocks of flats. It was expected, however, that by quantity production, using a quartz crystal controlled oscillator and a cavity resonator type of tuning system, the price could be reduced considerably. The system is envisaged for use only in the centre of a town which it could 'flood' with direct radiation. Its maximum radius of service is about 20km (about 12.5 miles).

Novel Car Aerial

One of the surprises among the commercial exhibits was a new type of car radio aerial called the Alpha 3 and shown by Hans Kolbe & Co. under their 'fuba' brand name (which they always spell with a small 'f'). It was designed by Hans Kolbe in conjunction with Professor Meinke, of the Institute for High Frequency Technique at Munich.

Incorporating a wing mirror, it is intended to be used as such. This alone is an asset today when vandals enjoy an orgy of snapping off telescopic aerials.

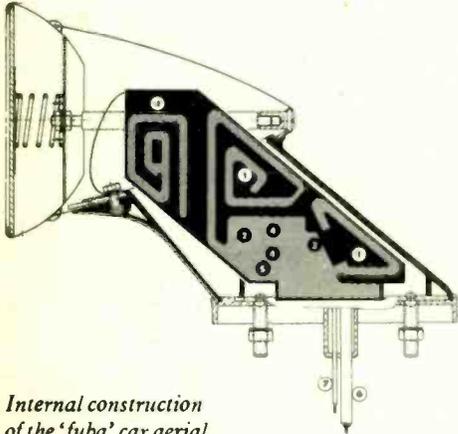
Inside the housing is a printed-circuit panel containing three aerial loops and two



Wing mirror car aerial introduced by Hans Kolbe.

transistor amplifiers, one for a.m. and the other for f.m. Even in car radios in Germany where there are some .000 v.h.f. stations it is necessary to make provision for f.m. reception, and this aerial system covers all a.m. broadcasting frequencies from 150kHz to 25MHz as well as the v.h.f./f.m. range in Band II.

The rim of the mirror forms part of the aerial pick-up system. It is made of rustless steel and is shaped to fit in its spring-loaded mounting as a ball joint, so that it can be adjusted in its application as a wing mirror.



Internal construction of the 'fuba' car aerial showing the printed circuit board.

Its internal construction can be seen from the accompanying illustration. The aerial loops, mirror rim and the electronic assembly form an integrated whole whose impedance matches the transistor input elements. The low impedance of the device helps to avoid interference pick-up. On v.h.f. the aerial loops form a bandpass circuit which rejects interference from transmissions outside the v.h.f. radio band, even though their field strength may be high. In the wideband a.m. coverage special design features are incorporated to prevent static interference and cross-modulation. The outputs of the two amplifiers are combined and matched to the coaxial cable. Also a protective diode is provided to by-pass static surges, which can wreck the input transistor in a car radio receiver.

Power supply to the amplifiers is taken via a separate lead from the car's electrical system, and the amplifiers will operate on 6V to 15V at 5-11mA.

The price of the Alpha 3 aerial in Germany is expected to be about DM.90 (say £9).

Cheaper V.T.Rs

Another surprise was the sudden appearance of video tape recorders by several manufacturers at the domestic-user level of about DM.2,000 (£200). Blaupunkt (a member of the Bosch Group and known in the U.K. as Blue Spot), Grundig, and Telefunken all showed prototypes, and Philips had two models, one (type LDL 1000) priced as low as DM.1,880.

Telefunken uses $\frac{1}{2}$ -inch tape on 18cm (about 7 inch) reels at 19cm/sec (about 7.5in/sec) giving a playing time of 60 minutes. It is said to be equally suitable for colour and monochrome recording, and the company hope with improved tape oxides to

better the present 3MHz bandwidth.

Philips use $\frac{1}{4}$ -inch tape, of which a length of 480 metres (a little under 1,600ft) will run for about $\frac{1}{4}$ hour. The instrument uses transistors throughout and operates from the mains. Of transportable proportions, it weighs 12kg (about 26 $\frac{1}{2}$ lb). Sound and synchronizing signals are carried on narrow edge bands.

Home Cine TV

Something more than a coincidence must have led NordMende to produce at the same exhibition as the series of domestic, or entertainment, video tape recorders their Colorvision equipment. This unit comprises a colour television receiver and an 8mm film scanner and reproduces the cine film on the screen of the TV receiver. The optics and film transport mechanism were developed in association with another company, Paillard S.A. (Bolex).

It is quite a domestic piece of equipment housed in a large console cabinet. The colour receiver occupies the left half of the cabinet and the film scanner, together with a separate tape cassette unit for the sound commentary, the right-hand half.

Advantages claimed for this method of reproducing cine film pictures are that it is silent in operation, does not require complete blacking-out of the room, provides the user with complete control through his TV receiver of such parameters as brightness, contrast and colour saturation, a still picture (it can hold one frame as long as required without any risk of overheating), it can be left ready for use in a living room without any need for elaborate setting-up procedure, and of course it provides the purchaser with a built-in 25-inch colour receiver.

The model on show was a prototype (but it was being demonstrated) and the price was not fixed, but it was believed it would be somewhere around DM.4,000 (about £400).

Full technical details are not available, but visible inspection showed that the film scanner employed a raster on the screen of a small oscilloscope and that the film passed through an optical lens system continuously, without a frame-by-frame gate. It is not clear, for instance, how the 18 picture-per-second sequence that they quote for the Super-8 film is synchronized with the picture frequency of the receiver; nor how



Philips domestic sound and vision recorder type LDL 1000.

the continuous film transport can be stopped to produce a still.

From the film scanner the picture is broken up optically by dichroic mirrors into its red, green and blue components, which are then converted electrically into colour-difference signals prior to their application to the receiver. The sound commentary is quite independent, but it is incorporated in the same compartment as the film scanner.

All-embracing home entertainment

Another quite original idea shown by NordMende was the Vario-Center, a fully comprehensive high-fidelity domestic sound and vision entertainment device in a severely contemporary but original styling. In appearance it resembled a large sphere with three slices cut off the sides to provide flat vertical surfaces, and a fourth slice off the top to present a flat horizontal surface.

On one of the vertical surfaces is mounted a NordMende integrated stereo amplifier with a four-band a.m./f.m. tuner and control unit, with 30 + 30W continuous sine-wave output (model 8002/ST); on another surface is their model 8002/T4 tape recorder; and on the third the latest (hybrid) transistor 25-inch colour TV receiver. On the horizontal surface at the top is a Perpetuum Ebner PE2020 record player with a Shure M75MG cartridge.

Loudspeaker systems comprise two semi-spherical enclosures each with three bass, three middle and two tweeter units. They can each handle up to 50W.

Electronic record players

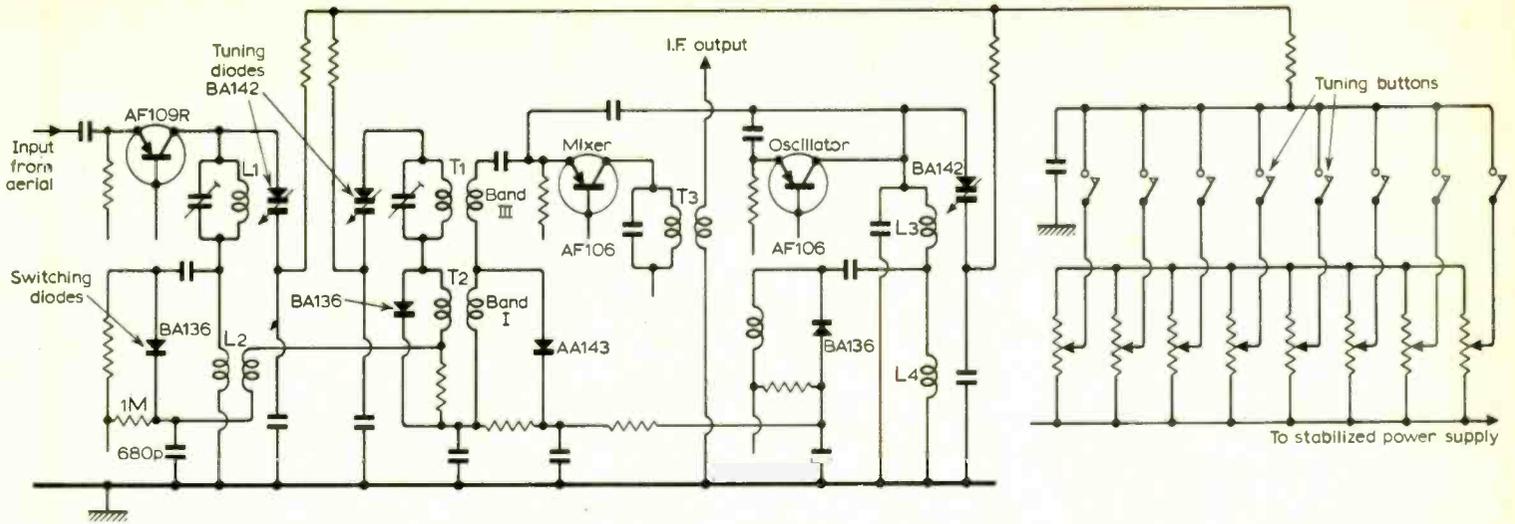
Because the show was national, several importing companies held private shows in various parts of the town. One of these was held by Paillard-Bolex G.m.b.H., of Munich, who are distributors in Germany for the Swiss-made Thorens equipment.

They were showing an entirely new Thorens disc record playing deck (type TD125) with several interesting features. One feature is the shock-absorbent mounting for the turntable and pickup. Only the turntable and pickup, together with some electronic components are mounted on the chassis, and the whole chassis assembly weighs about 15lb. Its inertia, together with the springy suspension, enables quite violent vibrations to be absorbed.

The only link between the two, apart from the springy suspension, is the (10:1 ratio) drive belt, a soft slim rubber band which absorbs any vibration. No gears are employed, and there is no mechanical speed-change device. Driving power for the 16-pole



Thorens record player which features a shock-absorbent mounting for the turntable and pick-up.



Simplified diagram of the Blaupunkt v.h.f. television tuner using varicap diodes.

synchronous motor is derived from a 20W transistor amplifier driven from a Wien bridge oscillator, whose frequency determines the speed of the turntable in three steps for 16, 33 and 45 r.p.m. Rumble is claimed to be better than -68dB (DIN 45539 weighted standard).

For speed monitoring, stroboscopic markings for 50 and 60Hz mains on the underside of the turntable base are optically conducted to a window at which they can be compared with a neon lamp. A variable potentiometer provides $\pm 2\%$ correction. The deck can be operated from battery or mains.

Finally, a feature that can be seen in the Thorens photograph is a new style for switch knobs that was evident on quite a number of stands in the exhibition. This is the large flat type of knob seen in the foreground, which measures about 50 x 30 x 6 mm and looks like a bar of chocolate. The three seen here are slide-type controls for speed change, on/off and pickup raising and lowering.

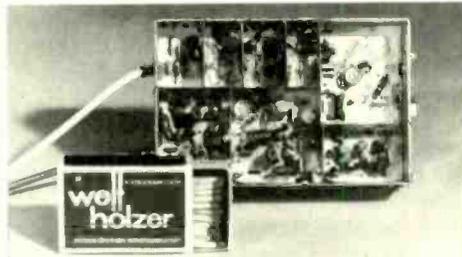
In contrast to the entirely free suspension of the Thorens was that of Braun in their new PS 600 record player, which they cautiously state to be their first automatic player. This one lifts and lowers the pickup automatically, but it can also be adapted to change records. Its vibration-absorption is similarly effective, but to avoid the possibility of an oscillation being set up in the freely-floating system they have equipped it with critical hydraulic damping. Like the Thorens, too, this player has electronic control and electrical speed change.

Braun also introduced at the show a new type of loudspeaker cone which they call a 'Kalottenmembran'. Used as the middle-frequency unit in their 4-unit L 710 enclosure (two bass, one middle and one high-note) the new material permits a 'flatter' cone angle and thus provides a better 'spread' of sound in the upper frequencies.

Electronic TV tuning

Monochrome television was to be seen on every set-maker's stand, but colour was claiming the attention of both exhibitor and visitor. From the British observer's point of view the most interesting feature, both in colour and monochrome, was capacitance-diode tuning used by all but one manufacturer (Körting).

One of the great simplifications of the



Grundig all-band television tuner, with electronic tuning and band-switching, compared with a standard matchbox. It has no moving parts.

diode tuning technique is that once the circuits are set up and aligned, tuning of any number of stages can be effected by the adjustment of a single potentiometer. Press-button tuning is reduced practically to the need to switch a single low-voltage low-current d.c. line, each button being associated with its own potentiometer. As a result, remote control by a multi-way cable is simply an extension of the press-button unit on the set, and no motors are required.

Several manufacturers offered remote control, some by cable-less ultrasonic devices. Saba was actually demonstrating an ultrasonic remote control that changed programme and controlled colour saturation and volume. It was interesting to observe that all manufacturers included saturation adjustment on their remote-control units, and some included contrast as well. These facilities of course require motors.

A simplified diagram of the Blaupunkt v.h.f. electronic tuner, shown in the accompanying drawing, which is representative of general practice in Germany. In addition to diode tuning it also incorporates diode band switching, and both tuning and band switching include the u.h.f. tuner, which is omitted from our simplified diagram.

Three circuits are tuned by BA142 diodes, as shown by the diode/capacitor symbols used in Germany to present a varicap diode. Band switching is effected by three BA136 diodes and an AA142 diode. On the right is shown the assembly of programme selector switches and potentiometers, of which there are usually six or seven, with a single lead between it and the tuner. Another lead would be necessary for band switching, of course, and that is controlled by an

angular adjustment of the slider potentiometer shaft. Power supply for tuning is always derived from an integrated-circuit voltage-stabilizing circuit. Slide-type controls seem to have taken over from rotary knobs in most kinds of domestic equipment.

Prices in Germany for colour receivers range generally around DM.2,300 for a 25 inch table model, DM.2,000 for 22 inch and DM.1,700 for 19 inch. For monochrome 23 inch is the norm, and a table model would sell at about DM.550 upwards.

A number of exhibitors had two loudspeakers in their 25-inch table colour TV receivers and some had tone controls, but a rather unexpected innovation from the country that originated the PAL system was the provision on two or three makes of colour tone controls. These take the form of slider potentiometers calibrated with red or yellow at one end and blue the other, and they attenuate the blue gun emission (for a 'warmer' colour) or vice versa.

Prices of colour sets were all fixed by registration with the Kartellamt, but monochrome prices were all 'recommended', as they are here. Either way there is an added 'value tax', equivalent there to our purchase tax except in severity. It is always included in the quoted price and it amounts to 11% of the retail value of the goods. It is added at all stages along the distribution line and is still 11% even if the price is cut, because the final seller charges the full tax but deducts from it what has already been paid at other stages down the line. It sounds as though administration might be expensive.



The special Funkausstellung stamp.

News of the Month

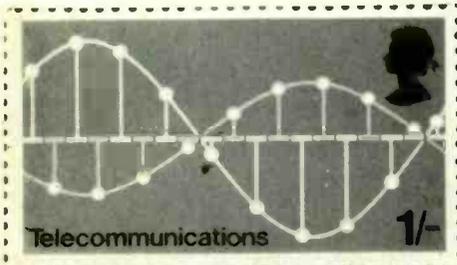
Register of engineers

The creation and administration of a composite register of "the engineering community" is foreshadowed by an announcement from the Council of Engineering Institutions. At a meeting of the Board on September 4th it was unanimously resolved that "the Council of Engineering Institutions will, in collaboration with other interested parties and subject to the agreement of the Privy Council, initiate the formation of an organization to create and administer a composite register covering the principal sections of the engineering community, currently chartered engineers, technician engineers, and engineering technicians".

A working party, consisting of one representative from each of the fourteen Institutions within C.E.I., which include the I.E.E. and I.E.R.E., under the chairmanship of Sir Arnold Lindley, has been set up to implement the resolution. The first duty of this working party will be to prepare a submission to the Privy Council to get agreement to such modifications to the C.E.I. Charter and By-Laws as may be necessary and then to determine which other interested parties should be invited to collaborate.

Aesthetics and electronics

The Marconi-Elliott Microelectronics factory at Witham, Essex, has won for the London architects Anthony B. Davies and Associates the gold medal award for industrial architecture made triennially by the Incorporated Association of Architects and Surveyors.



The sampling technique used in pulse code modulation, which was invented by Alec Reeves, of Standard Telecommunications Laboratories, Harlow, is symbolized on one of the four stamps issued to mark the establishment of the new Post Office Corporation.

Colour TV show

The colour television show organized by the B.B.C., I.T.A. and B.R.E.M.A. started its tour in Leicester on October 14th. The venues and dates for the exhibitions until the end of the year are: Stockport, Town Hall, Oct. 27-Nov. 1; London, Euston Station forecourt, Nov. 8-29; Birmingham, Mecca Ballroom, Dec. 5-10; Glasgow, McLellan Galleries, Dec. 16-20.

Incidentally, according to B.R.E.M.A., deliveries of colour receivers for August were 1,000 higher than for the same month of 1968 but the total of 60,000 for the first eight months of the year was 18,000 lower.

Technical design competition

Designers and technicians under the age of 35, who are still undergoing professional training or who have not worked professionally for more than two years, can take part in the competition for the Braun prize for technical design.

This competition which is to be held in 1970, is the second of its type. The first was held in 1968 when Germany and Japan won the major awards. The winning individuals or teams can receive up to DM 25,000 (= £2,500). To give some idea of the range of designs eligible, in 1968 122 projects were filed—from a cooking plate to a transportation system.

The competition is sponsored by Braun Aktiengesellschaft, 6242 Kronberg/Ts., Postfach 115 116, Germany, in co-operation with "Gestaltkreis" of the Federal Association of German Industries.

Airfield control radar

An X-band airfield control radar, called the ACR430, intended to meet the needs of small airfields has been introduced by Plessey Radar. The new equipment, which replaces the earlier ACR424 has a dual role in that it continuously radiates one beam for general purposes.

A single aerial reflector system fed by twin horns and dual transmitter/receivers provides the two-beam coverage. One horn illuminates the reflector to give a cosecant squared pattern for surveillance. The other horn partially illuminates the reflector producing a pencil beam with the accuracy

required for surveillance radar approaches. Circular polarization is used to reduce the effects of precipitation clutter.

The output from a particular horn-transmitter/receiver combination can be switched to either or both displays which, together with the master control unit, can be up to 1,000 metres away from the aerial without the need for line amplification equipment. Two 300mm (12 inch) diameter displays provide selection of four range scales from 4 to 32 nautical miles.

European multi-role combat aircraft

A European company was set up, on the signing of an agreement in Munich recently, called Avionica Systems Engineering GmbH which will be responsible for planning the electronic systems for the European multi-role combat aircraft. The company will have its headquarters in Munich and will consist of members drawn from the following three companies: Elliott Automation and Advanced Military Systems Ltd [U.K.], Elektronik-Systeme-Gesellschaft [West Germany], and FIAR-CGE and Selenia Industries Elettroniche Associate S.p.A. (Italy).

The new company will receive a contract for the electronic systems for the new aircraft from Panavia, which is also a consortium consisting of: the British Aircraft Corporation, Messerschmitt-Bolkow-Blohm and Fiat from the same three countries.

The Ferranti award

The British Computer Society has set up an annual award for the best candidate in its professional examinations.

The award, which is £150 donated by Ferranti, will be made by the council of the society on the recommendations of the chairman of the education board.

The first recipient of the award was Geoffrey Hollis who is a computer systems analyst with the Gulf Oil Company.

Solar flare early warning installation

A system of 24-hour forecasts of the best frequencies to use in the shortwave band has been worked out by Swedish Telecommunications Administration. This will make use of a telescope installed for this purpose on the roof of a building at Farsta outside Stockholm. The telescope will be used to register solar flares and provide an early warning of disturbance to radio communications.

Tape player for colour

Lasers and holographic techniques have been employed by R.C.A. to play back, through a colour television set, full-colour programmes recorded on very cheap transparent plastic tape. A laboratory model of the SelectaVision tape player system was recently unveiled in America and is expected to be on sale to the public in the early 1970s. The cost should be about \$400 for the player and less than \$10 for a half-hour recorded tape. The system is claimed to be as easy to operate as a record player.

"The engineer is a woman"

In an effort to encourage women to enter the engineering professions the Ministry of Technology has produced a film called "The Engineer is a Woman". In the film five women from mechanical, civil, electronic and electrical engineering, explain how and why they became engineers. The film is intended for 13- to 18-year-olds and can be obtained free of charge for non-theatrical use from: The Central Film Library, Bromyard Avenue, Acton, London W.3.

Semiconductor plant expanded

The Ferranti semiconductor assembly plant at Ormsgill, Barrow-in-Furness, is to be doubled in size to over 50,000 sq.ft. By about mid 1970 the plant will be capable of assembling more than 20 million semiconductor components per year from material processed at the "parent" plant at Gem Mill, Chadderton, Oldham.

Data book demise

After being well known to engineers for over 30 years the Mullard Data Handbook, which consisted of a large number of black loose leaf folders, is to be discontinued. In its place three multi-part books are being prepared which will list data in the same format as before, on Mullard's design range of components.

Book one (blue cover) of the new series will cover semiconductor devices and integrated circuits and will be divided into six parts. Book two (orange cover) will deal with valves and tubes and will have five parts. Book three (green cover) will be in three parts and will provide data on components and materials.

Users who took out new subscriptions to the original handbook service during or after

Operational Amplifiers—Pt. 10

We regret the omission from this issue of the concluding instalment of the series of articles on operational amplifiers by G. B. Clayton.

May 1968 will receive equivalent replacements from the first set of the new publication free of charge.

The fourteen parts will cost 12s each and should be available between now and January 1970, depending on the part required. Every year each part will be up-dated and reprinted and will be available at the same price; 12s. Orders for the new handbook should be sent, with remittance, to Central Technical Services, Mullard House, Torrington Place, London W.C.1.

Mini-computer

A physically small computer, known as the 18C, is being developed by Arcturus Electronics Ltd, with the backing of the National Research Development Corporation. It uses medium scale i.c.s and has a 16-bit word length. Parity checks are built in. Data can be manipulated between several registers without returning to the main memory. It has a multi-register configuration—two registers may be used as index registers. The memory may vary in size from 256 to 32,000 words. Production is to begin soon and the 18C will be available in a desk-top console on a seven-inch tall standard rack-mounted package. Both versions will hold up to 8,000 words of memory or interfaces for peripheral devices. It is expected that the selling price with 4,000 18-bit words of memory and a Teletype ASR33 will be under £4,000. A system with 256 words of memory could, in quantity, sell for under £2,000.

Portable radio receives weather broadcasts

Zenith Radio Corporation have produced an a.m./f.m. portable radio with all the usual facilities plus a pre-tuned channel of 162.55MHz. On this frequency there are almost continuous broadcasts in America giving information on local weather and water conditions, so the radio should be popular with all those who enjoy "messing about in boats". The price in the U.S.A. will be just under \$ 50.

Satellite link for Indonesia

Indonesia's new communications satellite ground station will link the country with the U.S.A., Europe, Japan, Australia, Hong Kong, Singapore and Malaysia. The station is located in Djatiluhur, Java, approximately 100km from the capital and was built by the defence communications division of International Telephone and Telegraph Corporation. It is equipped to provide a variety of international communication services—telephone, telegraph, facsimile, leased channel service, alternate voice-data and both colour and monochrome television.

I.E.E.-I.E.R.R.E. liaison

For some time there has been gradual drawing together of the I.E.E. and the I.E.R.E. and many joint meetings and conferences have been arranged. Now a joint liaison committee has been set up "To examine, and to report on, the advantages, disadvantages and problems of possible methods of combining the activities of the two institutions in a manner which would be in the best interests of the members of both institutions, and to make recommendations for the closer working together of the two institutions."



A panoramic view of the "largest semiconductor factory in Europe"; Mullards at Southampton. With almost 400,000sq.ft. of floor space and a staff of 3,000 Mullards are endeavouring to obtain a larger share of the world's semiconductor market. Dr. F. E. Jones, managing director of Mullard, has predicted that by 1980 the market for transistors will be 16,000M units and for integrated circuits 8,000M units, requiring over 1,000 tons of silicon a week. Mullard have other semiconductor plants at Stockport and Blackburn and are building another at Thornaby in Yorkshire which should start production at the end of the year and will eventually have a floor area of 200,000sq. ft.

Letters to the Editor

The Editor does not necessarily endorse opinions expressed by his correspondents

The B.B.C. should think again

Now I have heard everything! Twenty years after implementing the Copenhagen Wave-length Plan, nearly fifteen since v.h.f. broadcasting was begun, and just at the time when this service has reached the remotest parts of the Kingdom, the British Broadcasting Corporation is "prepared to consider" reallocating the medium-frequencies! Why? Where is the technical and economic sense in this?

Do the B.B.C.'s engineers really think that they can hoodwink the public at large into believing that by transmitting Radio 1 on two medium-frequencies to cover the country, all the interference problems will disappear overnight? This reallocation would end the day-time distortion caused by interaction between the ground-waves of adjacent transmitters using 1214kHz, but it will certainly do nothing to overcome the night-time fading and the ear-splitting beat interference from the Albanian station at Scutari. Neither is 908kHz going to be satisfactory with the East German Burg transmitter occupying this channel.

Radio 1 is supposed to be a national programme, so surely it should take its place alongside Radios 2, 3 and 4 on v.h.f. where the service coverage extends—potentially—to 99.7% of the population. If money is not available to establish a complete nationwide Radio 1 v.h.f. network, then I think that the B.B.C. should be required to give an undertaking that all the proposed local stations should carry it at least during the evening periods when the medium-frequency transmissions are subject to fading and foreign interference.

Again, why bother at this time to improve Radio 4 m.f. coverage when that achieved on v.h.f. will still be better by between one and two per cent of the population?

In proposing to reallocate and improve m.f. reception and thereby continue the side-by-side duplication of three programmes on two entirely different transmission systems, the B.B.C. is going to leave itself and we listeners in as big a muddle as ever. V.H.F. receiver sales will be retarded and a useful opportunity to work out with fellow E.B.U. Members a phased close-down of non-essential transmitters lost.

If the B.B.C. is still staffed by competent professional broadcasters and engineers, why

do they not put forward a bold, imaginative Plan for the seventies rather than palliatives more suited to the fifties? This, sir, is a sincere plea to ask the B.B.C. to think again.

AUSTIN UDEN,
Aylesbury,
Bucks.

Logic Display Aid

During the building and testing of the *Wireless World* Logic Display Aid, which is an extremely useful and clever device for the laboratory, we have found a number of errors.

The first anomaly is on page 258 of the June issue and concerns component values in the dian circuit. Resistors RV_5 (12) and RV_7 (14) in the circuit are of 500Ω but were found to be too low in value to reduce the current sufficiently to control the output voltage to the required level. Actual measured values in the boards built were RV_5 (12) 3.6kΩ and RV_7 (14) 1.56Ω, but 10kΩ components were used as these were available at the time.

The multivibrator, IC6/B2 on page 311 July issue was found to run at about 12kHz with the capacitors of the shown value. Using 0.022μF raised the frequency to about 24kHz which was considered to be satisfactory.

An error is to be found on page 377 of the August issue, Fig. 62. Pin 5 of IC2 should go to pin 16 socket 7 and not 17 as shown.

When construction had reached board 8 it was found that in the assembly a ZN330E was fitted for IC4 as in the component list, but a ZN362E was needed. The component list states one too many ZN330Es and one too few

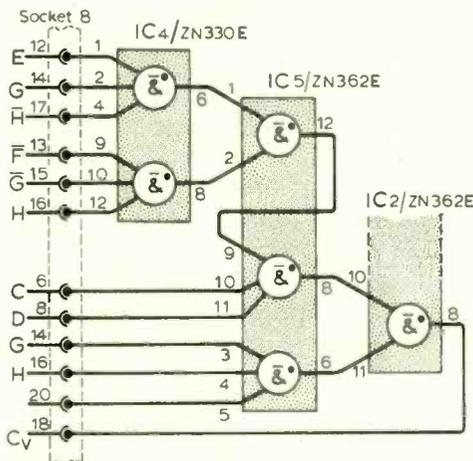


Fig. 1

ZN362E. The ZN330E was used in position 4 on board 8. The extra gate needed was found on board 8, IC5, the wiring of which is shown in Fig. 1.

Fig. 64 also has an error; pin 1 and pin 12 of IC3 should go to pin 8 of IC4.

On page 419, Fig. 66, pin 8/B2 should be relabelled pin 23/B2. The K signal comes from P9/B8 not P5/B6 and the T signal from P5/B8, not P9/B6.

A different arrangement for the video was employed as shown in Fig. 2. This provides bright-up pulses only when clock pulses and video are present, completely eliminating any

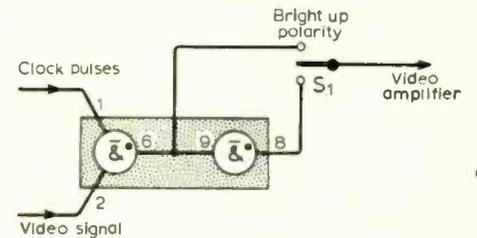


Fig. 2

fly back signals. The second gate was used as an inverter so providing positive or negative bright-up as this may be required for future use in the instrument built. Also a more sophisticated video amplifier was used, as a circuit board was salvaged from a project abandoned some time ago.

H. J. BACON,
Barking Regional College of Technology.

The author replies:

I am much indebted to Mr. Bacon for taking the trouble to note the errors in the article. This will make life easier for other constructors. His idea of providing a switch to select either positive or negative going bright-up pulses is a good one. Yet another way of obtaining satisfactory video blanking will be described in part 8 of the series of articles as the original blanking circuit did not perform very well with some oscilloscopes.

I would be very pleased to hear from others who have used the display aid for teaching as it would be useful to have an assessment of the instrument's value as a teaching aid and to hear of the students' reaction to it.

BRIAN CRANK.

F.M. receiver bandwidth

It is disappointing to find Mr. L. Ibbotson stating, in his otherwise informative contribution, that something like 180kHz i.f. bandwidth will provide 15kHz audio bandwidth when a maximum frequency deviation of 75kHz is employed (*W.W.* June 1969, "Test Your Knowledge", Q.9).

The i.f. bandwidth (for a single sine wave tone) is determined by the Bessel expansion of the equation for the modulated wave:

$$e = E \sin(\omega t - m \cos \omega_m t) \text{ i.e.}$$

$$e = E [J_0(m) \sin \omega t - J_1(m) \cos(\omega_c \pm \omega_m)t - J_2(m) \cos(\omega_c \pm 2\omega_m)t + \dots \text{ etc. to infinity.}$$

$J_n(m)$ is the Bessel coefficient of the first kind, order n and argument m

$$\text{modulation index} = \frac{\text{deviation frequency}}{\text{modulating frequency}}$$

the standard convention is that the significant sidebands are all whose amplitude is greater than 1%.

In the case quoted, the mod. index = $75/15 = 5$, and reference to a table of Bessel Functions will show that $J_8(5)$ is the last order of argument 5 which is greater than 1% (it is 1.841%, whereas $J_9(5)$ is 0.552%). Hence there are 8 pairs of significant sidebands.

The bandwidth = $2 \times n \times \text{mod. freq.}$, where n is the number of pairs of sidebands. With 8 pairs,

$$\text{bandwidth} = 2 \times 8 \times 15\text{kHz} = 240\text{kHz}.$$

From above it will be seen that if the i.f. bandwidth is only 180kHz, then mod. freq. =

$$\frac{180}{2 \times 8} \text{kHz} = 11.25\text{kHz}.$$

A listening comparison will quickly demonstrate the validity of the foregoing, the 'rule of thumb' sets really are disappointing. One such may be the 'F.M. Tuner Using Integrated Circuits' described in the same issue. If its bandwidth (3dB down) is in fact 160kHz, then it will have an audio bandwidth of only 10kHz.

L. E. WAUGH,
New Malden,
Surrey.

The author replies:

I agree with the result quoted by Mr. Waugh that if we wish to include all side frequencies with an amplitude greater than 1% of the unmodulated-carrier amplitude, then for a modulating frequency of 15kHz and a maximum deviation of 75kHz an i.f. bandwidth of 240kHz is required. I do not agree, however, that this is the standard convention. Some authorities, it is true, claim that all side frequencies with amplitudes greater than 2% of the unmodulated-carrier amplitude should be included—this would require the inclusion of 7 pairs of side frequencies and hence a bandwidth of 210kHz.

I do not agree that restricting the i.f. bandwidth to 180kHz will restrict the received audio bandwidth to 11.25kHz; f.m. does not work that way. If an audio signal with components up to 15kHz is radiated, then the same range of audio signal components will be received—together with an amount of non-linear distortion products determined by the degree by which we restrict the i.f. bandwidth.

L. IBBOTSON.

Listener fatigue and ultrasonics

In an article in the April, 1969, issue Mr. Linsley Hood suggested that "listener fatigue" may be due to the ability of many transistor amplifiers to give large power outputs at super-sonic (ultrasonic) frequencies which cause a response in modern high-quality speaker systems.

I have been carrying out experiments deliberately feeding "white noise" through a high-pass filter to Mr. Linsley Hood's class A amplifier which was coupled to a commercial three-speaker high-quality reproducing system. This arrangement was found to be capable of producing a vague feeling of discomfort over a period of some hours whether

or not normal programme material was being handled.

Further experiments with specific ultrasonic frequencies indicated that, with my apparatus, the discomfort was noticeable only at fairly high power levels (3W or more), and at frequencies just out of audible range (20-25kHz).

Other evidence on this subject has been obtained from users of high-powered ultrasonic cleaning equipment, who report vague feelings of discomfort and a desire to move away when working in the vicinity of such apparatus.

Bearing in mind that, although normal programme material may not contain appreciable signals at ultrasonic frequencies, such unwanted signals can arise in equipment; there seems to be a strong argument for always using a steep-cut low-pass filter circuit with high-quality amplifiers.

The extra realism or "presence" sometimes claimed for apparatus having a response far beyond the sonic spectrum may in fact be a very mixed blessing.

NORMAN W. VALE,
Mickleover,
Derby.

Second-order active filter

I would like to correct various errors which crept into my note 'A Simple Second-Order Active Filter' (*Wireless World*, April 1969, p. 185).

The formula quoted was derived using a high gain infinite input impedance amplifier; it should have been

$$\frac{e_o}{e_i} = \frac{-1}{1 + \alpha s\tau + (s\tau)^2}$$

where $\tau = RC$ and the 3dB frequency is given by

$$\omega_c = \frac{1}{\tau}.$$

The degree of peaking is governed by choice of α , with critical damping (no peaking) for $\alpha = 2$. However, critical readers will have noticed that my values for

$$c_s \left(= \frac{\alpha c}{3} \right)$$

for the practical responses given, do not agree with the theoretical transfer function. This is due to the finite input impedance of the transistor pair. This does not detract from the utility of the circuit however. Better agreement would be obtained by reducing both R and R_c (33k) and increasing C .

JOHN FIRTH,
Ottawa,
Canada.

Operational amplifiers

Your August, 1969, issue includes Part 7 of the series of articles on operational amplifiers by G. B. Clayton which contains two points on which I would like to comment. The first concerns the circuit diagram under the heading 'Monostable Multivibrator (1)'. If this diagram is correct the circuit cannot work

in the manner described by the author, for a negative pulse cannot be applied to terminal A from the input point labelled 'trigger'. If, on the other hand, diode D_2 is shown the wrong way round, the waveform labelled e_A will have a positive level, in the stable state, whose value depends partially on the value of the unlabelled resistor adjacent to D_2 on the figure.

The other point worth a comment concerns the section 'Regenerative Comparator'. The author's illustration of a *rectangular* hysteresis loop illustrates a common situation in which the loop gain is high for all values of output p.d. e_o except those very close to the saturation values. But this is a particular case. Regenerative circuits such as these reach their threshold levels when the loop amplification reaches unity, and for small values of the feedback ratio β the switching points can occur at values of e_o that are considerably less than the saturation values. There is a further comment worth making in relation to this situation. If integrated circuit operational amplifiers are used as regenerative comparators with small hysteresis, as required in many applications, it will be found that the elimination of high frequency parasitic oscillations becomes a very difficult problem indeed. It may become necessary then to use two stages. The first stage is a non-regenerative comparator with the required degree of amplification obtained by negative feedback and the second stage is a regenerative comparator with ample hysteresis and well-defined threshold levels.

H. SUTCLIFFE,
Professor of Electronic Engineering,
University of Salford.

The author replies:

I would like to thank Professor Sutcliffe for his comments. The circuit diagram under 'Monostable Multivibrator (1)' is in error, the diode D_2 has been shown the wrong way round. The positive level of the waveform e_A shown in the text as $\beta V_{o\text{max}}^+$ will, as Professor Sutcliffe points out, be partially dependent on the value of the unlabelled resistor, the effect is small however if as I had assumed (but neglected to state) the value of R_1 is considerably less than the value of the unmarked resistor.

Regarding his second comment, the use of low β and hence small hysteresis is, I would think, likely to give rise to parasitics at switching in any form of regenerative comparator, whether using i.c. op. amps or not. I would therefore consider the case discussed in the text as being the usable form of a regenerative comparator circuit although it is strictly a particular case. Professor Sutcliffe's comment will make readers aware of the difficulties of using small hysteresis with regenerative comparators.

G. B. CLAYTON.

More "Letters" are on
p.535

Personalities

This year's I.E.E. Faraday Lecturer is **J. H. H. Merriman**, C.B., O.B.E., M.Sc., A.Inst.P., F.I.E.E., a director of the new Post Office board. Mr. Merriman, who is 54, and a physics graduate of the University of London, joined the Post Office Research Station, Dollis Hill, in 1936. Six years ago he became assistant engineer-in-chief of the Post Office, and in 1965 deputy engineer-in-chief. Two years later he was appointed to the new post of director of engineering and in August 1967 he became senior director: development. He was recently appointed member for technology of the board of the new Post Office Corporation. Last December Mr. Merriman accepted the invitation to become visiting professor in the department of electronic science and telecommunications at the University of Strathclyde, Glasgow.

John A. Saxton, D.Sc., Ph.D., the new chairman of the Electronics Division of the I.E.E., is director of the Radio & Space Research Station at Ditton Park, Slough, Bucks. Dr. Saxton, who is 55, was, until his appointment to the Research Station in 1965, director of the U.K. Scientific Mission in Washington, D.C., and scientific attaché at the British Embassy there. He was for a time on the staff of the college before joining the Radio Division of the National Physical Laboratory, and in March last year he accepted a visiting professorship in physics at University College, London.

Donald G. Fink, general manager of the Institute of Electrical and Electronics Engineers, New York, has received the Outstanding Civilian Service Award of the United States Army Electronics Command "For his outstanding and dedicated service since 1963 as a member, vice-chairman, and chairman of the United States Army Electronics Command Electronics Advisory Group, Fort Monmouth, New Jersey, which has materially assisted in the advancement of the systems concept in tactical communications and resulted in great benefits to the Electronics Command and the Army".

Sir Raymond Brown, O.B.E., Comp.I.E.R.E., has relinquished his appointment as Head of Defence Sales of Her Majesty's Government, which he had held for over three years, and has rejoined Racal Electronics Ltd as president. Sir Raymond, who, until his Government appointment, was chairman and managing director of the company of which he was co-founder, was knighted in this year's Birthday Honours. **E. T. Harrison** continues as chairman of the board and chief executive.

Bryan L. H. Wilson, M.A., A.M.Inst.P., has become chief scientist at the Alfen Clark Research Centre of The Plessey Company, at Caswell, Northants, which he joined in 1953 and where he has been leader responsible for solid-state research since 1963. He is a graduate of Jesus College, Cambridge, where he took the natural sciences tripos. Much of Mr. Wilson's early work was concerned with the development of silicon integrated circuits. Subsequently, his activities have included the development of photocells and thermoelectric materials.

C. R. Knowles, M.A., is appointed chief engineer, and **S. Woodcock**, B.Sc., products manager responsible for selling and marketing in the components group of Ferranti's Electronic Display Department. The components group manufactures cathode-ray tubes (and associated coils), valves and photon devices. Mr. Knowles, who is 32, graduated in natural sciences from Jesus College, Cambridge. He joined Ferranti Ltd in 1961 as a development engineer in the cathode-ray tube laboratory. He became chief development engineer for valves in 1967 and was made assistant works manager in October of that year. Mr. Woodcock, after military service in the Far East, graduated from Leeds University in 1950 and joined Ferranti in 1951 as a member of the physical laboratory. He worked initially on the development of the aluminizing process for TV picture tubes and on phosphor screens, but later switched to work on industrial and radar tubes. Since 1966 he has been chief engineer, c.r.t. development.

Arthur I. Llewelyn, O.B.E., B.Sc., has been appointed director of the Ministry of Technology's Computer Aided Design Centre, Cambridge, which began operating earlier this year, and aims to develop the application of c.a.d. techniques in industry in co-operation with Cambridge University. Mr. Llewelyn, after studying at the University of Wales Engineering Department, Cardiff, joined Bawdsey Research Station at the outbreak of war where he was concerned with the early developments of radar, and later was responsible for early airborne pre-control and navigational-computing systems. In 1960 he took up an appointment with NATO as scientific adviser to the Allied Air Forces Central Europe. Mr. Llewelyn returned to the U.K. in 1965 and joined the Ministry of Technology and has latterly been head of the Computer Advisory Service.

This year's recipient of the David Sarnoff Gold Medal of the American Society of Motion Picture and Television Engineers is **Peter C. Goldmark**, B.S., Ph.D., president and director of research of C.B.S. Laboratories, Stamford. He started his professional career with Pye Radio in Cambridge, where in 1935 he was in charge of television engineering. Dr. Goldmark, who was born in Budapest, Hungary, received his doctorate in physics from the University of Vienna, and after service with Pye went to the United States and joined the Columbia Broadcasting System as chief engineer in 1936. In addition to his position in C.B.S. which he has held since 1954 Dr. Goldmark is a visiting professor in medical electronics in the Department of Radiology at the University of Pennsylvania Medical School.

W. Roy Thomas, F.I.E.E., aged 51, is appointed group technical executive of Plessey Electronics Group where he will be responsible for co-ordination of all research and development work for the research centres, at West Leigh and Roke Manor. Mr. Thomas had been with Elliott-Automation since 1952 where latterly he was group chief scientist, a director of Elliott Space & Weapon Automation Ltd and E A Radar Systems Ltd and chairman of Elliott Electronic Tubes Ltd. From 1939 to 1952 he was with the Royal Aircraft Establishment, Farnborough, where he was concerned with work which culminated in the design of the TRIDAC three dimensional missile-aircraft simulator. At Elliotts he was responsible for the development of FACE, the field artillery control system using the 920B computer. Latterly Mr. Thomas co-ordinated the activities of the six research laboratories of Elliott Automation concerned with advanced techniques in computers, avionics, radar, optoelectronics microcircuits and space. Mr. Thomas is chairman of the joint E.E.A./S.B.A.C. avionics research committee for guided weapons, space and electronics. He is also the

U.K. representative on the organizing executive committee of EUROSAT.

Frank H. Taylor, F.I.E.E., has been appointed a senior principal research engineer at Standard Telecommunication Laboratories, Harlow, Essex, which he joins from S.T.C's Radio Products Group, New Southgate. Mr. Taylor had been technical manager and systems manager for the group's aviation and communications business.

P. J. Allin, B.Sc., A.M.I.E.E., aged 28, has joined Intercontinental Systems Inc. (UK) Ltd, of Woking, as terminal systems engineer. Mr. Allin obtained his degree in electronic engineering at the City University (formerly Northampton College) after which he spent six years at the Central Electricity Research Laboratories in Leatherhead. Since 1966 he has been with Cable and Wireless as an electronics designer.

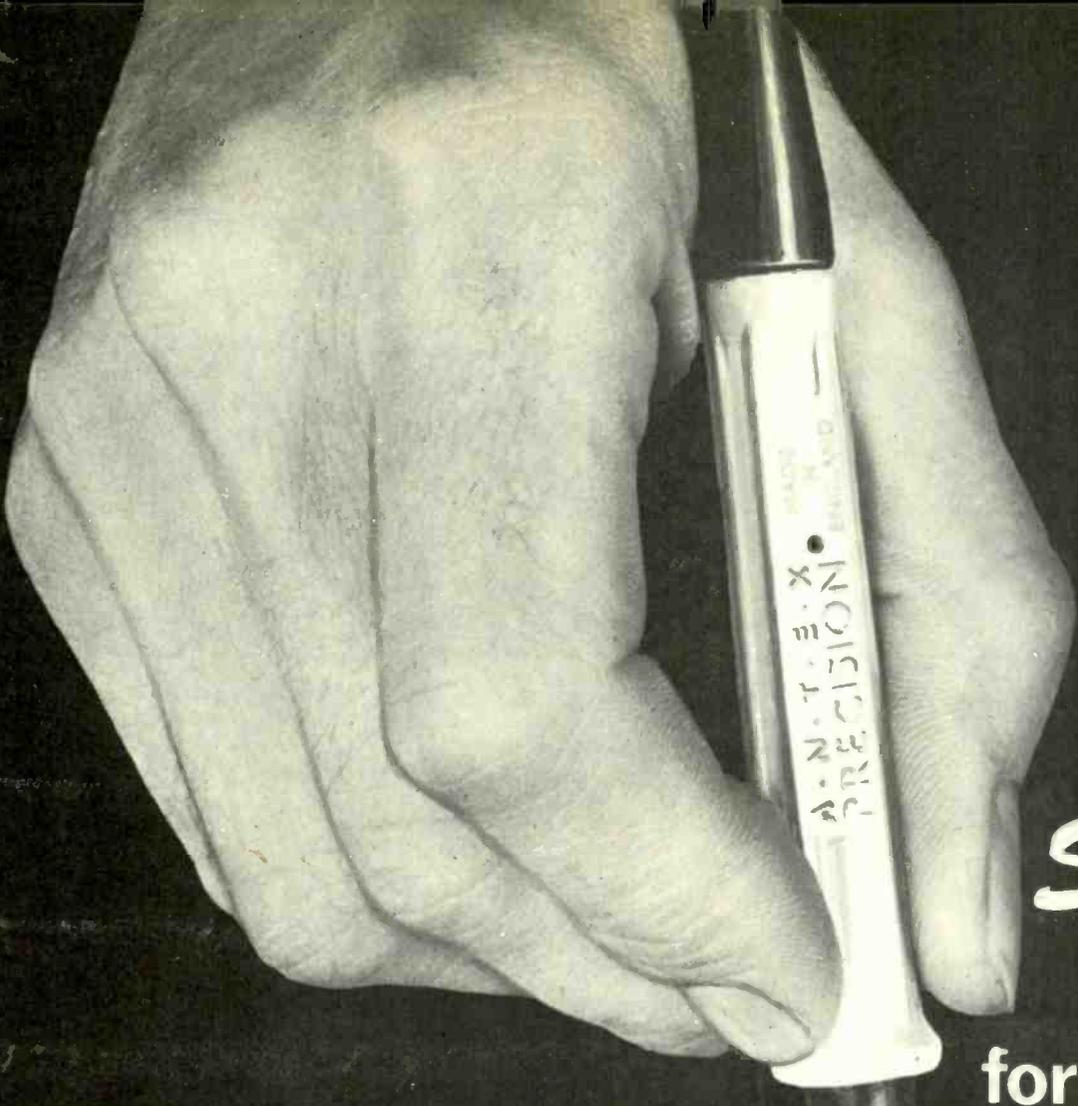
R. O. K. Turvey, B.Sc.(Eng.), M.I.E.E. has been appointed general manager of Cole Electronics' manufacturing division (formerly known as C. A. Cook Ltd.) at Wickford, Essex. Mr. Turvey held previous appointments as chief engineer of the Transmission Division of A.E.I. Woolwich and as manager of the Terminal Equipment Department of Submarine Cables Ltd.

C. P. Crompton, M.I.E.R.E., who joined Orbit Controls Ltd, of Cheltenham, as a senior project engineer on its formation 18 months ago, has been appointed chief engineer. Mr. Crompton, who is 41, previously held senior engineering posts with Advance Controls Ltd., Racal Communications Ltd., and the Sperry Gyroscope Co.

The appointment of **Elvin F. Collins** as electronics production manager is announced by Solartron Electronic Group, Farnborough. He succeeds **Dennis Burton**, recently appointed director of production. Mr. Collins, aged 38, has been with Solartron for eleven years, latterly as product manager for digital instruments. Prior to joining Solartron he worked as a test gear engineer with the Ministry of Supply.

G. W. Mackenzie, M.I.E.R.E. has been appointed by the B.B.C. Head of Engineering, Northern Ireland. He joined the Corporation in 1941 at the Edinburgh studio centre. In 1954 he became a lecturer in the Engineering Training Department where, since 1963, he has been head of the technical operations section.

T. Aspin has been appointed technical manager of the Industrial Electronics Division of Mullard Ltd and becomes a director of Associ: Semiconductor Manufacturers Ltd and of the Mullard Radio Valve Company Ltd. Mr. Aspin joined Mullard in 1946 and since 1966 has been general product manager of the company's Consumer Electronics Division.

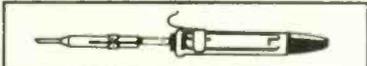


Sign here!!

for your
miniature
soldering
iron.

CN 15 Watts. Ideal for miniature and micro
miniature soldering. 18 interchangeable spare
bits available from .040" (1mm) up to 3/16"
For 240, 220 or 110 volts. 32/6

from
32/6



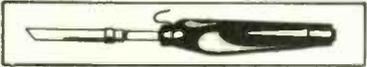
G18 watts. Fitted 3/32" bit for miniature
work on production lines. Interchangeable
spare bits, 1/8", 3/16" and 1/4" available.
For 240, 220 or 110 volts. 32/6.



E20 watts. Fitted with 1/4" bit.
Interchangeable spare bits 3/32", 1/8",
3/16" available. For 240, 220, 110
volts. From 35/-

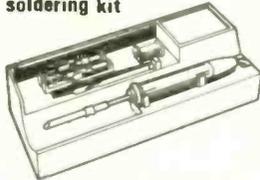


ES25 watts. Fitted with 1/8" bit.
Interchangeable bits 3/32", 3/16" and 1/4"
available. Ideal for high speed production
lines. For 240, 220, 110, 24 or 12 volts.
From 35/-



F40 watts. Fitted 5/16" bit.
Interchangeable bits 1/4", 3/16", 1/8", 3/32"
available. Very high temperature iron. For
240, 220, 110, 24 or 20 volts. From 42/6
Spare bits and elements for all models
and voltages immediately available from stock.

**Complete precision
soldering kit**



PLUS 36-page booklet on
"How-to-Solder"—a mine
of information for amateur
and professional.

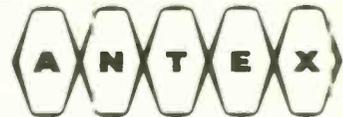
This kit—in a rigid plastic
"tool-box" — contains

- Model CN 15 watts
miniature iron, fitted
3/32" bit. Interchangeable
spare bits. 3/32", 1/8".
- Reel of resin-cored
solder
- Felt cleaning pad
- Stand for soldering iron

From Electrical and Radio
Shops or
send cash to Antex. **49/6**



Model CN 240/2
15 watts - 240 volts
Fitted with nickel plated bit (3/32") and in
handy transparent pack. From Electrical
and Radio Shops or send cash to Antex. **31/.**



PRECISION MINIATURE SOLDERING IRONS

Antex, Mayflower House, Plymouth, Devon.
Telephone: Plymouth 67377/8.
Telex: 45296, Giro No. 2581000.

- Please send me the Antex colour catalogue
- Please send me the following irons

Quantity Model Bit Size Volts Price

.....
.....
.....

I enclose cheque/P.O./cash value

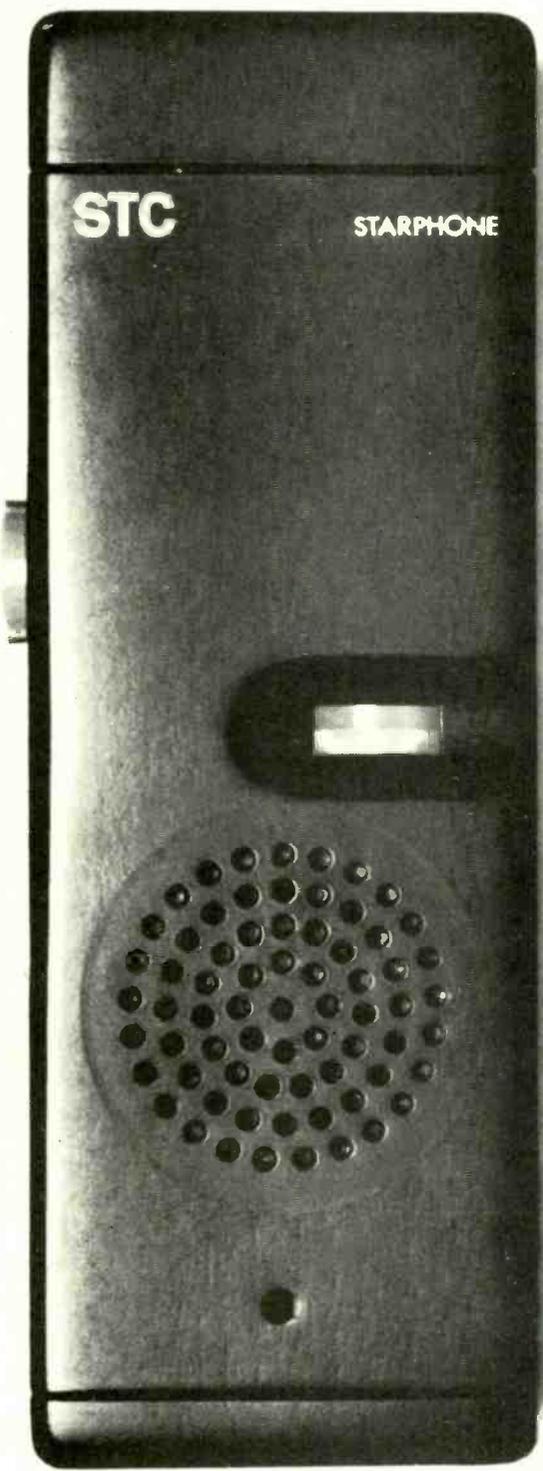
NAME

ADDRESS

..... WW11

WW—103 FOR FURTHER DETAILS

STARPHONE by STC



Starphone—actual size

The World's Smallest UHF Radiotelephone

The Starphone is unique. It's the first radiotelephone designed to go in the pocket without external wires or rods. Operating on UHF, STC Starphone has an astonishing penetration of buildings and steel structures, and can give you instant two-way communication with your staff over a wide area.

Write for details to
STC Mobile Radiotelephones Limited,
New Southgate, London N.11. England.
Telephone: 01-368 1200.
Telex: 261912.

An associate of



Attach your letter heading to this panel.
Please send me full details of your
STARPHONE

Name
Position

www

STC
Mobile Radiotelephones

Active Filters

4. Basic theory: Active circuits

by F. E. J. Girling* and E. F. Good*

The essence of active-filter design is realisation of 2nd-order response with Q factor $> \frac{1}{2}$ without using both capacitance and inductance. Three simple feedback loops are analysed: (1) two lags and negative gain, (2) a lag-lead network with positive gain, (3) a balanced parallel-T network and negative gain; and the basic relationships between available gain and maximum Q are derived. An abstract discussion of sensitivity to variations in amplifier gain and in passive component values is also attempted.

1st-Order networks

We have seen in Part 2 that the two 1st-order transfer functions $1/(1 + pT)$ and $pT/(1 + pT)$, can be realised with CR networks; and it follows that any transfer function that can be reduced to a product of 1st-order factors can in principle be realised by a CR network (though buffer amplifiers may be very helpful in a practical situation). There is no active-filter problem.

2nd-Order networks

For a 2nd-order transfer function, for example

$$1 / \left(1 + \frac{1}{q} pT + p^2 T^2 \right),$$

the condition of $q = \frac{1}{2}$ marks a dividing line: when $q < \frac{1}{2}$ passive CR realisation is possible, but when $q > \frac{1}{2}$, not. (The condition $q < \frac{1}{2}$ is, of course, covered by the paragraph above, since then the transfer function may be resolved into two real 1st-order factors.) The limitation can be removed, however, by the use of gain and feedback.

For the basic system with 100% feedback shown in Fig. 1(a)

$$\frac{V_{out}}{V_{in}} = \frac{\mu}{1 - \mu} \quad (1)$$

If, therefore, as in Fig. 1(b),

$$\mu = \pm AF(p) = \pm AF_1(p)/F_2(p),$$

where $F_1(p)$ and $F_2(p)$ are the numerator and denominator respectively of $F(p)$,

$$\frac{V_{out}}{V_{in}} = \frac{(\pm A)F_1(p)}{F_2(p) - (\pm A)F_1(p)} \quad (2)$$

The aperiodic gain constant is written ($\pm A$) so that A may be a positive quantity whether the amplifier gain is positive or negative. In general this simplifies the labelling of diagrams and discussion of changes in the magnitude of A . In addition in the following analysis, to emphasise the difference and to avoid confusion when making comparisons, A is used when the gain factor is negative and K when it is positive. Three circuit configurations will be analysed:

1. A two-lag network and negative gain,
2. A lag-lead (1st-order band-pass) network and positive gain,

*Royal Radar Establishment

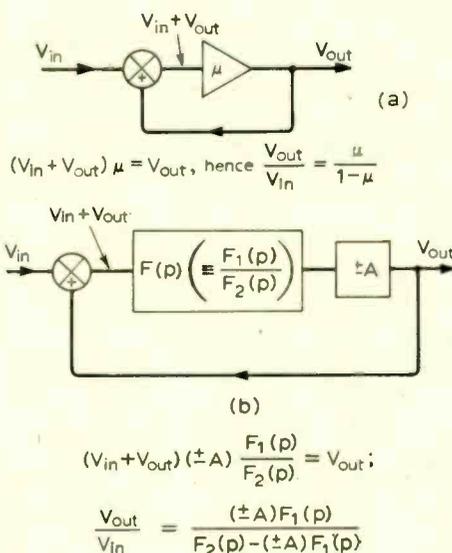


Fig. 1(a). Schematic of active feedback system; (b) the same in which μ is arbitrarily divided into a frequency-dependent factor and an aperiodic factor.

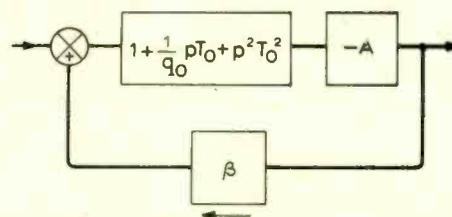


Fig. 2. A basic method of increasing Q factor.

3. A balanced parallel-T network and negative gain.

Two lags and negative gain

The transfer function of a two-lag network may conveniently be written as shown in Fig. 2, so that q_0 and T_0 are the initial values of q and T for the system; i.e., the values before feedback is applied. By setting $\beta = 1$ the system becomes of the same form as Fig. 1, and by substituting in equn. (2)

$$F_1(p) = 1, F_2(p) = 1 + \frac{1}{q} pT_0 + p^2 T_0^2,$$

the loop-closed transfer function is obtained as

$$\begin{aligned} \frac{V_{out}}{V_{in}} &= - \frac{A}{1 + \frac{1}{q} pT_0 + p^2 T_0^2 + A} \\ &= - \frac{A}{A + 1} \times \frac{1}{1 + \frac{pT_0}{q_0(A + 1)} + \frac{p^2 T_0^2}{A + 1}} \quad (3) \end{aligned}$$

Comparison with the standard form for a 2nd-order denominator, $1 + pT/q + p^2 T^2$, then gives

$$T = T_0/(A + 1)^{1/2} \quad (4)$$

and

$$q = q_0(A + 1)^{1/2} \quad (5)$$

Thus, remembering that the nominal cut-off or undamped resonant frequency $\omega_c = 1/T$, we find that the application of feedback multiplies both ω_c and q by $(A + 1)^{1/2}$. The effect is shown in Fig. 3, although these curves are drawn for the situation where A is constant and the varying parameter is the feedback fraction β . By substituting $1/pT$ for pT , or otherwise, the corresponding results for a loop containing two leads are found to be that q is multiplied and ω_c is divided by $(A + 1)^{1/2}$.

Generally the dependence of cut-off frequency on amplifier gain is undesirable in a practical circuit. But there are ways of reducing it to a second-order effect, for example by combining the amplifier and one of the lags into a feedback integrator; and the relation between q and loop gain, equn. (5), still applies.

When

$$A \gg 1, q = q_0 A^{1/2} \text{ approx.} \quad (6)$$

from which the sensitivity of q to small changes in zero-frequency gain, A , is obtained as

$$\frac{\Delta q}{q} = \frac{1}{2} \frac{\Delta A}{A} \quad (7)$$

This is a satisfactory result to the extent that there is no magnification of errors, and one would expect that in a practical circuit A would be stabilized by using an amplifier of much higher gain, say A_0 , reduced to the required gain A by negative feedback—

$$A = \frac{A_0}{1 + A_0 \beta} \quad (8)$$

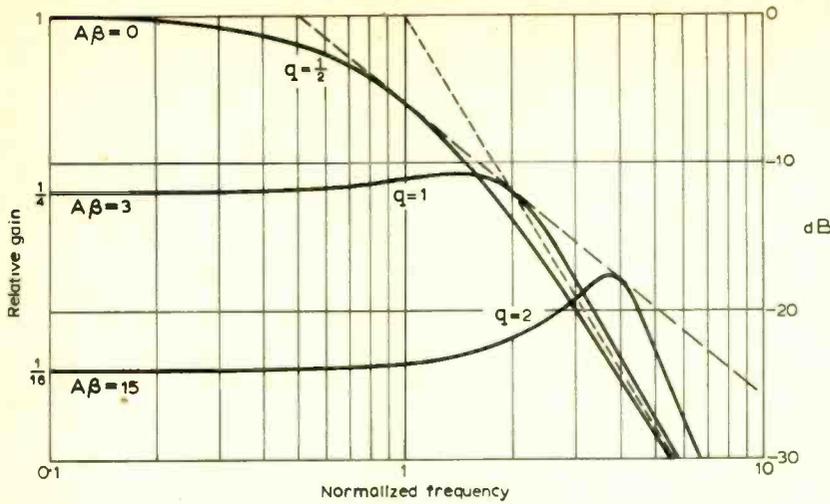


Fig. 3. Showing the effect of negative gain and feedback on a two-lag network. A is constant, β varies.

Black's formula, which may be rearranged to

$$\frac{1}{A} = \frac{1}{A_0} + \beta \tag{9}$$

Thence, by differentiation, if β is constant

$$\frac{\Delta A}{A} = \frac{\Delta A_0}{A_0} \cdot \frac{A}{A_0} \tag{10}$$

which is the well-known result for a negative-feedback system, viz. relative changes in closed-loop gain are proportional to relative changes in open-loop gain multiplied by the ratio closed-loop gain to open-loop gain (i.e., the ratio of required gain to available gain). Thus, in principle, by making A_0/A large enough the dependence of A on A_0 can be reduced as much as may be desired. It is to be expected, however, that in practice when $A_0/A \rightarrow \infty$

it will be found that A is affected by changes in β , and that eqn. (7) becomes effectively

$$\frac{\Delta q}{q} = -\frac{1}{2} \cdot \frac{\Delta \beta}{\beta} \tag{11}$$

This result also is satisfactory, as it again shows that the circuit does not exaggerate changes in component values.

Because for a passive CR network $q_0 > \frac{1}{2}$, and often because of practical constraints is considerably $< \frac{1}{2}$, eqn. (5) shows that even for a moderate value of q (say $q = 5$) a quite high minimum value of A is needed. Consequently in a "designable" circuit, where a higher intrinsic gain will be used than the minimum needed, the gain used may be of the order 1,000 or more. This may seem a high price to pay. Nevertheless the two-lag loop (if the high-pass equivalent is included) is the basis of all the preferred methods of realising active filters —because of the low sensitivity to errors in component values. This low sensitivity derives from the fact that if A is a real number; i.e., shows no appreciable phase shift over the band of frequencies for which the magnitude of the loop gain is ≥ 1 , the system is essentially stable no matter what variations there may be in gain or in component values. This is made clear by the Nyquist plot for the ideal loop. Each lag contributes a maximum phase shift of 90° , and together they give a cardioid-

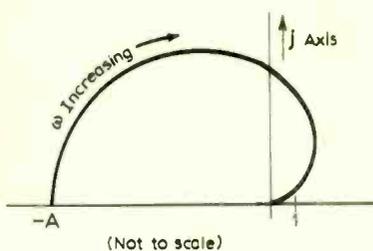


Fig. 4. Nyquist plot for feedback loop with two lags and negative gain.

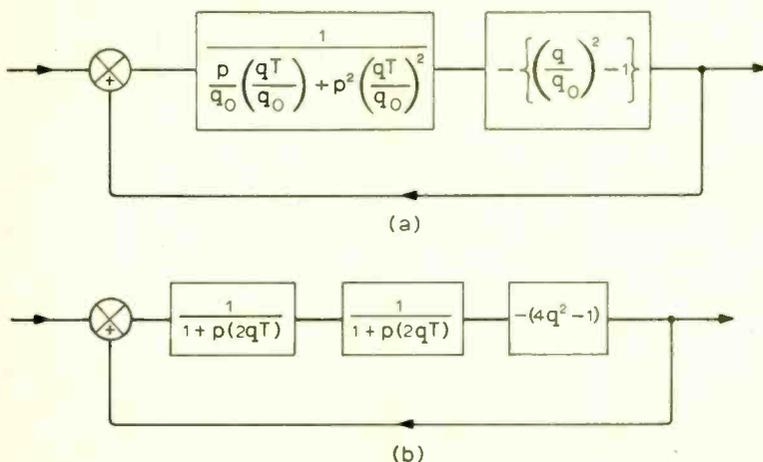


Fig. 5. Block diagrams for synthesis of feedback loops containing two lags, or their analogue (two leads, or two "tuned circuits").

shaped curve as shown in Fig. 4. The curve does not cross the horizontal axis, the limiting phase shift being 180° , and so can never encircle the point 1, $j0$.

The results of this analysis of the two-lag loop are summarized in the block diagrams of Fig. 5, which can be useful as the starting point for some practical designs, particularly of bandpass filters using the low-pass to bandpass transformation rules.

Eqns. (4) and (5) give the initial value T_0 that must be chosen to give a closed-loop value T as

$$T_0 = qT/q_0 \tag{12}$$

and the value of gain, A , required to raise q_0 to q as

$$A = (q/q_0)^2 - 1 \tag{13}$$

These results are incorporated in Fig. 5(a). When the passive network can be represented as two equal isolated lags, Fig. 5(b), $q_0 = \frac{1}{2}$, and $q/q_0 = 2q$. Consequently $T_0 = 2qT$, and $A = 4q^2 - 1$. Where there are two unequal lags, they may be multiplied together and treated as case (a). Since q_0 will be $< \frac{1}{2}$, A will be greater than for case (b).

The discussion of two simple lags and gain may appear to be an out-of-date approach when it is already known that many practical circuits are going to be built around high-gain operational amplifiers used as integrators. But loop gain is of such fundamental importance to the design of an active filter, that it is always necessary at least to know that enough has been provided to satisfy a given specification. A high-gain integrator is easily shown to be equivalent to a lag and gain, and the results of this section will be found to provide a unified basis for the analysis of a wide range of problems.

A lag-lead network, or network with "tuned-circuit" response

The transfer function for tuned-circuit response, with centre frequency $\omega_0 = 1/T$, Q factor q_0 , and normalized to unity gain at the centre frequency is

$$\frac{\frac{1}{q_0} pT}{1 + \frac{1}{q_0} pT + p^2 T^2}$$

Except that the gain at the centre frequency is always less than unity, the transfer function of a passive CR lag-lead network is of the same form and may be represented as in Fig. 6, $k < 1$. (See Part 3, eqn. (23) and Table I.)

Substitution in eqn. (2) gives for the transfer function with the feedback loop closed:

$$\begin{aligned} \frac{V_{out}}{V_{in}} &= \frac{\frac{kK}{q_0} pT}{1 + \frac{1}{q_0} pT + p^2 T^2 - \frac{kK}{q_0} pT} \\ &= \frac{\frac{kK}{q_0} pT}{1 + \frac{1 - kK}{q_0} pT + p^2 T^2} \end{aligned} \tag{14}$$

This shows that the feedback leaves the centre or resonant frequency unaltered (which was to be expected from consideration of symmetry), and increases the Q factor [if $0 < kK < 1$], since now

$$q = q_0 / (1 - kK). \quad (15)$$

Clearly as $kK \rightarrow 1$ the increase in q becomes very great, and when $kK > 1$ the Q factor becomes negative and the circuit will oscillate. The system is, in fact, equivalent to the familiar application of "reaction" to a tuned circuit in a simple radio receiver. As a method of increasing Q factor, and gain at the centre frequency, the system is very effective, but likely to be tricky unless means can be found to stabilize the performance.

The sensitivity to small relative changes in loop gain is easily derived from equn. (15) by differentiation and substitution as

$$\frac{\Delta q}{q} = \frac{\Delta(kK)}{kK} \left(\frac{q}{q_0} - 1 \right). \quad (16)$$

When $q \gg q_0$ relative changes in loop gain are exaggerated by the factor q/q_0 approximately, and this is a useful warning if q_0 and k may be taken as constant and K is the factor most susceptible to uncontrolled changes.

The same conclusion can be deduced from the Nyquist plot, which, as shown in Fig. 7, is a circle passing through the origin, the diameter OD representing kK the loop gain at the centre frequency. When $q/q_0 \gg 1$, $OD \rightarrow 1$, since as equn. (15) tells us, $q/q_0 = 1/(1 - OD)$. Small changes in OD then give much greater relative changes in the gain margin $(1 - OD)$ and consequently large changes in performance over a band of frequencies corresponding to a section of the plot centred on the point D; i.e., at and around ω_0 .

However, when a gain factor critically affects performance, the factor and consequently the performance may (and should) be stabilized by feedback, as is well known (see equns. (8), (9), et sequ.). Then $K \rightarrow 1/\beta$ very nearly, and β is typically determined by two resistors as shown in Fig. 8, so that

$$K = 1/\beta = (r_1 + r_2)/r_1, \quad (17)$$

and the sensitivity of K to changes in r_1 and r_2 is given by

$$\frac{\Delta K}{K} = - \frac{\Delta r_1}{r_1} \left(1 - \frac{1}{K} \right) \quad (18)$$

and a similar expression (without the prefixed minus sign) for $\Delta r_2/r_2$.

When $K \gg 1$ changes in r_1 and r_2 cause proportional changes in K , and so, because of the magnification of errors in K shown by equn. (16) for $q \gg q_0$, working in this region necessitates holding $(r_1 + r_2)/r_1$ to a much tighter tolerance than the required tolerance on q . Even when $K = 2$, ($r_2 = r_1$), changes in either resistance cause changes in K which are relatively only half as great. Admittedly accurate and stable resistors are not difficult to come by, but as a general principle it is preferable to avoid this region. When $K \rightarrow 1$, ($r_2 \ll r_1$), the sensitivity of K to changes in r_1 and r_2 becomes very small; and of great interest is the limiting condition when 100% negative feedback is applied, then $\beta = 1$, r_2 dis-

appears, and $K = A_0/(A_0 + 1)$, thus $K \rightarrow 1$ as $A_0 \rightarrow \infty$ and does not depend on the accuracy of any component. Performance is still affected by k and q_0 , and as these are in general mutually dependent, the system will now be analysed explicitly as a loop containing a lead-lag network.

If the frequency-dependent network can be represented by the lead-lag transfer function

$$\frac{pT_2}{1 + pT_2} \cdot \frac{1}{1 + pT_1}$$

$$= \frac{pT_2}{1 + p(T_1 + T_2) + p^2T_1T_2}$$

$$k = \frac{T_2}{T_1 + T_2}, \text{ and } q_0 = \frac{\sqrt{T_1T_2}}{T_1 + T_2} \quad (21), (22)$$

Hence, substituting in equn. (15), we find

$$q = \frac{\sqrt{T_1T_2}}{T_2(1 - K) + T_1} \quad (23)$$

$$= \frac{1}{x(1 - K) + \frac{1}{x}} \left[\text{where } x = \sqrt{\frac{T_2}{T_1}} \right]. \quad (24)$$

When $K < 1$, this expression is of a familiar form and gives

$$q_{max} = \frac{1}{2\sqrt{1 - K}} \quad (25)$$

when the ratio of time constants

$$x^2 = \frac{1}{1 - K} \quad (26)$$

Thus when $K = \frac{3}{4}$, $q_{max} = 1$; $K = \frac{15}{16}$, $q_{max} = 2$; $K = \frac{63}{64}$, $q_{max} = 4$; etc. This behaviour is shown in the lower and right-hand half of Fig. 9.

When $K = 1$, there is no maximum and

$$q = x = \sqrt{\frac{T_2}{T_1}} \quad (27)$$

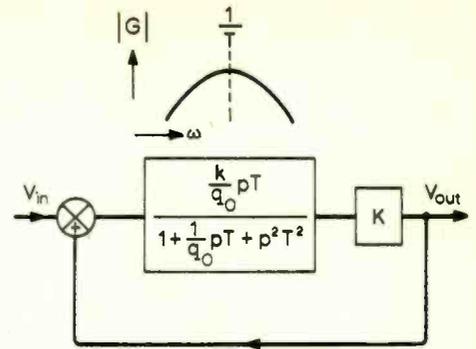


Fig. 6. Positive gain and a network with "tuned-circuit" response, given by equn. (14).

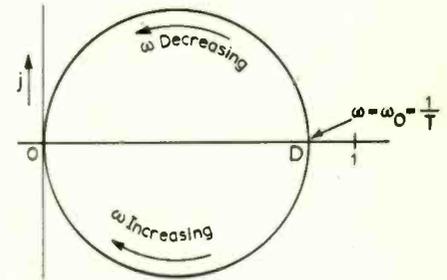


Fig. 7. Nyquist plot for positive-feedback loop containing lead-lag network.

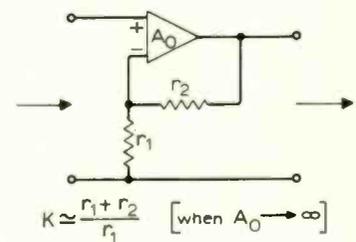


Fig. 8. Positive-gain amplifier with gain stabilized by feedback.

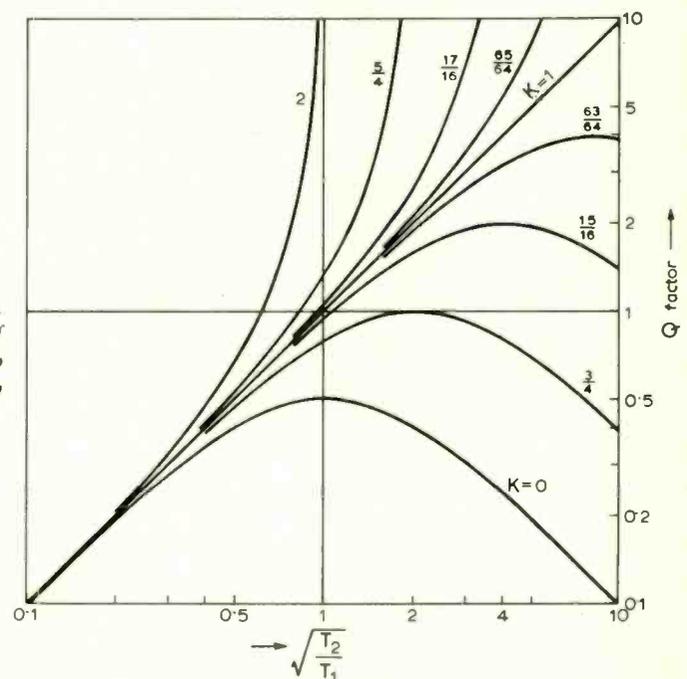


Fig. 9. Illustrating equn. (25). Shows the effect of the gain K and the ratio T_2/T_1 on a lead-lag loop with positive gain.

As already mentioned we can make $A \rightarrow 1$ very closely by applying 100% negative feedback to a high-gain amplifier, as for example by the emitter-follower connection. Provided that the Q factor aimed at is not too close to q_{max} , as given by equn. (25), performance depends almost only on the ratio of the two time constants. The information about q_{max} contained in equn. (25) is perhaps easier to interpret if we substitute $A_0/(A_0 + 1)$ for K [where A_0 = internal gain]. The equation then becomes

$$q_{max} = \frac{1}{2} \sqrt{(A_0 + 1)} \quad (28)$$

This result is the same as that deduced for two lags and negative gain, equn. (5), when $q_0 = \frac{1}{2}$ (the maximum possible value), and $A = A_0$ (the full internal gain of the amplifier); and the identity demonstrates that in circuits which do not exaggerate the effect of component tolerances as q is raised there is no substitute for amplifier gain.

When $K > 1, q = \infty$ when $x^2 = 1/(K - 1)$. (29)

This is shown by the curves in the upper and left-hand part of Fig. 9. By choosing K correctly high Q factors can be obtained with any value of T_2/T_1 . But in general in this region, except close to the diagonal representing $K = 1$, it can be seen from the shape and spacing of the curves that high values of Q factor are obtained at the expense of high sensitivity to both K and the ratio T_2/T_1 ; i.e., the familiar disadvantages of positive feedback appear.

Active filters using a balanced parallel-tee network

It has been shown in Part 3 that the parallel-tee network consist of a low-pass network and a high-pass network connected in parallel; and also that if the input voltage is introduced at the foot of the tees band-pass response is obtained and the network may be analysed as a lag-lead network and a lead-lag network in parallel. The existence of these parallel paths gives the parallel-tee network some special properties which can be useful. But, in general, filter circuits using the parallel-tee network contain, from one point of view, redundant components; i.e., they contain more components than the minimum necessary to obtain the specified order of response. Synthesis and analysis depend on the assumption that the six components of the network are accurately matched. Such circuits therefore fall outside the main theme of this series. They do, however, show a very modest gain requirement for a given Q factor compared with the two-lag loop. It is of interest, therefore, to derive the relation between q and available loop gain for the feedback system shown in Fig. 10(a). The notion behind the setting up of such a system is, of course, that as feedback is increased the response at high and low frequency is depressed and the -3 /dB points move closer together.

The effect is shown in Fig. 10(b), which is drawn for the situation where A is constant and the feedback fraction β is the parameter which is varied. The figure has been drawn for $q_0 = \frac{1}{2}$, the greatest value that can be

obtained from a passive CR network: in practice q_0 is likely to have a lower value, say $\frac{1}{3}$ (see Part 3).

By setting $\beta = 1$, so that the zero-frequency loop gain is simply $= -A$, and substituting in equn. (2), we find

$$\frac{V_{out}}{V_{in}} = \frac{-A(1 + p^2T^2)}{1 + \frac{1}{q_0}pT + p^2T^2 + A(1 + p^2T^2)}$$

$$= -\frac{A}{A+1} \times \frac{1 + p^2T^2}{1 + \frac{1}{q_0(A+1)}pT + p^2T^2} \quad (30)$$

which shows that

$$q = q_0(A + 1) \quad (31)$$

or

$$q \approx q_0A, \text{ when } A \gg 1. \quad (32)$$

Thus $q/q_0 \propto A$, and consequently for $q/q_0 \gg 1$ a much smaller value of A is required than in a two-lag loop (where $q/q_0 \propto A^2$).

The linear relationship between q and A gives

$$\frac{\Delta q}{q} = \frac{\Delta A}{A} \quad (33)$$

or

$$\frac{\Delta q}{q} = \frac{\Delta q_0}{A_0} \cdot \frac{A}{A_0} \quad (34)$$

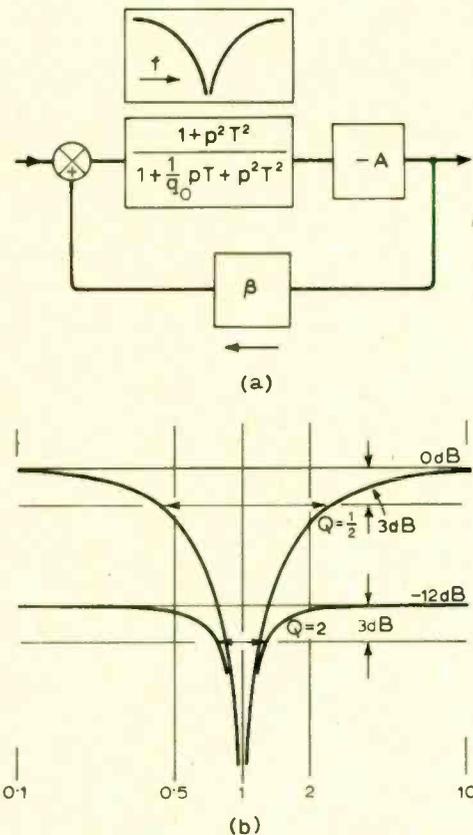


Fig. 10. (a) Feedback loop containing parallel- T network. (b) Shows increases in Q factor by application of feedback.

when A is obtained from an amplifier of high gain, A_0 , to which additional negative feedback is applied.

It can hardly be emphasized too strongly, however, that performance is sensitive to unbalance in the parallel- T network, and that consequently errors in component values can easily invalidate the results derived above.

Loop gain and through gain

It is the nature of the closed feedback loop that determines the inherent characteristics of the resulting resonant circuit, viz. the undamped resonant frequency and the Q factor, which manifest themselves in the denominator of transfer functions of the type $F(p) = V_{out}/V_{in}$. It is, of course, often possible to enter or leave the circuit in several ways, and this gives a choice of numerator functions. But provided all voltage sources are of effectively zero internal impedance so that they do not alter the impedances of the branches into which they are introduced, and that all output voltages are observed without adding any appreciable shunt admittance,* the denominator of $F(p)$ is invariant, being a reflection of the natural motion of the circuit (i.e., of the way in which transients decay).

In simple cases the nature of the transfer functions obtained from the various possible connections can often be predicted from inspection of the circuit. Thus, for example, in Fig. 11(a) for an input V_1 there is a two-lag network between input and output, and the response is low-pass. For an input

*There are parallel arguments for current sources and current outputs.

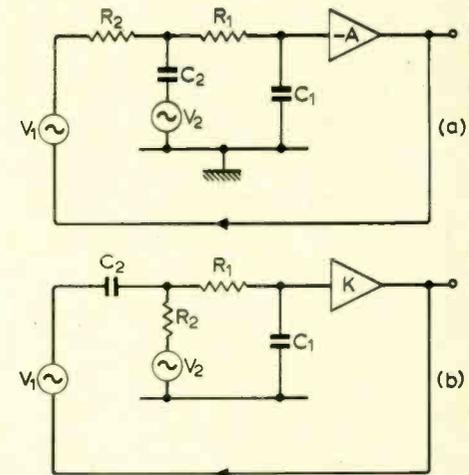


Fig. 11. Showing how a change in the position of the input can convert a low-pass filter to band-pass and vice versa.

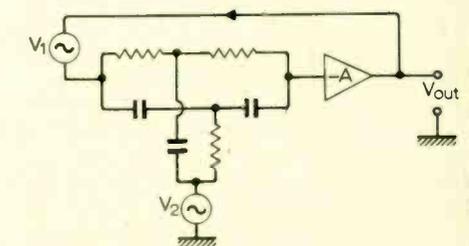


Fig. 12. Active parallel- T system with alternative input connections.

New Books

V_2 there is a lead-lag network between input and output, and the response is simple band-pass (or "tuned-circuit"), with (of necessity) $T (= 1/\omega_c)$ and q the same as for the response to V_1 . Similarly in Fig. 11(b) for an input V_1 there is a lead-lag network between input and output, and the response is simple band-pass: for an input V_2 there is a two-lag network between input and output, and the response is low-pass. These properties are not peculiar to active networks, and examples of the multiple responses that can be obtained from a passive network have been given in Part 3.

For each circuit, if one transfer function is known, simple reasoning will lead to the others. Thus we already know that for Fig. 10(a) the transfer function for an input V_1 is, using eqn. (3), and in Part 3 eqn. (3) and Table 1

$$\frac{V_{out}}{V_1} = -\frac{A}{A+1} \cdot \frac{1}{1+pT/q+p^2T^2} \quad (35)$$

where

$$T = \sqrt{\frac{C_1 C_2 R_1 R_2}{A+1}}$$

$$q = \frac{\sqrt{(A+1)(C_1 C_2 R_1 R_2)}}{C_1 R_1 + C_1 R_2 + C_2 R_2}$$

and we can derive the transfer function for V_2 from this equation by finding a relation between V_1 and V_2 and substituting.

V_1 can be replaced by a current source V_1/R_2 in parallel with R_2 , and V_2 by a current source $V_2 p C_2$ in parallel with C_2 . The two current sources are effectively connected between the same two nodes (the output impedance of the amplifier being by definition zero) and so will give the same output if they are equal to one another, $V_1/R_2 = V_2 p C_2$. Hence the wanted relationship is $V_1 = V_2 p C_2 R_2$, and the required transfer function

$$\frac{V_{out}}{V_2} = -\frac{A}{A+1} \cdot \frac{p C_2 R_2}{1+pT/q+p^2T^2} \quad (36)$$

For Fig. 10(b) we have, from eqns. (14), (15), and Table 1 of Part 3

$$\frac{V_{out}}{V_1} = \frac{k K p T / q_0}{1 + \frac{1}{q_0} (1 - k K) p T + p^2 T^2} \quad (37)$$

where

$$k = \frac{C_2 R_2}{C_1 R_1 + C_1 R_2 + C_2 R_2}$$

$$\frac{1}{q_0} = \frac{C_1 R_1 + C_1 R_2 + C_2 R_2}{\sqrt{(C_1 C_2 R_1 R_2)}}$$

$$T = \sqrt{(C_1 C_2 R_1 R_2)}$$

i.e.

$$\frac{V_{out}}{V_1} = \frac{K p C_2 R_2}{1 + \frac{1}{q_0} (1 - k K) p T + p^2 T^2} \quad (38)$$

By the method of the previous paragraph we then find $V_2 = V_1 p C_2 R_2$, and consequently

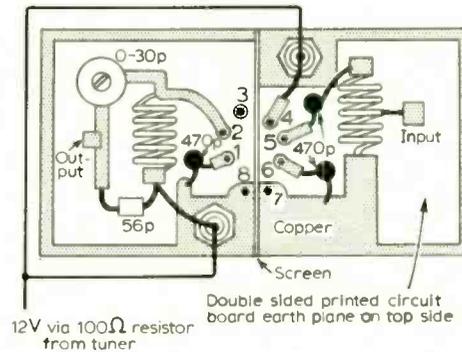
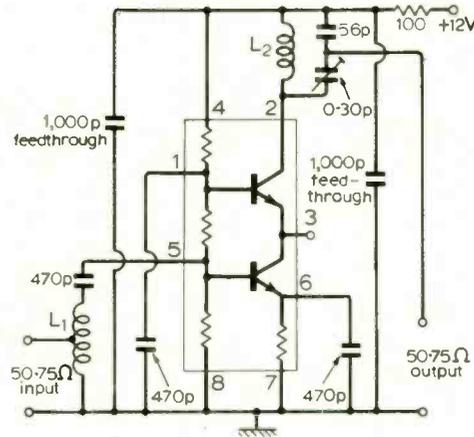
$$\frac{V_{out}}{V_2} = \frac{K}{1 + \frac{1}{q_0} (1 - k K) p T + p^2 T^2} \quad (39)$$

Superficially this l.p. transfer function suggests that gain is not stabilized by feedback. In a practical situation, however, we should have $K = A_0/(\beta A_0 + 1)$, where $\beta A_0 \gg 1$.

To keep the analysis as simple as possible Fig. 10(a) was drawn with the parallel-tee network in the forward path. To obtain "tuned-circuit" response the input, now called V_2 , could be reconnected as in Fig. 19 (Part 3), leading to the arrangement shown in Fig. 12. Other examples of the multiple-response potentialities of one basic loop will be found in later parts.

R. F. amplifier for f.m. tuner

In reply to the letter in last month's issue regarding the problem of radiation from the local oscillator of the integrated circuit f.m. tuner described in the June issue, the author (G. J. Newnham), stated that a suitable r.f. amplifier was being prepared. Below we give the circuit diagram and layout he has supplied.



The 90MHz amplifier employs a 316-04 i.c. made by Marconi-Elliott Microelectronics. Both coils consist of five turns of 18 s.w.g. (0.3in diameter, 0.25in long), and L_1 is centre-tapped.

BAILEY AMPLIFIER REPRINT

In our September issue we announced that the reprint of the articles by Dr. A. R. Bailey on his 20-W and 30-W amplifiers and pre-amplifier "will be on sale within the next month". We regret that plate-making and printing difficulties have seriously delayed publication. It now seems likely that the reprint will not be available until the end of November. We apologise to the many readers whose orders have not been executed.

Transistor Audio and Radio Circuits, from Mullard, is a manual of established and practical circuits for use by radio and audio service engineers, equipment manufacturers, students and home constructors. A wide range of circuits, from portable radio receivers to high-quality amplifiers is presented in detail and a chapter is devoted to test equipment. The chapter headings are: silicon and germanium transistors; basic h.f. circuits; basic a.f. circuits; radiograms, record players and portable radios; tape recorders; car radios; high-quality audio equipment; high-quality f.m. tuners; test equipment. Appendices cover biasing arrangements for h.f. circuits, B.B.C. test-tone transmissions, and six data charts and nomograms. Pp.205. Price 30s, (p. and p. 2s.) Mullard Ltd, Mullard House, Torrington Place, London W.C.1.

Servicing with the Oscilloscope, by Gordon King, presents the oscilloscope, from a practical standpoint, as a valuable aid to servicing and fault-finding in radio, television and audio equipment, including the latest stereo-radio and colour television circuits. The illustrations include many photographs of oscilloscope traces encountered when testing both faulty and correctly operating equipment. Pp.176 including a three-page index. Price 28s. Butterworth & Co. (Publishers) Ltd, 88 Kingsway, London W.C.2.

Hi-Fi and Tape Recorder Handbook, by Gordon J. King, is based on the author's previous book **The Practical Hi-Fi Handbook** published by Odhams Books in 1959 and now out of print. There are fifteen chapters written in a technically uncomplicated manner. The first chapter discusses special terms in the audio vocabulary—including decibel, phon, and harmonics—and explains the principles of recording and of stereophony. The rest of the book expands all these terms in relation to voltage amplifiers, valve and transistor power amplifiers, loudspeakers and disc and tape systems. The final chapter is on video tape-recording. Detailed circuits and photographs of commercial equipment are used in the discussions. There are two appendices—on amplifier specifications, and on test tapes and records—and a good index. Pp.304. Price £2. Butterworth & Co. (Publishers) Ltd, 88 Kingsway, London W.C.2.

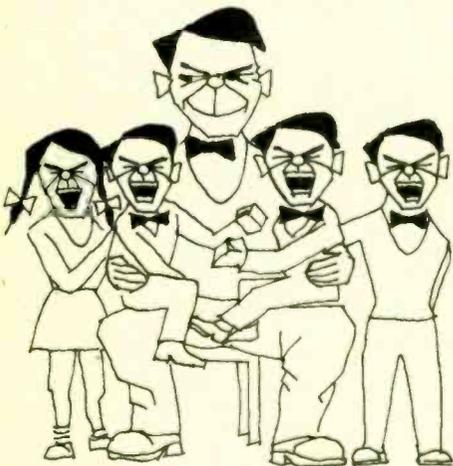
Glide Path, by Arthur C. Clarke, recalls the struggles of a group of scientists, flyers and specially trained servicemen to perfect a radar talk-down system for planes during World War II. This novel is not prophetic, but documents a rapid and important technical development in communications. Pp.229. Price 30s. Sidgwick & Jackson Ltd, 1 Tavistock Chambers, Bloomsbury Way, London W.C.1.

Living with Hi-Fi

A wife's definition of 'tolerance'

by Heather Dinsdale

Although I have a great deal of sympathy for wives whose husbands seem to be married to a car, or a fishing rod, or a set of golf clubs, I claim a special consideration for those poor wives like myself whose husbands are dedicated to sound reproduction (I use the phrase advisedly) in any shape, form or size. To start with, all the work has to be done indoors; there is none of this banishing him to the garage, the river or the golf links. The



Husbands . . . dedicated to sound reproduction

hi-fi units invade the whole house, interconnected with long snake-like cables which are always placed just inside doorways for the unwary wife and children to trip over. The mess is not even confined to the visual senses; the most execrable sounds literally shake the house from time to time, especially when the baby has just been put to bed. This is all performed in the name of the great god hi-fi. ("I'm sorry, but the baby will just have to get used to it.")

The sheer size of the loudspeakers is another thing. Before we got married I was given my annual brainwashing at the Audio Fair, and I gradually learned that large loudspeakers sound better than small. My great mistake was to admit this. Now, my protests that we are being crowded out of house and home by bigger and bigger speakers are countered by impossible rationalizations. ("But you did say at the Audio Fair that those huge horns sounded very good.")

It is bad enough giving house room to completed hi-fi units; up to a point they

have their uses for standing vases of flowers on, but the flowers mysteriously disappear shortly before the whole house shakes to the closing scene of "Götterdämmerung". (Presumably the vases would shatter if they were left in the room.) But those of you who think that I am being unreasonable have not had to live with an amplifier through all its stages from design and development to demonstration. There are, in fact, five distinct phases: design, development, testing, manufacture and demonstration.

The design phase begins quietly. It is characterized by my husband developing an increasing absent-mindedness and loss of memory where household chores (e.g. washing-up) are concerned. For some reason this loss of memory does not apply to meal-times. Scraps of paper covered in hieroglyphics are left all over the house, and the slide-rule features prominently. The postman staggers up the drive laden with manufacturers' catalogues, and I find myself taking down meaningless telephone messages. Isn't it funny how the 'phone always rings while I'm feeding the baby; perhaps I ought to tell Mrs. Parkinson!

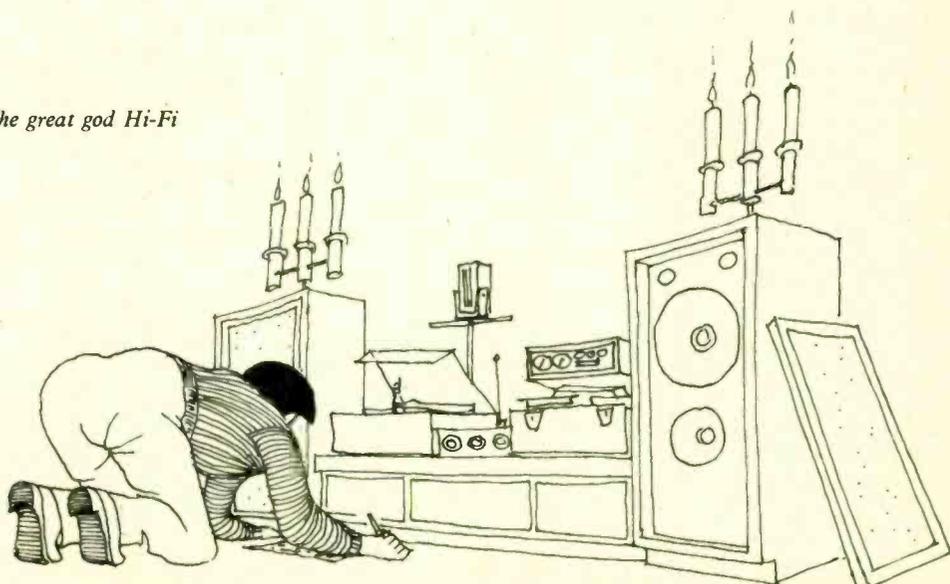
Testing

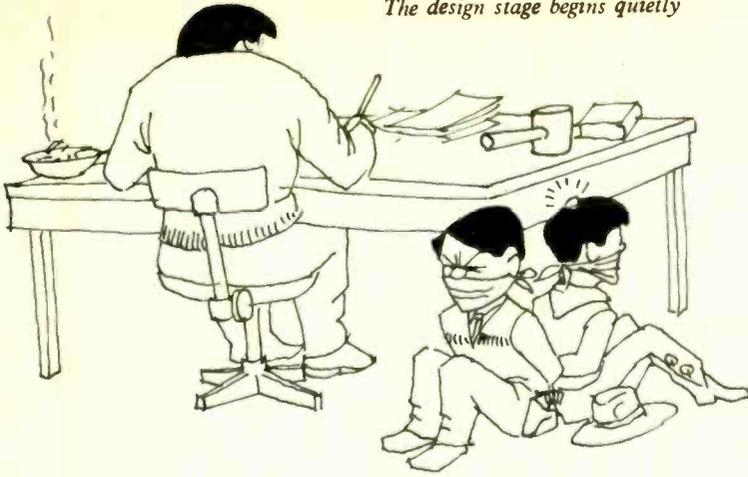
Once the design is completed, development can begin. This is normally done on the floor. I have carried out a careful research pro-

gramme on the action of vacuum cleaners, and I can now report that resistors and transistors are always sucked up in preference to dirt and dust. ("Have you seen a thing looking like a little striped shrimp? It's gone where? But that was part of a matched set—took me hours. You'll have to empty the bag.") During the development phase, various instruments with small television screens appear and stand around the room. These offer infinite attraction to the children. ("Don't touch that—it's Daddy's. Yes, that's a green snake. No, you mustn't feed it.") I have discovered that there is a technique for getting solder out of carpets, but not for removing the actual burn mark. We have solved this latter problem by using a dark brown rug, and the smell of burning hair disappears quite quickly if you leave the windows open. At one time I got very upset when I thought he wanted to use the breadboard, but I know now that a breadboard is not a board, and has nothing to do with bread, either. Once the breadboard has been made, we start the testing phase. Previously, testing has consisted of making measurements on meters but now the ears are assaulted. Certain records have been earmarked (*sic*) 'demonstration quality' and these are played at varying volumes, with small modifications made to the amplifier between each test. I must admit that some of these records do sound extremely good—in moderation. Unfortunately, after it has been struck about 12 times in the hour, Donner's hammer (in "das Rheingold") seems to take up residence in my head. When we lived in a flat, the neighbours downstairs remarked one day on the apparent proximity of the railway station. I hadn't the heart to explain that we had recently invested in a Transacord recording of Pacifics (whatever they may be), and we were "just trying it out". It is, incidentally, an interesting and valuable fact that both our children enjoy very loud sounds, but it doesn't help in the subjective assessment of noise levels. ("But Darling, how can I hear if there is any hum or hiss if the baby's bawling in the background.")

When the tests have been finished we may go back to the drawing board, in which case the whole rigmorole I have described is liable

The great god Hi-Fi



The design stage begins quietly

to be repeated. Otherwise, we proceed to manufacture. I must admit that the units finally produced look quite presentable. Thank goodness that the breadboards don't last for ever!

Manufacture

Manufacture requires extensive use of the kitchen table for "metal bashing". ("Can't possibly use the garage—too damp and draughty.") The metal arrives as large sheets, and is first carefully marked out. Next the holes are drilled on the table or the floor as convenient, using a thick board as a back. ("I'm afraid the drill missed the board, Dear. I don't think the hole is too noticeable.") I once thought that drilling was the final operation, but no! Most of these little holes are pilots. Some of them have to end up square, and these produce the worst sound of all. A small vice is clamped to the kitchen table, and the small holes are opened out using hacksaws and files. The screeching sound is really dreadful. It fills the head, and seems to continue long after the work has been completed. A thin film of metal dust covers everything for days afterwards. After the holes have been cut, the metal is bent (blessed relief, this operation is silent), and we come to painting. Normally I quite like the smell of paint, but the crackle-finish paint with which all the metal work is treated has the most horrible odour. I was intrigued at the beginning to see whether the attractive crackle finish came straight out of the tin, and was disappointed to see that it looked just like conventional paint. Then the awful truth slowly dawned on me. The paint had to be treated in the gas cooker—my cooker—and despite my protests, the hor-

rible smelly paint was bundled into the oven. I carefully examined the oven after the operation, and mercifully the smell had disappeared. The Sunday joint tasted just as good as ever the following day, so now we cure crackle paint quite regularly. ("Don't know what you were rabbiting about! It must be done in the oven, whether it smells or not.")

The little components are fixed on to printed circuit boards, which first have to be designed. After a roughly pencilled layout, adhesive black tape is carefully stuck in position, along with small circles and other rather rude-looking shapes. This process can be carried out anywhere, including railway carriages and even in bed. Unfortunately it leaves a trail of short black sticky pieces wherever it goes. Removing short pieces of sticky tape from the carpets is even more difficult than removing solder, and it is hard to keep the children away from it. Luckily, this phase does not last long, but when the boards come back, all cut and drilled, I must say goodbye to the kitchen table again. Soldering irons are very useful for determining the melting point of plastics. We soon discovered that plastic tablecloths melt easily and give off an obnoxious smell when burnt, and we now have a selection of household articles, including an alarm clock, a salad fork and a toy duck all with neat round holes depicting the path of the soldering iron.

If anyone asks me what is the most effective domestic missile, I reply without hesitation: wire ends from cutting resistor leads to size. The short wires boomerang back and forth across the room, and it is only by sheer good fortune that the whole family have not sustained serious injuries. The wires lodge in the most unusual places and continue to

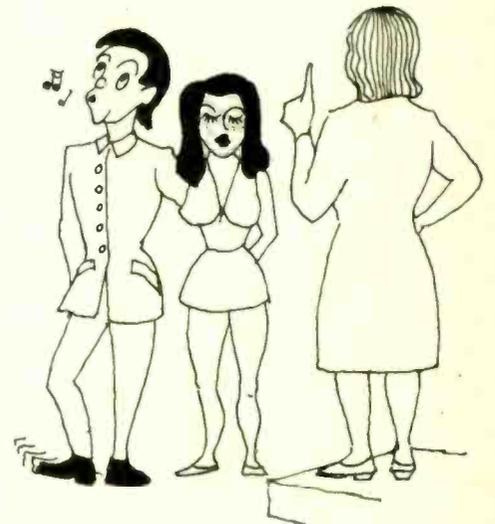
*This process can be carried out anywhere . . . even in bed!*

turn up months after the exercise in ballistic missiles has finished. I found many years ago as a child that the most effective way of locating dropped drawing pins is to crawl around on hands and knees. I can report with feeling that the best way of finding dropped wire ends is to sit on the upholstered furniture without too many clothes on.

Demonstration

When manufacture has been completed, we come to the final phase: demonstration. This resembles the earlier testing phase, but is more intensive. In addition, visitors turn up at the most unexpected times to "hear the new amplifier". We also have long listening sessions while minute adjustments are made. At about this time, I begin to think that perhaps it has all been worthwhile, because of the fine musical results. We have also met a number of interesting people and been in correspondence with many more.

I read once of some advice to young girls thinking of marriage: "Don't, but if you must, don't marry an engineer." If you marry an audio engineer, be prepared for a completely different way of life, governed by the everlasting search for better sound quality, in which all normal domestic planning is

*Advice to young girls . . . don't!*

subordinate to loudspeaker positioning and the need to allow the designs to appear. In every engineer there is a designer trying to get out, and if you try to inhibit him, then sullenness sets in, leading to moroseness and maybe a lot worse.

I must conclude: he's been muttering for some weeks about designing a colour television set, and I am getting more and more worried about what this might entail. I might as well not bother; if he has decided to do it, then it must be done, and a mere wife is powerless to stop it. At least our test-cards will be in colour (I doubt if he will have time for actually watching programmes) and as the work proceeds the sound of metal-bashing, the smell of burning plastic, and the barrage of small wires will ensure that I know exactly what he is doing.

I wonder what the children will be when they grow up?

Transistor Distortion Characteristics

The performance of transistors in voltage amplifying circuits

by J. L. Linsley Hood

Developments in transistor manufacture have led to the ready availability of inexpensive devices. In particular, the planar silicon types (which are characterized by high gain, low leakage current, low noise and good high frequency characteristics) allow the construction of a.c. amplifying circuits having a performance which is better than all but the best of existing valve circuits.

Unfortunately, when transistors are used as voltage amplifiers the shape of the base voltage/collector current characteristics gives rise to waveform distortion, and the conditions which are most favourable for high stage gain and high input impedance (high collector load impedance, low I_b) are also those which lead to high levels of (predominantly second-harmonic) distortion.

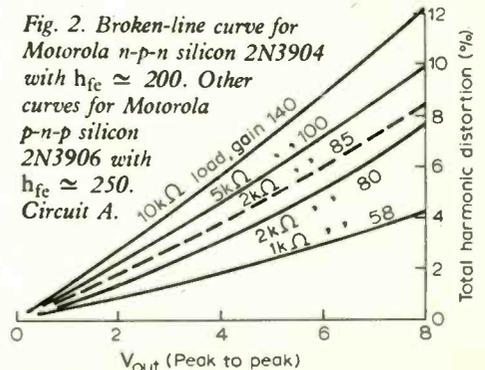
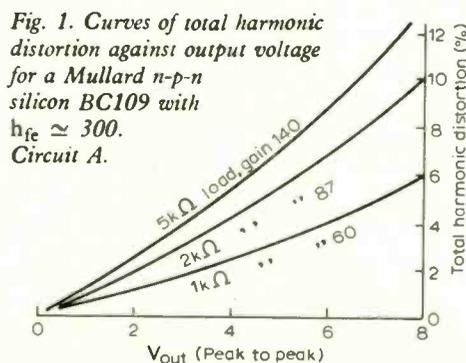
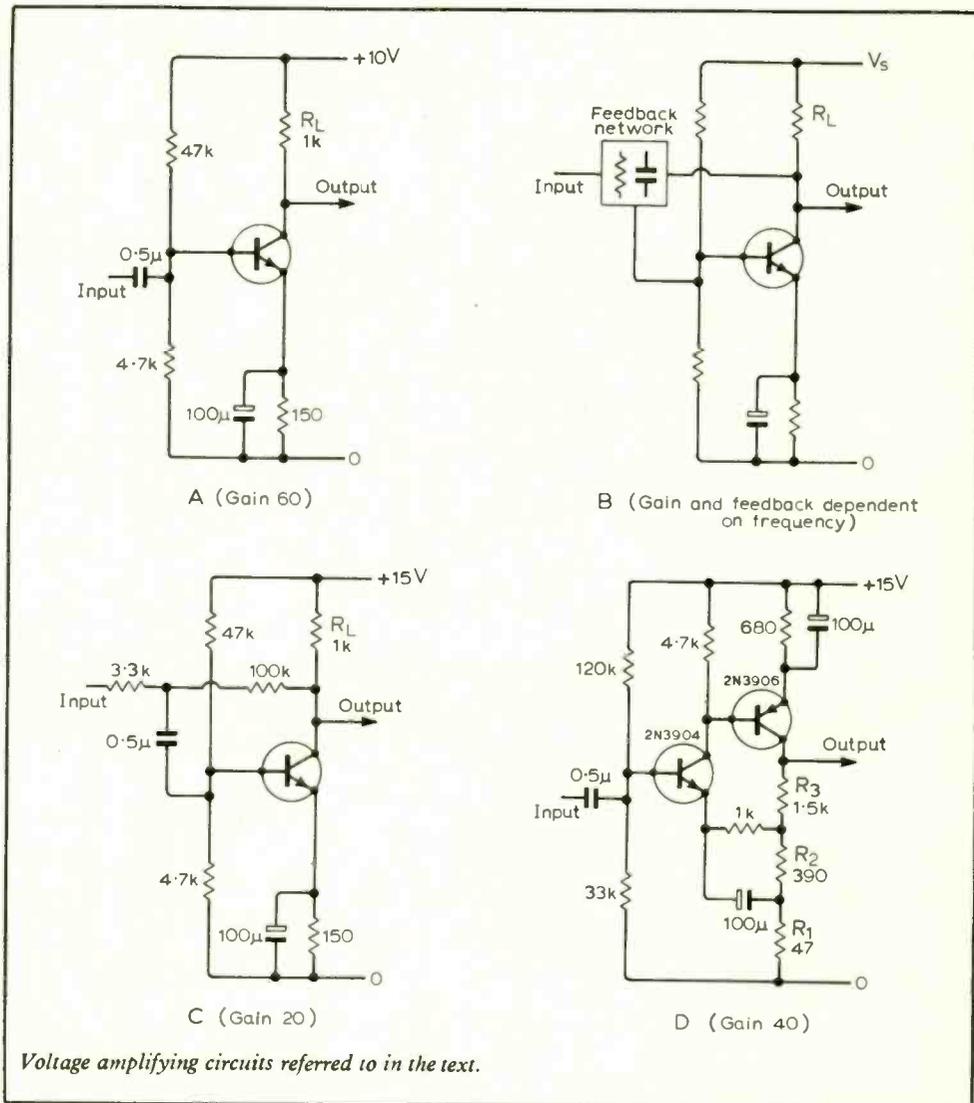
The performance of five different silicon transistor types is shown in Figs.1-3, and that of two germanium types in Fig.4, as measured at 1kHz using circuit A. In each case the actual value of the emitter bias resistor was adjusted so that the collector voltage was equal to half the supply voltage.

In general, the higher the current gain of the transistor, and the larger the collector load resistor, and the output voltage as a proportion of the supply voltage, the greater the total harmonic distortion. Also, as would be expected from the I/V curves, the silicon transistors gave higher distortion levels than the germanium types, and also, in the cases examined, had higher current gains.

No significant difference in performance was observed between different transistors of the same type having similar current gains, although those of planar construction gave a somewhat higher gain/distortion ratio than those with diffused junction.

This type of non-linearity is important, for example, in audio pre-amplifier tone control circuitry, where compensation networks in the negative feedback path are employed as in circuit B, to modify the gain-frequency characteristics. At the mid-point frequency of such an amplifier, the gain may be unity and the distortion factor consequently very low, but where the feedback is reduced in order to obtain, say, treble or bass lift, the output distortion will increase by the same amount.

Also, conventional audio power amplifiers may require an input signal of the order of 0.6-1.0V r.m.s. (equivalent to 1.7-2.8V peak to peak) and as can be seen from Figs.1-3, a simple transistor amplifier of the type shown



Announcements

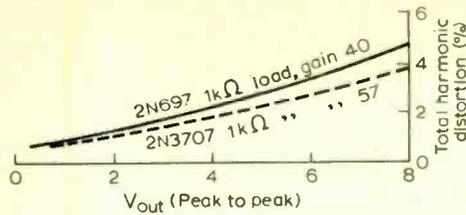


Fig. 3. Curves for Ferranti n-p-n silicon 2N697 with $h_{fe} \approx 80$, and Texas Instruments n-p-n silicon 2N3707 with $h_{fe} \approx 180$. Circuit A.

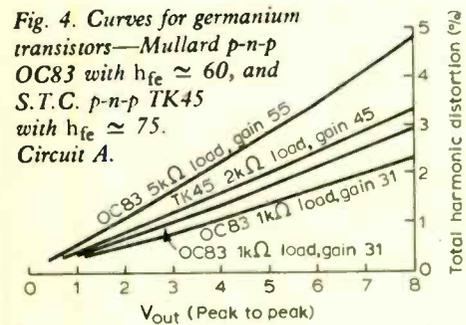


Fig. 4. Curves for germanium transistors—Mullard p-n-p OC83 with $h_{fe} \approx 60$, and S.T.C. p-n-p TK45 with $h_{fe} \approx 75$. Circuit A.

in circuit A would introduce 1–2% harmonic distortion. If 0.1% total harmonic distortion is the target figure, the largest output which could be obtained from such a circuit would be some 180mV peak to peak, equivalent to some 60mV r.m.s.

The use of negative feedback improves matters, but the reduction in distortion is accompanied by a reduction in gain. Using a higher supply voltage will increase proportionately the output signal voltage available at a given distortion level, and a single stage amplifier of this type, such as shown in circuit C, operating from a 15V supply rail and designed to have an output of 1V r.m.s. at 0.1% t.h.d., has a stage gain of only 4 or 5.

Since the reduction in the distortion is more nearly equal to the reduction in gain when the open loop gain is high, a better answer is to use a two-stage amplifier, such as that shown in circuit D. Here the output transistor is operated under favourable conditions, with a fairly low value of collector load resistance, and with an input circuit of fairly high impedance, while the input transistor is only required to deliver a small output voltage swing. The open loop gain of the circuit is approximately 8000, and the total harmonic distortion over the frequency range 20Hz to 20kHz is less than 0.04% at 8V peak to peak. Since the stage gain is determined by $(R_1 + R_2 + R_3)/R_1$, if R_1 is reduced the gain (and distortion content) will be proportionately increased. For example, if $R_1 = 20\Omega$, the stage gain will be 100, and the distortion factor at 8V peak to peak will be 0.1%.

The use of such a circuit as the final stage of an audio pre-amplifier* allows the preceding stages to operate at lower output voltage levels, with advantage in terms of harmonic distortion. Further, several such stages could be used in cascade, with passive RC or LC networks, for tone control purposes.

“Sound 70 International” is the title being given to next year’s exhibition of the Association of Public Address Engineers. It will not be held at Harrow as in the past but at the Camden Town Hall, Euston Road, London N.W.1, from 10th to 12th March.

The 1st International Exhibition of Recreation and Leisure will be held in Geneva, Switzerland from May 28th to June 7th 1970. The organizers are making a special feature of amateur radio activities.

The British Computer Society is moving its headquarters from Dorset Square to 29 Portland Place, London W.1.

“Talking About Colour Television” is the title of the latest filmstrip produced by the Mullard Educational Service. The film is intended for students with a working knowledge of monochrome television and is available, with a 54-page teacher’s book, from The Slide Centre Ltd, Portman House, 17 Brodrick Road, London S.W.17.

RCA has announced plans to invest more than £375,000 in a new plant in Jersey, Channel Islands, as an improved base for expanding its commercial electronic products activities in Europe.

ITT Components Group Europe has opened a new branch office at 28d Glenacre Road, Cumbernauld, Scotland.

GNT Automatic A/S (has moved from St. Helens Place, London, to 10 College Road, Harrow, Middx. (Tel: 01-863 4378).

Guest Electronics Ltd., Nicholas House, Brigstock Road, Thornton Heath, Surrey, will in future be known as Guest International Ltd.

Davall Electronics Ltd, which was recently acquired by Eric Electronics Ltd, South Denes, Great Yarmouth, Norfolk, has been re-named Eric Controls Ltd.

Crouzet (England) Ltd, of Brentford, Middx, announce that they are changing their name to Crouzet Ltd and will shortly be adding aerospace electronics and process control equipment to their products.

Alfred Imhof Ltd have announced that conditional contracts have been exchanged whereby their parent company Parnell Investments Ltd will acquire the entire issued share capital of Bedco Ltd. There will be a single trading company called Imhof-Bedco Ltd.

Danish agents. SEMCO, of Copenhagen, have been appointed agents for components manufactured by Electrosil Ltd, Pallion, Sunderland, Co. Durham.

A Canadian company is being formed jointly by International Computers Ltd and International Management Associates. The company, International Computers (Canada) Ltd, will have exclusive rights to market the I.C.L. 1900 Series computers in Canada.

Technical Measurement Corporation (U.K.) Ltd, 14 Yeading Lane, Hayes, Middx, have been appointed European distributors for Nuclear Equipment Corporation, of California, manufacturers of solid-state detectors and preamplifiers, non-dispersive x-ray photon spectrometers and NIMAMP operational amplifiers for nuclear applications.

V-F Instruments Ltd, Gloucester Trading Estate, Hucclecote, Gloucester GL3 4AA, have been appointed exclusive U.K. agents for Data Device Corporation, of New York. The range of products manufactured by the American company includes: operational amplifiers, A/D converters, D/A converters, multiplexers, logarithmic modules and instrumentation amplifiers.

Racal Elektronik GmbH, 5300 Bonn, Aduauerallee 89a, is a new company formed by the Racal Electronic Group in Western Germany.

The Beyer microphone company of Western Germany has formed a company in the U.K. for the distribution of its products. The new company, Beyer Dynamic (G.B.), is operating from 1 Clair Road, Haywards Heath, Sussex.

The audio products of the Pioneer Electronic Corporation of Tokyo are to be marketed in Britain by the Hi-Fi Division of Shiro (UK) Ltd, 8 Bush Lane, Cannon Street, London E.C.4.

Celdis Ltd, Reading, Berks, have been appointed by General Instrument (UK) Ltd to market their range of semiconductors and tantalum capacitors.

An agreement has been signed between GEC-AEI (Electronics) Ltd of Stanmore, Middlesex, and Kollsman Instrument Ltd of The Airport, Southampton, for the manufacture and sale by Kollsman of various types of induction digitizer. These units, developed and patented by GEC-AEI Electronics, give a digital representation of the angular position of a shaft.

The Digital Systems Department of Ferranti Ltd has been awarded a contract by the Ministry of Defence valued at over £300,000, for the manufacture of digital data link equipment for the Royal Navy.

Plessey Radar has received orders valued at approximately £50,000 for the WF3 windfinding radar to be supplied to meteorological organizations in Australia, Ceylon, Pakistan and the U.K.

Pye TVT Ltd has installed an £8,000 closed-circuit television system for surveillance on the east and west towers of the Severn Bridge.

Redifon Ltd, Wandsworth, London S.W.18, has been awarded a contract for the manufacture and installation of eleven ship radio stations. Five stations are to be built for Canadian Pacific Steamships Ltd, the remainder for the Bibby Line and ACL, the Atlantic Container Line consortium. The company is also supplying £85,000 worth of radio equipment for twenty-six BP and Shell tankers.

Police walkie-talkies. Rank Telecommunications has received an order from the Metropolitan Police, valued at £122,000, for the supply of Mitre two-way personal radio transceivers.

Plessey Telecommunications Group has received contracts worth over £350,000 from the G.P.O. for eight electronic telephone exchanges.

The G.P.O. has awarded a contract worth almost £300,000 to Standard Telephones and Cables Ltd, for the provision of a microwave radio system to transmit bulk telephone traffic and television signals between Birmingham and Bristol.

Eastern Electricity have awarded a £0.5M contract to Ferranti for the supply of telemetry/telecontrol equipment to be used for the remote supervision and control of over 400 Eastern Electricity substations.

*Linsley Hood, J. L., “Modular Pre-amplifier Design”, *Wireless World*, July 1969.

Circuit Ideas

I.C. driver for power amplifier

By virtue of its very large input and output voltage ranges and excellent common mode rejection, i.c. type 709 may be made the basis of a power amplifier. Obtaining sufficient voltage swing to drive a complementary class B output stage, is achieved by complete exploitation of the bootstrap principle. Suppose that the op. amp. gives a maximum output swing $\pm V_o$ and will operate with a common mode input voltage in the range $\pm V_i$, both V_o and V_i being measured relative to the op. amp. power supply in the normal way. Both sides of the op. amp. power supply are bootstrapped in phase with the output in such a way that, when the output is at $+V_o$ the supply has been bootstrapped up by an amount equal to V_i so that the input is now at $-V_i$. Thus the total swing obtained relative to earth is $\pm(V_o + V_i)$. Typical values for a 709 running off $\pm 15V$ supplies are $V_o = 14V$ and $V_i = 10V$, giving a total peak-to-peak swing of 48V which should increase to about 55V if the 709 is run at its rated limits.

This principle has been employed in the circuit shown. C_2 , R_1 , R_2 and the corresponding primed components cause the op. amp. power supply to be bootstrapped by about 40% of the output voltage, and the capacitors also provide a bootstrap for the drivers in the normal way. The d.c. voltage across the load is held by feedback to a few millivolts (the 709 input offset voltage) and the gain is such that 10W output is obtained from just under 200mV input. C_1 was a 500 μF , reversible electrolytic, but 50 μF would be adequate for normal audio purposes and it could probably be an ordinary, polarized component. Alternatively it could be omitted completely if one were prepared to tolerate a few tenths of a volt d.c. across the load or to trim the 709 offset voltage to zero. The diodes between the 709 inputs eliminate any possibility of latch-up occurring, and the frequency compensation components shown were found to give an adequate margin of stability in the circuit built. It was necessary to use a fairly low-impedance signal source (below about 5k Ω), otherwise strong high-frequency oscillation occurred, but

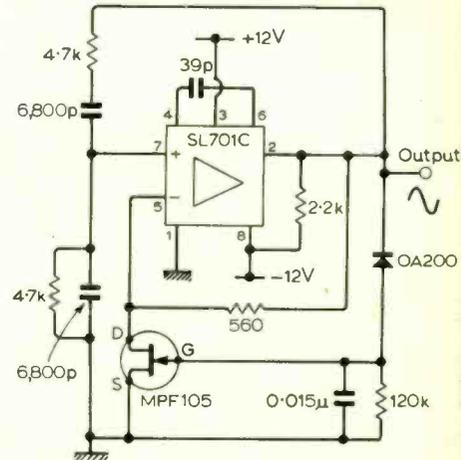
this is thought to be a result of the particular circuit layout employed.

The 3dB points for the circuit given were at about 1.5Hz and 150kHz. Distortion was not measured, but it should be very low since the circuit has roughly 55dB of negative feedback at low frequencies.

J. M. A. WADE
 Cavendish Laboratory,
 Cambridge

Constant amplitude oscillator

A stable sinusoidal output, independent of any change in supply voltage, can be obtained using the circuit shown below. The output from the wien bridge oscillator is fed back to the gate of the f.e.t. after rectification and smoothing. Since the drain-source voltage is much less than the gate-source voltage (negative), the dynamic resistance



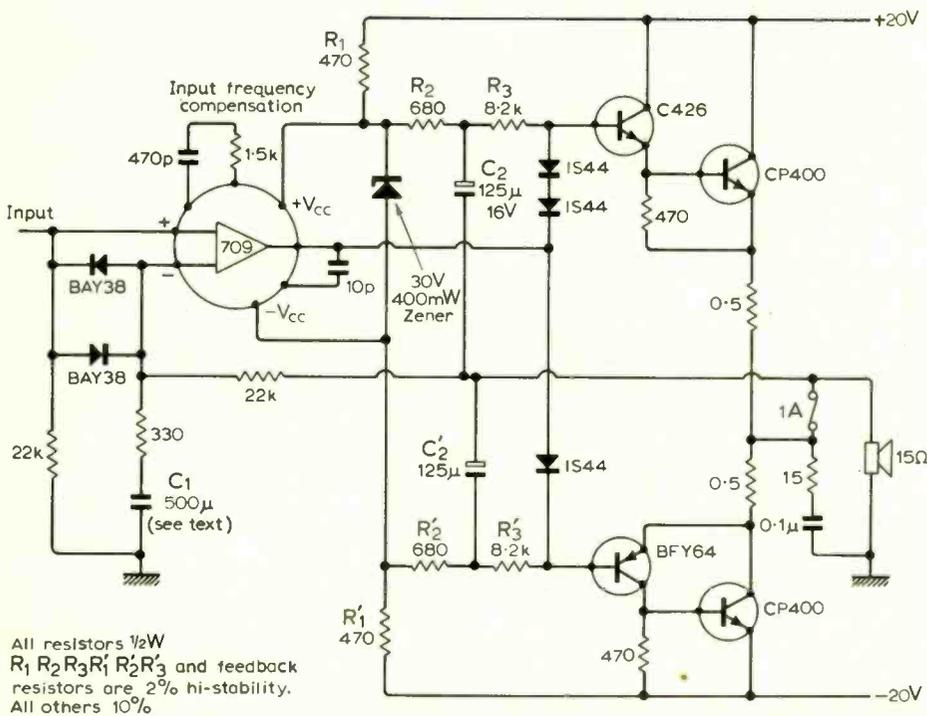
Oscillator giving constant amplitude sinewave output with unstable supply.

of the f.e.t. varies linearly with the latter. Any variation in supply voltage, which apparently changes the output, will change the dynamic resistance of the f.e.t. keeping the output constant. The frequency of oscillation of the circuit shown is 5kHz. Variation in frequency is only 0.02% with a 30% change in supply voltage.

A. BASAK
 Chelsea College of Science & Technology,
 London S.W.3

An invitation

If you have developed or happened upon an original circuit configuration to perform a simple or a complex operation, or have used standard components in an unconventional manner, we would like to hear from you. Send a concise description, in the form of a circuit diagram and notes, and we will consider its publication as a circuit idea. £5 is paid for each contribution published.



All resistors 1/2W
 R_1 R_2 R_3 R'_1 R'_2 R'_3 and feedback resistors are 2% hi-stability. All others 10%

Power amplifier employing op. amp. type 709.

The way we make resistors is unique. To an extremely tough optical glass "heart" we fuse, molecule for molecule, an oxide film. At great heat. The result is an extra, diamond-like hardness and toughness that defies deterioration under the most adverse conditions . . . long after humidity, for example, has eroded the less robust types of film resistor. Electrosil resistors are virtually unaffected by thermal and mechanical shock, too. That's why they are specified more than

ever today for the electronics industry, where high reliability is paramount.

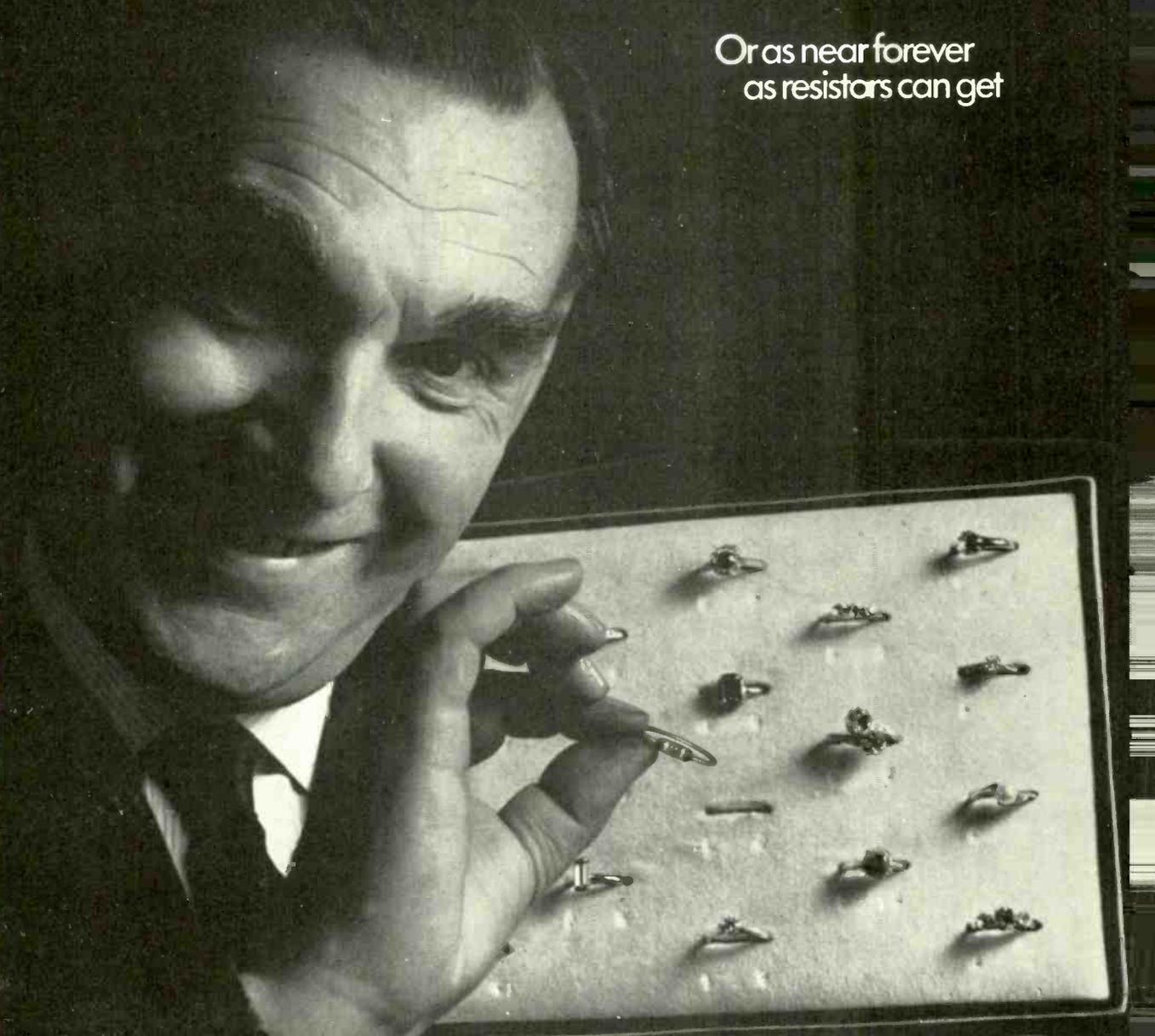
Electrosil Limited, P.O. Box 37, Pallion, Sunderland, Co. Durham. Telephone: Sunderland 71481. Telex: 53273.



have the experience

Electrosil resistors are forever

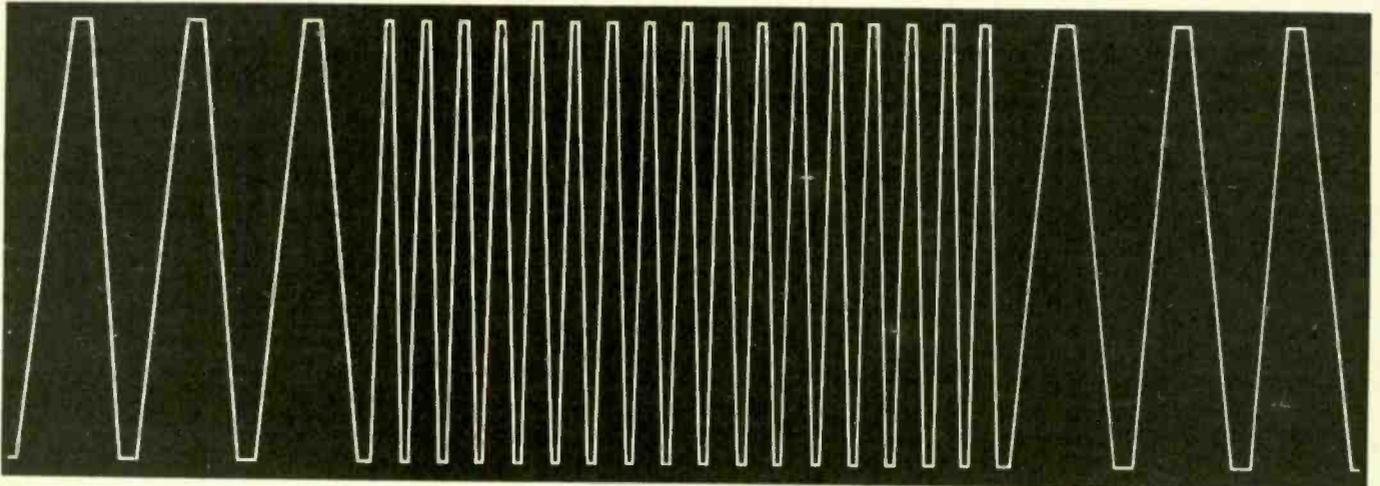
Or as near forever
as resistors can get



WW-105 FOR FURTHER DETAILS

www.americanradiohistory.com

Marconi LINCOMPEX...



Marconi radio terminal equipment

Marconi, foremost in the design of radio terminal equipment, have added to their already comprehensive range—Lincompex—the means of compensating for the variable characteristics of h.f. propagation.

Lincompex

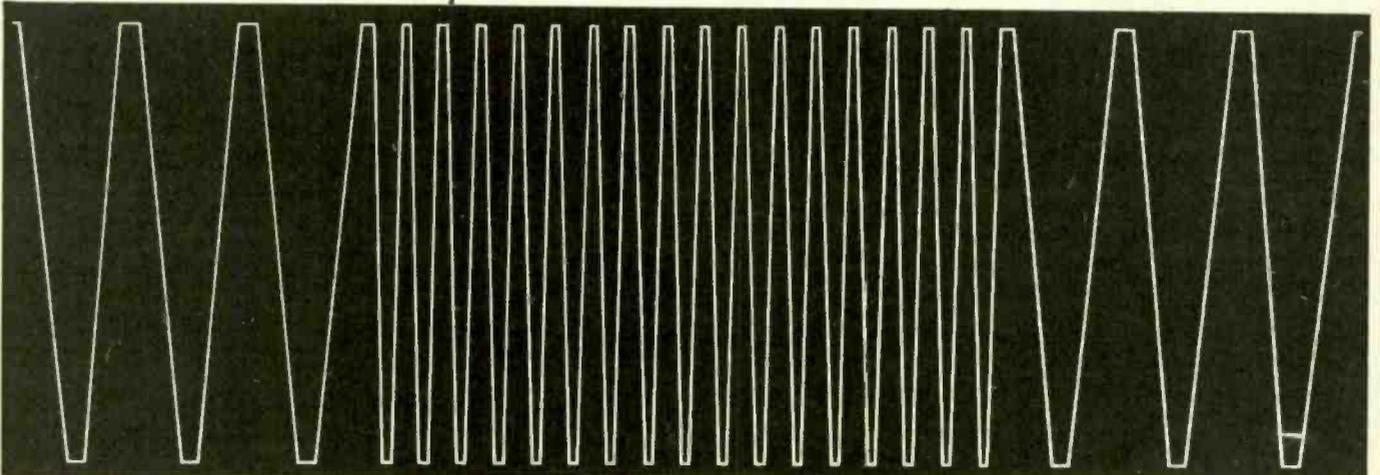
Developed from the original British Post Office design to give a service on h.f. radio telephone circuits comparable with high-quality, long-distance cable. Improved service, fewer 'repeats' and greatly increased service hours make Lincompex the key to direct 'subscriber to subscriber' contact on long distance h.f. circuits.

...the most advanced system available

- **SMALL SIZE:** Only one 7 in. shelf per channel.
- **LOW COST:** Introduction of new techniques has considerably reduced capital cost.
- **RIGID STABILITY:** Expertly engineered circuitry, including microcircuits, gives the high degree of stability and linearity required for successful operation.

Marconi LINCOMPEX is designed for association with Marconi H5510 series of Terminal Equipments and built to maintain for years its designed performance.

Marconi Telecommunications Systems



Wireless World Logic Display Aid

7: Some more modifications and a description of the prototype

designed by B. S. Crank*

This month sees the end of the description of the instrument. Next month's article, the last in this series, will be devoted to a few logic circuits that may be used with the instrument for instructional purposes. The last two possible modifications will now be described.

7: Enabling any display area to be switched to any mode of operation

This is an extension of modification 6 and the only requirement is that modification 4 should have been carried out. Four complete sets of control switches laid out as in the left hand side of Fig. 85 are incorporated. The switches are mounted in four rows, one row for each display area, and each row contains Venn, Truth, and Karnaugh control switches plus switches to control the content of the Truth table third column. The switches marked S_0 are pressed when it is desired to have no third column (two-variable Truth table) in any particular display area. The S_0 switches have no connections to them and therefore do not appear in any of the circuit diagrams, their sole purpose is to mechanically cancel the associated $C = 0$ and $C = 1$ switches.

Each row of switches fitted in this modification (do not confuse with modification 8 switches of Fig. 85) consists of two sets of three-button miniature radio switches, supplied by G. W. Smith, and as specified in the parts list for the basic instrument.

By gating the outputs of the bistables Q and W each row of switches is made operative for one display area only. The outputs of all the switches are then combined in gating to produce the control signals for the basic logic circuit. Fig. 86 gives the extra circuitry necessary.

The outputs of the bistables Q and W are combined in NAND gates 1, 3, 4, and 5 to produce signals corresponding to each display area. These outputs are the negative form of the required address signal ($\overline{Q\overline{W}}$, $Q\overline{W}$, $\overline{Q}W$, and QW). Each of these four signals is fed to a set of three mode control switches (Venn, Truth and Karnaugh). The output of all switches for the same mode (four each for Venn, Truth and Karnaugh) are combined in NAND gates 18, 20 and 21. For instance, all the Venn switches are connected to gate 18 to provide the V control signal for the main logic unit.

Imagine that the following switches are pressed, S_1 , S_7 , S_{13} , and S_{18} , and also imagine that both the X and the Y counter hold all zeros. The bistables Q and W will be reset so the \overline{Q} and \overline{W} lines will have a voltage upon them. Both inputs to gate 1 will therefore be UP and the output of gate 1 will be DOWN. Notice that the outputs of

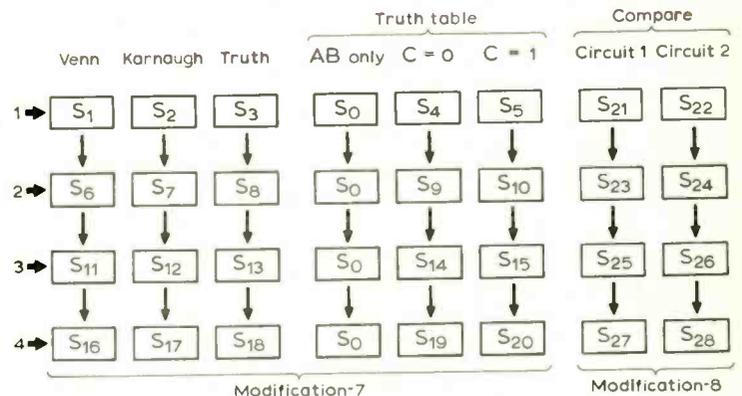


Fig. 85. Layout of the switches on the front panel.

gates, 3, 4 and 5 will be UP because at least one of their inputs will be DOWN.

The DOWN at the output of gate 1 will appear at the input of gate 18 via S_1 so that the output of gate 18 will be UP, switching the main logic unit into the Venn diagram mode of operation. The inputs to gates 20 and 21 will either be UP, or open, so that the outputs of these gates will be DOWN as will the T and K control signals. Notice that because the output of gate 18 is DOWN the output of gate 19 will be UP, switching both dians to the Venn operating mode.

Sixteen pulses from the clock generator will trace the first column of dots in display area 1. The sixteenth pulse will set bistable Q and bring the beam in the c.r.t. to the top-left-hand dot of display area two. Now the Q and W lines will be UP.

The output of gate 3 will go down and the outputs of gates 1, 4 and 5 will go UP. The output of gate 18 will go DOWN and the output of gate 19 will go UP. The V control signal will therefore also be DOWN and the dians will be switched to the Venn/Karnaugh mode.

The DOWN at gate 3 will be relayed via S_7 to gate 20 and the K control signal will go UP switching the main logic unit to the Karnaugh map mode of operation. All other outputs of this circuit to the main logic unit will be DOWN.

Fifteen more pulses from the clock generator will trace the first column of dots in display area 1. The sixteenth next pulse will set the first bistable in the X counter (E) and reset the Y counter to all zeros. $\overline{Q\overline{W}}$ will now exist and the main logic unit will be switched to Venn operation (gate 1, 5, and gate 18/19) in the same way as before. The second column of dots will then be traced out, first in display area number 1 and then in display area number 2

* assistant editor, *Wireless World*.

with a change-over to Karnaugh operation in between.

This process will repeat itself sixteen times with the main logic unit being switched from Venn to Karnaugh operation as the dot passes out of display area 1 into display area 2. After the sixteen repetitions the beam will be at the bottom right-hand corner of display area two (having scanned both display areas one and two), 512 clock pulses will have been generated, the X and Y counter will be in the following state ABCDQEF \bar{G} H \bar{W} and the main logic unit will be in the Karnaugh mode of operation.

One more clock pulse will drive the counter to $\bar{A}\bar{B}\bar{C}\bar{D}\bar{Q}\bar{E}\bar{F}\bar{G}\bar{H}\bar{W}$ and place the spot at the top left-hand corner of display area number three. QW now exists. Gate 4, S₁₃ and gate 21 will cause the main logic unit to be switched to the Truth table mode. When display area number four is reached QW will exist and gate 5, S₁₈ and gate 21 will keep the instrument in the Truth table mode. After 512 more clock pulses both display areas three and four will have scanned and the process will repeat itself starting with display area number one again.

At the same time as all this was going on the output variables of the instrument, as decoded by the various variable forming logic circuits and controlled by the V, K, and T control signals derived from Fig. 86, were being fed to some sort of external logic circuit. The output of this logic circuit was being used to intensity modulate the

c.r.t. beam either directly or via the 1 and 0 character generators as dictated by the V, K, and T control signals.

From the above description it can be seen how any of the display areas could have been switched to any of the operating modes if desired. If, for instance, S₂, S₇, S₁₂, and S₁₇ had been pressed, all four displays areas would operate in the Karnaugh map mode. If the buffer stages only of Fig. 84 were incorporated then a six variable Karnaugh map would result. It is advised that these stages be added with this modification because of the greater flexibility afforded.

Having described the circuitry required to produce the V, K and T control signals it is now necessary to have a look at the third column of the Truth table and the Truth table variable T_C.

Output $\bar{G}\bar{H}$ from the main logic unit, which, if you remember, addresses the third column of the Truth table, is inverted in gate 2 to form GH, and is fed to gates 7, 10, 13 and 16. Also fed to these gates are the four combinations of Q and W which have been inverted in the gates 6, 9, 12 and 15. The switches S₄(b), S₉(b), S₁₄(b), S₁₉(b) select C = 0 in the Truth table by feeding the outputs of gates 7, 10, 13, and 16 to gate 22. The output of gate 22 is inverted in gate 23 because the main logic unit requires the inverse of the T_C = 0 signal. For T_C = 1 S₅(b), S₁₀(b), S₁₅(b), S₂₀(b) and gates 24 and 25 are employed.

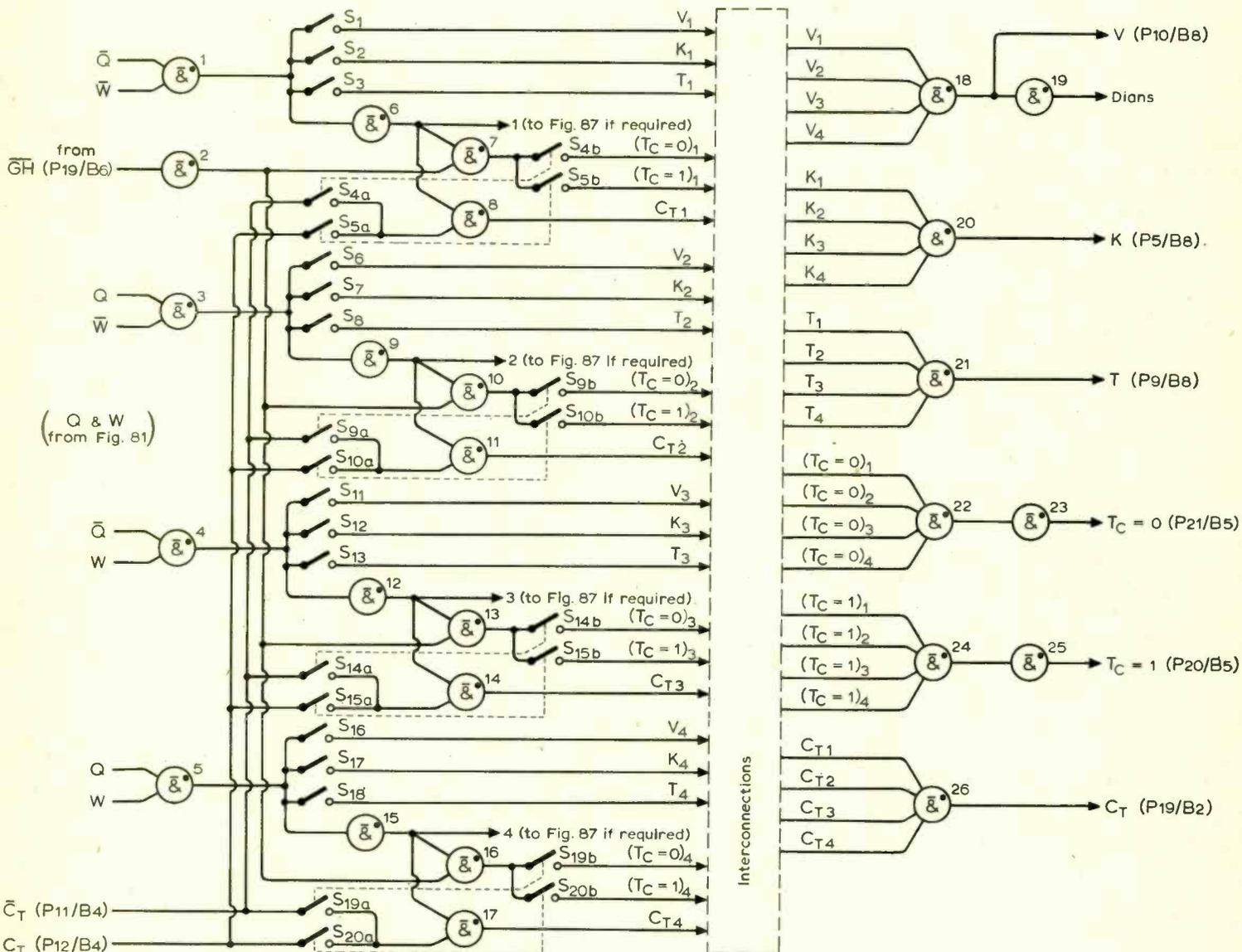


Fig. 86. The circuit of modification 7.

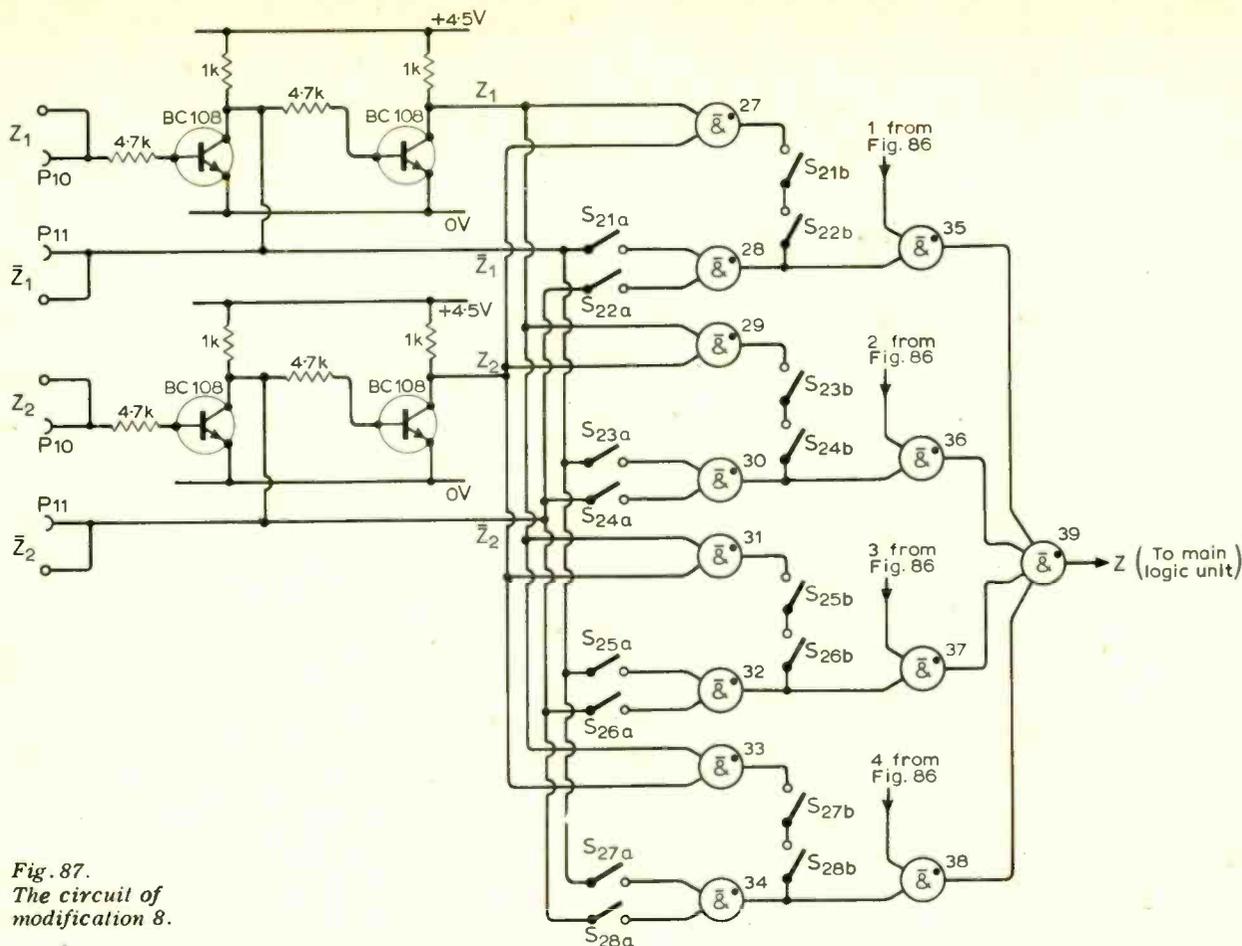


Fig. 87. The circuit of modification 8.

These switches can therefore be used to cause all 1s to be displayed in the third column of a Truth table (T_C). Another pole (a) on the same switches causes the C_T or \bar{C}_T output variable of the main logic unit to be gated with Q and W area addressing signals which are combined in gate 26 to provide C_T for the main logic unit. This ensures that when $C = 0$ in column three of a Truth table \bar{C}_T is presented to the external logic circuit, when $C = 1$ then C_T is output.

As mentioned earlier the switches S_0 (Fig. 85) do not have any electrical connections and serve only to cancel out the $C = 0$ and $C = 1$ switches so that the C column of the Truth table is blank.

8: Adding individual comparison facilities for each display area

This modification is carried only when modifications 4 and 7 have been incorporated. It enables up to two external logic circuits to be connected to the Display Aid and enables any display area to be switched to show the output of circuit one or the output of circuit two or the difference between circuit one and circuit two. The circuit diagram is shown in Fig. 87.

Z and \bar{Z} inputs to the instrument are provided by the two transistor double inverter stages. The gating system is identical to that shown in Fig. 79 and described under modification 3, only now there are four of them, one for each display area. An additional gate for each display area (35, 36, 37 and 38) combines the output of the comparators with the area address signals available at gates 6, 9, 12, and 15 of Fig. 86.

The output of gates 35, 36, 37, and 38 are combined in gate 39 to provide the Z input for the main logic unit. The layout of the switches is shown at the right hand side of

Fig. 85. Taking area one as an example: closing S_{21} will show the output of external circuit one in area one; pressing S_{22} will show the output of external circuit number two in area one; pressing both S_{21} and S_{22} will show the difference between external circuits one and two in area one.

Switch combinations

It will be interesting at this point to see how the various photographs shown in part one of this series (p. 198, May issue) were produced.

In photograph A a binary full adder was connected to the display aid, the SUM output was connected to the Z input. The switches which were pressed were as follows:

- area one: Truth table (S_3); $C = 0$ (S_4), and circuit one (S_{21}).
- area two: Truth table (S_8); $C = 1$ (S_{10}) and circuit one (S_{23}),
- area three: Karnaugh map (S_{12}); and circuit one (S_{25}),
- area four: Venn diagram (S_{16}); and circuit one (S_{27}).

For photograph B the external logic circuit was an AND gate with its output connected to the Z_1 input of the display aid. The input of the AND gate was connected to the output variables A, B and C. Switch positions were as follows:

- area one: Truth table (S_3); $C = 0$ (S_4), and circuit one (S_{21})
- area two: Truth table (S_8); $C = 1$ (S_{10}), and circuit one (S_{23})

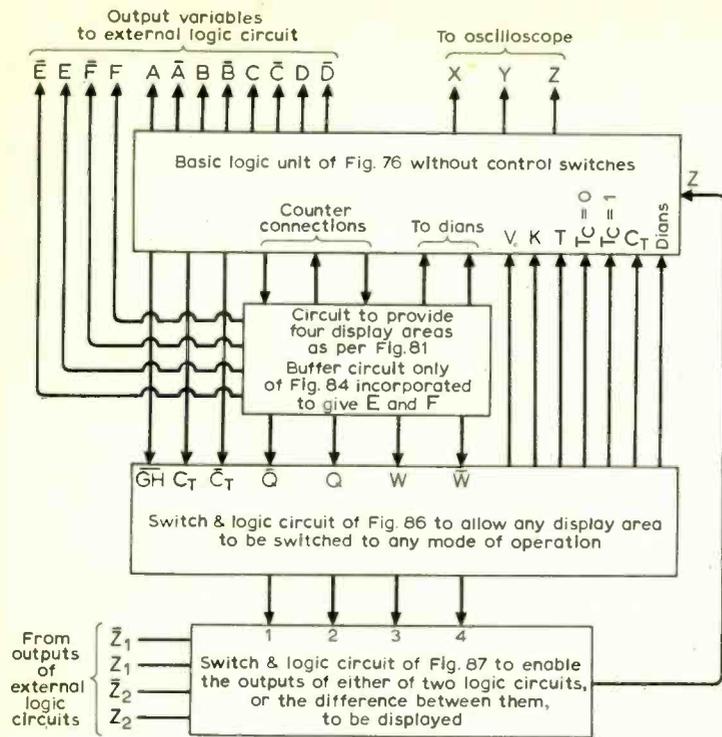


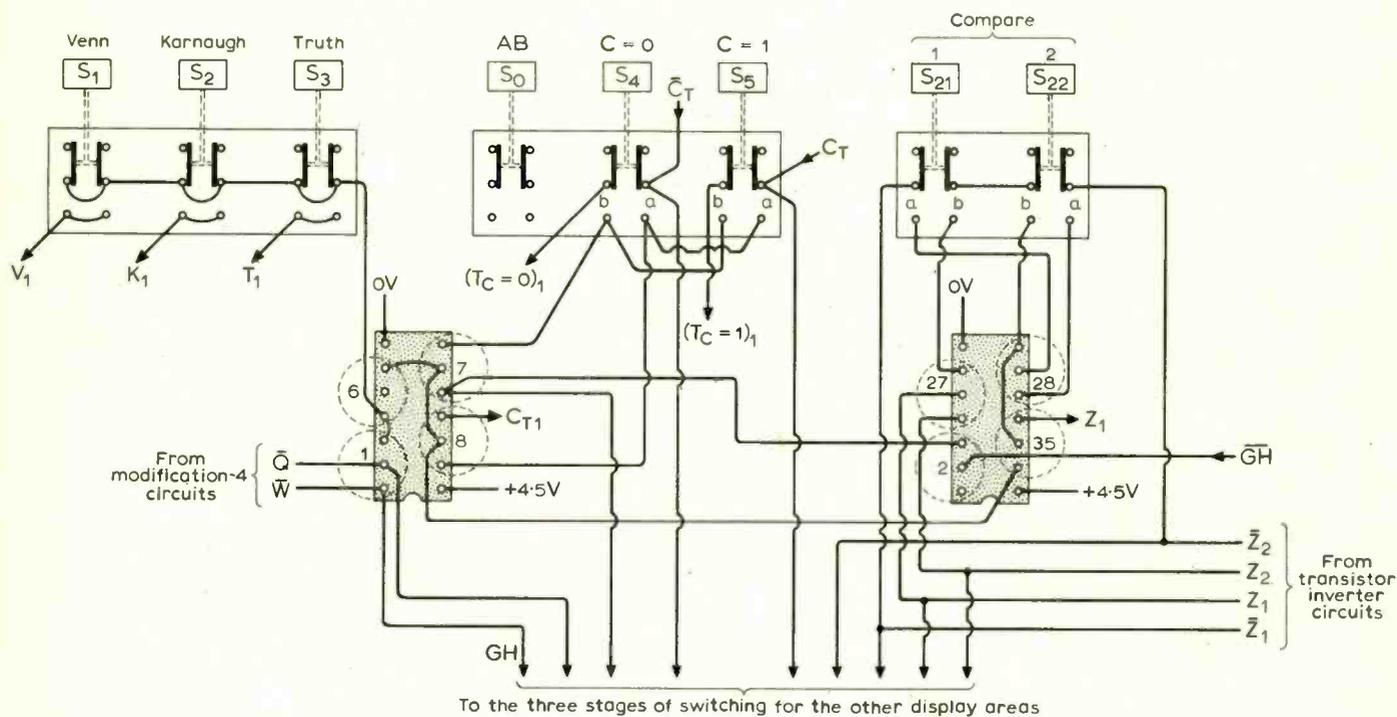
Fig. 88. A block diagram showing the interconnection of units in the type U instrument.

area three: Venn diagram (S_{11}); and circuit one (S_{25})
area four: Karnaugh map (S_{17}); and circuit one (S_{27})

In photograph C the output variable A was connected directly to the Z_1 input and the output variable \bar{A} was connected to the Z_2 input of the display aid. Switch positions were as follows:

area one: Venn diagram (S_1); and circuit one (S_{21})
area two: Karnaugh map (S_7); and circuit one (S_{23})
area three: Venn diagram (S_{11}); and circuit two (S_{26})
area four: Karnaugh map (S_{17}); and circuit two (S_{28})

Two binary adders were used to produce photograph D. One of the adders was deliberately made unserviceable and its SUM output was connected to Z_1 . The sum output



(Above) Fig. 89. Part practical layout for type U instrument. The two i.cs are ZN346Es.

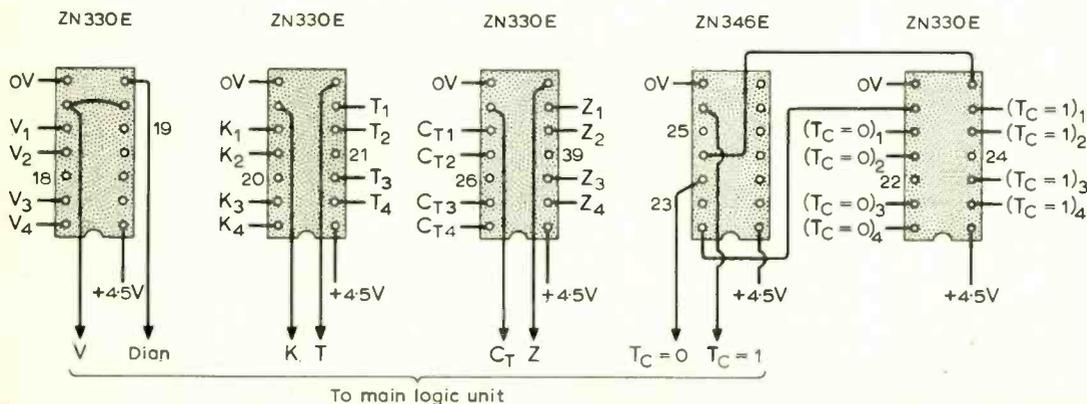


Fig. 90. More wiring details of the type U instrument.

of the serviceable adder was connected to Z_2 . Switch positions were as follows:

- area one: Venn diagram (S_1); and circuit one (S_{21})
- area two: Venn diagram (S_6); and circuit two (S_{24})
- area three: Venn diagram (S_{11}); and difference (S_{25} and S_{26})
- area four: Karnaugh map (S_{17}); and difference (S_{27} and S_{28})

The above examples were given in order that the reader may see how to operate the instrument so that the various logic and switching circuits can be more readily understood.

Building the type U logic display aid

The prototype instrument was type U as mentioned in the list of compatible modifications given last month and as such incorporates modifications 4, 7 and 8. It is proposed to give some practical details of this instrument, but of course it would be impossible to give the same detail for all 21 types.

The system block diagram is shown in Fig. 88. This does not require any comment, however, it should be of value when the time comes to interconnect all the various units.

Fig. 89 gives a wiring diagram for the switching circuits for display area number one. The three switching circuits for the other three display areas are wired-up in almost the same way. The only difference is that the \overline{GH} output of the main logic circuit only requires to be inverted once (gate 2, Fig. 86) which is done in Fig. 89. This means that when all four stages are wired-up there will be three spare two-input gates. These can be used to partly fill the need for some of the buffer-amplifiers needed for the E and F variables for six-variable Karnaugh map operation.

Fig. 90 shows how the output side of the switching circuit is wired-up. The numbers near the integrated circuits of Figs. 89 and 90 correspond to the gate numbering in Figs. 86 and 87.

If one examines Fig. 73 (p. 421, September issue) the necessary components for modifications 7 and 8 can be seen mounted on a board on the extreme right behind the mains transformer. The board in the foreground, bolted to the main logic unit, contains the parts necessary for modification 4.

Faults on this part of the circuit (modifications 7 and 8) can be very, very trying. The reader is advised to take extreme care with the construction. It is a good plan to adopt some form of colour-coding system, particularly with the switch wiring, and stick to it.

The switches themselves do not have any mounting holes, so the procedure adopted in the prototype was to solder them to mild steel angle which was bolted to the front panel; however, this is a matter of personal preference.

The description of the *Wireless World* Logic Display Aid is now complete and we wish you well with the construction.

Next month, in the last article in this series, a simple modification will be described showing how the aid may be used with a 19-inch oscilloscope and some external logic circuits will also be suggested.

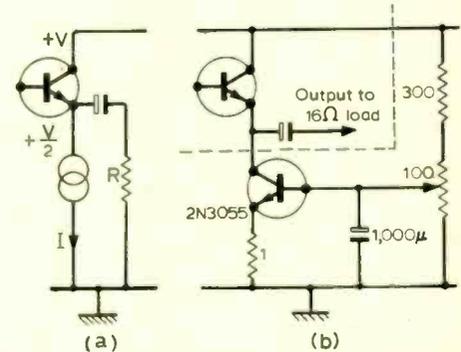
(To be concluded)

More Letters to the Editor

(Other letters on pages 518-19)

Amplifier efficiency

Mr. Vanderkooy's letter (August issue, p.381), set me thinking. Why waste audio power in an emitter load, why not replace it by a constant current source adjusted to give the correct standing current, and, of course, having a relatively high dynamic impedance? (Fig. a.). The only a.c. load is now provided by R , and so the emitter of the output transistor should be at half the supply potential.



With the transistor full on, current through the load will be, instantaneously, $(V/2)/R$ and with it cut off, the current will be I . These two currents should be equal, i.e. $I = V/(2R)$, e.g. with a supply of 30 volts and load of 15 ohms, the standing current should be 1 amp. Efficiency should be 25% if the constant current source is ideal and the output transistor has zero saturation voltage.

To test the theory, I used Mr. Vanderkooy's circuit, replacing the 22-ohm emitter resistor by the hurriedly devised and far from ideal arrangement of Fig. b. Using a supply of 32 volts and a standing current of 1 amp, output power at the onset of symmetrical clipping was just over 5 watts. Increasing the supply to 40 volts and the current to 1.2 amps, the maximum output rose to nearly 10 watts, an efficiency of about 20%. This is not a new idea—a similar circuit was used by P. F. Ridler for the output stage of his "Low Distortion RC Oscillator" (*W.W.*, August 1967, p.383), and it needs a fairly large heat-sink area, but ten watts or so may be obtained without resorting to water cooling! Of course, all one has to do now is to drive the lower transistor and one arrives at Mr. Linsley Hood's class A circuit!

IAN G. JOHNSON,
Farnborough, Hants.

Radio in airship R100

The Electrical Engineering Squadron at this Station has undertaken to renovate, on behalf of the Royal Air Force Museum, the experimental receiver, Type RX18A, from the R100 airship.

We would be grateful if you could publish this appeal for information on the receiver, especially with regard to valve types and coil winding details.

R. M. HARRISON (F/O),
R.A.F., Syerston,
Newark, Notts.

Test Your Knowledge

Series devised by L. Ibbotson* B.Sc., A.Inst.P., M.I.E.E., M.I.E.R.E.

18.: Waveguide components and techniques

In all the questions it is assumed that the basic waveguide is standard rectangular and that it is propagating the dominant mode.

- The behaviour of a waveguide component or circuit can often be inferred by analysis of the equivalent twin-transmission-line circuit. In constructing the analogue the transmission-line wires are taken to lie:
 - along the centre lines of the broad walls of the guide
 - along the centre lines of the narrow walls of the guide
 - along a pair of opposite corners of the guide
 - along a pair of adjacent corners of the guide separated by a broad guide wall.
- If a waveguide component, in which changes of guide dimensions occur, is to be designed with the aid of the equivalent transmission-line circuit, appropriate values of line impedances to use for the various guide sections are in each case:
 - the wave impedance of the section of guide
 - the wave impedance multiplied by the narrow guide dimension
 - the wave impedance multiplied by the wide guide dimension
 - the wave impedance multiplied by the narrow guide dimension and divided by the wide guide dimension.
- A waveguide component may be found to contain an "iris" (a thin metal plate or plates perpendicular to the guide axis extending part of the way across). The purpose of the iris is generally to:
 - protect the component by providing a point at which sparking will occur first if the component is overloaded
 - "match out" a mismatch in the component
 - suppress higher order modes
 - prevent dust from reaching certain parts of the component.
- A waveguide component is required to have a slot in the guide wall parallel to the axis of the guide, and the slot must not radiate a significant amount of microwave energy. The slot:
 - may be anywhere in the guide walls
 - may be anywhere in a wide wall, but must not be in a narrow wall
 - must be either along the centre line of a wide wall or a narrow wall
 - must be along the centre line of a wide wall.

5. In order to determine, with the aid of a Smith Chart, a point at which a susceptance can be placed to match a mismatched waveguide termination, three of the following need to be known (and nothing more). Select the redundant information:

- the v.s.w.r.
- the position of the voltage minimum nearest to the source of mismatch
- the frequency
- the guide-wavelength.

6. The principle of reciprocity is obeyed:

- by all waveguide components
- by no waveguide components
- by all waveguide components except certain ferrite devices
- only by certain waveguide components containing ferrites.

7. If the construction of a waveguide component requires two similar small discontinuities to be introduced into the guide, the distance between them:

- should be as small as possible
- should be as large as possible
- should be a whole number of half guide-wavelengths.
- should be an odd whole number of quarter guide-wavelengths.

8. In a microwave resonant cavity the electric and magnetic fields:

- have maximum amplitudes which coincide in space, and are in phase
- have maximum amplitudes which coincide in space, and are in phase quadrature
- are in phase, and the maximum amplitude of one coincides in space with the minimum amplitude of the other
- are in phase quadrature, and the maximum amplitude of one coincides in space with the minimum amplitude of the other.

9. It is desired to build a resonant cavity, to resonate at a given frequency, having as high a Q as possible (the general form of the cavity being specified). The cavity should be designed to have:

- as large a volume as possible
- as large a surface area as possible
- a maximum ratio of volume to surface area
- a minimum ratio of volume to surface area.

10. A resonant cavity terminates a waveguide. The v.s.w.r. in the guide at the

resonant frequency of the cavity is found to be 2:1 and the position of the standing-wave pattern at resonance is the same as its position when the frequency is well away from resonance. The coupling parameter of the cavity is:

- zero, (b) $\frac{1}{2}$, (c) unity, (d) 2.

11. Most microwave generators require to feed a waveguide in which the V.S.W.R. at the input does not exceed a specified value (often 1.5:1). If a generator feeds a waveguide with a large mismatch the main effect is:

- electrical breakdown in the waveguide
- a reduction of power output from the generator in all cases
- a change in generator frequency only
- both power output and frequency instability.

12. In a waveguide choke coupling an effective good contact is achieved at the waveguide wall by moving the actual point of physical contact one quarter wavelength back along a half-wave short-circuited guide section (the choke). The choke ring cut into the flange always has a much wider slot than the gap between the flanges (which forms the first half of the choke). The reason for this is:

- convenience of manufacture
- to give the joint broad-band properties.
- to prevent arcing at the corner
- so that dirt will not be trapped in the choke ring.

13. In a simple coaxial line to waveguide transformer (probe launching section) the distance between the probe and the short-circuit in the guide should be approximately:

- one half free-space wavelength
- one half guide wavelength
- one quarter free-space wavelength
- one quarter guide wavelength.

14. In a directional coupler the coupling holes:

- must be in broad faces of both guides
- must be in narrow faces of both guides
- must be in the broad face of one guide and the narrow face of the other
- may be either in the broad faces of both guides or the narrow faces of both guides.

15. In a compensated magic T (hybrid junction):

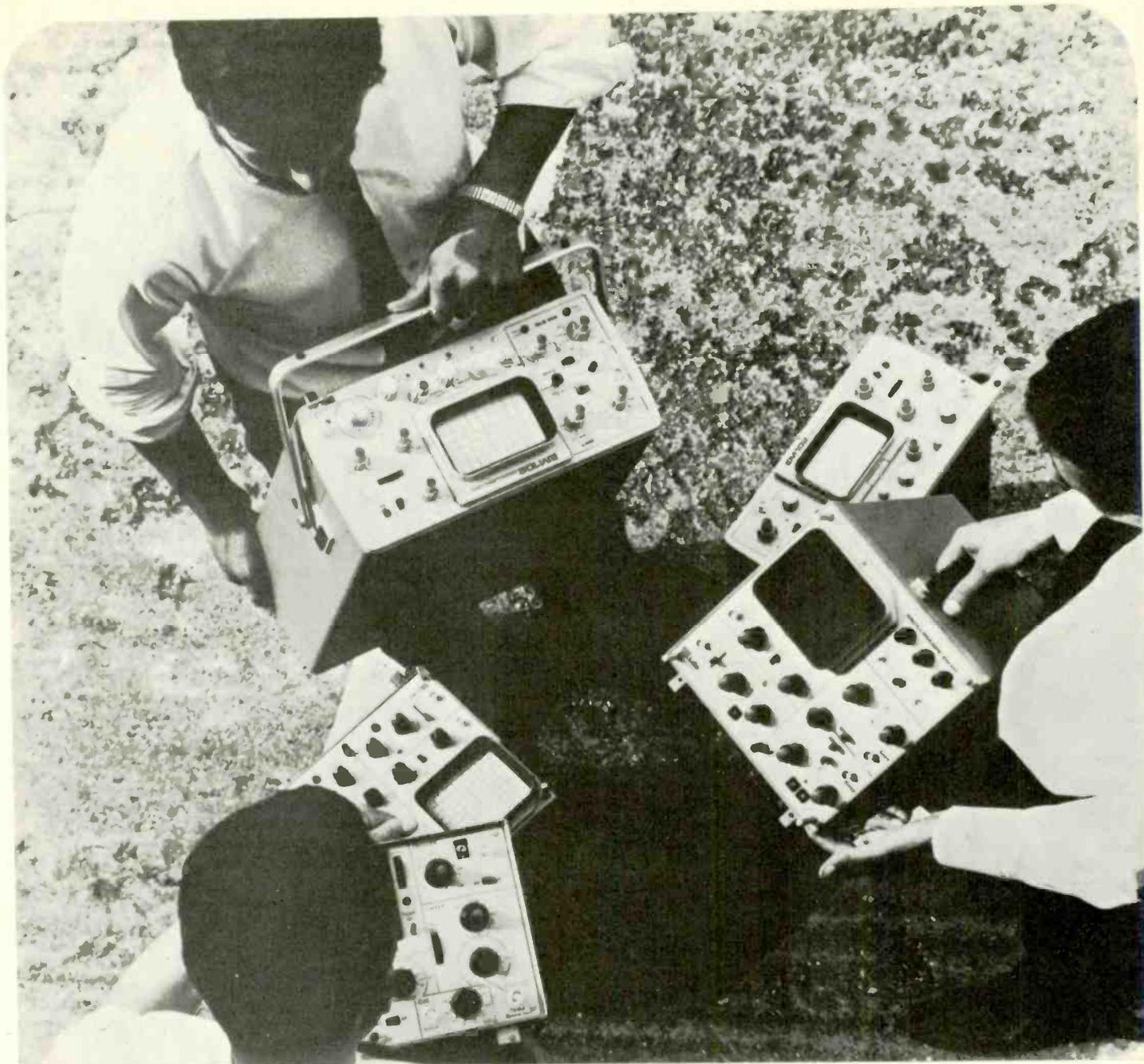
- each arm is isolated from the other three
- each arm is isolated from two of the other three
- each arm is isolated from the arm opposite
- only one pair of arms are isolated from each other.

16. Of the forms of attenuator listed below one reflects energy rather than absorbing it. It is:

- the resistive film attenuator
- the piston attenuator
- the flap attenuator
- the rotary vane attenuator.

Answers and comments, page 549

* West Ham College of Technology, London, E.15.



Detectives?

Our clue finders are "battery powered" for portability; "tough" for reliability; and "economical".

Our range of portable battery/mains oscilloscopes covers the majority of service requirements.

Advanced technology and design ensure fast detection of equipment failure.

we'll solve your problem

Prices from £130.

For further advice or technical information write or ring.



SE Laboratories (Engineering) Limited. North Feltham Trading Estate, Feltham, Middlesex.
Telephone: 01-890-1166 & 5246 (sales); 01-890-5876 (works). Telegrams: Selab, Feltham. Telex: 23995.
Northern Sales Office, Bessell Lane, Stapleford, Nottingham. Telephone: Sandiacre 3255.

WW-126 FOR FURTHER DETAILS

TECHNICAL TRAINING

in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

Many diploma and examination courses available, including expert coaching for:

- C. & G. Telecommunication Techns'. Certs.
- C. & G. Electronic Servicing
- R.T.E.B. Radio/T.V. Servicing Certificate
- Radio Amateurs' Examination
- P.M.G. Certs. in Radiotelegraphy
- General Certificate of Education, etc.

Examination Students coached until successful

NEW SELF-BUILD RADIO COURSES

Learn as you build. You can learn both the theory and practice of valve and transistor circuits, and servicing work while building your own 5-valve receiver, transistor portable, and high-grade test instruments, incl. professional-type valve volt meter—all under expert tuition. Transistor Portable available as separate course.

POST THIS COUPON TODAY

for full details of ICS courses in Radio, T.V. and Electronics.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 222, Intertext House, Stewarts Road, London, S.W.8

Please send me the ICS prospectus—free and without obligation.

(state Subject or Exam.)

NAME

ADDRESS

10/69

INTERNATIONAL CORRESPONDENCE SCHOOLS

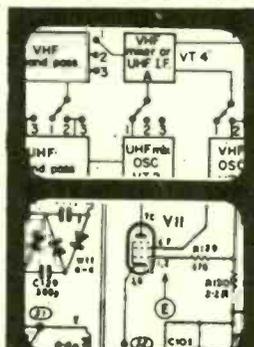
WW—128 FOR FURTHER DETAILS

Speed up SERVICING -step up PROFITS



with

RADIO & TV SERVICING



Repair data on
Colour TV
MONO TV. RADIOS.
RADIOGRAMS. CAR
RADIOS. RECORD
PLAYERS. TAPE RE-
CORDERS.



Here in 4 handy volumes you have on call the vital repair information needed to beat the frustration and time loss that fritters away the opportunity to earn more. Packed with 2,657 circuits, printed panel and component layout diagrams, tables and waveform graphs, it covers over 1,000 of the popular 1965-69 TVs, Radios, Radiograms, Car Radios, Record Players, and Tape Recorders—including the latest information on COLOUR TV.

GUARANTEED MONEY SPINNER

Written by a team of expert Research Engineers, Radio & TV Servicing speeds up repair work for year after year—there's no other publication like it and is much sought after in the trade—guaranteed to speed up repair work and increase your earnings.

OVER 2,175 PAGES

Over 1,000 popular models from 1965-1969.

ALL THESE MAKES COVERED

Aiwa, Alba, Baird, Beogram, Beolit, Bleupunkt, B.R.C., Bush, Carousel, Cossor, Dansette, Decca, Defiant, Dynaport, Dynatron, Eddystone, Ekco, Elizabethan, Ever Ready, Ferguson, Ferranti, Fidelity, G.E.C., Grundig, Hacker, H.M.V., Hitachi, Invicta, K.B., Klinger, Kolster-Brandes, Loewe-Opta, McMichael, Marconiphone, Masteradio, Monogram, Motorola, Murphy, National, Newmatic, Pam, Perdio, Peto-Scott, Philco, Philips, Portadyne, Pye, Radiomobile, Radlonette, R.G.D., Regentone, Roberts' Radio, Robux, Sanyo, Sharp, Smith's Radiomobile, Sobel, Sony, Standard, S.T.C., Stella, Stereosound, Telefunken, Teletron, Thorn, Trans Arena, Ultra, Unitra, Van Der Molen, World Radio.

Examine Radio & TV Servicing at home without obligation to buy—send no money—just post coupon today.

Sent by post on 7 days FREE TRIAL

To: Buckingham Press Ltd., P.O. Box 14, Gatehouse Rd., Aylesbury, Bucks. Please send RADIO & TV SERVICING—4 volumes, without obligation to buy. I will return the books in 8 days or post:

Tick Full cash price of £16. or
here 20/- dep. and 16 monthly payments of 20/-, paying £17 in all.
(If you are under 21 your father must fill in coupon.)

Full Name (BLOCK LETTERS PLEASE)

Address

County

Occupation

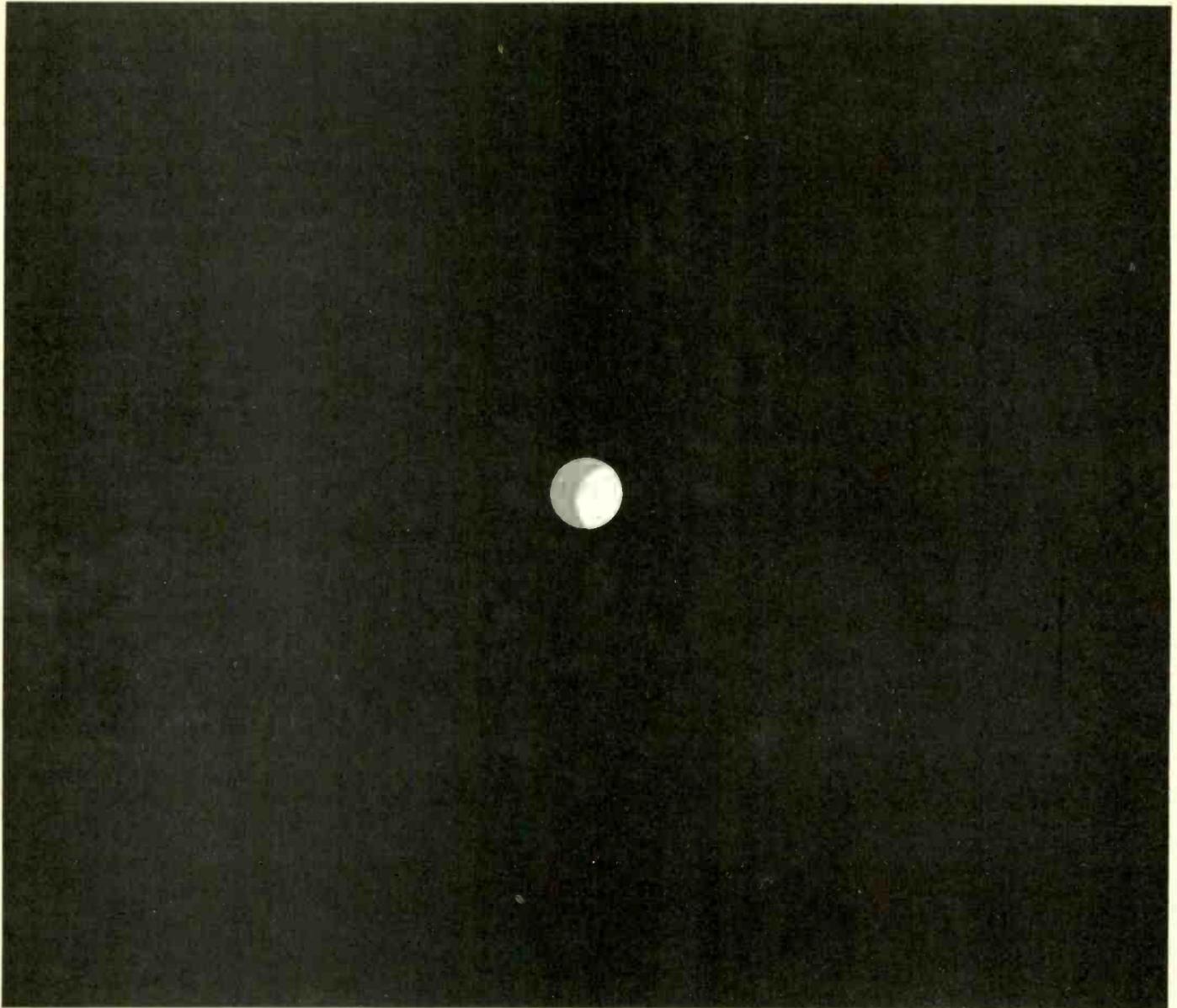
Signature

RV4/5083

Please tick (if) here
The address on left is
my/our property
Rented
unfurnished
Furnished
Temporary
address
If none of the above
please answer here

Mr.
Mrs.
Miss

WW—129 FOR FURTHER DETAILS



rare eclipse

The apertures in a cathode ray tube gun must be aligned precisely in spite of production tolerances in the six or more electrodes involved. Errors of the order of a tenth of a thou make all the difference if a round, crisp spot is to be maintained. The requirement is a dead fit for each component, no less. To this end, BRIMAR have developed their own methods for the production of assembly jigs to meet these exacting requirements.

Even after assembly in such accurate jigs as these, the guns are still subjected to rigorous 100% inspection; including a final optical test of alignment, where even fractional differences mean rejection.

And in addition to this, BRIMAR have an unparalleled capability in chemistry, electron optics and vacuum physics enabling them to



offer the widest design diversity backed by a *personalised customer service*. This service, provided by engineers with extensive experience of the electronics industry, covers advice on tube characteristics, operating conditions and associated components.

Tailored packaging and reliable delivery to meet production schedules are also part of the BRIMAR Service.

Want to know more about BRIMAR Industrial Cathode Ray Tubes?—ask to see our latest catalogue.

THORN Thorn Radio Valves and Tubes Ltd.
7 Soho Square, London, W1V 6DN Tel: 01-437 5233

WW—108 FOR FURTHER DETAILS

World of Amateur Radio

Local authorities and amateurs

British amateurs are concerned at the difficulties which are sometimes encountered from local and government authorities in the installation of transmitting and receiving aerials on residential property (often it seems as an outcome of complaints of television interference). The main problems arise from the Town and Country Planning Act, 1962, which is increasingly being interpreted as requiring that planning permission should be obtained for even relatively modest masts and towers and aerial arrays.

A further threat is that, with the availability of all-u.h.f. television, some local authorities are believed to be preparing to extend their regulations to v.h.f. aerials (for example for the 70 or 144 MHz bands) which would previously have been regarded as of roughly similar construction to domestic television aerials and therefore not requiring planning permission. Attempts by the R.S.G.B. to exclude from planning permission aerial masts and towers of under 35ft in height and carrying typical amateur aerials have been rejected by the Minister of Housing and Local Government. The Ministry claims that the local planning authorities should continue to have the opportunity to consider individual proposals.

Some amateurs have also been faced with demands from local authorities for an increase of rateable values of homes where there is a large amateur aerial installation. While to date it seems that most of these demands have been successfully contested,

the Treasury has rejected an R.S.G.B. request that no such proposals for rating increases should be made.

There can be little doubt that current legislation provides the authorities, where they so wish, with the means to harass, rather than encourage, amateur activity.

Birth of broadcasting

Regular broadcasting in the U.K. was initiated, not only at the request of, but through the insistence of the experimental amateur—so commented *Wireless World* in 1923. This era has been recalled recently by special amateur v.h.f. and h.f. contests held as part of the Dutch commemoration of what (at last) is now generally regarded as the start, 50 years ago, of the first regular radio broadcasting service in the world—the concerts and talks broadcast over PCGG at The Hague from November 6th, 1919 onwards. These concerts were initiated and advertised by a young Dutch engineer Hanso Idzerda who, even before the first World War, had founded a Technical Wireless Bureau and who, in 1917, had persuaded Philips at Eindhoven to manufacture what became known as the Philips IDZ valve.

The Hague concerts pre-dated those from KDKA, Pittsburg, which has often been given credit for the start of regular broadcasting. Incidentally, the first musical transmission was made by Fessenden on an h.f. alternator station in 1906.

Idzerda's later life was marked by disappointments, with his pioneering achievements often belittled as large firms came into

the field. His death was equally tragic. He was executed by the Germans in November 1944 on suspicion of espionage when caught searching for fragments of an exploded V2 rocket in a prohibited area.

There can be little doubt that the Dutch concerts helped create the demand by wireless enthusiasts in the U.K. for the start of regular broadcasting. In 1921, following an appeal in *Wireless World*, about £750 was subscribed by British enthusiasts to allow the concerts to continue.

Television interference

The recently released Post Office statistics for cases of interference to television and radio reception in 1968 show a marked increase in the number ascribed to amateur and other transmitters. Of 70,254 interference cases closed by the P.O. investigators, 1151 or just over 1.5% were ascribed to amateur transmitters. The number has risen appreciably in the past five years or so. It is widely believed by amateurs that modern TV receiver installations, particularly those fitted with transistor wideband mast-head (or back-of-set) pre-amplifiers, are much more susceptible to strong local signals on frequencies far removed from the TV channels than older receivers. Another increasing problem is the number of viewers using set-top aerials which can be much more susceptible to interference.

Amateurs are however hoping that the spread of u.h.f. television will result in a marked easing of the position, since instances of amateurs causing interference on Bands IV and V are far rarer than on v.h.f.

The Post Office statistics also show the rising incidence of interference generated by thermostat controls in domestic gas and oil-fired central heating systems, particularly after some months of operation. Electrical interference from such contact devices now exceeds that from electric motors, previously the most frequent cause of interference.

In Brief: Membership of the R.S.G.B., in the year to June 30th, rose by 1347 to a total of 15,392—this compares with an increase of 644 in the previous year. The membership now includes rather over one-half (some 8000) of all British licensed amateurs. Its overseas membership is 1378 . . . The Australian Post Office has approved the installation by amateurs of unattended v.h.f. repeater stations operating on the 144-MHz band . . . The French P.T.T. is to support, at the next congress of the Universal Postal Union, a proposal that would admit QSL cards in the "small packet" post . . . The Scottish v.h.f. convention is being held at The Carlton Hotel, North Bridge, Edinburgh, on October 26th; the convention includes a dinner, lectures and an exhibition (GM3OWU, "Westerlea", 9 Juniper Avenue, Juniper Green, Midlothian, EH14 5EG) . . . For the first time amateurs have spanned the English Channel using the 10-GHz band. Dain Evans, G3RPE, operating portable near Dover contacted the French amateur station F2FO/P near Cap Gris Nez. The British station had an output of only 15mW with a 10-inch dish aerial.

PAT HAWKER, G3VA

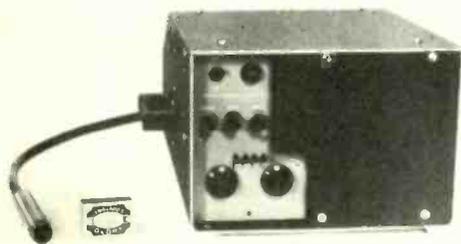


Arthur Robinson, G3MDW, secretary of the Northern Heights Amateur Radio Society, Yorkshire, photographed during a visit to W1BB, the well-known station near Boston, Massachusetts of Stewart Perry, the veteran "Top-Band" (1.8MHz) enthusiast. The current "Top Band" DX season has opened with a number of notable long-distance contacts including several between Australia and the Eastern United States.

New Products

Sub-miniature Television Camera

A sub-miniature television camera (type BC1103), believed to be the smallest commercially available in the world, has been designed by E.M.I. for inspection of the inside of pipes and for operation in inaccessible locations under arduous conditions. The BC1103 consists of two units, the cylindrical camera head and a camera control unit. The camera head measures only 24mm in diameter and 122mm in length, is complete with integral lens and lighting unit, and is sealed to prevent the ingress of moisture and dirt. A 13mm (½-inch) vidicon camera tube is used and the high performance head amplifier employs f.e.t.s and integrated circuits. The lens lighting unit incorporates a lens with an angle of view of approximately 40°. The f/6 camera lens gives adequate depth of field for pipes of bore from 25mm to 65mm. The camera head can be connected to its associated control unit by up to 65m of steel reinforced camera cable. The camera control unit



(shown in the photograph with the camera) weighs only 19kg. The control unit provides all the power, scanning and processing circuits for the camera channel. Broadcast type 625/525 line synchronizing pulses ensure compatibility with all makes of video monitors and video tape recorders. Three camera controls (target, beam and electrical focusing), in addition to the lighting intensity controls and the power on/off switch are mounted on a recessed front panel. An air pump is fitted to the camera control unit to provide cooling and to enable the camera head to be operated continuously in ambient temperatures up to 45°C. E.M.I. Electronics Ltd, Hayes, Middx.

WW307 for further details

Digital A.C./D.C. Multimeter

Apart from the benefits gained from a digital display, the TE 360 multimeter from Guest International exhibits best-case accuracy figures of $\pm 0.1\%$ of reading, $\pm 0.1\%$ of f.s.d., and is capable of a wide variety of measurements. These include 20 ranges covering a.c. and d.c. voltage and d.c. current, and five ranges of resistance. Voltage may be measured up to 1kV, current up to 2A, and resistance up to 2M Ω

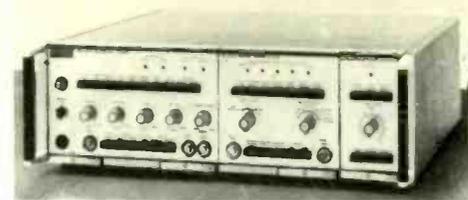


Input impedance varies from 10M Ω to 1kM Ω on d.c. volts and is 10M Ω on all a.c. voltage ranges. The display includes 3 digits and over-range indication, polarity and decimal points. Readings are given at 0.2s intervals and there are optional facilities for b.c.d. and print command outputs. Power requirements are 115 or 230V, 50 to 60Hz. A battery version is available. Price £198. Guest International Ltd, Nicholas House, Briggstock Road, Thornton Heath, Surrey, CR4 7JA.

WW327 for further details

Video Test-signal Generator

A complete set of signals for checking and measuring the video characteristics of television studio equipment, transmission links and transmitters is provided by a new test-signal generator available from Pye Unicam. All signals generated conform to C.C.I.R., I.E.C., and C.M.T.T. requirements. The generator, Philips PM 5572/74, features integrated-circuit design virtually throughout and consists of three modules which are housed in a case 132mm high. The three units—blanking mixer and power supply unit, sine-wave generator and pulse generator—are interconnected by either cable or plug-in connectors, and the complete generator can be expanded through the addition of further modules. The sine-wave unit can be used as a fixed-frequency, multiburst or video-sweep generator. In the first mode of operation it provides 1-10MHz signals variable in 1MHz steps. In the second, it produces 1-5MHz multiburst signals with or without black-white reference lines, and in the third it gives sweep signals from 100kHz—10MHz with or without 1MHz markers. Various types of test signal for checking the performance of video-transmission circuits, video-amplifiers, etc., are provided by the pulse generator unit. These include square-wave, sawtooth, staircase and sine² signals. Square-wave signals are available with repetition rates of 0.5 and 50Hz, and 15 and 250kHz, and all have risetimes of less than 60ns. However, filters can be switched in to ensure standard risetimes. Sawtooth signals



provided consist of line-frequency sawtooths with or without intermediate lines at the black-white level. The staircase signal has either five or ten steps. Both types of signal can have superimposed 1-10MHz or colour sub-carrier signals added in the blanking mixer. Where a superimposed colour sub-carrier is used with the above signal, it is also possible to switch in a colour-burst signal. The amplitude of all components in the composite signal can be adjusted via controls on the blanking mixer, and other controls permit, for example, black-white signals to be clipped or limited as required. It is also possible to invert the set-up level and include or exclude frame information from the composite signal. Pye Unicam Ltd, York Street, Cambridge.

WW310 for further details

Four-quadrant Multiplier

Philbrick/Nexus Research, is now offering a small four-quadrant multiplier. The model 4450 is compatible for use as a computing element in the laboratory and, in applications where an accurate multiplication process is required with no limitations as to the polarity of the input signals. Several applications such as modulation, frequency doubling, and power measurements, can be accomplished using the model 4450. The multiplier operates at rated accuracy to 10kHz with full output voltage capabilities to 100kHz. Its output is representative of the instantaneous product of two input signals. Only one external



trim is required for setting up. An optional scale factor trim may be used to improve accuracy to $\pm 0.6\%$ typical ($\pm 1\%$ maximum) referred to 10V full-scale output. When scale-factor trim is not used, accuracy is $\pm 1\%$ typical and $\pm 2\%$ maximum. The price of the model 4450 in quantities of 1-9 is £41 10s each. Philbrick/Nexus Research, 81a North Street, Chichester, Sussex.

WW309 for further details

Frequency-synthesized Drive Unit

An h.f. drive unit, designated type GK 203, is announced by the Communications Division of Redifon. All solid-state and self-contained, with integral power unit, the GK 203 uses frequency synthesis to develop 285,000 channels in 100Hz steps from 1.5 to 30MHz and to generate modulated signals in seventeen selectable modes of transmission. The new unit can be used with

most h.f. transmitters and linear amplifiers. While the GK 203 will accept an input from an external frequency standard, it incorporates an internal reference source which can be used as a standard for other equipment. Where several of these drive units are used, an economy may be effected by omitting the reference source from all except one master unit. Transmission modes cover c.w., m.c.w., d.s.b., compatible a.m., s.s.b. with fully suppressed carrier or with pilot carrier at -16dB or -26dB levels, and, as an optional extra facility, i.s.b. at either of two pilot carrier levels. On all services employing a single sideband the u.s.b. or l.s.b. mode is selectable by a front-panel switch. Automatic volume compression can be switched in to maintain a high modulation index even at



low speech levels, and automatic voice or tone activation of transmit/stand-by switching can also be selected. Sidetone and two forms of muting are available for associated receiver, to provide aerial muting or a.g.c. desensitizing. Redifon Ltd, Broomhill Road, Wandsworth, London S.W.18.

WW329 for further details

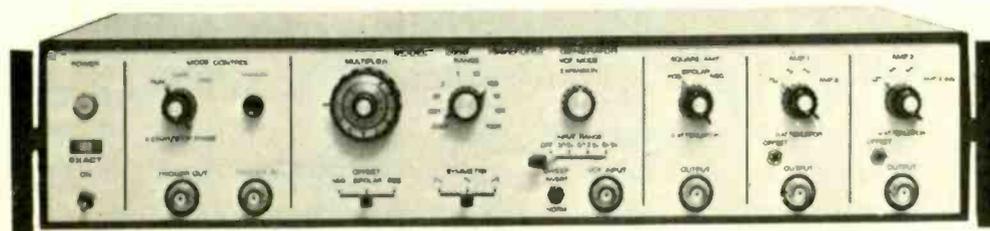
6,000-watt Amplifier

A 6,000-watt amplifier has been developed by Derritron. Whilst primarily designed for operating with a 1950lb thrust vibrator, this amplifier can be used as a variable frequency power source. The amplifier incorporates an oscillator and a closed-circuit water cooling system, and uses silicon transistors throughout. Check-out facilities are included and the amplifier is protected against overload. Derritron Electronics Ltd, Sedlescombe Road North, Hastings, Sussex.

WW314 for further details

Multi-waveform Generators

The series 500 waveform generators from Environmental Equipments is designed to provide the functions of many different instruments, such as square-wave generator, sine-wave oscillator, sweep generator, f.m. modulator, variable repetition-rate pulse-generator, ramp and raster generator, stimulation and simulation signal in medical research, control signals for aerospace and environmental testing. These generators feature bipolar-sine, square, triangle, ramp, reverse ramp and pulse outputs. In addition models 504B and 505B add haversine and haversine-triangle waveforms. The wide frequency range extends from 0.0001Hz (greater than 2 hours) to 1MHz (1μs) covering requirements from biological to radio frequencies. Models 503B and 505B offer precise control of frequency by an external voltage. By applying a 0 to +5V, 0 to -5V, or 0 to ±2½V the frequency can be swept



over a 50:1 range—usable range is 100:1. All models have triple output amplifiers giving push-pull output if required, high output voltage, and adjustable d.c. offset. Gating, triggering (single shot) and variable start/stop phase are also available. Typical waveform specifications are: sine distortion, less than 1%, triangle linearity better than 99%, square wave rise/fall times 50ns. Environmental Equipments Ltd, Denton Road, Wokingham, Berks.

WW338 for further details

Solid-state High-voltage Equipment

Miles Hivolt have produced an instrument enabling a 25kV 1 mA supply to be contained within a panel height of only 133mm. The output of this instrument, the Hivolt TH25, can be short-circuited indefinitely, or load flash-over can occur without damage either to the driver transistors or the associated circuits. Plug-in printed circuit boards are used in a modular design. The e.h.t. generator comprises an oscillator module and a moulded voltage multiplier stack. The TH25 is fully metered for current measurement. The voltage is set by means of a ten-turn potentiometer. Although the Hivolt TH25 is produced in such a small size, heat dissipation has been kept extremely low and there is no undue temperature rise. The equipment is designed for bench or rack mounting. Alternatively, the company are supplying the model TH20 which may be accommodated in manufacturers' equipment and as such does not require metering. In this case the voltage adjustment is by means of a ten-turn preset potentiometer normally set by the user within the range 10-20kV. Miles Hivolt Ltd, Shoreham, Sussex.

WW306 for further details

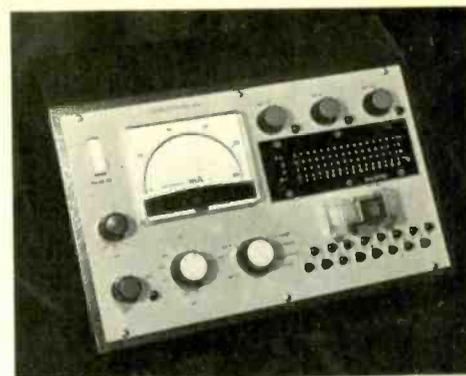
Transistor-switched Indicator Lamps

Available from Oxley Developments is a new range of transistor-switched indicator lamps, for use with negative logic. They use a p-n-p transistor, and are switched ON by a negative signal. The new units have complementary characteristics to the current range of transistor-switched indicator lamps. The "Barb" feature permits simple fixing on the front of the panel and allows close grouping of the units. The removable lens cap, available in seven colours, facilitates bulb replacement from the front of the panel. Also, lens caps can be supplied which are virtually unbreakable. Oxley Developments Company Ltd, Priory Park, Ulverston, North Lancs.

WW319 for further details

Digital Integrated Circuit Tester

A compact, low cost, integrated circuit tester, manufactured by John Reeve Instruments, (designated the 51B) provides push-button selection of any test pin on most standard types of d.t.l. and t.t.l. circuits. Measurements are displayed on a 5in scale-length meter. Fully protected against overload and fitted with self-contained variable

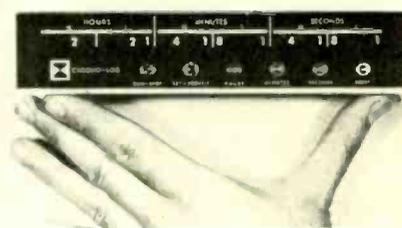


power supplies and a pulse generator, the instrument is completely portable. Flexibility in operation is assured by utilizing manual control and dispensing with the need for programming cards. Up to 16 circuit pins are provided for on the basic instrument and packages of any configuration may be tested by using test sockets with adaptors which plug into the front panel of the instrument. The tester can be used in conjunction with various items of ancillary equipment for checking other types of logic or displaying circuit characteristics on a transistor curve tracer. Fully automatic functional tests and semi-automatic test sequencing can be carried out using special plug-in units. Price £235. John Reeve Instruments, 8 Ownstead Gardens, South Croydon, Surrey. CR2 0HH.

WW303 for further details

Digital Clock and Time Code Generator

A series of integrated circuit digital clocks and time code generators is available from Sintrom Electronics. The digital clock, the 30,000, designed for use with computers, data logging, data processing and digital readout systems requiring real or elapsed time inputs, is available in over 7,000 standard versions. Outputs, in b.d.c. or Nixie decimal front panel displays, can be in units of less than a second or as long as a month. The b.c.d. output is available in serial and/or parallel format. A wide variety



of timebases is available. An interlock circuit allows the external system to 'hold' the clock during readout without introducing any timing error. The time code generator, which provides I.R.I.G. and N.A.S.A. time code formats in both modulated carrier and level shift forms in addition to b.c.d. outputs, provides timing information to analogue recorders as well as to digital systems. Many versions are available with choices of timebase, power supply, output format and displays. Sintrom Electronics Ltd, 2 Castle Hill Terrace, Maidenhead, Berks.

WW331 for further details

L.F. Signal Generator

A v.l.f. and l.f. signal generator (type 422) is announced by the Airmec division of Racal. It is a solid-state crystal-monitored digital-display instrument, and has a continuously variable output from 0.005Hz to 50kHz. The 10V square



and sinewave outputs are available via a built-in matched $600\ \Omega$ 80dB attenuator and an unattenuated triangular output is provided at 5V p-p about earth. The 422 is suitable for many applications, including the audio, servo and medical fields. A coarse tuning control gives continuity of tuning by making the direction of rotation for frequency increase reversible for successive half-ranges of the frequency decade switch. This "zig-zag" arrangement obviates the necessity of reversing the coarse control back over its full travel when switching between decades. Accuracy is up to ± 2 parts in 10^5 with stability of 1 in 10^4 over 30min. The precision with which selected frequencies are displayed is demonstrated by the least significant digit in the readout indicating micro-hertz for the lowest frequency range. The use of high-frequency basic oscillatory circuit ensures that the output frequency can be altered with no appreciable time delay. This, together with the fast presentation readout time of 110 milliseconds for any frequency, enables changes of output frequency of the instrument to be effected and displayed instantaneously. Racal Instruments Ltd, Bennet Road, Reading, Berks.

WW302 for further details

Miniaturized Reed Switch

The FR/Hamlin reed switch MTRR-2 has been reduced in size. The glass length is now 0.54in (13.7mm) instead of 0.625in, but the diameter remains at 0.090in. Contact rating is 10W maximum at 250mA. The off-centre gap makes the MTRR-2 ideal for permanent magnet applications. FR Electronics, Wimborne, Dorset.

WW334 for further details

Megohmmeters

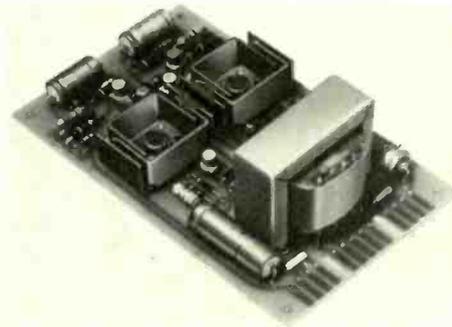
General Radio have announced two new megohmmeters; types 1863 and 1864. These meters are useful for measuring insulating materials as well as capacitor or semiconductor leakage. Although similar in appearance and accuracy, their operating ranges differ in order to meet differing needs. The 1863 can measure resistances from $50k\ \Omega$ to $20\ T\ \Omega$ ($2 \times 10^{13}\ \Omega$) at five test voltages from 50 to 500V. The 1864 (illustrated) can measure resistances from $50k\ \Omega$ to $200\ T\ \Omega$ at 200 test voltages from 10 to 1000V. Each



has an output voltage that is proportional to meter reading for limit testing. General Radio Company (U.K.) Ltd, Bourne End, Bucks. WW301 for further details

Op. Amp. Power Supply

Weir's compact new model 915/912 power supply is suitable for use with most makes of operational amplifier requiring a balanced 12 or 15V regulated d.c. supply at currents up to 100mA. The units have long-term overload and short-circuit protection effected by constant current limiting at approximately 120% of rating. The two outputs can also be used in series to provide single outputs of 30V or 24V at 100mA. Both outputs have dual remote sensing for use where the power unit has to be located at some distance



from its load. Connections can be made via a printed circuit edge connector which is supplied with the unit. Regulation drift is less than 0.05%. Ripple and noise are less than 1mV p-p. Weir Electronics Ltd, Durban Road, Bognor Regis, Sussex.

WW318 for further details

Wire-wound Resistors

Impectron now distribute a resistor, called the Cerwistor, in which instead of the usual method of winding the resistance wire on the outside of a tube or bar of porcelain it lies *inside* the porcelain. This construction ensures that even the thinnest resistance wire is given mechanical protection. The Cerwistor is small in relation to the rated dissipation, and its flat body takes up very little space. It is available in 3-, 5-, 8- and 10-watt ratings at standard preferred values as recommended by I.E.C. series E24 which means 24 values between 1 and 10, between 10 and 100, etc. The insulation resistance is greater than $1000M\ \Omega$ (with silicon protection even greater than $100,000M\ \Omega$). Standard tolerance is $\pm 5\%$ of the nominal resistance value, better tolerances can be supplied as specials. Impectron Ltd, King Street, London W.3.

WW315 for further details

Miniature Stabilized Power Unit

The PU40 miniature power unit from Fenlow provides stabilized d.c. voltages between $\pm 10V$ and $\pm 15V$ set by two external resistors. The input is the mains supply of 210 to 225V 40 to 60Hz. It is an encapsulated unit measuring approx. $82 \times 63 \times 25$ mm and has the following performance. Output current 40mA on each line with short-circuit protection. Line regulation is 0.01% for input voltage variation between 210 and 255V. The no-load to full-load regulation is 0.01%, and the total noise and ripple less than 2mV on each line. The unit is intended to drive a number of operational amplifiers, but its price of £20 should mean that it will find much wider applications as a building block for use in small



mains-powered instruments and also for experimental work in the laboratory. Fenlow Electronics Ltd, Whittet's Eyot, Jessamy Road, Weybridge, Surrey.

WW308 for further details

Contact Cleaner

A glass fibre eraser available from Garford-Lilley and Brother is suitable for contact and commutator cleaning, as well as for the preparation of joints prior to soldering. This brush will remove not only oxidation, but many forms of contamination from copper, aluminium, steel, etc., without damage to the components. The eraser consists of a stiff glass fibre brush mounted in a pencil shaped metal body. The exposed brush length can be adjusted for wear by a screw device fitted at the top of the body. Refills are available in boxes of 25 brushes. Garford-Lilley and Brother Ltd, 3 Hampton Court Parade, East Molesey, Surrey.

WW336 for further details

Trimmer Potentiometer

Reliance Controls have introduced four new trimmers. The CW52 miniature wire-wound trimmer is unsealed and available in a resistance range of $20\ \Omega$ to $20k\ \Omega$ with a resistance tolerance of $\pm 10\%$. Mechanical adjustment is 20 turns. Pin configuration is 0.2in, 0.3in and 0.4in with 0.5in between the outer pins. The CW52 can also be used for panel mounting and allows for adjustment through a panel up to $\frac{1}{4}$ in thick. The CW52 is thus an unsealed version of the already established fully sealed CW51. The CW53 and CW54 are two new sealed trimmers with the same electrical specification as the CW52. The CW53 is



based on a dual in-line configuration with a 0.5in spacing along, a 0.3in spacing across, the body. The wiper connections on this trimmer are duplicated for mechanical stability. The CW54 has a 0.3in, 0.4in and 0.1in pin configuration with 0.7in between outer pins. The CW55 is an unsealed version of the CW54 with identical electrical specifications. All these trimmers are manufactured with terminals of gold-plated brass and wipers of gold-plated beryllium copper. Reliance Controls Ltd, Drakes Way, Swindon, Wilts.

WW311 for further details

D.C. Amplifier

Advance Industrial Electronics announce the introduction of the new Zeltex Model 240 f.e.t.-

input differential amplifier designed for use in low-level d.c. transducer, gain-switching and unloading-circuit applications. The unit features a built-in feedback network, adjustable closed-loop gain. Gain is set to any value between 1 and 1000 with an external resistor. High input impedance (10^{11} ohms) and an 80dB common mode rejection ratio (at any gain setting) make the Model 240 suitable for industrial, medical and biological applications. The gain-bandwidth product is 1MHz min. The unit can be soldered to a p.c. board or plugged into an optional mating connector. Price (1—9) £37. Advance Industrial Electronics, Raynham Road, Bishops Stortford, Herts. **WW321 for further details**

Universal Digital Comparator

A digital comparator, the 6003B, designed to provide computer decision-making facilities when used in conjunction with any digital output device, is now available from Sintrom. It will accept single or multiple input data-groups from the parent digital equipment, compare the input to present limits, and within 20ms indicate one of five possible output decisions. The decision signals are in the form of contact closures and front panel lights. The model 6003B will accept

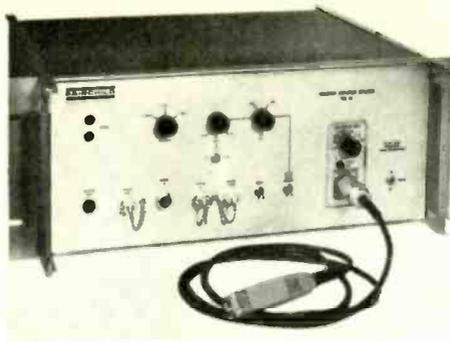


information from any digital equipment with outputs in 1-2-4-8 or 1-2-4-2 parallel b.c.d. form, whether the signal indicates frequency, voltage, capacitance, data card or computer information. One comparator can provide up to five output decisions, totalling 17 digits maximum and limit settings can be quickly made by means of front panel thumbwheel switches or remote programming from other equipment. Comparator units can be stacked to increase output decisions. Sintrom Electronics Ltd, 2 Castle Hill Terrace, Maidenhead, Berks.

WW316 for further details

Transient Amplitude Detector

A battery-operated transient amplitude detector capable of reproducing a 30ns width pulse to 90% amplitude accuracy has been developed by, and is now available from, Electro-Metrics Corporation, a subsidiary of Fairchild Camera and Instrument Corporation. The unit, designated model TAD-66, makes use of a high impedance differential probe for handling input signals from 0.001V to 25V. Four peak detectors, operating in parallel, sample and hold the input signal after amplification—two operating on the normal input and two on the input inverted—to assure fully redundant peak detection. The outputs of each pair of peak detectors are fed to amplitude comparators. Each comparator sees only the highest signal level that was fed to the detectors. A timing and sampling system alternately samples the outputs of the comparators to provide a pulse train, each pulse representing the highest transient seen during the sample time of the peak detectors. Sampling rates are variable from 10Hz to 1200Hz from built-in triggering, or up to 10kHz from external triggering. Slow sampling rates provide data that can be displayed on oscilloscopes and X-Y plotters. At the highest rates, the outputs are handled by a computer or other fast reacting device. The 30ns pulse-width handling capability means that the TAD-66 will handle signals accurately at frequencies from 10Hz to up to nearly

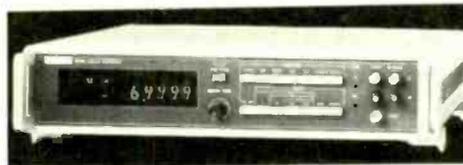


50MHz. If amplitude accuracy is not important and only indication of a transient is required, the unit will sample, hold and provide an output indication of a transient with a width of only a very few nanoseconds. The unit is battery-operated and has both a 600 Ω balanced output and a 50 Ω single-ended output for connecting to external display devices. Fairchild Electro-Metrics Corporation, 88 Church Street, Amsterdam, New York 12011, U.S.A.

WW313 for further details

Digital Multimeter

Fluke International announces a digital multimeter which uses an analogue-to-digital converter with only one-fifth of the parts normally required. The unit, Model 8300A, has five digits plus 20% over-ranging. The basic unit measures 0 to 1100V d.c. in three ranges. Sampling speed is 25ms. Low-cost options include a.c. voltage, millivolt-ohms, external reference (ratio) and fully isolated remote programming and data output. Because the new a.-d. technique substantially cuts down on the number of components used, a number of operating characteristics are improved. The new technique used in the Fluke 8300A is



based on storage capacitors, a single b.c.d. counter and a resistive ladder network to serially determine and display all digits. It is called the recirculating remainder A to D system. Fluke International Corporation, Garnett Close, Watford WD2 4TT.

WW322 for further details

Transistor Arrays

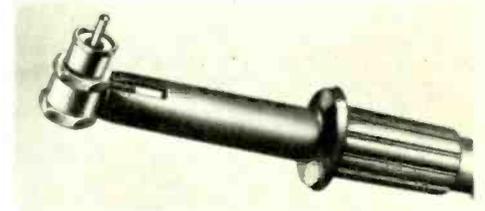
Two general-purpose transistor arrays have been added to the range of linear i.c.s available from R.C.A. The CA3026 and CA3054, which contain dual independent differential amplifiers with associated constant current transistors on a common monolithic substrate, have wide applications in low-power systems at frequencies from d.c. to 120MHz. Bias and load resistors have been purposely omitted to allow maximum application flexibility. The monolithic construction of the arrays gives close electrical and thermal matching between each pair of amplifiers, making these devices particularly useful in dual channel applications. The six n-p-n transistors which form each pair of amplifiers are general purpose types exhibiting low l.f. noise and a gain bandwidth product in excess of 300MHz. The CA3026 is contained in a hermetic 12-lead TO-5 package and is rated for operation from -55° to $+125^{\circ}$ C. The CA3054, which is electrically identical to the CA3026, is contained in a 14-lead dual in-line plastic package for applications requiring a limited operating temperature range, between 0° C and $+85^{\circ}$ C. The

many applications of these devices include dual sense amplifiers, dual Schmitt triggers, multi-function combinations, i.f. amplifiers, product detectors, doubly balanced modulators and demodulators, balanced quadrature detectors, cascade limiters, synchronous detectors, pairs of balanced mixers, synthesizer mixers and balanced cascode amplifiers. The CA3026 and CA3054 are available at 15s 6d each for quantities of 100 plus from R.C.A.'s three distributors: Semicomps Northern Ltd, Robert Electronics Ltd, and Electronic Component Supplies (Windsor) Ltd. Large orders of 1,000 plus should be made direct to R.C.A. Ltd, Sunbury-on-Thames, Middlesex.

WW324 for further details

Oscilloscope Probe Adaptor

Sealectro have developed a new right-angled sub-miniature adaptor for use with oscilloscope probes. Designated Conhex 55-005-0119, the device will convert standard shielded probes to right angled devices and is particularly useful for



multiple test point monitoring in complex circuitry. The unit can be screwed into the end of the oscilloscope probe assembly in place of the standard tip. All metal parts are gold plated and the insulator is of Teflon. Sealectro Ltd, Farlington, Portsmouth, Hants.

WW317 for further details

Remote Programming Digital Multimeter

Dana Electronics announce a new range of programmable digital meters—the 4433/235 (non-isolated output) and the 4434/235 (isolated output). Both have isolated programming facilities for a.c., d.c., ohms and active filter as standard. The 4434 has the added feature of a built-in delayed command generator. These delays are appropriate to the function or filter speed called up and release the systems engineer from settling-time problems. The delayed command can be



over-ridden at any time by direct command. Prices: 4433/235—£1,050; 4434/235—£1,150. Dana Electronics Ltd., Dallow Road, Bilton Way, Luton, Beds.

WW326 for further details

Monolithic Linear Multiplier

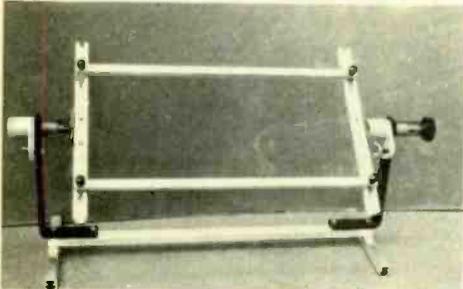
A monolithic linear four-quadrant multiplier, the MC1595, is available from Motorola. The output voltage is a linear product of two input voltages and a constant scale factor. The circuit is so designed that the scale factor and the input/output voltage ranges can be adjusted by the user to accommodate a wide variety of applications. Good linearity is obtained—typically 0.5% error for the X-input and 1% for the Y-input. Other features of the MC1595 are good temperature stability and an input voltage range of ± 10 V. Applications of the MC1595 include arithmetic opera-

tions (multiplication, division, squaring, finding square roots, and determining mean square), detection (a.m., f.m., phase and synchronous), modulation/demodulation (a.m. and balanced), frequency doubling, direct reading electric power measurements, trigonometric operations, and electronic gain control. Also available is a relaxed specification version with a temperature range of 0°C to +75°C, known as MC1495L. The multiplier is housed in a TO-116, 14-pin, dual in-line ceramic package. Motorola Semiconductors Ltd, York House, Empire Way, Wembley, Middx.

WW330 for further details

P.C. Board Holder

The Keyston Mark II printed circuit work-holder is suitable for bench mounting or free standing. The work frame accepts boards up to 15 × 10in (380 × 250mm) and up to $\frac{1}{16}$ in (3mm) thick and the working angle may be adjusted to suit the individual operator. The trunion mountings have

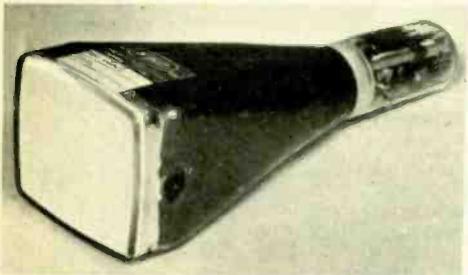


positive notch locations allowing the board to be reversed in a single operation. Extra guide rails can be fitted for simultaneous multi-assembly of smaller boards. A foam component-clamping pad is available. Keyston Engineers Ltd, 8 Tettenhall Road, Wolverhampton, Staffs.

WW312 for further details

Instrument C.R.T.

The M-O Valve Co. announces an extension to its range of high performance instrument c.r.t.s, with the introduction of the 1400B—a single gun, mesh-p.d.a. type having a display of 10cm × 8cm



and an overall length of only 35cm. The X-sensitivity is 11V/cm and the Y-sensitivity 5V/cm. Deflection linearity is better than 5%. A typical final anode voltage for the 1400B is 12kV and under these conditions it can be used in oscilloscopes having bandwidths of 100MHz. The M-O Valve Co. Ltd, Brook Green Works, London W.6.

WW323 for further details

“Communications” Transistors

Twenty new “communications” transistors manufactured by T.R.W. Semiconductors Inc, California, are now available from M.C.P. Electronics. All are designed to be capable of withstanding severe mismatch under adverse load or phase conditions. These 12.5V devices are divided into four families. The five designated 2N5687-91 are for use in the 20-88MHz band and they range in power from 1.5 to 40W. Series 2N5702-6 is for use in the 144-175MHz band with a similar

output power range. Five transistors designated 2N5697-5701 cover the 450-470MHz band and have power outputs from 0.25 to 20W. The fourth series, 2N5710-14, is specifically designed for high level a.m. modulation applications. Power output in this group ranges from 0.3 to 20W. M.C.P. Electronics Ltd, Alperston, Wembley, Middlesex.

WW305 for further details

Electronic Switches

Now available from Interplanetric is a range of electronic switches, which employ Schottky diodes, for applications where high reliability, small size and fast switching is required. With low distortion and good transient response, the performance is claimed to be superior to that of balanced mixers used as switches. Low-loss, wide band, ferrite networks further contribute to the efficiency of the switches. Switching port voltages have been selected such that a positive voltage turns the switch on, and a negative voltage turns the switch off, thus avoiding the threshold uncertainty which results when zero switching voltage is used. Models are available with a built-in driver operating from a standard unipolar switching input compatible with common integrated circuitry. Interplanetric, 39-49 Cowleaze Road, Kingston upon Thames, Surrey.

WW332 for further details

Pulsed J-band Gunn Diode

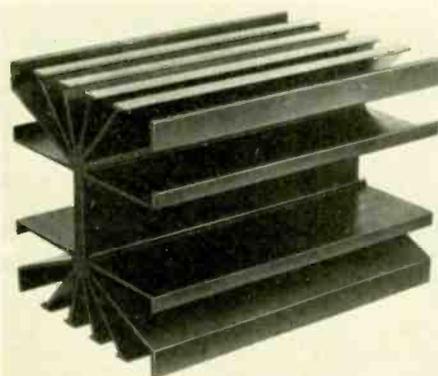
A pulsed J-band (12-18GHz) hybrid mode Gunn effect oscillator has been announced by Plessey. Designed principally for use in high resolution, short range radar, these devices are made from epitaxial gallium arsenide layers grown by a process originating from the Allen Clark Research Centre at Caswell. The devices can be operated in both coaxial and waveguide cavities. Power outputs are up to 5W under 1μs pulsed conditions, and p.r.f.s up to 50kHz. Conversion efficiencies are between 7 and 12%. Rise times are typically less than 2ns, and typical input requirements are 30V, 2A. Plessey Components Group, Microelectronics Division, Cheney Manor, Swindon, Wiltshire.

WW333 for further details

Heatsink Extrusion

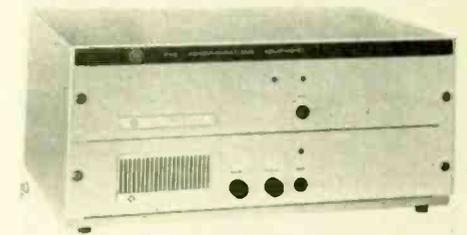
The latest heatsink material to be added to the Jermyn range is the A25/2007. This extrusion offers a very large surface area with a substantial mounting web for the semiconductor. A feature of the extrusion is its light weight: for example a thermal resistance of 0.5°C per watt is typical for the heatsink type A25/2022 which is black anodized and has an overall size of approx. 115 × 120 × 140mm long. The extrusion is also available in lengths up to 1 metre. Jermyn Industries, Vestry Estate, Sevenoaks, Kent.

WW325 for further details



Radiotelephone Fixed Station

A new radiotelephone fixed station has been announced by Pye Telecommunications Ltd. Known as the F30FM, the fixed station, which is fully solid-state, is suitable for simplex or duplex operation in one of four frequency bands in the range 32.5—174MHz. There is



a choice of 12.5kHz, 20/25/30kHz or 40/50/60 kHz channel spacing and the transmitter has a power output of 30W. Modular construction in conjunction with printed circuit sub units provides easy access to all components and simplifies servicing. Pye Telecommunications Ltd, St Andrew's Road, Cambridge.

WW337 for further details

Low Reverse-leakage Rectifiers

Soliton of America announce a series (F927) of high-voltage axial lead, low reverse-leakage rectifiers. The series has a p.i.v. range of 5,000 to 25,000V and a reverse leakage of 1μA at 25°C, and will handle 0.5A at 55°C in free air. The



devices can be applied in all standard, single and polyphase rectifier circuits. The units are corona free and said to meet stringent electrical, mechanical and environmental specifications. Soliton Devices, Inc, 256 Oak Tree Road, Tappan, N.Y.10983, U.S.A.

WW320 for further details

Phase Sensitive Detector

AIM Electronics announces a new phase sensitive detector type PSD 122A which has an output drift less than 0.005% per °C and with a full scale deflection of ± 5V. This means that zero drift is less than 250μV/°C. Linearity is better than 0.05% and there is an overload indicator which shows when the incoming signal is outside the permitted limits. The dynamic range is over 70dB.

The instrument has its own meter built in. The unit accepts a reference signal of over 100mV r.m.s., which is used either as a quadrature or in-phase reference to the measured signal. The measured signal is 1 volt r.m.s. for full scale deflection of the meter (corresponding to ± 5 volts at the monitor socket). The sensitivity may be increased to 1μV r.m.s. input for full scale deflection by the use of AIM's standard range of filters and amplifiers. The PSD 122A has an input bandwidth of 150kHz and a noise equivalent bandwidth of 0.025Hz. Price £147. AIM Electronics Ltd, The River Mill, St. Ives, Huntingdon.

WW304 for further details

November Meetings

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

LONDON

- 5th I.E.E.—“Some feasibility studies of synchronized oscillator systems for p.c.m. telephone networks” by M. R. Miller and “Wisdom: a method of synchronizing distributed systems to a p.c.m. system” by P. A. Wing at 17.30 at Savoy Pl., W.C.2.
- 5th I.E.E.—“C.A.D. of communication systems and circuits” by P. S. Brandon at 18.00 at the London School of Hygiene & Tropical Medicine, Keppel St., W.C.1.
- 6th R.T.S.—“The application of silicon diode array targets in television camera tubes” by A. J. Woolgar and C. J. Bennett at 19.00 at the I.T.A., 70 Brompton Rd., S.W.3.
- 7th I.E.E.—Colloquium on “Bio-electrical engineering and power sources” at 14.30 at Savoy Pl., W.C.2.
- 7th Brit. Acoustical Soc.—“Microwave acoustics” at 17.00 at Imperial College, S.W.7.
- 11th I.E.E.—Discussion on “Studies of the lower atmosphere by modelling techniques” at 18.00 at 9 Bedford Sq., W.C.1.
- 12th I.E.E.—“Mintech and the electronics industry” by I. Maddock at 17.30 at Savoy Pl., W.C.2.
- 12th I.E.E.—“Noise problems in measurement” by Dr. E. A. Faulkner at 17.30 at Savoy Pl., W.C.2.
- 12th I.E.E.—“Locomotive-borne computer for continuous train control” by M. S. Birkin at 18.00 at 9 Bedford Sq., W.C.1.
- 12th Soc. Environmental Eng.—“The British calibration service” at 18.00 at Imperial College, Mech. Eng. Dept., Exhibition Rd., S.W.7.
- 12th S.E.R.T.—“Industrial electronics” by A. F. Giles at 19.00 at the London School of Hygiene & Tropical Medicine, Keppel St., W.C.1.
- 13th I.E.E./I.E.E.—Second lecture on “Physiology for engineers” at 18.00 at St. Bartholomew's Hospital Medical College, E.C.1.
- 13th R.T.S.—“Colour recording—a look at the ‘video printing’ and ‘Vidtronic’ systems” by R. J. Venis and J. Mulliner at 19.00 at the I.T.A., 70 Brompton Rd., S.W.3.
- 14th I.E.E./I.E.E.—Discussion on “Computer standardization: bane or blessing? (an examination of the issues especially with respect to I/O interfaces)” at 14.15 at Savoy Pl., W.C.2.
- 17th I.E.E.—Discussion on “Alternatives to degree examinations as a means of assessment” at 17.00 at Savoy Pl., W.C.2.
- 18th I.Mech.E.—Discussion on “Computer aided design” at 09.30 at 1 Birdcage Walk, S.W.1.
- 18th I.E.E.—“Solid state television receivers—a pattern of second generation designs for monochrome and colour” by P. L. Mothersole at 18.00 at the London School of Hygiene & Tropical Medicine, Keppel St., W.C.1.
- 19th I.E.E.—Discussion on “Instruments for the recovery of signals from noise” at 17.30 at Savoy Pl., W.C.2.
- 20th Inst. Electronics.—“A technique for the evaluation of data communication networks” by M. B. Ashdown at 18.30 at the London School of Hygiene & Tropical Medicine, Keppel St., W.C.1.
- 21st I.E.E.—Colloquium on “R.F. and microwave industrial heating” at 10.00 at Savoy Pl., W.C.2.
- 21st I.E.E.—“Recollections of the early days of the thermionic valve industry” by S. R. Mullard and L. S. Harley at 17.30 at Savoy Pl., W.C.2.
- 26th I.E.E.—“Management by objectives” by D. Simpson at 18.00 at 9 Bedford Sq., W.C.1.
- 27th R.T.S.—Symposium on “Professionalism and training in educational television” at 17.00 at the I.T.A., 70 Brompton Rd., S.W.3.

BELFAST

- 25th I.E.E.—“Audio frequency hi-fi amplifiers” by I. Hardcastle at 18.30 at the Ashby Inst., Queens University, Stranmillis Rd.

BIRMINGHAM

- 12th R.T.S.—“Electronic video recording” by Sir Francis McLean at 19.00 at Broadcasting House, Carpenter Rd.

BRIGHTON

- 11th I.E.E.—“The place of the library in electronic engineering” by Miss E. Garratt at 18.30 at the College of Technology.

BRISTOL

- 19th I.E.E./I.E.E.—“E.M.I. 2001 colour television camera” by I. J. P. James at 19.00 at the University.
- 27th I.E.E.—Faraday Lecture “People, communications and engineering” by J. H. H. Merriman at 18.30 at Colston Hall.
- 28th I.E.E.—Faraday Lecture at 10.00 (students) at Colston Hall.

CAMBRIDGE

- 13th I.E.E./I.E.E.—“Digital control of radar displays” by H. Giles at 20.00 at the University's Engineering Labs, Trumpington St.

CARDIFF

- 12th I.E.E.—“Moire fringe measurement and numerical control of machine tools” by A. T. Shepherd at 18.30 at the University of Wales, Inst. of Science & Technology.
- 13th—“The electron microscope” by B. Rees at 19.00 at the University of Wales Institute of Science & Technology, Cathays Park.
- 14th S.E.R.T.—“Traffic control” by A. Gregory at 19.30 at Llandaff Technical College, Western Avenue.

CHATHAM

- 20th I.E.E.—“The Concorde flight control and landing systems” by D. M. Fryer at 19.00 at the Medway College of Technology.

COVENTRY

- 13th I.E.E.—“The use of light frequencies in communications” by R. B. Dyott at 19.15 at the Lanchester College of Technology.

DORKING

- 5th I.E.E.—“Medical electronics” by Dr. D. W. Hill at 19.30 at Martineau Hall, Dorking Halls.
- 25th I.E.E.—“Computer aided design” by J. A. Weaver at 19.30 at the Star & Garter Hotel.

DURHAM

- 26th I.E.E.—“Modern techniques of air-traffic control” by J. Henderson at 19.30 at the University's Science Labs, South Road.

GLOUCESTER

- 18th I.E.E.—“Electrics and electronics in aircraft” by H. Hill at 19.30 at the Technical College, Brunswick Rd.

HIGH WYCOMBE

- 18th I.E.E.—“Elementary principles of digital computers” by L. F. Cowan at 19.15 at the College of Technology.

HUDDERSFIELD

- 27th I.E.E.—“Lasers” by Prof. O. S. Heavens at 19.00 at the College of Technology, Dept. of Electrical & Electronic Engineering.

LEICESTER

- 13th I.E.E.—“Ground station aerials for satellite communications” by D. H. Shinn at 18.30 at the University Physics Lecture Theatre.

LIVERPOOL

- 12th I.E.E.—“Aircraft and instrumentation” by C. A. Williams at 19.00 at the University's Dept. of Electrical Engineering.

LOUGHBOROUGH

- 18th I.E.E./I.E.E.—“Impact of microelectronics for circuit engineers” by C. S. Den Brinker at 18.30 at the University of Technology, Edward Herbert Bldg.

MALVERN

- 13th I.E.E.—“Airborne collision avoidance systems” by S. S. D. Jones at 19.30 at the Abbey Hotel.

MANCHESTER

- 18th I.E.E.—“Automobile electronics” by W. F. Hill at 19.15 at the Renold Bldg., U.M.I.S.T., Altrincham St.
- 27th S.E.R.T.—“Stereo broadcasting” at 19.30 at Renold Bldg, U.M.I.S.T.

NEWCASTLE-UPON-TYNE

- 5th S.E.R.T.—“The Post Office Tower of London” by A. W. Mead at 19.30 at the Charles Trevelyan Technical College, Maple Terrace.
- 12th I.E.E.—“Application of positive temperature coefficient thermistors” by C. G. Smith at 18.00 at the Polytechnic (Rutherford College), Dept. of Physics & Physical Electronics.

NEWPORT, I.O.W.

- 14th I.E.E.—“Radar in a marine environment” by H. Giles at 19.00 at the Technical College.

PLYMOUTH

- 13th I.E.E./I.E.E.—“Satellite communication” by J. Lawson at 19.00 at the University.

READING

- 24th I.E.E.—“Hi-fi” by J. Moir at 19.30 at the J. J. Thomson Laboratory, the University, Whiteknights Park.
- 25th I.E.E.—“Automatic test equipment” by O. H. Davie at 19.30 at the J. J. Thomson Laboratory, the University, Whiteknights Park.

RUGBY

- 18th I.E.E.—Faraday Lecture “People, communications and engineering” by J. H. H. Merriman at 14.30 (students) and 19.30 (public) at the Granada Cinema.

RUGELEY

- 6th I.E.E.—“Electronic musical instruments” by Leslie E. A. Bourne and B. Arnold at 19.00 at Shrewsbury Arms Hotel, Market St.

SOUTHAMPTON

- 25th I.E.E.—Faraday Lecture “People, communications and engineering” by J. H. H. Merriman at 10.30 and 14.30 (students) and 18.30 (public) at the Guildhall.

Literature Received

For further information on any item include the appropriate WW number on the reader reply card

ACTIVE DEVICES

We have received the following literature from Nobel Electronics, Nobel House, 5-7 High St, Welling, Kent.

- Semiconductor summary 1969, listing STC digital and linear i.c.s, transistors and diodes **WW401**
- Semiconductor price list for above catalogue **WW402**

RCA Great Britain Ltd, Lincoln Way, Windmill Road, Sunbury-on-Thames, Middx, have produced the following publications:

- RCA solid-state products guide **WW403**
- SK series replacement guide **WW404**
- Mounting hardware supplied with semiconductor devices **WW405**

Mullard minibook No.3 "Semiconductor devices" has been prepared by the Mullard educational department as an introduction to semiconductor devices for those with only a very basic knowledge of electronics. It is available from Mullard Educational Service, Torrington Place, London W.C.1, price 5s.

Amendments for the AEI Semiconductors and Technical Data Book have been prepared by AEI Semiconductors, Carholme Road, Lincoln.

- 12A, amendments for Vol.1 **WW406**
- 12B, amendments for Vol.2 **WW407**

PASSIVE COMPONENTS

West Hyde Developments, 30 High St, Northwood, Middx, have published a catalogue which describes the Contil Mod-2 range of p.v.c. coated instrument cases **WW408**

Ferranti Ltd, Dunsinane Ave, Dundee DD2 3PN, Scotland, has the following microwave literature available:

- Ferrite circulators 5.9 to 6.4 GHz **WW409**
- Ferrite circulators 3.7 to 4.2 GHz **WW410**

The full range of products manufactured by Oxley Developments Co. Ltd, Priory Park, Ulverston, Lancs., such as Barb insulators, plugs and sockets and trimmer capacitors, is described in a catalogue **WW411**

Received from Eric Electronics Ltd, South Denes, Great Yarmouth, Norfolk, the following literature:

- Moulded track potentiometers **WW412**
- Additional data sheets and price list for Eric catalogue **WW413**

"Battery replacement guide" gives the RCA equivalent for batteries in the domestic products of over 300 manufacturers. RCA Great Britain Ltd, Lincoln Way, Windmill Road, Sunbury-on-Thames, Middx. **WW414**

HARDWARE

The "Zip Twist" fastener, which can be pushed on to studs of fragile material and given a quarter-of-a-turn to lock and which has a self-threading action for removal, is the subject of a leaflet from the Carr Fastener Co. Ltd, Stapleford, Nottingham NG9 8AJ **WW415**

The "Pana Vise", which is a bench mounted vice allowing work to be held at any compound angle within a half sphere, is described, with accessories, in literature from Special Product Distributors, 81 Piccadilly, London W1V 0HL **WW416**

P.T.F.E. shapes, including rod, tube, sheet, strip and sleeving, are described in publication from Polypenco Ltd, Gate House, Welwyn Garden City, Herts. **WW417**

EQUIPMENTS

A Ins rise-time sampling unit, the type S-5, which has a 1M Ω -15pF input impedance, is described in a leaflet from Tektronix UK Ltd, Beaverton House, Harpenden, Herts **WW418**

The following two bopklets are available from Aveley Electric, South Ockendon, Essex:

- Systron Donner analogue computers (10/20-40/80) **WW419**
- Aveley news (monthly) giving information on equipment imported from Germany **WW420**

A digital integrated circuit tester (type 51B) is the subject of a leaflet from John Reeve Instruments, 8 Ownstead Gardens, Sanderstead, South Croydon, Surrey CR2 0HH **WW421**

A series of low-noise broadcast quality microphone amplifiers are described in a leaflet from Elcom (Northampton) Ltd, Weedon Road, Industrial Estate, Northampton **WW422**

A wide range of instrumentation is described in a booklet "New electronics for measurement, analysis and computation" from Hewlett-Packard, 224 Bath Rd, Slough, Bucks **WW423**

GENERAL INFORMATION

Available from the City and Guilds of London Institute, 76 Portland Place, London W1N 4AA, a publication called "SI Symbols, abbreviations & conventions", price 2s.

We have received two more books in the "Measurements concepts" series from Tektronix U.K. Ltd, Beaverton House, Harpenden, Herts. They cost 10s each including postage.

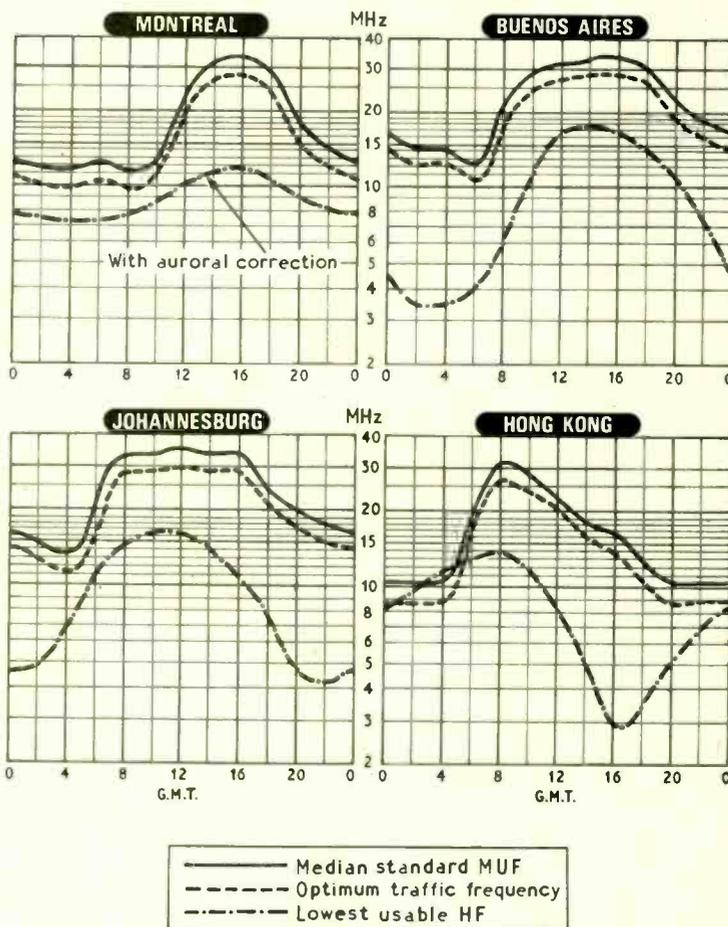
"Spectrum analyzer measurements" and "Automated test systems".

The latest edition of the British Amateur Electronics Club Newsletter contains a report of the Club's exhibition of electronic games and articles of constructional interest. Mr. C. Bogod, 26 Forrester Road, Penarth, Glam.

The following literature has been produced by the British Standard Institution, 2 Park Street, London W1Y 4AA:

- PD6435: "Instructions to technical committees for the preparation of generic specifications for electronic parts of assessed quality", price 21s.
- BS9500: "Sockets of assessed quality for electronic tubes and valves and plug-in devices: generic data and method of test," price 16s.

HF Predictions — November



It will be seen that the MUF for Johannesburg is just below 35MHz for an eight-hour period with very small variations. This should provide excellent conditions in the 26-MHz broadcasting band and the 25-MHz amateur band. The South America curve tends to a similar shape and favourable daylight conditions can also be expected. The Far East route will require full use of frequency complements to combat the continually changing MUF.

LUFs depend partly on geographic variation of atmospheric noise level and therefore, unlike MUFs, do not apply to both directions of a route. Those shown were calculated by Cable & Wireless Ltd for reception of specific point-to-point services in the U.K. but serve as a guide for all modes and services.

Real & Imaginary

by Vector

“Plus ça change, plus c'est la même chose”

This month I'm going to do something that I'm rather good at, namely sitting back and letting someone else do the work. The excuse for doing so is contained in a paper read at a meeting of the Institution of Electrical Engineers under the title “Co-ordination of Research in Works and Laboratories”.

In his introduction H. R. Constantine, the author, reminds us that to be a great and prosperous nation today implies being at the forefront in scientific genius and in engineering capacity. He then takes his first side-swipe at us by saying that there was a time when this country was able to hold its own against any other nation, but that we are now in the process of falling asleep while others surpass us.

He goes on to say that the reasons why we have lost our commercial supremacy are not to be found in any lack of ability or want of inventive genius. Our backsliding has been mainly due to the lack of responsiveness by government authorities, manufacturers and financial leaders to the needs of scientific genius. Many examples (he says) could be given of new ideas or inventions devised by British brains which have been ignored here and have subsequently been taken up abroad. The situation is aggravated by the national characteristics of selfishness and stubbornness which prevents a Britisher from communicating his methods to his fellow workers. (Strong meat for any Learned Society to digest!)

Arguing for more co-ordination in research the author notes that powerful banking organizations exist to offer a stronger financial front against foreign competition while various employers' associations are in being to further business. There are also selling organizations to promote exports, so why not a research combine also?

He then sets out one approach to the problem. This envisages the establishment of a vast national research laboratory (or complex of laboratories) under the control of a government-appointed body consisting of engineer-representatives of universities and industry. The administrative side would be undertaken by another body, chosen for its business ability.

This maxi-laboratory would take over the whole of the pure research now done by universities, colleges, technical institutions and private or works laboratories. Any manufacturer who wanted a given matter researched would apply to the central au-

thority who would be in a position to tell him what had already been done in that particular line and to advise him regarding the best way to continue. Any research project brought to a successful conclusion would be passed to the central 'bank' where it would be freely available to any British manufacturer who wanted it. (Note that these suggestions apply only to pure research; each manufacturer would be free to conduct his own applied research.)

Having painstakingly built a nationalized edifice brick by brick (only a few of the main features have been described above) the author puts a substantial charge of high explosive in its basement and proceeds to light the blue touchpaper. The proposal (he maintains) is impracticable on grounds of cost. He then expounds an alternative scheme. This, much abbreviated, is a method of co-ordinating existing laboratories. It proposes a central board of control composed of private individuals representing the various interested parties—universities, manufacturers and so on. This board would keep full records of what individual laboratories were doing and would maintain records of published research work on the largest possible scale. The board would be given full powers to order any laboratory to undertake a specific piece of research or to leave another alone.

One essential feature of the scheme is to provide a posse of travelling engineers whose duties would be to visit the various laboratories at frequent intervals and to report back to H.Q. giving general and detailed accounts of what was afoot, or of research that was needed. New ideas would also be culled. As with his first suggestion the author recognizes that one of the prime requirements would be the establishment of an efficient central records office.

At this juncture the author pauses to consider the evils of continuing with a multiplicity of independent laboratories, each working in comparative ignorance of what others were doing. He makes the following points:—

- (1) In general, manufacturers' laboratories tend to attempt too many researches at once and are not properly equipped to do any one of them.
- (2) They are usually under the ultimate control of a top executive whose orientation is towards sales, not research.
- (3) It is physically impossible for each individual firm to acquire and maintain a

technical library on a scale that ensures it contains information on everything.

(4) Each laboratory is intensely jealous of all rivals and will on no account let others know what it is doing. As a result, twenty firms could be carrying out exactly the same research work.

Item (4) is clearly a major stumbling block and the author is at pains to deal with it. In his scheme a manufacturer's research information would be sent to the central board under a strict seal of security; it would be used primarily for records purposes, to ensure that overlapping of projects did not take place.

University laboratories would still continue with their routine laboratory training programmes; the central board would be interested only in the absolutely new experimental work in hand. The board would work in close liaison with the university authorities, merely ordering that specified research should be carried out over a certain period and giving general instructions as to how it should be approached.

Patents are one of the headaches in any such scheme and the author deals faithfully with this problem also. He suggests that an equitable solution would be to invest the central board with the responsibility of deciding whether it was worth while to take out a patent application in any given circumstance; if it were, the board would do so, paying all the attendant expenses. It would then proceed to dispose of the rights to those manufacturers declaring themselves interested, in consideration of agreed payments. After these payments had been pooled, the inventor and his assistants would be appropriately rewarded.

The author concludes by saying that in spite of the detailed proposals set out, the chief purpose of the paper is to draw attention to the need for fresh thinking on how research could best be handled, both in the national interest and for the benefit of manufacturers and universities. His final words are an appeal to the Institution to take the initiative and convene a conference of all potentially interested parties, “in order to settle in the first place the absolute necessity for some such concerted action and to come to some decision as to the general outlines that such a scheme would have”.

In the discussion that followed the reading of the papers, the proposals were damned with faint praise. Some words of the final speaker are, I think, worth recording:

“I am perfectly certain it is a waste of energy to try to centralize the whole business of research . . . overlapping [of research projects] is a very good thing. There is a certain sporting element in overlapping and I think if an Englishman is to make any progress in research or anything else he must be able to feel that there is a certain amount of sport at the back of it all—money is not sufficient. There must be that sporting element of rivalry . . .”

And that's about all I've room for; the paper itself is very much longer. But one final word if I may: The paper was read before the Institution just over fifty years ago and was published in the *Journal of the I.E.E.* in October, 1920. Meanwhile, relax. You're not being nationalized yet.

THE SINCLAIR SYSTEM 2000 range is an original concept in which very advanced circuit and production techniques result in equipment comparable to far costlier types in quality and performance. The units form a complete stereophonic system or may be bought and used separately as required. Solid aluminium is used throughout in matching designs of outstanding elegance and the amplifier and tuner can be stacked or positioned side by side.

THE AMPLIFIER has a total output of 36 watts RMS music power (17.5 watts per channel). Total harmonic distortion is 0.5% at 1 kHz. Six push buttons serve for the selection of seven inputs—ceramic and low output magnetic pick-ups, radio, microphone, auxiliary, tape head output of 71

and 3½ ips and mono/stereo. Frequency response extends from 15 Hz to 30 kHz ± 1 dB. Rotary controls are used for volume, bass, treble and balance. Outputs may be fed to loudspeakers of any impedance from 3 to 15 ohms. Case size—12 x 6 x 2 inches high (30 x 16 x 5 cm).

THE VHF/FM TUNER uses a pulse counting discriminator for the best possible audio quality. Important features include interstation noise suppression, built-in AFC and automatic fine tuning, making the tuner a delight to handle. Tuning is from 86 to 108 MHz. A plug-in stereo decoder is available for adding to the mono version, or the tuner may be purchased complete in stereo form.

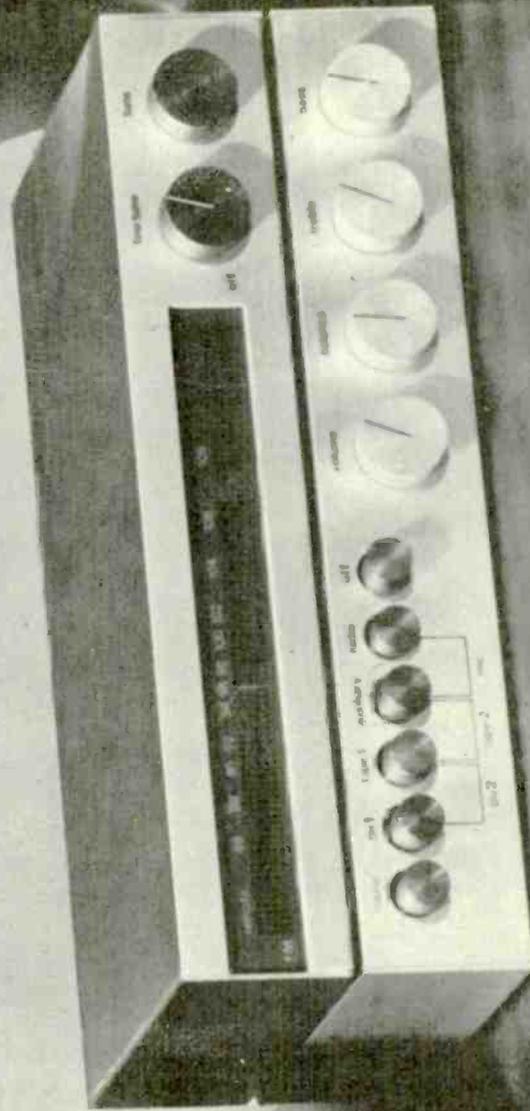
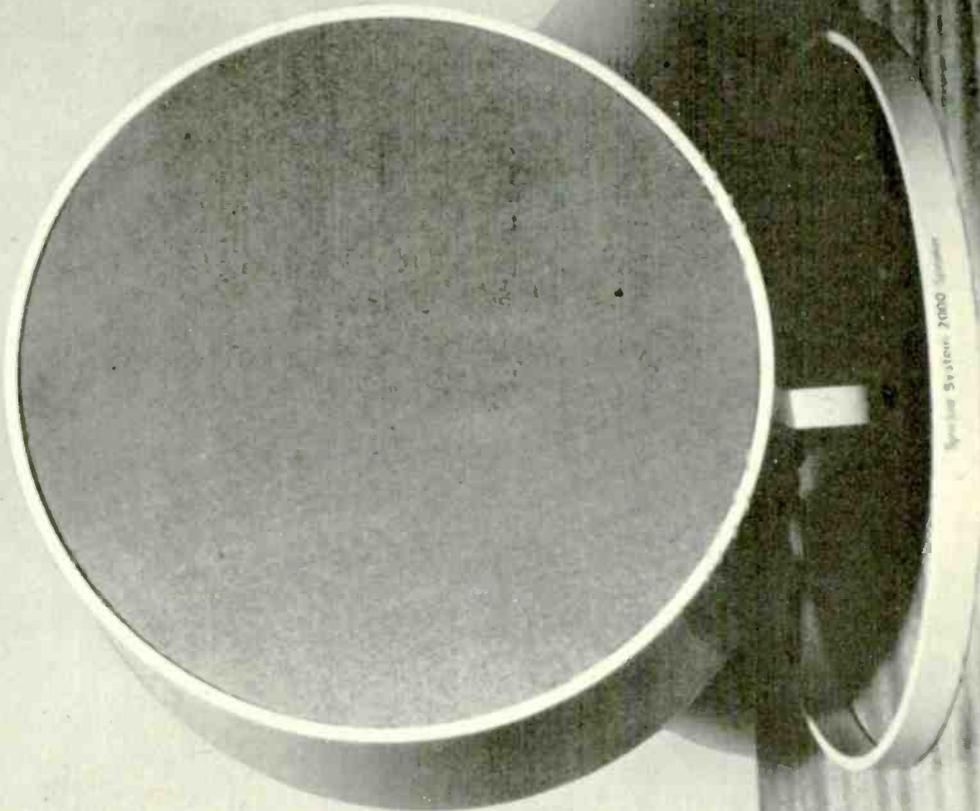
THE LOUDSPEAKER is an outstanding example of attractive contemporary design

in which very high standards of reproduction are incorporated. This remarkably compact unit handles up to 10 watts continuous loading and has an impedance of 4 ohms at 1 kHz. Size 9 inches diameter by 4 inches deep.

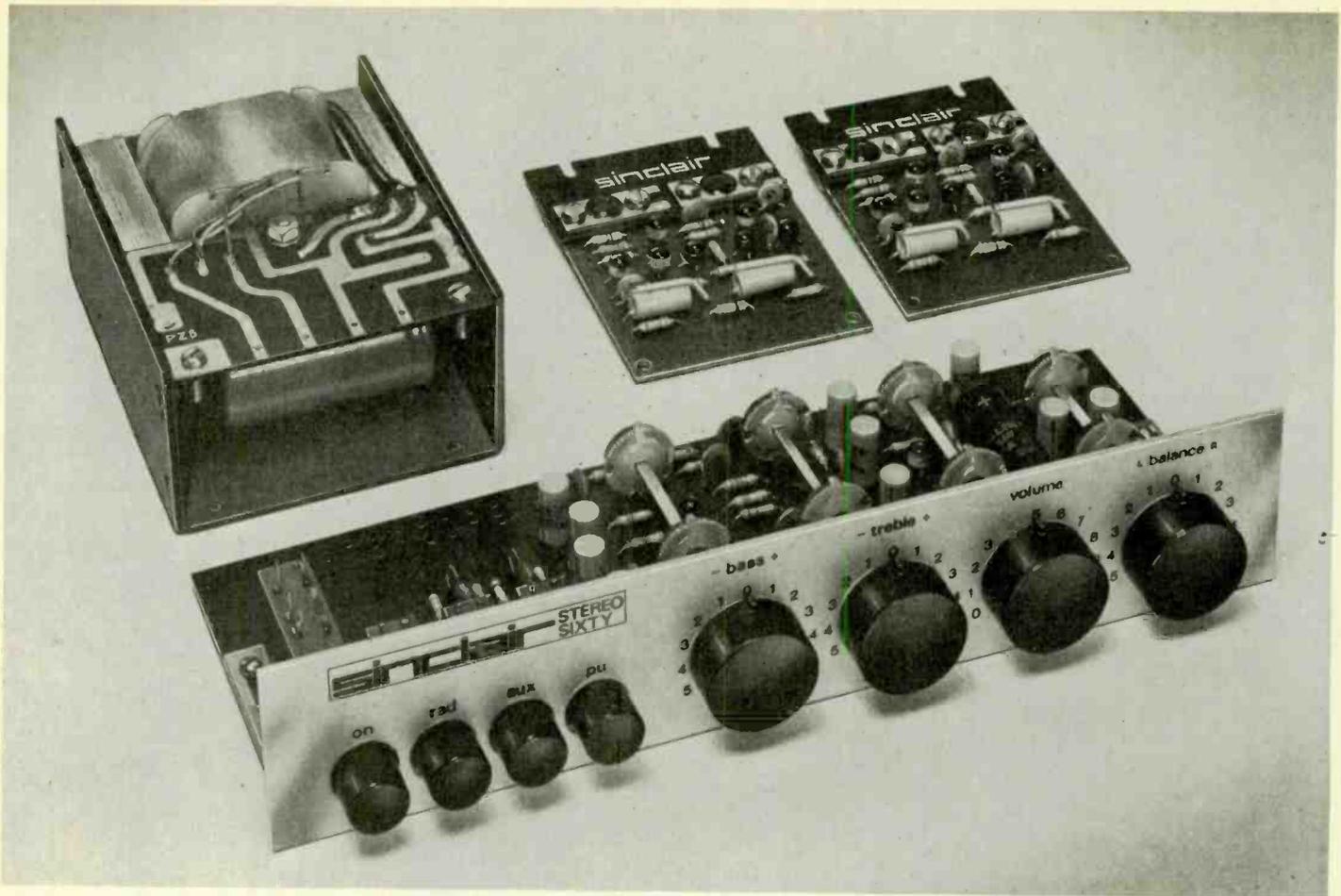
Ask your dealer to demonstrate the System 2000 and judge this imaginatively designed equipment for yourself, or write or phone for leaflet.

- System 2000 35 watt Integrated Stereo Amplifier 20 gms
- System 2000 F.M. Tuner 25 gms
- 13,0 P.T. surcharge
- Plug-in stereo decoder 4 gms
- System 2000 4 ohm loudspeaker 12 gms
- +4.7 P.T. surcharge

Sinclair Radionics Limited, 22 Newmarket Road, Cambridge. Tel. Cambridge 52731



SINCLAIR



Project 60 an exciting alternative

The buyer of an amplifier today has a remarkably wide variety to choose from. It is unlikely that a purchaser would have real difficulty in finding a unit that met all his requirements, although the price might not be as low as could be wished. The only snags are that one's needs can change and that the technically correct amplifier may be physically inconvenient. If you are confident that there is an amplifier available, of the right size and price, which will meet all your needs for the foreseeable future, then that is your best buy. If not, however, we can offer you another possibility which we believe to be an exciting alternative approach. That alternative is **Project 60**.

Project 60 is a range of modules which connect together simply to form a complete stereo amplifier with really excellent performance. So good, in fact, that only 2 or 3 amplifiers in the world can compare with it in overall performance.

The modules are: 1. The Z-30 high gain power amplifier, which is an immensely flexible unit in its own right. 2. The Stereo 60 preamplifier and control unit. 3. The PZ.5 and PZ.6 power supplies. A complete system comprises two Z-30's, one Stereo-60 and a PZ-5 or PZ-6. The power supplies differ in that the PZ-6 is stabilised whilst the PZ-5 is not. This means that the former should be used where the highest possible

continuous sine wave rating is required. In a normal domestic application there will not be a significant difference between using either power unit unless loudspeakers of very low efficiency are being used.

All you need to assemble your system is a screwdriver and a soldering iron. No technical skill or knowledge whatsoever is required and, in the unlikely event of you hitting a problem, our customer service and advice department will put the matter right promptly and willingly.

Perhaps the greatest beauty of the system is that it is not only flexible now but will remain so in the future. We shall shortly be introducing additional modules which will include a comprehensive filter unit, a stereo F.M. tuner and an even more powerful amplifier for very large systems. These and all other modules we introduce will be compatible with those shown here and may be added to your system at any time.

Project 60 modules have been carefully designed to fit into virtually every known type of plinth or cabinet and templates provided enable you to position them. Only holes have to be drilled into the wood of the plinth and any slight slips here will be covered completely by the aluminium front panel of the Stereo 60. The Project 60 manual gives all the instructions you can possibly want clearly and concisely.

AUDIO & PHOTO CINÉ FAIRS, STAND 95, OLYMPIA

sinclair

SINCLAIR RADIONICS LTD · 22 NEWMARKET ROAD · CAMBRIDGE
Telephone: 0223 52731

WW—111 FOR FURTHER DETAILS

Z-30 TWENTY-FOUR WATT CONTINUOUS SINE WAVE POWER AMPLIFIER

The Z-30 is a complete power amplifier of very advanced design employing 9 silicon epitaxial planar transistors. Total harmonic distortion is incredibly low being only 0.02% at full output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Thus you can be utterly certain that your Project 60 system will do full justice to your other equipment however good it may be. The Z-30 is unique in that it will operate perfectly, without adjustment, from any power supply from 8 to 35 volts. It also has sufficient gain to operate directly from a crystal pickup. So in addition to its use in a high fidelity system you can use a Z-30 to advantage in your car or a battery operated gramophone for your children, for example. These, and many other applications of the Z-30, are covered in the Project 60 manual.

SPECIFICATIONS

Power output—15 watts continuous sine wave into 8 ohms using a 35 volt supply; 24 watts continuous sine wave into 3 ohms using a 30 volt supply.

Frequency response: 30 to 300,000 Hz \pm 1dB.

Signal to noise ratio: better than 70dB unweighted.

Distortion: 0.02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Size: 3 1/2 x 2 1/2 x 1/2 inches.

Input sensitivity: 250mV into 100 Kohms.

Damping Factor: > 500.

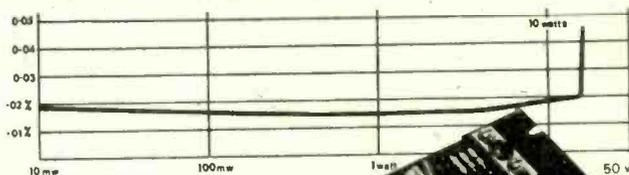
Output—Class AB:

Loudspeaker impedances 3 to 15 ohms.

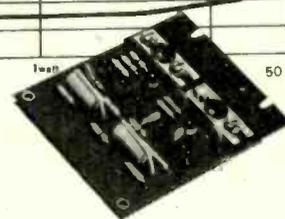
Power requirements: 8 to 35 V.d.c.

APPLICATIONS

High fidelity amplifier; car radio amplifier; record player fed direct from pick-up; Intercom; electronic music and instruments; P.A., laboratory work, etc. Full details of these and many other applications are given in the manual supplied with your Z.30.



Power versus distortion curve of Sinclair Z.30.



Ready built, tested and guaranteed, with Z.30 manual.

89/6

STEREO SIXTY PREAMPLIFIER AND CONTROL UNIT

The Stereo 60 is a stereo preamplifier and control unit designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout and great attention has been paid to achieving a really high signal-to-noise ratio and excellent tracking between the two channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

SPECIFICATIONS

● Input sensitivities—Radio—up to 3mV;

Magnetic Pickup—3mV Correct within \pm 1dB on R.I.A.A. curve. Ceramic Pickup

—up to 3mV; Auxillary—up to 3mV.

● Output—1 volt.

● Signal-to-noise ratio—better than 70dB.

● Channel matching—within 1dB.

● Tone Controls—TREBLE +15 to -15dB.

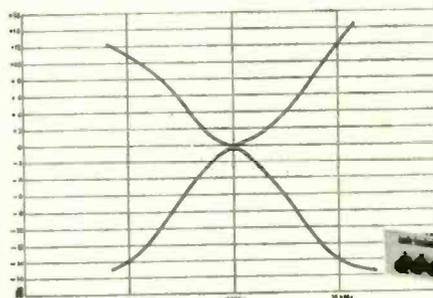
at 10 KHz; BASS +15 to -15dB at 100 Hz.

● Power consumption 5mA.

● Power requirement—PZ.5 or PZ.6.

● Finish—brushed aluminium front panel with black knobs.

● Mounting—on cabinet front by spindle bushes and adjustable brackets.

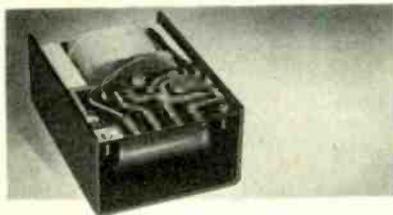


Ready built, tested and guaranteed

£9. 19s. 9d.



SINCLAIR POWER SUPPLY UNITS



PZ-5 30 volts unstabilised—sufficient to drive two Z-30's and a Stereo 60 for the majority of domestic applications.

Price: £4. 19s. 6d.

PZ-6 35 volts stabilised—ideal for driving two Z-30's and a Stereo 60 when very low efficiency speakers are employed.

Price: £7. 10s. 6d.

AT THE
AUDIO FAIR
STAND 95

GUARANTEE

If at any time within 3 months of purchasing Project 60 modules from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter.

SINCLAIR RADIONICS LIMITED
22 NEWMARKET ROAD, CAMBRIDGE
Telephone 0223 52731

sinclair

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE
Please send

NAME

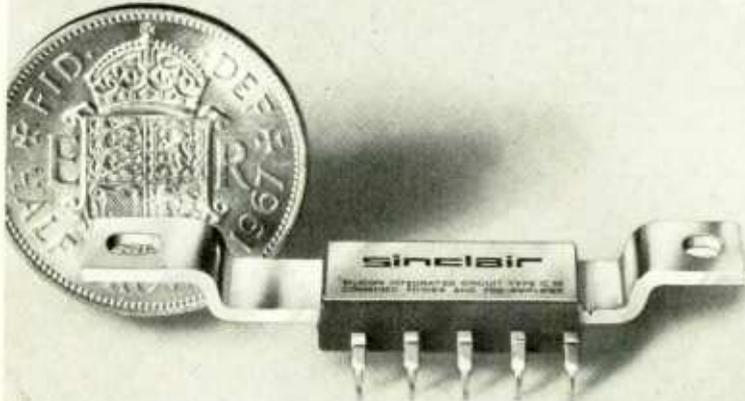
ADDRESS

for which I enclose cash / cheque / money order

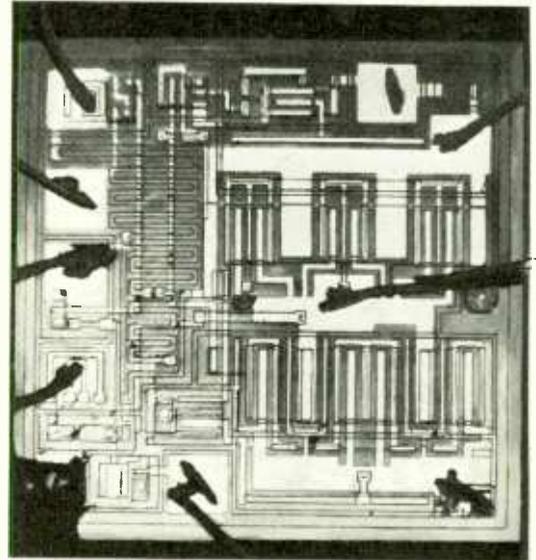
WW11.69

WW—112 FOR FURTHER DETAILS

SINCLAIR IC-10



10 WATT MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER AND PRE-AMP



A 13 transistor circuit measuring only one twentieth of an inch square by one hundredth of an inch thick!

the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by one hundredth of an inch thick, has an output power of 10 watts. It contains 13 transistors (including two power types), 2 diodes, 1 zenor diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of the usual tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout), etc. Once proven, the circuits can be produced with complete uniformity which enables us to give a 5-year guarantee on each IC-10, knowing that every unit will work as perfectly as the original and do so for a lifetime.

USE THIS ORDER FORM FOR YOUR IC-10

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE

Please send

NAME
ADDRESS
.....
.....
.....

for which I enclose cash/cheque money order

WW.11.69

■ SPECIFICATIONS

Output: 10 Watts peak. 5 Watts R.M.S. continuous
 Frequency response: 5 Hz to 100 KHz \pm 1dB
 Total harmonic distortion: Less than 1% at full output.
 Load impedance: 3 to 15 ohms.
 Power gain: 110dB (100,000,000,000 times) total.
 Supply voltage: 8 to 18 volts.
 Size: 1 x 0.4 x 0.2 inches.
 Sensitivity: 5mV.
 Input impedance: Adjustable externally up to 2.5 M ohms.

■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from cross-over distortion at all supply voltages, making battery operation eminently satisfactory.

■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

SINCLAIR

IC-10 with IC-10 manual and 5-year guarantee **59'6**
 Post free.

AUDIO PHOTO-CINE FAIRS, OLYMPIA, STAND 95
 SINCLAIR RADIONICS LIMITED
 22 NEWMARKET RD, CAMBRIDGE Tel: 0223 52731

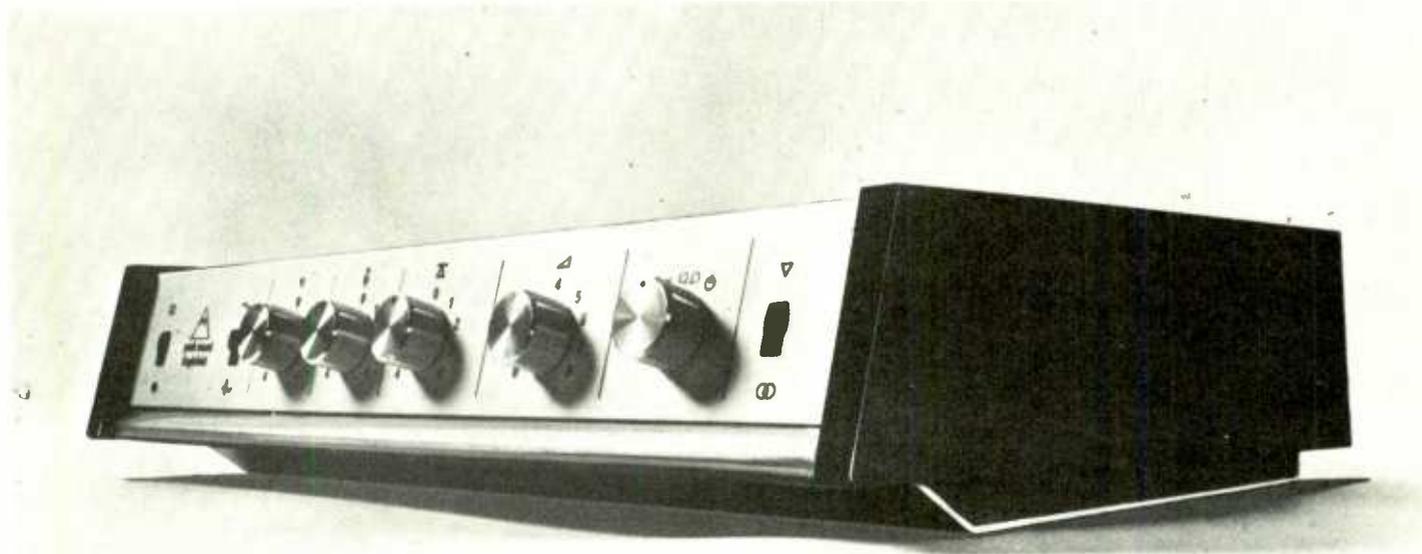


WW-113 FOR FURTHER DETAILS

peak sound



englefield



A NEW DESIGN FROM PEAK SOUND

Think of a stereo amplifier delivering 12 watts R.M.S into 15 ohms per channel and having a total harmonic distortion of 0.1% at full output at 1 kHz. Think what an overload factor of 29dB means on all inputs. Think what it means, too, to have a top-flight amplifier housed in a cabinet of elegantly original design that is both beautiful and completely practical back and front. Think what such an amplifier with its many desirable features might cost – then remember that by assembling the Peak Sound "Englefield" yourself from the pre-built lab. tested modules we design and make, you can own one of the best designed amplifiers you have ever heard for about £38. The ease with which you can do this will delight you. So will the performance and appearance of the complete equipment. The Englefield system enables you to use the exclusive design cabinet for either a 12 + 12 watt assembly or 25 + 25 watt assembly, the pre-amp and tone control unit module being common to either. Each has its own built-in necessary power supply unit.

think
of hi-fi
this way

OTHER PEAK SOUND PRODUCTS

- ES.10-15 Bassandall Loudspeakers as described in Wireless World.
- SA.10-10 Economy Stereo Amplifier in kit form
- "Cir-Kit" circuit building strip.
- Matching Stereo Tuner Modules available shortly.

SPECIFICATION

Using two Peak Sound PA 12-15's, SCU 400 and PS 45K
 Power output per channel 13 watts into 15Ω; 18w into 8Ω; 24w into 3Ω, all R.M.S.
 Frequency bandwidth—10Hz to 45kHz for 1dB at 1 watt
 Total Harmonic Distortion at 1kHz at 11.5w into 15Ω—0.1%
 Input sensitivities— Mag P.U. 3.5mV Imp. R.I.A.A. equalized Tape—100mV linear; Radio 100mV linear
 Overload factor— 29dB on all input channels
 Signal/noise ratio— -65dB on all inputs
 Controls— Volume: Treble (+12 to -12dB at 10kHz); Bass (-12dB to +12dB 100Hz) Filter 9kHz at 12dB/octave; Mono/Stereo; On-off; Balance
 Using two PA 25 15 amplifiers and PS/88S power supply output is then 26 watts into 15Ω per channel at 1kHz or 35w into 8 watts

THE MODULES

An Englefield Stereo Amplifier offers the constructor choice of either the well-known and proven PA.12-15 or PA.25-15 power amplifier modules.

Englefield Amplifier Cabinet with front panel, knobs, sockets, cut and stripped wire to length, fuses, edge connectors, etc.	£8 0 0
Two PA.12-15 power amp. built modules (£5.19.6 each)	£11 19 0
SCU/400 Pre-amp./Control module, built	£15 15 0
PS/45 Power Supply kit	£4 10 0
	£38 4 0

Using two PA.25-15 power amplifier modules at £11.15.0 each and PS/88S Stabilized Power Supply Unit at £13.10.0, total price for complete system comes to **£58 15 0**



Go to your Stockist. Peak Sound products are already available from dealers in all parts. If your own local stockist is not yet ready with the Peak Sound items you require, please send direct together with your supplier's name and address and your requirements will be dealt with without delay.
TRADE ENQUIRIES INVITED.
PEAK SOUND (HARROW) LTD.,
32 St. Jude's Road., Englefield
Green, Egham, Surrey
 Telephone: EGHAM 5316

To Peak Sound, 32 St. Jude's Rd., Englefield Green, Egham, Surrey.

Details of Englefield systems, please and

Name

Address

Write your stockists name and address in margin below and cut out with coupon if necessary.

WW-114 FOR FURTHER DETAILS

Wilkinsons EST. 1921



MEGGERs 500 volts 1000 Megohms with test leads, in leather case with strap £38.
ALL BRITISH METERS COMPLETE LIST AVAILABLE
 Microamps 0/100 2in. MC 40/-, 0/500 2in. MC 25/-, 0/500 2 1/2in. MC 37/6. Milliamps 0/50 2 1/2in. MC 35/-, 0/500 2in. MC 35/-, 0/500 3 1/2in. MC 34/-, Amps 50-0-50 2in. MC 17/6, 0/5 2in. MC 42/6 with fixing clip. Volts 0/1 2in. MC 44/-, 0/5 AC/DC MI 3 1/2in. 55/-, 0/10 3 1/2in. AC MCR 70/-, 0/20 2in. MC 42/6 with clip. 0/40 2in. MC 42/6 with clip. 0/50 3 1/2in. MC 34/-.
MICROAMPS 0/50 scaled in Rontgens 2 1/2in. MC 50/-.
CELL TESTING VOLTMETERS 3-0-3v DC. complete with leads and prods in leather case 3in. scale 40/- each, post 3/-.
PORTABLE VOLTMETERS 0/250 MI AC/DC 6in. scale in wood case £7.10.0.

FREQUENCY METERS 45/55 c.p.s. 230V AC 6in. dia. flush round £10.10.0.
VISCONOL CATHODE RAY CONDENSERS. .001 mfd 10KV 5/-, .002 mfd 15KV 9/-, .02 mfd 10KV 10/-, .025 2.5KV 9/-, .05 mfd 5KV 9/-, 0.1 mfd 4KV 9/-, 6KV 17/6, 0.5 mfd 2.5KV 17/6, 1 mfd 2KV 17/6.

LEDEX ROTARY SOLENOIDS AND CIRCUIT SELECTORS, size 5S. 4 pole 11 way and off 110/-, 24 pole 11 way and off 210/-, 54 pole On/Off 150/-.

GEARED REVERSIBLE MOTORS by Crouzet Ltd. 1 r.p.m. or 3 r.p.m. 24 volts A.C. 4 watts 37/6 each, can be operated from 230 volts with our 20/- Transformer.

ONE HOLE FIXING SWITCHES. D.P.S.T. 3 amp, 250 volt A.C., 2/- each.

JACK PLUGS. 2 point screw on cover, 2/6, post 1/-, PO 201 on headphone cord, 3/- each, post 2/-.

JACKS 3 point 10H 17/6 2 each.

SUB-MINIATURE Microswitch Honeywell S.P.D.T. type IISMITN13, size 1/2" x 1" x 1/2" 6/6 each, or mounted in five 2 1/6 post free.

HIGH SPEED COUNTERS. 3 1/2" x 1". 10 counts per second with 4 figures. The following D.C. voltages are available: 6v., 12v., 24v., 50v. or 100v. 35/- each.

VEEDER ROOT MAGNETIC COUNTERS with zero reset 800 counts per minute, counting to 999,999, 110 volts or 125 volts A.C. or 110 volts D.C. 65/- each, post 3/-.

MINIATURE SILVER ZINC ACCUMULATORS. 1.5 volt 1.5 ampere size 2" x 1-1/3" x 0-63", only 1 1/2 oz.; quantities available, 12/6 each, 120/- doz., post 1/6.

IN-LINE DIGITAL DISPLAY UNIT. 28 volts 5" x 4" x 1 1/2" five single Units each displaying 11 messages in letters, symbols and numbers, £35 complete.

MOTORS. 1/2 h.p. 230/250 volts 1425 r.p.m., shaft 1/2" x 1", resilient mounting, 80/- each. **TERMINAL BLOCKS.** 2 way 5C/430 3 way 5C/432 50/- per 100, post 6/-, £20 per 1,000, cse 15/-.

STABILIZED POWER UNITS. RcaL Inss. AC input 200/250v. DC output positive HT 200/230v., stabilized load current 250 mA, negative HT 150v., stabilized 15 mA, new unused, £40 each.

EQUIPMENT RACKS P.O. STANDARD TYPE. 6ft. U channel sides drilled for 19in. panels, heavy angle base 150/-, cse 20/-, **DESK UNITS** for Racks 35/-.

DOUBLE TRIODE E88CC. Mullard & Brimar, 12/- each. **ECC81,** Marconi, 4/- each. **12BH7,** Brimar, 7/6 each. **GET875,** 5/6 each. Send for stock list.

HANDSETS P.O. type with press in handle, and sound powered earpiece, carbon mic., 4 core flex and plug YA 6451, 17/6 each, 800 available.

HEADPHONES. Balanced Armature 56 Ohm complete with Carbon Breast Microphone, flex and plug in portable wood case (YA 6401), 18/- each.

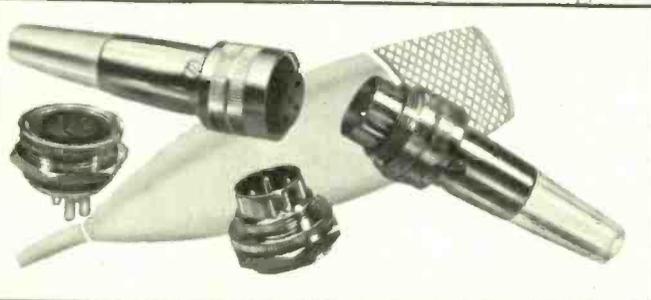
EQUIPMENT WIRE. 1/024, 7/0076, 14/0048 PVC covered 100 and 200 yd. reels. All colours 80/- per 1000 yds., post 6/-, Multicore standard 8 core cable individually coloured, screened and PVC sheath, £6 per reel 75 yds, post 8/-.

L. WILKINSON (CROYDON) LTD.
 LONGLEY HOUSE LONGLEY RD. CROYDON SURREY

Phone: 01-684-0236

Grams: WILCO CROYDON

WW-115 FOR FURTHER DETAILS



Sole Distributors

Super Electronics Ltd.

5 VIOLET HILL, LONDON N.W.8

TELEPHONE: MAIDA VALE 8281

WW-117 FOR FURTHER DETAILS

F.A.L. 'PHASE 50'

Public Address Amplifier



29 GNS.

Recommended Retail price

A superb solid state A.C. Mains unit for vocal and instrumental groups and General Public Address use

- ★ 50 Watts Output (Peak Rating)
- ★ Output matching for speakers from 3-30 ohms
- ★ 3 separately controlled inputs
- ★ Separate Bass and Treble Controls
- ★ Frequency Response 22 c.p.s. to 30 Kcs.
- ★ High Sensitivity

SEND S.A.E. FOR FULLY DESCRIPTIVE LEAFLET

AVAILABLE FROM YOUR LOCAL DEALER
 Wholesale and Retail enquiries to Manufacturers

FUTURISTIC AIDS LTD., 103 Henconner Lane, Leeds 13

WW-116 FOR FURTHER DETAILS



W.H.M.

WOW AND FLUTTER METER (R.M.S) MODEL III

SYDNEY HOUSE, 35 VILLIERS ROAD, WATFORD WDI-4AL

WW-118 FOR FURTHER DETAILS

HIRE ELECTRONIC TEST GEAR

— calibrated and ready to plug in

Livingston Hire

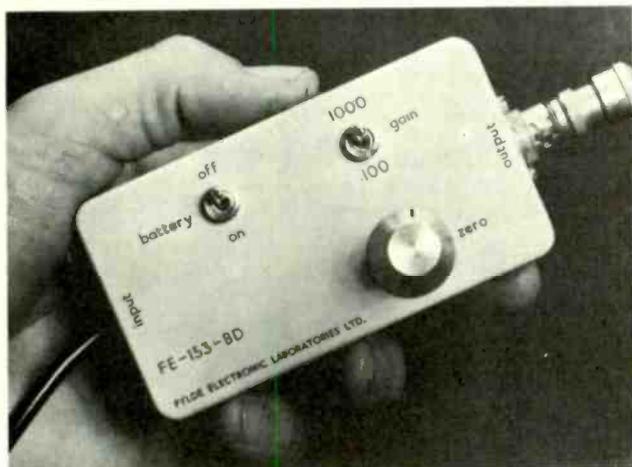
01-267 0414

WW-119 FOR FURTHER DETAILS

DC DIFFERENTIAL AMPLIFIER

FE-153-BD

£38-10-0



low drift * low noise
 high common mode rejection
 small size * battery powered

Also:

wide range of general purpose dc amplifiers,
 bridge supplies and bridge units for instru-
 mentation and control purposes.

FYLDE

Electronic Laboratories Ltd
 Oakham Court, Preston. PR1 3XP
 Telephone: Preston 57560

WW-120 FOR FURTHER DETAILS

TRANSFORMERS

DESIGNED TO CUSTOMER'S OWN SPECIFICATIONS FOR
 ALL APPLICATIONS UP TO 100 KVA. "C" CORE, PULSE,
 3 PHASE, TOROIDS, HIGH TEMPERATURE, ETC.

Samples from our standard production ranges:-

*Mains	£	s.	d.
350-0-350V. 60mA., 6.3V. 2A.	2	2	0
500V. 300mA. 6.3V. 4A., 6.3V. 1A.	3	19	9
500-0-500V. 0.25A., 6.3V. 4 Act., 6.3V. 3 Act., 5V. 3A.	4	19	9
525-0-525V. 0.5A., 6.3V., 6 Act., 6.3V. 6 Act., 5V. 6A.	5	13	6

*Low Voltage

30-0-30V. 4A.	3	12	6
28V. 1A., 28V. 1A., 28V. 1A., 28V. 1A., 30V. 250mA.	4	15	0

*Primaries 10-0-200-220-240V.

20W Transistor Amplifier (W.W. Nov. 1966)

Driver	1	4	6
Mains	1	19	6
L.P. Filter, Chassis Mounting	12	6	
L.P. Filter, Printed Circuit Mounting	15	6	

70V & 100V Line Matching

Fitted with terminal panel, taps at 0.5, 2, 4 and 8W. into 15 ohms
 9/- each in 100 Lots
 Flying leads, taps at 1/2, 1, 2 and 4W. Into 3 ohms .. 7/3 each in 100 Lots

Prices inclusive of postage and packing, each.
 For small quantities, cash with order, please.

HOWELLS RADIO LIMITED

CARLTON ST., MANCHESTER, M14 4GT 061-226 3411

WW-121 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 certifi-
 cates 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.: 01-692 2689

E.I.D. & G.P.O. APPROVED

CONTRACTOR TO H.M. GOVT.

WW-122 FOR FURTHER DETAILS

GAREX ELECTRONICS

MAIL ORDER

CHINNOR, OXON

GAREX TWOMOBILE TX complete, £35.

GAREX FOURMOBILE complete, £35.

TW PHASE 11 TRANSVERTER 28-144 MHz, £69.

TW PHASE 11 Matching Power Unit, £34.

15 watt QQVO3-10 TX less case (heaters) PSU mod. and
 crystal, 6 or 12v. Heaters. Post 4/6, £8.15.

20 watt plus. QQVO3-20a. or 6-40a. TX as above, but fitted
 into diecast box. Post 4/6, £14.10.

70cm Aerial c/o relay 50v. working 50 ohm. 150 watts. New.
 Post 2/6, £3.5. Matching B.N.C. Plugs, 6/- each.

6 pf Butterfly capacitors with short shaft. 1/8" dia. New. Post
 6d., 5/-.

We will be restocking Birmingham Branch with components
 and kits, etc., from the first week in October. Many new items.
 Saturdays 10 a.m. to 6 p.m. Sundays, 10 a.m. to 2.30 p.m.
 G3MMJ in attendance.

Garex Wholesale Ltd., 1189 Bristol Road South,
 Birmingham 31. 021-475 6453.

OUR GUARANTEE IS YOUR SATISFACTION
 SPECIAL EXPORT SERVICE

Callers welcome, please telephone G3MMJ ex ZS6QP
 Kingston Blount 476 OTH45-476

Northern area agents: Derwent Radio, Scarborough, Yorks.
 Scarborough 63982

WW-123 FOR FURTHER DETAILS

4! brings you a mountain of components at manufacturers' prices

The serious amateur should never be without this comprehensive price list and guide to semiconductors and electronic components from RCA, IR, SGS, Emihus, Semitron, Keyswitch, Plessey, Morganite, Litesold and others (together with manufacturers' application data) which you can buy direct from us at manufacturers' prices e.g. IN914 1/3d. □ IN916 1/11d. □ 2N697 4/5d. □ 2N706 2/3d. □ 2N706A 2/9d. □ 2N929 5/8d. □ 2N1613 4/8d. □ 2N3011 9/1d. □ 2N3053 6/2d. □ 2N3055 15/9d. □ 3N140 15/3d. □ BFY50 4/8d. □ BFY51 3/9d. □ BSY27 18/- □ BSY95A 3/3d. □ C407 4/6d. □ CA3012 18/3d. □ CA3014 25/6d. □ CA3020 25/9d. □ OA200 1/9d. □ OA202 1/11d.



Build the NEW Mainline Audio Amplifier kits - UP TO 70 WATTS

The result of the combined resources of SGS and RCA, these quasi circuits set new standards in quality and performance. Each kit is complete with circuit diagram, all semiconductors, resistors, capacitors and printed circuit board.

12A.....	£7. 0. 0.
25A.....	£8. 5. 0.
40A.....	£9. 0. 0.
70A.....	£10.10. 0.

Any two will make an outstanding stereo equipment.



To: Mainline Electronics Limited, Thames Avenue, Windsor, Berkshire

I enclose 4/-. Please send me your price list and guide

I am interested in Amp Mainline Audio Amplifier Kits. Please send me full data

I am interested in receiving data on preamplifier & power supply kits

NAME _____ ADDRESS _____

(A member of the ECS Group of Companies)

WW-124 FOR FURTHER DETAILS

TRS SECTION 1

The following amplifiers are styled and kitted by T.R.S. using quality components and backing them with well presented instructions and backed by T.R.S. service. Valves and transistors are included as appropriate. All are self-powered unless stated.

MULLARD SERIES

3-3 MONO

3 watt output, tapped for 3 and 15 ohms. Sensitivity: 100mV. Bass and treble controls.

Kit .. £7.19.6 (Carr. 7/6)
Built and tested £10.10.0 (Carr. 7/6)

5-10

Still ranks as one of the best designs ever. 5 valves, 10 watts, o/p for 3 and 15 ohms.

Basic Kit (requiring pre-amp stage) .. £10.10.0 (Carr. 7/6)
Built .. £13. 0.0 (Carr. 7/6)

Basic, with passive control system .. £12.10.0 (Carr. 7/6)
Built .. £15.15.0 (Carr. 7/6)

2 VALVE PRE-AMP

5 input switching plus auxiliary tone controls, etc.

Kit .. £6.19.6 (Carr. 5/6)
Built .. £9.10.0 (Carr. 5/6)

BASIC 5-10+D VALVE PRE-AMP

Built and tested £21.10.0 (Carr. 10/-)

10+10 STEREO

A highly efficient and dependable stereo unit with the best of Mullard

and T.R.S. features. O/p transformers tapped for 3 and 15 ohms. Can accept ceramic or crystal P.U. direct otherwise pre-amp is necessary.

Kit .. £18.10.0 (Carr. 12/6)
Built and tested £22.10.0 (Carr. 12/6)

2+2 VALVE STEREO AND PRE-AMP

Built and tested £13.19.6 (Carr. 7/6)
T.R.S. 4+4

Transistor amplifier based on Mullard modules and produced to provide good quality and appearance at low cost. 4+4 watts output. For 3-15 ohms speakers. Input switching, etc. Bass and treble controls. Simple module assembly. Amp and pre-amp with front panel and knobs.

Kit .. £7.19.6 (Carr. 3/6)
Teak sided cabinet .. £1.17.6 (Carr. 2/6)

24V. Power pack £2. 5.0 (Carr. 2/6)
Complete kit inc. OIN plugs and sockets .. £12.10.0 (Carr. 7/6)

T.R.S. F.M. TUNER

Assemblies from modules obtainable separately. Features interstation suppression, A.F.C., etc. Modules and chassis, scale and tuning drive come to .. £15.15.0 (Carr. 7/6)

Mains power unit .. £2. 5.0 (Carr. 3/-)
Cabinet to match "4+4" .. £1.17.6 (Carr. 2/6)

Multiplex decoder for stereo .. £10.10.0 (Carr. 2/6)

T.R.S. 6 VALVE AM/FM TUNER

With power supply, valves, large illuminated station-named scale. Push button on-off and wave change, "magic eye" indicator. Tunes Med. waves and F.M. Diode output for tape.

Kit with power unit .. £12.10.0 (Carr. 7/6)
Kit less power unit .. £11.10.0 (Carr. 7/6)

MODULES

T.R.S. 12 watt-15 ohm amplifier as specified in *Practical Wireless*. 12-12 Stereo amplifier, built .. £5.19.6

Kit, complete .. £4.11.0

SINCLAIR Z.30—New power amplifier, as advertised .. £4. 9.6

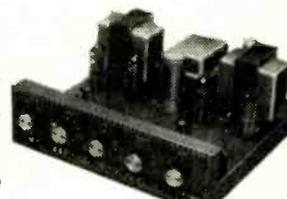
SINCLAIR STEREO SIXTY Pre-amp/tone control .. £9.19.6

SINCLAIR PZ.5 power supply unit .. £4.19.6

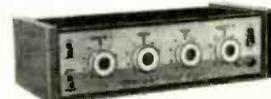
SINCLAIR IC-10 integrated circuit amplifier and pre-amp. .. £2. 9.6

SINCLAIR "MICROMATIC" MIDGET RADIO RECEIVER—smaller than a matchbox.

Kit .. 49/6
Built .. 59/6



5-10 MULLARD 10-10



TRS 4-4



6 VALVE AM/FM



SINCLAIR IC.10

TRS SECTION 2

ELECTROLYTICS

Tubular			
1/350v	..	TCC 2/-	
2/150v	..	TCC 2/-	
2/450v	..	BEC 2/3	
4/350v	..	TCC 2/-	
8/150v	..	TCC 2/-	
8/450v	..	BEC 2/3	
8 x 8/450v	..	BEC 4/6	
8 x 8/450v	..	BEC 3/6	
16/450v	..	DUB 2/-	
100/25v	..	TCC 5/-	
16 x 8/450v	..	TCC 5/6	
32/350v	..	BEC 3/6	
32 x 32/350v	..	BEC 5/-	
25/25v	..	TCC 1/9	
50/50v	..	BEC 1/9	
50/25v	..	BEC 1/9	
50/12v	..	BEC 2/-	
100/25v	..	TCC 4/6	
1000/5v	..	..	3/3
1000/50v	..	..	6/9
2000/25v	..	..	6/-
Can Type (Clips 3d.)			
8/500v	..	DUB 3/-	
16/350v	..	TCC 3/-	

COMPONENTS, ACCESSORIES, etc.

8+16/450v	..	TCC 5/-	
16+16/450v	..	TCC 5/6	
32+32/450v	..	TCC 6/-	
42+32/275v	..	HUNTS 8/6	
16+16+16+32/350v	..	TCC 6/6	
50+50/350v	..	TCC 6/6	
32+32+8/350v	..	TCC 6/6	
60/350v	..	TCC 11/6	
60+100/350v	..	BEC 11/6	
64+120/275v	..	BEC 11/6	
100+100/350v	..	BEC 14/6	
100+400/275v	..	TCC 16/6	
100+200+200/350v	..	BEC 3/6	
2000+4000/6v	..	BEC 3/-	
1000+1000/6v	..	..	10/6
5000/25v	..	..	13/6
2500 mfd 64v	..	..	12/6
4000 mfd 40v	..	..	12/6
6400 mfd 25v	..	..	12/6
2000 mfd 50v	..	..	10/6
Condenser Mounting Clips			
1 in. x 4d. each		1 1/2 in. 5d. each	
Tubulars		Each	
-001 mfd to -01 mfd 450v	..	..	10d.
-1 mfd 350v	..	..	10d.
-02 mfd to -1 mfd 500v	..	..	1/-
-22 mfd 350v	..	..	1/9
-22 mfd 500v	..	..	2/-
-5 mfd 500v	..	..	TCC 2/6
-25pf 10Kv	..	..	TCC 5/6
-001 mfd 6Kv	..	..	TCC 8/6
-0005 mfd 20Kv	..	..	TCC 9/6
-001 mfd 20Kv	..	..	TCC 18/6
-1 mfd 7Kv	..	..	..
CONDENSERS			
Silver Mica and Ceramics—Pre. values.			
Micas, and Silver Mica 2.2pf-1000pf			
ea. 6d. 1200pf-8000pf ea. 9d. Ceramics,			
2.2pf-5000pf 9d. -01mfd 1/-			
Close Tolerance Condensers S/Mica			
10% Type 5pf-500pf	Each	9d.	
600pf-5000pf	..	1/-	
1% Type 2pf-100pf	..	11d.	
100pf-250pf	..	1/2	
270pf-800pf	..	1/4	
820pf-2200pf	..	2/-	
Hi Voltage (Pulse) Ceramic Condensers,			
12Kv. 10pf-350pf	Each	1/9	
TRIMMERS—Ceramic (Compression			
Type)			
30pf, 70pf	9d.	100pf, 150pf	1/3
250pf	1/6	600pf	1/9

TRS SECTION 3

PLAYING UNITS, CARTRIDGES & PLINTHS

GARRARD SP.25 Mk. II
10 1/2 in. die-cast t/table, cueing device and counterbalance. Less cartridge.
In maker's carton .. £11.19.6 (Carr. 7/6)

GARRARD LM.2025
With Sonotone 9TA/HC cartridge and lift control .. £11.19.6 (Carr. 7/6)

PLINTHS
Garrard WB.1 .. £3. 7.6 (Carr. 5/-)
Garrard Clearview Cover SCP.1 .. £3. 5.0 (Carr. 4/6)
Garrard Scandinavian Type .. £5. 5.0 (Carr. 5/-)

CARTRIDGES
When bought together with playing units.
Decca Deram, £5.5.0; BSR TC8/H (Stereo compatible), 25/-; BSR Stereo TC.85, 28/6; Sonotone 9TA/HC, 60/-; Acos GP.93-1, 30/-.

TRS SECTION 4

VINAIR—Latest I.C.I. Cabinet and Speaker covering. Mottled light-Grey Off-White, Fawn, Black, etc., 2/6 persq.ft. Multiples of 6 in. cut. 25/6 per yd. Maximum width 48 in.
Send 1/- for Samples—Refundable.
BONDACOUST—Speaker Cabinet Acoustic Wadding (as used by leading Hi-Fi Speaker mfrs.), 18 in. wide. Any length cut. 2/6 per ft.; 7/- per yard
ENAMELLED COPPER WIRE
New 2 oz. reel prices
14g-20g, 3/-; 22g-28g, 3/6; 30g-34g, 4/3; 36g-38g, 4/9; 39g-40g, 5/-.
Other gauges quoted for.
TINNED COPPER WIRE
16g-22g .. 4/6 per 2 oz.
PVC CONNECTING WIRE
10 Colours (for Chassis wiring, etc.) Single or stranded Conductor 3d. per yd.
SLEEVING—Various Colours
1 mm., 2 mm., 3d. yd.; 3 mm., 4d. yd.; 4 mm., 5d. yd.; 6 mm., 6d. yd.
EXCLUSIVE T.R. TAPE BARGAIN
Professional quality full frequency Mylar Tape by famous m/fr. Attractively presented in coloured simulated leather wallets with space for spare reel.
5 in. 900 ft. 12/6 5 1/2 in. 1200 ft. 17/6
7 in. 1200 ft. 17/6 7 in. 1800 ft. 22/6
Post and packing 1/6 per reel, plus 6d. each for extra reels.
EMPTY TAPE REELS (Plastic)
3 in., 1/6; 4 in., 2/-; 5 in., 2/-; 5 1/2 in.,

MATERIALS, LOUDSPEAKERS, etc.

2/3; 7 in., 2/6.
PLASTIC REEL CONTAINERS (Cassettes)
3 in., 1/6; 5 in., 2/-; 5 1/2 in., 2/3; 7 in., 2/6.
VEROBOARD—All standard sizes stocked.
2 1/2 x 3 1/2, 3/-; 2 1/2 x 5, 3/8; 3 1/2 x 3 1/2, 3/9; 3 1/2 x 5, 5/8; 17 x 2 1/2, 12/6; 17 x 3 1/2, 15/-
Accessories—Term Pins, 1/- doz. 3/-; pkt. Face Cutter, 7/3. Pin inserting tool, 9/6.
"CIR-KIT"—Adhesive copper strip, 5 in. by 1/16 in. spool .. 2/-
WAFER SWITCH ASSEMBLIES .. Each
1 x 12, 2 x 6, 4 x 3, 3 x 4 way wafers 4/6
Fluxing assemblies, with washers, etc. 6/6
PLUGS AND SOCKETS
Phono plugs, 1/-; sockets, 1/-; per pr. 1/6
DIN 5-pin plugs, 3/-; 5-pin sockets, 1/6;
3-pin plugs, 3/-; 3-pin sockets, 1/6.
VOLUME CONTROLS
1 1/2 in. dia. Long Spindles. Famous make. All values 5000 ohms-2 Megohms. Guaranteed 12 months.
Log or Linear tracks .. Sw. 5w. 3/6; DP Sw. 5/-
ditto Centre Tapped 1/2 Megohm Log, 1 Megohm .. Less Sw. 8/-
Twin Ganged Stereo controls 1 1/2 in. dia. Long Spindles.
All values 5000 ohms to 2 Megohms. Less Sw. Each 8/6

FOR BETTER BARGAINS

TRS

RADIO COMPONENT SPECIALISTS

70 BRIGSTOCK ROAD THORNTON HEATH

SURREY Telephone: 01-684 2188

ENQUIRIES & ORDERS

When sending enquiries, they must be accompanied by a stamped and self-addressed envelope. Orders should be written clearly on one side of the paper and cost of carriage added. Where not quoted, please add as follows: 1 lb., 1/-; 1 lb., 1/9; 2 lb., 3/6; 6 lb., 5/-; 10 lb., 6/6; 14 lb., 8/-; over, 10/6. Where postage is overpaid, we credit you with the difference. S.A.E. brings latest T.R.S. Lists.



2kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2kW), switch down for half heat (1kW), switch central blower cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3.15.0. Post and ins. 7/6.

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-alk, mostly resin filled. Kit A—15-20 w. 19/6. Kit B—30-40 w. 19/6. Kit C—50 w. 19/6. Kit E—65 w. 19/6. Kit MF1 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.

BECKASTAT

This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures, 13A loading. Will save its cost in a season. 19/6. Post and ins. 2/9.



REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types: Miniature. 1in. long x approximately 1/16in. diameter. Will make and break up to 1/4A up to 300 volts. Price 2/6 each. 18/- per dozen. Standard. 2in. long x 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 2/- each. 18/- per dozen. Flat. Flat type, 2in. long, lead over 1/16in. thick, approximately 1in. wide. The standard type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price 6/- each. £3 per dozen. Small ceramic magnets to operate these reed switches 1/3 each. 12/- dozen.

60 r.p.m. Gearing Motor. This is a powerful unit, driven by a mains motor of similar type, but rather larger than the average Tape Deck or Record Player motor. The gear boxes may be detached. It is, in fact, a unit measuring approximately 3 1/2 x 2 1/2 x 1 1/2 in. thick. The final drive shaft is 1/2 in. wide, 1/2 in. long. 35/-.

A Micro Meter bargain. Limited quantity only, centre zero 50-0-50 micro amps. This is a Weston Meter enclosed in clear Perspex case for flush mounting. Dial size approximately 2 1/2 in. wide. The scale is not engraved but has a red part in the centre and a green part to the left of centre. Scale could be cleaned off and re-written to suit your particular requirements. Regular price probably over £5 each, our price 29/6 each.

Battery Record Player. Made by Collaro. This is made up on a unit plate with speed selector and pick-up. The turntable is a heavy one and measures approximately 9 1/2 in. Pick-up is fitted with the famous "Studio cartridge. Price 69/6. Post and ins. 6/6.

E.H.T. Condenser. 28kV. 0-0011 mfd. Suitable for transmitting test conditions at 300k/c. Bakelite case. 18/6 each. 85 Watt Tubular Element. Very well made unit. The element is wound on a porcelain former then encased in a brass tube terminated with beaded leads 12in. long. Normal mains voltage. Price 5/- each or 54/- per doz.

Press to Make Switch. Double pole, 5A contacts or can be used as single pole, 10A contacts 250 volt working. Single hole fixing. 2/6 each. 24/- dozen.

Door Switch. Contacts open when plunger is depressed. Prevents lights being left on. 15A contacts, 230 volt working. Made by Arrow. 3/6 each. 36/- per dozen.

Rotary Appliance Switch. 16A, 230 volt on moulded ceramic base. Operated by pointer knob (not supplied). 2/- each. 18/- per dozen.

E.H.P. Motor. Made by the French (Ceskor) Company. This is an excellent totally enclosed motor, powerful enough to operate small lathe, drilling machine, washing machine, etc. Its speed is 1,460 r.p.m. Made for normal 50 cycle, 230/250 volts mains, totally enclosed, size 2 1/2 x 3 1/2 in. dia. with 1/2 in. of 1/2 in. spindle. Price 19/6 plus 4/6 post and ins.

FLEX BARGAINS

Screened 3 Core Flex. Each core 14/0076 Copper PVC insulated and coloured, the 3 cores laid together and metal braided overall. Price £2.15.0 per 100 yds. coil

15A 3 Core Non-link Flex. 70/0076 insulated coloured cores, protected by tough rubber sheath, then black cotton braided with white tracer. A normal domestic flex as fitted to 3kW fires. Regular price 3/6 per yd. 50 yd. coil £4.10.0, or cut to your length 2/6 per yard.

10A 3 Core Non-link Flex. As above but cores are 28/0076 Copper. Normal price 2/6 per yd. 100 yd. coil £7.10.0, or cut to your length 1/9 yd.

6A 2 Core Flex. As above, but 2 cores each 23/0076 as used for Vacuum Cleaners, Electric Blankets, etc. 39/6 100 yd. coil.

3-CORE WATERPROOF FLEX

6A, 23/0076 circular PVC covered as fitted to electric drills and most portable appliances, ideal extension lead. Regular price 1/6 per yard, our price 79/6 for 100 yard coil. Post 5/6.

Elliott Sealed Contact Reed Relay. Three circuits closed by 3 volt or 100MA. 9/6 each.

Slim Tubular Microphone. For hand holding or frontal suspension—lever switch—high impedance with lead and plug for cassette tape recorder but suitable for most amps. 19/6.

500MA Movable Coil Meter. 2in. flush mounting round meter ex-Government but unused and perfect. 17/6.

TANGENTIAL HEATER UNIT



Winter is coming but act today and you won't dismay. This heater unit is the very latest type, most efficient and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Units complete, wired ready to fit into cases, i.e. motor, impeller, 3 kW heater switching 1, 2 and 3 kW, and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need on/off switch. 79/6. Postage and insurance 6/6. Don't miss this.

STEREO CABINET

Size 26in. x 14in. x 9 1/2in. deep—speaker compartment each end. Centre portion with hinged lid and removable bottom has platform for autochanger and room for amplifier. Two tone (red and grey) rexine covered but loud speaker ends need metal grilles. With handle and clips, 22/6. Carriage and packing 15/-.



SOLDER GUN

A must for every busy man, gives almost instant heat; also illuminates job. 100 watt £20.2/40v. 39/6 (saves you over 30/-), post and ins. 4/6. BIG JOB 250 watt model 89/6 (saves you over £3.10), post and ins. 6/6.

BUY TIME SLOT METERS

If you hire out equipment such as TV sets by the hour then these slot meters are what you require. We have 3 types, 8d. an hour, 1/- an hour and 1/6 an hour. Brand new. Made by the famous Weston Company. Price £3.19.6. post and ins. 6/6



HORSTMANN 'TIME & SET' SWITCH

(A 30 Amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price 29/6. Post and ins. 4/6.



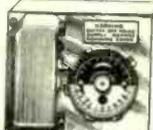
DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar panels advertised at £5. Our price 39/6, plus 3/6 post and insurance.



ELECTRIC TIME SWITCH

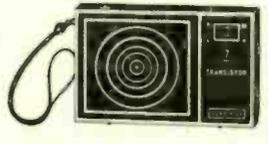
Made by Smith these are AC mains operated, NOT CLOCKWORK ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5A changeover contacts will switch circuit on or off during these periods. 59/6. post and ins. 4/6. Additional time contacts. 10/- pair.



THIS MONTH'S SNIP

'GLADIATOR' 2 WAVEBAND TRANSISTOR RADIO

7 transistor, 2 wave band (medium & long) pocket radio with carrying handle and earphone socket. These radios use a ferrite slab aerial and a conventional superhet circuit with built-in moving coil speaker. Completely built up, ready to play. Offered at less than importer's price due to bankrupt purchase. A remarkable bargain. 39/6 plus 3/6 post and insurance.



3 STAGE PERMEABILITY TUNER

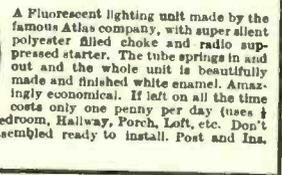
This Tuner is a precision instrument made by the famous "Cydron" Company for the equally famous Radiomobile Car Radio. It is a medium wave tuner (but set of longwave coils available as an extra if required) with a frequency coverage 1,690 Kc/s-525 Kc/s and intended to operate with an I.F. value of 470 Kc/s. Extremely compact (size only 2 1/2 in. x 2 in. x 1 1/2 in.) with reduction gear for fine tuning. Snip price this month, 12/6 with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post Free.



ATLAS SLIMLINE FLUORESCENTS

THE TWENTYLITE

A Fluorescent lighting unit made by the famous Atlas company, with super silent polyester filled choke and radio suppressed starter. The tube springs in and out and the whole unit is beautifully made and finished white enamel. Amazingly economical. If left on all the time costs only one penny per day (uses 1 unit). Measures 2ft. long. Is ideal Kitchen, Bedroom, Hallway, Porch, Loft, etc. Don't miss this amazing offer, 39/6 with tube. Assembled ready to install. Post and ins. 6/6 extra.



DREAMLAND CLOCK SWITCH

The wonderful DREAMLAND mains operated clock switch will automatically switch your blanket on and off each evening and you will always have a warm bed. It's luminous; you can always see the time and it's a really beautiful unit. An ideal gift. Can also control tape recorder, radio, lamp, etc., up to 500w. 39/6 plus 3/6 post and ins.



1 WATT AMPLIFIER & PRE-AMP

5 transistors—highly efficient made for use with tape-head G4 but equally suitable for microphone or pick up. Limited quantity 29/6. Full circuit diag. also shows tape controls 5/-.



VARYLITE

Will dim incandescent lighting up to 600 watt from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob £3.19.6.



HI FI BARGAIN

FULL F1 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S.—Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—121 over mounting lug—Baffle hole 11in. diam.—Mounting holes 4, holes 1/2 in. diam. on pitch circle, 1 1/2 in. diam.—Overall height 5 1/2 in. A 40 speaker offered for only £3.8 6 plus 7/6 p. & p. Don't miss this offer. 15in. 30 watt £7.19.6. 18in. 100 watt £24.10.0.



Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

MINIATURE WAFER SWITCHES

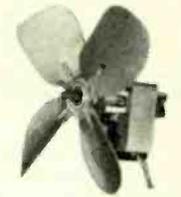


2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/6 each. 36/- dozen, your assortment.

WATERPROOF HEATING ELEMENT 26 yards length 70W. Self-regulating temperature control. 10/- post free.

AC FAN

Small but very powerful mains motor with 6 1/2 in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.



DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions 19/6, plus 2/6 post and insurance. Made up model also available 37/6 plus 2/6 p. & p.

MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heater, etc. New and perfect. Snip at 9/6. Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

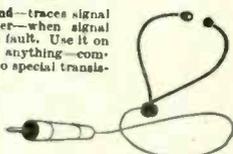
QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have a bedside for tea, baby's food, etc. 19/6, post and insurance 1/6. 12v. car model also available.



RADIO STETHOSCOPE

Easiest way to fault find—trace signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece 29/6—twist stetosop instead of earpiece 7/6 extra—post and insurance 2/9.



MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 18/6, plus 3/6 postage.



PROTECT VALUABLE DEVICES

FROM THERMAL RUN-AWAY OR OVERHEATING: Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90 deg. to 190 deg. F. or with the dial removed range setting is between 80 to 800 deg. F. Price 10/-.

PHILIPS TRIMMER

0-30pf of an old design but one which has never been bettered. 1/- each. 10/- doz. £4.0.0 per 100.



ROTISSERIE MOTOR

Very powerful 7 r.p.m., operates from standard A.C. mains. 29/6, plus 3/6 P. & P.



230 VOLT SOLENOID

1/2 in. stroke. Size 2 1/2 in. x 2 in. x 1 1/2 in. 14/6, postage 2/9.



SPRING COIL LEADS

as fitted to telephones, 4 core 2/6 each, 3 core 2/- each.



PP3 BATTERY ELIMINATOR

Run your small transistor radio from the mains—full wave circuit. Made up ready to wire into your set and adjustable high or low current. 8/6 each.



INSTRUMENT BUZZER

6-12 volts, adjustable tone, a very neat metal cased U.S.A. made unit approx. 1 1/2 in. x 1 1/2 in. thick. 6/6 each.

0-0005mFd TUNING CONDENSER

Proved design, ideal for straight or reflex circuits 2/6 each. 24/- doz.



ELECTRONICS (CROYDON) LTD Dept. WW, 266 London Road, Croydon CRO-2TH Also 102/3 Tamworth Road, Croydon

"OSCILLOSCOPES"

Double Beam, Single Beam and Differential Types Available Now

	Price
Telegquipment D55	£95
E.M.I. WM8. DC-15 MHz	£100
Naggard Model 311 DB	£225
Hewlett Packard 130 A	£95
Marconi TF 1277	£105
Solartron CD 5235	£49
Solartron CD 711	£55
Solartron CD 7115/2	£75
Mullard 140/3	£125
Furzhill Model 0-100	£22
Hartley 13A DB	£22
Cossor 1049 DB	£35
Cossor 1035 DB	£25
Lavoie 05-73 DC-35 MHz	£150
Solartron CD 514	£40
Cossor 1065	£35
Telegquipment 520	£18

Please write for further details

"SPECIAL OFFER"

Solartron Highly Stabilised P.S.U. Model SRS 151A

Output 20-500 v. in two ranges. Positive line at 300 mA. Variable output 170 v. fixed; 0-170 v. variable. Two A.C. outputs at 6.3 v. A.C. are provided.

These units are offered in first-class condition. For A.C. mains. 200-250 v. A.C. Overall case dimensions 20x16x10 ins. approx. Price £35. Packing and carriage 30/- Handbook available with P.S.U.

*** TRANSISTORISED STABILISED * Low Voltage P.S.U. Type 4D**

3-30 v. D.C. at 3 amps. Fully variable. Current limiting control. Sensing facilities for remote operation. Protected and fused for 110/250 v. A.C. mains. Small size only: 5½x5x11 ins. deep. Stability: 1000-1. Ripple: 1 mV. max. Weight: 16 lbs. These units are built to high present-day standards and are offered BRAND NEW BOXED at £20 inclusive of post and packing.

ALSO AS ABOVE

1 amp model. Type 4B Size 4x3½x7 ins. Weight: 6 lbs. Price £13.10.0 inclusive of post and packing.

UHF RECEIVER R.D.O.

With 3 R.F. tuning units to cover 38-1000 MHz. These receivers are built to U.S. Navy specifications and are ideally suitable for laboratory and communications use. For 240 v. A.C. operation. Price £105. Post and packing 40/-.

PORTABLE 12 v. BATTERIES

Non-spillable lead acid type. Rating: 12 v. 4 amp. hours, will withstand heavy overloads without damage. Size 4x4x4 ins. Weight: 4 lbs. Supplied fully sealed/charging instructions. BRAND NEW BOXED 45/-. Post and packing 4/6. Ideal for Model Boats and Photo Floods, etc.

A.E.I. MINIATURE UNISELECTORS

Coil resistance 250 ohms. Type 2200A. Supplied with base. Quantities available.



Price £4.19.6

VIBRATING REED FREQUENCY METERS

Range 55-75 c/s in 2 scales, having total length of 10 ins. for 110 v. (or 240 v. with transformer). Manufacturer: Trub Tauber, Zurich. Price £12.10.

NIFE BATTERIES-NICKEL IRON

We have for disposal complete sets comprising 2 batteries to a total of 12 v. at 180 amp/hours. Supplied filled as NEW CONDITION. Price £45 per set. Carriage extra.

DIRECTIONAL COUPLERS FOR REFLECTOR POWER MEASUREMENT

One of the major uses of a directional coupler is to obtain a sample of the R.F. Power in a transmission line and apply it to an indicator. We can supply couplers with a power handling capacity of up to 300 Watts, the response is flat over the 66-88 Mc/s, 156-184 Mc/s and 200-450 Mc/s bands. Two pick-up probes are mounted on the coupler, one giving incidence the other reflective power, the voltage developed is rectified and may be fed to a calibrated meter, C/W 50 ohm plugs. Price 60/-.

R.F. ATTENUATORS TYPE A38

These attenuators are contained in a screened cast case and are suitable for the audio to VHF range up to 300 Mc/s. Input level 0.5 watts max. Impedance 75 ohms. Attenuation 80 dB in steps of 20 dB. Weight: 9 oz. Panel mounting. List price £10. Special offer price 85/- post paid.

BURNDEPT R.F. PLUGS

These difficult-to-obtain plugs, suitable for Londex aerial, C/O relays and other types of equipment, are supplied NEW EX CABLES at 4/6 each or 3 for 12/-. Post and packing 6d.

EDDYSTONE DIALS

Complete tuning unit, Catalogue No. 898. Complete with logging scale/flywheel tuning and fixing instructions. Supplied BRAND NEW BOXED. 70/-. Post and packing 4/6.

EDDYSTONE DIE-CAST BOXES

Contains sensitive amplifier originally intended for amplification of P.E. cells. C/W input socket, fuse, signal lamp, P.S.U. (mains) amplifier, fully transistorised. BRAND NEW 32/6. Post and packing 2/6.

LEDEX ROTARY SWITCHES

Standard wafer size: 1½ ins. Single-pole 12-way, 3-bank flange mounting. 48 v. D.C. coils. Minimum voltage 30 v. D.C. Supplied BRAND NEW 45/-. Similar to above but one wafer with long spindle to enable user to make up to own requirements. Coil voltage: 30-48 v. D.C. BRAND NEW 35/-.

NON-INDUCTIVE RESISTORS

These are high quality heat sink type. Rated at 15 ohms, 250 watt. Size only 4½x2x2½ ins. A Dale product at a surplus price. Only 19/6 each, post and packing 2/6.

IMHOF'S INSTRUMENT CASES

Finished in mottled grey stove enamel with satin finish trim. Size width for standard 19 in. equipment. Height 10 ins. Depth 15 ins. With front panel and ventilated rear panel. Supplied BRAND NEW £4.10.0 each. Carriage 10/-.

COMMUNICATIONS RECEIVERS

Redifon R50M. 16.5 Kc/s-32 MHz in 8 bands. These well-known receivers are in world-wide use. Especially built to marine specifications. Price as new £105. Used model reconditioned to specification £85. Supplied with mains 240 v. A.C. P.S.U.

CINCH PRINTED CIRCUIT CONNECTORS

Edge type, gold plated. Length 5 ins. 30-way, 5/16 spacing. 4 for 10/-. Post and packing 1/-. Quantities available

HIGH VALUE RESISTANCE BOX TYPE R.7003

Specification. Range: 0.01-11.10 Megohm in 0.01 Megohm divisions. Accuracy: 0.05 per cent. Maximum power rating: 0.1 watt per step. Case: Hammer finished stove enamel. List price £60. Our price £22.10.0.

PORTABLE WHEATSTONE BRIDGE

Specification. Type: Moving Coil Galvanometer. Ranges: (1) 0.05 to 5 ohms; (2) 0.5 to 50 ohms; (3) 5 to 500 ohms; (4) 50 to 5,000 ohms; (5) 500 to 50,000 ohms. Scales: Switched. Slidewire: 0.5 to 50. Galvanometer Scale: 10-0-10. Case: Moulded plastic. Internal Source: 4 v. Dry battery. Operating Temperature: +10 to +35 deg. C. Operating Humidity: Up to 80 per cent R.H. Dimensions: 200x110x65 mm. Weight: 0.9 kg. List price £25. Our price £9.19.6.

PORTABLE MULTIRANGE METER



Specification. Ranges: 0-60 and 0-300 µA, D.C. 0-3, 0-30 and 0-120 mA, D.C. 1.2 and 12 amps D.C. 0.6-3 and 6-30 mA, A.C. 24-120 mA, A.C. 0.24-12 A, A.C. 3-12-30-300-600-1,200 and 6,000 v. D.C. 0.6-3, 2.4-12, 6-30, 60-300, 120-600, 240-1,200 and 1,200-6,000 v. A.C. 3-333 ohms, 0.3-30 Kohms, 0.03-3 megohms D.C. Resistance: -12 to +78 Decibels. Frequency: 50 cps. Input Resistance D.C.: 20,000 ohms/volt. Input Resistance A.C.: 2,000 ohms/volt. Temperature Range: -10 to +50 deg. C. Dimensions: 255x215x170 mm. Weight: 8 kg. Supplied with 2 voltage dividers, H.V. leads, spare rectifiers, 1.5 and 22.5 v. battery. List price £25. Our price £10.19.6.

RHODE AND SCHWARZ EQUIPMENT Polyskop II. 0.5-1,200 MHz.

Diagraph Type ZDD. 300-2,400 MHz.

Signal Generator and Klystron Power Supply Type SMCB. 1.7-5,000 MHz.

UHF Signal Generator Type SCR. 1,000-1,900 MHz.

UHF Millivoltmeter Type URV.

BOONTON SIGNAL GENERATOR TS 497/B/URR

Attenuation 0-1 micro v.-100 mV. Supplied in very good condition. Frequency coverage: 2-400 MHz.

SCHOMANDLE FREQUENCY METER FDI with Type FDMI Adaptor

Range: 30-900 MHz. Approved by G.P.O. as standard for mobile communications equipment, etc.

MARCONI DIGITAL FREQUENCY METER TF 1325/2

Range, with plug-in, up to 220 MHz. Supplied AS NEW £325 with plug-ins.

ADVANCE FREQUENCY COUNTER TIMER-TYPE TC IA

6 digit in line read out. List price £390. Our price £95.

FLUKE DIFFERENTIAL V.T.V.M. MODEL 821A

Range: 0-500 v. and 001-10 v. as null detector.

ENGLISH ELECTRIC INSULATION TESTERS

Fully variable to 10 kV. Metered output on voltage and current for 240 v. A.C. operation. Supplied AS NEW at £35 each.

	Price
Marconi TF913 AM/FM signal generator ..	£35
Marconi TF894 audio tester 10c/s-12 KHz	£15
Marconi TF899 A.C. millivoltmeter ..	£12
Marconi TF195 BFO range 0-40 KHz ..	£20
Marconi TF1400 double pulse generator ..	£90
Marconi TF723A crystal calibrator ..	£45
Marconi TF762C UHF signal generator 200-400 MHz	£45
Marconi TF340 output power meter ..	£15
Marconi TF102 amplitude modulator ..	£25
Marconi TF1104 television sweep generator	£65
Marconi TF675B pulse generator	£40
Marconi TF455E wave analyser	£125
Marconi TF886A circuit magnification meter	£75
Marconi TF329G/I circuit magnification meter	£70
Marconi TF1345/2 digital frequency meter with 2 plug-ins. Range continuous to 220 MHz. As new	£325
Marconi TF890A/4RF X band signal generator	£275
Marconi Type 6456 dual trace plug-in for TF2200 oscilloscope	£38
Marconi TF144G signal generator 85 KHz-25 MHX	£40

OPTOELECTRONICS from PROOPS

New Science Projects combine fascination of Optics with Electronics.

INFRA-RED TRANSMITTERS & RECEIVERS

INFRA-RED PHOTO RECEIVER — MSP3

Ultra sensitive detector/amplifier for infra-red (Gallium Arsenide) or visible light optical links reception. Spectral response 9500 Å. Robust, cylindrical package is coaxial with incident light to facilitate optical alignment and heat sinking.

85/- post free



MAX RATINGS

Total dissipation (in free air, $T_{amb} = 25^{\circ}C$) 100mW. Derating Factor 2mW/ $^{\circ}C$.
 Output Current Intensity 100mA. Voltage 25V. Operating Temperature from $-30^{\circ}C$ to $+125^{\circ}C$.

Supplied complete with suitable lenses, full Technical Data and Application Sheets, including Line of Sight Speech Link.

Unique devices in a brand new electronic field that can be exploited in a wide range of applications. Miniaturized construction and solid state circuit design is combined with outstanding modulation and switching capabilities to provide infinite possibilities as short distance speech and data links, remote relay controls, safety devices, burglar alarms, batch counters, level detectors, etc., etc.

GALLIUM ARSENIDE LIGHT SOURCE—MGA 100

Filamentless, infra-red emitter in a robust, sealed cylinder coaxial with beam to facilitate optical alignment and heat sinking.



35/- post free

MAX RATINGS

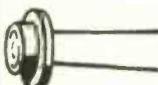
Forward current I_f max. D.C. 400mA. Forward peak current I_f max. (pk) 6A
 Power dissipation' 600mW. Derating factor for T_{amb} greater than $25^{\circ}C$ 7.5mW/ $^{\circ}C$.
 Reverse voltage V_R max. 1.0V.

*When mounted on an aluminium heat sink 1 in. x $\frac{1}{2}$ in. x $\frac{1}{2}$ in.
 Supplied complete with suitable lenses, full Technical Data and Application Sheets, including Line of Sight Speech Link.

PHOTOCONDUCTIVE CELLS

CADMIUM SULPHIDE CELLS (Cds)

Inexpensive light sensitive resistors which require only simple circuitry to work as light triggering units in a wide range of devices, such as: flashing or breakdown lights, exposure meters, brightness controls, automatic porch lights, etc. Not polarity conscious — use with A.C. or D.C. Spectral response covers whole visible light range.



MKY101-C

Epoxy sealed. $\frac{3}{8}$ in. diam. x $\frac{1}{8}$ in. thick. Resistance at 100 Lux — 500 to 2,000 ohms. Maximum voltage 150 A.C. or D.C. Maximum current 150 mW.

10/6 post free



MKY71

Glass sealed with M.E.S. base. Glass envelope $\frac{3}{8}$ in. diam., overall length 1 in. Resistance at 100 Lux — 50 Kohms to 150 Kohms. Maximum voltage 150 A.C. or D.C. Maximum current 75 mW.

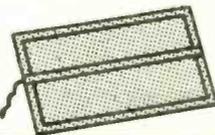
8/6 post free

PHOTOGENERATIVE CELLS

Selenium cells in which light energy is converted into electricity directly measurable on microammeter or used with amplifier as light trigger for alarm and counting devices, luminous fluxmeters, exposure meters, colorimeters, etc.. Spectral response covers visible light range.

Type 1 — $1\frac{1}{2}$ x $1\frac{1}{8}$ in. Output 1 mA at 0.6 volts at 1,000 Lux
 5/- post free

Type 3 — 100 x 50 mm. Output 4 mA at 0.6 volt at 1,000 Lux
 22/6 post free



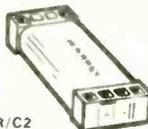
REED SWITCH COILS & CAPSULES



R/C6



R/C4



R/C2

Compact assemblies of reed switches and operating coils that permit the design of an infinite variety of multiple switch circuits in an extremely small space. They eliminate the bulk and open contact disadvantage of electro-mechanical relays; hermetically sealed contact isolation ensures long life reliability. Small enough to combine with solid-state components on printed circuit boards. Ideal for switching matrices, binary kits, control systems, etc. These were removed intact from highly expensive computer mechanisms and are guaranteed to be in perfect working order. Each capsule consists of a rare-metal screened, 24 volt DC operating coil on a nylon former with one detachable end for the removal and replacement of reed switches.

Types available:

R/C2 Two reed switches, contacts normally open. Size overall: $1\frac{1}{4}$ x $\frac{1}{2}$ x $\frac{1}{2}$ in. 5/- post free

R/C4 Four reed switches, contacts normally open. Size overall: $1\frac{1}{4}$ x $\frac{1}{2}$ x $\frac{1}{2}$ in. 10/- post free

R/C6 Six reed switches, 4 contacts normally open, 2 normally closed. Size overall: $1\frac{1}{4}$ x $1\frac{1}{2}$ x $\frac{1}{2}$ in.

15/- post free

FIBRE OPTICS

Highly flexible light guides that transmit light to inaccessible places as easily as electricity is conducted by copper wires. Fibre optics make it possible to control, miniaturize, split, reflect or transfer light from one source to many places at once and to operate photo devices, logic circuits, or illuminate in ways never before possible. Proops offer both glass fibre optics or inexpensive Crofon plastic fibres for hundreds of experiments or serious applications in a fascinating new science.

RANK TAYLOR-HOBSON ENGINEERS KITS



Basic fibre optic components that demonstrate new ways of employing light in serious applications. Two kits are available: each contains high-grade glass-fibre light guides consisting of thousands of fibres tightly bundled in flexible sheaths with ferruled, optically polished ends, together with connecting and light source components. Each is supplied complete with card wallets containing technical and application data.

KIT 1

Contains: 1.5 mm. x 24 in., 3 mm. x 18 in., and 6 mm. x 12 in. light guides, plus 24 in. long x 2 exit component for punched card or coding applications. Also battery operated light source, 2-way 'Y' adaptor with non-random separation, and 3 mm./3 mm. and 3 mm./1.5 mm. connectors.

KIT 2

Contains: 3 mm. x 18 in., 6 mm. x 12 in. light guides; 1.5 mm. 'Y' guide with two 12 in. long tails; 24 in. long 12 exit component for coding or punched card applications, 24 in. lengths of Crofon 64 filament and monofilament plastic light guide. Also, coherent solids consisting of 25 mm. diam. field flattening lens, 6 mm. x 12 in. image conduit with polished ends, 4 mm. x 25 mm. image Inverter. Complete with 2-way adaptor, fibre optic torch and batteries, 3 mm./3 mm. and 3 mm./1.5 mm. connectors.

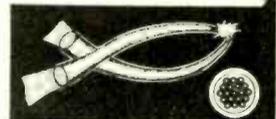
£16

Post free

£28

LOW-COST CROFON FLEXIBLE LIGHT GUIDE

Newly developed plastic light transmitting media made by Du Pont and consisting of 64 special plastic fibres, each .010 in. diam. and bundled together in a tough, flexible sheath. Can be used for many serious projects and inexpensive prototype work. Ends can be ground flat, dyed or capped with epoxy resin. Temp. range -40° to $176^{\circ}F$. No loss of light through bending. 12-page data and applications booklet supplied.



Minimum order—2 ft.

8/6 per foot post free

RCA TRIAC — CA40432

Suitable for light dimming and motor control circuits. Gate-controlled, full-wave, A.C. silicon switch with integral trigger that blocks or conducts instantly by applying reverse polarity voltage. Suitable for A.C. operation up to 250 volts; controls currents up to 1440 watts. Size only $\frac{1}{2}$ in. diam. x $\frac{1}{8}$ in. high. Complete with heat sink, data and applications information.



45/- post free

PROOPS

Proops Bros. Ltd., 52 Tottenham Court Road, London W1P 0BA
 Telephone: 01-580 0141

VALVES

OY31 7/6	FL81 6/9
DAF99 7/9	FL83 8/9
DPA3 7/9	FL84 7/8
DK99 8/9	FL84 6/8
DK99 7/8	FL800 14/9
DL99 6/8	FX 4 14/-
DL94 6/8	FX34 13/8
DL96 6/8	PY38 13/8
DM10 6/-	PY80 6/8
DM71 7/8	PY81 8/8
DY86 6/-	PY82 8/8
DY87 6/8	PY83 7/8
DY89 6/8	PY88 7/8
EAC80 6/8	PY800 9/8
EAF49 18/8	PY801 9/8
EB81 8/-	PY808 15/8
EB82 8/-	QV08-10 85/-
EB84 10/8	QV08-40 85/-
EB85 9/-	QV08-60 85/-
EBF81 7/8	QV08-80 85/-
EBF82 8/8	QV08-100 100/-
EBF83 8/8	QV08-150 100/-
EBF84 8/8	QV08-200 100/-
EBF85 8/8	QV08-300 100/-
EBF86 8/8	QV08-400 100/-
EBF87 8/8	QV08-500 100/-
EBF88 8/8	QV08-600 100/-
EBF89 8/8	QV08-700 100/-
EBF90 8/8	QV08-800 100/-
EBF91 8/8	QV08-900 100/-
EBF92 8/8	QV08-1000 100/-
EBF93 8/8	QV08-1100 100/-
EBF94 8/8	QV08-1200 100/-
EBF95 8/8	QV08-1300 100/-
EBF96 8/8	QV08-1400 100/-
EBF97 8/8	QV08-1500 100/-
EBF98 8/8	QV08-1600 100/-
EBF99 8/8	QV08-1700 100/-
EBF100 8/8	QV08-1800 100/-
EBF101 8/8	QV08-1900 100/-
EBF102 8/8	QV08-2000 100/-
EBF103 8/8	QV08-2100 100/-
EBF104 8/8	QV08-2200 100/-
EBF105 8/8	QV08-2300 100/-
EBF106 8/8	QV08-2400 100/-
EBF107 8/8	QV08-2500 100/-
EBF108 8/8	QV08-2600 100/-
EBF109 8/8	QV08-2700 100/-
EBF110 8/8	QV08-2800 100/-
EBF111 8/8	QV08-2900 100/-
EBF112 8/8	QV08-3000 100/-
EBF113 8/8	QV08-3100 100/-
EBF114 8/8	QV08-3200 100/-
EBF115 8/8	QV08-3300 100/-
EBF116 8/8	QV08-3400 100/-
EBF117 8/8	QV08-3500 100/-
EBF118 8/8	QV08-3600 100/-
EBF119 8/8	QV08-3700 100/-
EBF120 8/8	QV08-3800 100/-
EBF121 8/8	QV08-3900 100/-
EBF122 8/8	QV08-4000 100/-
EBF123 8/8	QV08-4100 100/-
EBF124 8/8	QV08-4200 100/-
EBF125 8/8	QV08-4300 100/-
EBF126 8/8	QV08-4400 100/-
EBF127 8/8	QV08-4500 100/-
EBF128 8/8	QV08-4600 100/-
EBF129 8/8	QV08-4700 100/-
EBF130 8/8	QV08-4800 100/-
EBF131 8/8	QV08-4900 100/-
EBF132 8/8	QV08-5000 100/-
EBF133 8/8	QV08-5100 100/-
EBF134 8/8	QV08-5200 100/-
EBF135 8/8	QV08-5300 100/-
EBF136 8/8	QV08-5400 100/-
EBF137 8/8	QV08-5500 100/-
EBF138 8/8	QV08-5600 100/-
EBF139 8/8	QV08-5700 100/-
EBF140 8/8	QV08-5800 100/-
EBF141 8/8	QV08-5900 100/-
EBF142 8/8	QV08-6000 100/-
EBF143 8/8	QV08-6100 100/-
EBF144 8/8	QV08-6200 100/-
EBF145 8/8	QV08-6300 100/-
EBF146 8/8	QV08-6400 100/-
EBF147 8/8	QV08-6500 100/-
EBF148 8/8	QV08-6600 100/-
EBF149 8/8	QV08-6700 100/-
EBF150 8/8	QV08-6800 100/-
EBF151 8/8	QV08-6900 100/-
EBF152 8/8	QV08-7000 100/-
EBF153 8/8	QV08-7100 100/-
EBF154 8/8	QV08-7200 100/-
EBF155 8/8	QV08-7300 100/-
EBF156 8/8	QV08-7400 100/-
EBF157 8/8	QV08-7500 100/-
EBF158 8/8	QV08-7600 100/-
EBF159 8/8	QV08-7700 100/-
EBF160 8/8	QV08-7800 100/-
EBF161 8/8	QV08-7900 100/-
EBF162 8/8	QV08-8000 100/-
EBF163 8/8	QV08-8100 100/-
EBF164 8/8	QV08-8200 100/-
EBF165 8/8	QV08-8300 100/-
EBF166 8/8	QV08-8400 100/-
EBF167 8/8	QV08-8500 100/-
EBF168 8/8	QV08-8600 100/-
EBF169 8/8	QV08-8700 100/-
EBF170 8/8	QV08-8800 100/-
EBF171 8/8	QV08-8900 100/-
EBF172 8/8	QV08-9000 100/-
EBF173 8/8	QV08-9100 100/-
EBF174 8/8	QV08-9200 100/-
EBF175 8/8	QV08-9300 100/-
EBF176 8/8	QV08-9400 100/-
EBF177 8/8	QV08-9500 100/-
EBF178 8/8	QV08-9600 100/-
EBF179 8/8	QV08-9700 100/-
EBF180 8/8	QV08-9800 100/-
EBF181 8/8	QV08-9900 100/-
EBF182 8/8	QV08-10000 100/-

ELECTRONIC ANTENNA CHANGEOVER SWITCH

Automatically transfers antenna for TX and vice versa without the use of relay or any moving part. Operates from 3.5 mcs to 28 mcs. No loss of transmitting power and provides gain of 2 dB in receiving sensitivity, with built-in power supply unit for 220/250V A.C. Our own manufacture. Full description and price upon request.

MARCONI TEST EQUIPMENT



SIGNAL GENERATOR TYPE TP 937 (CT 218). Frequency range—35 kHz-30MHz. 50 ft. Frequency scale. 200 kHz to 2MHz. Built-in Crystal calibrator Sinewave A.M. V.F.M. Output:—D.19V-IV £95. Carriage 30/-.

FM DEVIATION METER TYPE TP 791B. Frequency range: 4-250MHz, deviation 1-75kHz. Specification and price on application.

VIVM TYPE TP 958 (No. 3, CT 208). Ranges:—AC 0-150v in 5 ranges; 0-1500v with multiplier. DC 100-0-100v in 5 ranges. Frequency: 20Hz-100MHz. £95. Carriage 18/-.

NOISE GENERATOR TYPE TP 987/1. Frequency range:—100kHz-200MHz. Noise factor calibration:—0-30 in four ranges, directly calibrated. Impedance 71 ohm. £40. Carriage 30/-.



IMPEDANCE BRIDGE TYPE TP 936 (No. 5). Measures L & C at 80Hz, 1kHz, 10kHz. Ranges:—L: 1µH-100H. C: 1mF-100µF. R: 0.1ohms-100ohms. AC Bridge volts monitored and variable. Automatic detector sensitivity control. £105. Carriage 30/-.

DISTORTION FACTOR METER TYPE TP 142E. Frequency range: 100-8,000Hz in four ranges. Distortion range: 0.05 to 50%. Input impedance 600Ω, attenuation 0-60db continuously variable. Sensitivity 1mV. £42.10. Carriage 20/-.

PULSE GENERATOR TYPE TP 675F. Repetition frequency: 50Hz to 50kHz. Pulse duration: 0.15 to 100µ sec; built in 0.1 and 0.5µ sec delay lines. £40.10. Carriage 20/-.

SIGNAL GENERATOR TP 801/A. 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. £85. DITTO but 801/A1 with additional high level output. £89. Both P & P. 20/-, including necessary connectors, plugs, and instruction manual.

HEWLETT-PACKARD TEST EQUIPMENT

MODEL 524B ELECTRONIC COUNTER. Without plug in unit this instrument will measure frequencies from 10 c/s to 10.1 mc/s and periods of from 0-10 kc/s. Frequencies are read in kc/s with the decimal point automatically positioned, and time is read in seconds, milliseconds or microseconds again with the decimal point automatically positioned. Registration is in eight places, first six on neon lamp decades, last two on meters. Self check facility from internal 100 kc/s and 10 mc/s frequency standards. Complete with 525B plug in unit 100-220MHz. Full details and price on request.

MODEL 400D VALVE MILLIVOLT-METER. Voltage range: 1mV to 300V F.S.D. in 12 ranges. Frequency range: 10Hz to 4MHz. Input impedance 10MΩ and 15pF. Accuracy 2%. £38.10. Carriage 12/-.

MODEL 430C MICROWAVE POWER METER. Power range: 0.1 to 10mW F.S.D. in five ranges, also calibrated in DBM from -20 to +10. Frequency range: 10MHz to 'R' Band, depending on Bolometer mount. £58.10. Carriage 30/-.

SOLATRON EQUIPMENT

VP 252 VALVE VOLTMETER. Voltage range: 1.5mV to 15V F.S.D. In nine ranges. 10:1 attenuator input; accuracy 1%. Frequency range: 10Hz to 100kHz. Input impedance: Greater than 50MΩ with 20pF. Full specification upon request. £33.10. Carriage 15/-.

END OF RANGE. Come and choose whilst you can: CR100 £10, HRO £10. Coils for HRO 15/-, AR88 without case. £12.10.

COLLINS TX 231D-20. 3kw autotune. Specification and price on application.

MULLARD TX RX 8 CHANNEL. 1-5.13MHz Rx. Specification and price on request.

KELVIN & HUGHES PEN RECORDERS £35. Carriage 15/-.
GAUMONT KALEE (RANK STUDIO) MODEL 1740 WOW & FLUTTER METER. £105. Carriage 7/6.
BOONTON SIGNAL GENERATOR TS 497B/URR. 2-400MHz. £95. Carriage 30/-.
TS 418 B/U SIGNAL GENERATOR. 400-1000MHz. £105. Carr. 30/-.
AVO SIGNAL GENERATOR CT 378. 2-225MHz. £58.10. Carr. 18/-.

TELEPHONE ENQUIRIES

relating to TEST EQUIPMENT should be made to 01-748 8006 Extension 23.

TRANSISTORS, ZENER DIODES etc.

OAS 9/6	OAZ223 to	OC92 5/-	AC128 6/8	CR81/10 5/-	MPP10211/-
OA10 2/-	OAZ225 to	OC89DM 3/-	AC178 7/8	CR81/20 6/8	MPP103 9/8
OAT0 8/-	OC16 12/-	OC83 4/8	AC938 4/-	CR81/30 8/-	MPP104 10/-
OA71 2/-	OC92 10/-	OC83B 5/-	AD140 12/-	CR81/35 10/-	MPP105 10/-
OA79 1/9	OC95 7/8	OC139 6/8	AD149 18/-	CR81/40 11/8	Z Range
OA81 1/8	OC96 8/-	OC140 9/8	AF117 8/-	CR81/40 12/8	Zener diodes
OA200 1/9	OC98 12/8	OC170 5/-	AF118 10/-	CR83/05 6/-	2/6 ea.
OA202 9/-	OC99 12/-	OC171 6/-	AF124 7/8	CR83/30 9/-	7/6 ea.
OA210 7/8	OC95 10/-	OC172 7/8	AF127 5/-	CR83/30 10/-	Z8 range
OA211 9/8	OC98 9/8	OC200 7/8	AF139 10/-	CR83/30 11/8	5/- ea.
OA220 11/-	OC44 4/-	IN31 3/8	AF178 12/8	CR825/025 11/8	ZL range
OA220 10/-	OC45 2/8	IN31B 3/8	AF179 12/8	CR83/40 12/8	12/8 ea.
OA220 9/8	OC71 2/8	IN35 12/-	AF183 10/-	CR83/40 13/8	Z8 range
OA220 8/8	OC72 4/8	IN43 4/-	ASV28 9/8	CR83/40 14/8	7/8 ea.
OA220 7/8	OC73 11/-	IN70 4/-	BC107 3/8	CR83/40 15/8	7/8 ea.
OA220 6/8	OC75 6/-	2N1306 6/8	BFY61 4/8	CR83/40 16/8	7/8 ea.
OA220 5/8	OC76 5/-	2N1307 6/8	BFY62 4/8	CR83/40 17/8	7/8 ea.
OA220 4/8	OC81 4/-	2N805 10/-	BRV27 6/8	CR83/40 18/8	7/8 ea.
OA220 3/8	OC81D 3/-	AC128 6/8	BYZ16 12/-	CR83/40 19/8	7/8 ea.
OA220 2/8	OC127 7/8	BYZ16 12/-	BYZ16 12/-	CR83/40 20/8	7/8 ea.

TELEMETRY STATION

We are able to offer, one only, Telemetry Station of very recent American manufacture. Comprising Helical Antenna, oscilloscope receiver and associated units, Ampex tape recorder and power supply for the entire installation. Interested clients with a knowledge of this type of equipment are invited to phone or write for further particulars.

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 band on harmonics 5.0-6.25 Mc/s with accuracy + -2x10%. Incorporating calibrating quartz 100 kc/s + -5x10^-4 120/220v A.C. mains. £85. Carr. £2.

PYE EQUIPMENT

4 CHANNEL H.F. TRANSMITTER RECEIVER STATION. Comprising PTC 941 Crystal-controlled Receiver 1.6-14 mcs. Sensitivity 1 microvolt for 1W, output at all frequencies at 10dB S/N and PTC 931 60W Transmitter for RT, CW and MCW operation with push-button control for selection of any one of four pre-set channels. Full details and specification on request.
PYE RANGER P.M. MOBILE RADIO TELEPHONE. Transmitter output 7-10W; double superhet receiver, 12v DC positive or negative earth. Full details and specification on request. £45.0. Carriage 30/-.

BOONTON "Q" METER TYPE 160A. Frequency range 50 kc/s to 50 mc/s. "Q" range 0-250 with multiplier of 2.5. Main tuning capacitor 30-500pF with separate ± 3pF interlocking capacitor. Power supply 220/250vAC, £75. Carriage 30/-.

FOR EXPORT ONLY
S3 TRANSMITTERS. All spares available. COLLINS TCS. Complete installations and spare parts. 62 WIRELESS SETS. Complete installations and spare parts. P.S.U. for C42 & C45 12v and 24v R.C.A. TRANSMITTERS ET 4336. Complete installations and all spares. BC 610E & I TRANSMITTERS. Complete installations and all spares. No. 19 WIRELESS SETS. H.P. SETS and all spares R.210 RECEIVERS with all necessary accessories.

VOLUME METER (VU). 20-0-+3 internal resistance 3900 ohms at "O" 1V, 3in. square, flash £10, post paid.
BETTA GAMMA Probe type L314. Without connector £2.10.

DC MOVING COIL METERS
50µA 2in. Sq. panel. 32/6. 200µA 2in. rd. panel. 27/6. 1mA 2in. rd. panel. 22/6. 100mA 2in. rd. panel. 19/-.
25 amp. 3in. rd. proj. 27/6. 100v. 4in. rd. panel. 25/-.
FULL LIST OF OUR VERY LARGE STOCK OF METERS ON REQUEST.

29/41FT. AERIALS each consisting of can 3ft., 3in. dia. tubular screw-in sections. 11ft. (6-section) whip aerial with adaptor to fit the 7in. rod, insulated base, stay plate and stay assemblies, peg, reamer, hammer, etc. Absolutely brand new and complete ready to erect, in canvas bag, £39/6. P. & P. 10/6.
HARNES "A" & "B" control units, junction boxes, headphones, microphones, etc.
FIELD TELEPHONE TYPE "P". Housed in portable wooden cases. Excellent for communication in and outdoors for up to 10 miles. Pair including batteries, fully tested. £6.10. Carriage 10/-.

To:—COLOMOR ELECTRONICS
170 Goldhawk Rd., London, W.12.
Please send me your full list of Test Equipment Meters Valves Tick as required.
Name.....
Address.....

All overseas enquiries & orders please address to:
COLOMOR (ELECTRONICS) LTD.
170 Goldhawk Rd., London, W.12
Tel. 01-743 0899

P. C. RADIO LTD.
170 GOLDHAWK RD., W.12
01-743 4946

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Values. U.K. P. & F. up to 10/- 1/-; to 21 3/-; over £1 2/- in £. over £3 post free. C.O.D. 4/- extra.

Open 9-12.30, 1.30-5.30 p.m. except Thursday 9-1 p.m.

Lasky's

CLOSED CIRCUIT TELEVISION

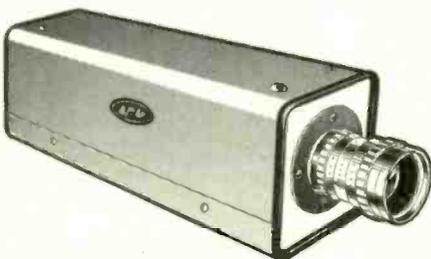
NEW AND PERFECT BRITISH MADE EQUIPMENT
AT LESS THAN HALF ORIGINAL COST!

An extremely flexible closed-circuit system made by Britain's largest manufacturer of electronic equipment. The basic system comprises two units—camera and control monitor. The units are fully transistorised with a wide use of printed circuitry making for compact size, simple installation and high reliability (both in and out of doors). High sensitivity and 625 line resolution ensure excellent picture quality under normal lighting conditions. Closed circuit television provides the penetrating, all-seeing eye that scans, inspects, controls and directs—that is today accepted as invaluable in almost every aspect of industry, commerce, transport and education. A wide range of accessories are available which further increase the system's almost limitless applications.

A LIMITED QUANTITY OF COMPLETE SYSTEMS AVAILABLE



SYSTEM SPECIFICATION Scanning standards: 625 line, 50 fields, 2:1 interlace. **Horizontal resolution:** 600 lines. **Bandwidth:** 8 Mc/s over complete system. **Linearity:** $\pm 2\%$ positional error. **Geometry:** $\pm 2\%$ of rectangle averaged over picture. **Auto Sensitivity:** over the range 60:1 in light value—normal picture obtained with illumination of only 2ft. candles (50% subject reflectance) at lens aperture of f/2. **Spectral Response:** Panchromatic. **Ambient Temperature:** Max. temperature for all units -30°C . to $+55^{\circ}\text{C}$. Power requirements 90/130 v. and 200/240 v. A.C., 50-60 c/s. **Consumption:** 45 watts including camera. **Camera Lenses:** Standard 16 mm. cine lenses with "C" mounts are normally used. **Accessories:** See under Camera and Control Monitor.



CAMERA

Totally enclosed dustproof unit only $3\frac{1}{2} \times 4 \times 10\frac{1}{2}$ in., weighing 4 lb. Finished in two-tone blue/grey. Vidicon tube. Automatic sensitivity control enables the camera to maintain full picture quality over a brightness range of 60:1. 625 line scanning standard 2:1 Interlaced, frame synchronised to mains supply. 600 lines horizontal picture definition with a bandwidth of 8 Mc/s. All supplies are obtained from the control monitor (consumption 5 watts).

CAMERA ACCESSORIES

Lenses: Superb quality 25 mm. (1 in.) f/1.8. "C" mount lenses made especially for this system are available, also a limited quantity of motorised zoom lenses.

Remotely Controlled Weatherproof Pan and Tilt Heads: Pan 340° at 6° per sec., Tilt $+50^{\circ}$ at 4° per sec. 230/250 v., 50 c/s operated.

Remotely Controlled Pan and Tilt for Indoor Use Only: Details as above.

Weatherproof Camera Housing: Windscreen Wiper, 75 w. heater, Internal circulation fan, mounting bracket for camera housing (the latter items are extras for the Weatherproof Housing).

CONTROL MONITOR

14 in. screen, overall size $16 \times 14 \times 18$ in. (excluding Remote Control Unit on which Monitor is shown), weight 30 lb. Panel controls provided: Mains on/off, Contrast, Brightness, Remote Focus. Preset controls (under side panels) include: Frequency lock, Monitor height, Frame linearity, Camera height, Camera width, Auto sensitivity, Camera linearity, Cable correction, Video Gain, Beam Current, Y shift, Electrostatic focusing for camera and monitor. Additional input: Video -100 mV peak white positive into 50 ohms; Synch. 2 v. peak/peak negative. Output: 100 mV peak white positive; 2 v. peak/peak negative. Ambient temperature range -30°C . to $+55^{\circ}\text{C}$.

ACCESSORIES

Remote Control Switching Unit (shown under Control Monitor): Controls auxiliary functions at the camera, i.e. pan/tilt, zoom, windscreen wiper, etc. Size $18 \times 14 \times 3$ in., weight 8 lb.

Distribution Unit: Used for selecting the required picture from those available on the control monitors and distributing it to the appropriate viewing monitor. Size $19\frac{1}{2} \times 13\frac{1}{2} \times 8\frac{1}{2}$ in., weight 30 lb.

Viewing Monitors: These are conventional domestic type receivers—19 in. and 23 in. models available.

Owing to the complexity and limited quantity of units available this equipment is available to CALLERS ONLY.

LASKY'S BASIC
SYSTEM PRICE

ONLY £135.0.0

1—camera (complete with Vidicon) less lens, 1—Control Monitor, 25 yds. of cable. PRICES FOR LENSES AND ACCESSORIES ON APPLICATION.

ALSO

A selection of multi-channel VIEWING MONITORS are available from stock suitable for use with many existing CCTV installations.

A selection of VIDEO TAPE RECORDERS are also available from stock. We will be pleased to quote on receipt of your requirements.

PLEASE NOTE—THESE SYSTEMS ARE AVAILABLE ONLY FROM OUR HEAD OFFICE
3-15 CAVELL STREET, TOWER HAMLETS, LONDON, E.1. Tel. 01-790 4821/2

A demonstration system is available for your inspection by appointment

Lasky's

TMK METER KITS ANOTHER LASKY'S EXCLUSIVE

These two new meter kits by TMK offer the professional, electronics hobbyist and student the unique opportunity of building a really first class precision multimeter at a worthwhile saving in cost. The impact resistant bakelite cabinets are supplied with the meter scale and movement mounted in position: the model 200 also has the rotary range selector in position. The highest quality in components and 1% tolerance resistors are used throughout. Both offer professional standards of accuracy. Supplied complete in every detail with full constructional, circuit and operating instructions.

MODEL 200

20,000 O.P.V. Multimeter. Features 24 measurement ranges with mirror scale. Large 3 x 2in. meter, full scale accuracy: DCV and current: $\pm 2\%$. ACV: $\pm 3\%$. resistance $\pm 3\%$. Special 0.6V DC range for transistor circuit measurements.

SPECIFICATION:

- DCV: 0-0.6-8-30-120-600-1,200V at 20K/OPV.
- ACV: 0-6-30-120-600-1,200V at 10K/OPV.
- DC Current: 0-0.06-6-60-600mA.
- Resistance: 0-10K-100K-1M-10M/ohms (58-580-5.8K-58K at mid-scale).
- Capacitance: 0-0.02-0.2 μ F (AC 6V range).
- Decibels: -20 to +63dB
- Output: 0.05 μ F blocking capacitor. Uses two 1.5V (U.7 type) batteries. Black bakelite cabinet, size 5 1/2 x 3 1/2 in. Complete with test leads.



LASKY'S KIT PRICE 85/- Post 3/6

MODEL 5025 50,000 O.P.V. FEATURING 57 MEASUREMENT RANGES

A highly reliable instrument using an entirely new range selection mechanism which permits the use of a really large meter in a more compact cabinet. The range selected is clearly indicated on the actual meter face facilitating instant identification without taking your eyes from the meter. High speed rotary range selection knob; also features polarity reversal switch, shielded meter movement with overload protection circuit, Special A and mA measurement ranges.

SPECIFICATION:

- DCV: 0-0.25-2.5-10-50-250-1,000V at 25K/OPV 0-0.125-1.25-5-50-25-125-500V at 50K/OPV.
- ACV: 0-3-10-50-250-1,000V at 2.5K/OPV 0-1.5-5-25-125-500V at 5K/OPV.
- DC μ A: 0-25 μ A at 125mA; 0-50 μ A at 250mA.
- DC mA: 0-2.5-25-250mA at 125mV; 0-5-50-500mA at 250mV.
- DC Amps: 0-5A at 125mV; 0-10A at 250mV.
- Resistance: 0-10M/ohms (13, 65, 650, 6.5K and 65K/ohms at centre scale).
- Output Capacitor (0.1 μ F, 400V) in series with ACV ranges.
- Decibels: -20 to +81.5dB in 10 ranges.

Operates on two 1.5V (U.7 type) batteries. Black bakelite cabinet, size 5 1/2 x 6 1/2 x 2 1/2 in. Strong resilient plastic handle. Complete with test leads.



LASKY'S KIT PRICE

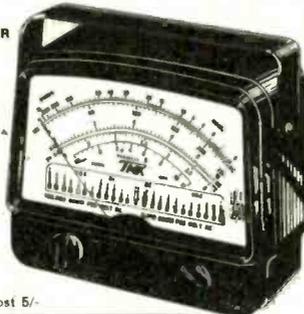
£10.10.0 Post 5/-

ALSO AVAILABLE READY-BUILT AND TESTED £12.10.0 Post 5/-

TMK 100K "LAB" MULTIMETER

BUILT AND TESTED

A highly accurate Multimeter using a 10 μ A. Meter hand calibrated to a DC accuracy of $\pm 3\%$ of full scale. Special features: ultra large meter scale, 6 1/2 x 3 1/2 in. Incorporating an entirely new type of range selection panel which gives instant identification without taking your eyes from the meter. An audible buzzer is provided for easy short testing. SPEC. DCV ranges: 0.5, 2.5, 10, 50, 250, 500, 1,000V at 100K/OPV. ACV ranges: 3, 10, 50, 250, 500, 1,000V at 5K/OPV. DC current: 0-10, 100 A-0-10, 100mA. 0-2.5, 10Amps. Resistance: 0-1K, 10K, 100K, 10M, 100M/ohms. Decibels: -10 to +48.4dB. Continuity test Audible buzzer. Operates on 1x1.5V U2 and 1x1.5V 8.154 type cells. Cabinet size 7 1/2 x 6 1/2 x 3 1/2 in. Weight 4lb.



LASKY'S

PRICE £19.10.0 Post 5/-

TTC Model C-1051

POCKET MULTIMETER, READY-BUILT

A completely new design 20,000 O.P.V. pocket multimeter with mirror scale and built-in thermal protection. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment Range spec. a.c. volts: 0-6-30-300-1,200V at 10K/ohms/V. DC volts: 0-3-15-150-300-1.2KV at 20K/ohms/V. Resistance: 0-60K-6Mega. DC current: 0-80 μ A-300mA. Decibels: -20dB to +17dB. Hand calibration gives extremely high standard of accuracy on all ranges. Uses one 1 1/2V penlight battery. Strong impact resistant plastic cabinet—size only 4 1/2 x 3 1/2 x 1 1/2 in. Two colour buff/green finish. Complete with test leads and battery.



LASKY'S PRICE 75/- Post 2/6

ALSO AVAILABLE C-1052 3 KOPV METER £5.19.6

GET YOUR LASKY'S AUDIO-TRONICS PICTORIAL

FREE

16 colour pages in large 16x11in. format packed with 1,000s of items from our vast stocks of Hi-Fi, Radio, Electronics, Test Equipment, Components, Communications, etc.

Send 1/- for post only and inclusion on our regular mailing list.

TE-20 RF SIGNAL GENERATOR

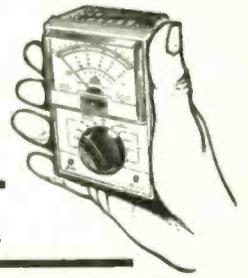
A high-quality factory-tested and calibrated RF Signal Generator offering a full frequency range cover of 120KHz in 6 bands plus one harmonic band. Dual high/low RF output terminals provided and separate variable Audio output. Etched circular scale accuracy $\pm 2\%$ —read against hair line on perspex cursor. Power "on" pilot light fitted. Brief specifications: Frequency range (6 fundamental bands): A 120-320KHz. B 320-1,000KHz. C 1-3, 4MHz. D 3.2-11MHz. E 11-38MHz. F 38-130MHz. Harmonic band 72-260MHz. Frequency accuracy $\pm 2\%$. Output-RF (high) 100mV max. RF (low) 100 μ V max. Audio output 400Hz. 6V approx. (adjustable). Power requirements 105/240V, 50/60Hz AC. Valve line-up: 12BH7A, 6AR5 and selenium rectifier. Strong metal case size 7x10x5 1/2 in. finished in grey crackle. Complete with test leads and instruction book.



LASKY'S PRICE £15.0.0 Post 5/-

TTC MODEL C-1000

A really tiny 1,000 O.P.V. pocket multi-tester with "big" meter performance. Precision 2 jewel meter movement. Hand calibrated to $\pm 3\%$ accuracy on full scale of DC ranges, 4% on AC ranges. 2 1/2 in. square meter. SPECIFICATIONS: ACV ranges: 0-10, 50, 250, 1,000V at 1K/OPV. ACV ranges: 0-10, 50, 250, 100V at 1K/OPV. DC current: 0-1-100mA. Resistance: 0-150K/ohms (3,000 ohms centre scale). Decibels: -10 to +22dB. Operates on one penlight cell. Two colour buff/green case size only 3 1/2 x 2 1/2 x 1 1/2 in. Click stop range selection switch. Ohms zero adjustment. Complete with test leads, battery and im.

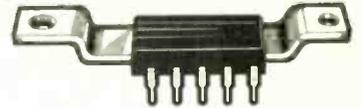


LASKY'S PRICE 39/6 Post 2/6

AVAILABLE NOW! THE IC-403

INTEGRATED CIRCUIT AMPLIFIER MODULE

Originally developed for computer and space projects—these tiny modules—size only 25x10x5 millimetres—represent the most amazing breakthrough in circuit design since the introduction of the transistor. The IC-403 is an integrated power and pre-amplifier requiring only the addition of tone and volume controls, power source and speaker to form a complete audio amplifier of 3W output. SPECIFICATION (ratings at 25°C): Output power typically 3W from 250mV input. Frequency response 20Hz to 80KHz $\pm 3dB$. Max. operating voltage 21V. Min. operating load 7.5 ohms. Pre-amp. input imp. 2M/ohms. Pre-amp. O.C. input current 50nA. THE IC-403 IS AVAILABLE FROM STOCK EXCLUSIVELY FROM LASKY'S—COMPLETE WITH INSTRUCTION DATA AND SUGGESTED CIRCUIT APPLICATIONS. FREE INSTRUCTION DATA LEAFLET ON REQUEST. JUST SEND S.A.E.

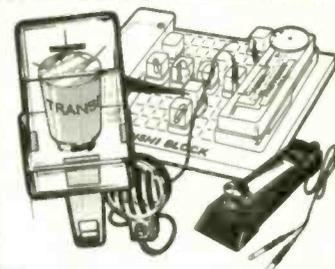


LASKY'S PRICE 49/6 Post 1/6. 2 for 95/- post free.

Also available from stock Sinclair IC-10. 59/6 post free.

DENSHI BOARD KITS EDUCATIONAL CIRCUIT SYSTEM

The DENSHI BOARD system enables the young experimenter and electronics hobbyist to produce a wide range of transistor circuits of increasing sophistication—without soldering or the use of any tools at all! Basically the system comprises a slotted circuit board into which plug-in components and bridge pieces are set to produce up to 30 different circuits. The components are encapsulated in transparent plastic blocks bearing the appropriate circuit symbol and value thus enabling even the complete novice to visually grasp the fundamentals of circuitry after only a few moments study. Each DENSHI



BOARD KIT comes complete with 80-page manual of circuits and data. THESE ARE JUST A FEW OF THE CIRCUITS YOU CAN BUILD IN MINUTES: VARIOUS RADIO RECEIVERS, AMPLIFIERS, MORSE CODE PRACTICE DEVICE, SIGNAL INJECTOR, SIGNAL TRACER, WIRELESS MICROPHONE, ETC. DENSHI BOARD KIT SR-1A comprises: Base board; tuner block; 4 resistors; choke coil transformer; 2SA transistor for RF; 2 diodes; 3 capacitors; battery block; morse key; antenna lead; crystal earphone; various bridge and connecting pieces and 80 page manual. This kit permits the building of 16 basic circuits.

LASKY'S PRICE £4.19.6 POST 3/6

DENSHI BOARD KIT SR-2A as SR-1A plus: 2SB transistor for AF; 2 resistors; 1 capacitor; crystal microphone; test probes; electrode; additional connecting pieces; 9V battery. This kit permits the building of 30 circuits.

LASKY'S PRICE £7.2.6 POST 3/6

Lasky's Radio Limited

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel: 01 723 3271

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: 01 353 2833

Open all day Thursday, early closing 1 p.m. Saturday

High Fidelity Audio Centres

42-45 TOTTENHAM CT. RD., LONDON, W.1 Tel: 01 580 2573

Open all day, 9 a.m. - 6 p.m. Monday to Saturday

118 EDGWARE ROAD, LONDON, W.2 Tel: 01 723 9789

Open all day Saturday, early closing 1 p.m. Thursday

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL STREET, TOWER HAMLETS, LONDON, E.1



Tel.: 01-790 4821

ELECTROVALUE

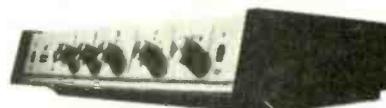
EVERYTHING BRAND NEW AND TO SPECIFICATION • LARGE STOCKS CATALOGUE WITH FULL TECHNICAL DATA—1/6d.

30 WATT BAILEY AMPLIFIER COMPONENTS

MJ481 } matched pair output 59/- 40361 12/6, BC125 12/-, BC107 3/6, 40362 16/9,
 MJ491 }
 40361 } matched pair drivers 30/3 Main amp PC board free with each transistor set.
 40362 }
Total for one channel £7.9.6 list, with 10% discount only £6.14.6.
Total for two channels £14.19.0 list, with 15% discount only £12.14.0.
Complete power supply kit £4.14.6 mono or stereo, subject to discount.
Complete regulated power supply kit £9.5.0 subject to discount. Further details on application.
2N2926 PLASTIC range Silicon NPN, 120MHz FT:
 Red spotβ = 55 to 110 2/3 Yellow spotβ = 150 to 300 1/9
 Orange spotβ = 90 to 180 2/3 Green spotβ = 235 to 470 2/3
Texas Silect range, TO92, 30V, 600mA NPN
BC107 series and plastic equivalents
 2N3704β = 90 to 330 3/9 300mW 300 MHz FT, TO18
 2N3705β = 45 to 165 3/5 BC107β = 125 to 500, 45V 3/6
 BC108β = 125 to 900, 20V 3/-
25V 200mA PNP BC109β = 240 to 900, 20V 3/6
 2N3702β = 60 to 300 3/6 180mW 300MHz FT, TO92 plastic
 2N3703β = 30 to 150 3/3 BC167β = 125 to 500, 45V 2/3
 BC168β = 125 to 900, 20V 2/-
Small signal NPN BC169β = 240 to 900, 20V 2/3
 2N3707 low noise 4/-
 2N3711β = 180 to 660 3/11 BC109 and BC169 are low noise.

PEAK SOUND AMPLIFIER KITS

The new Englefield Kits



Build It
 12+12
 or
 25+25

Brilliant new styling and available in two forms:
STEREO 15 WATTS PER CHANNEL
 Supplied in kit form with complete amplifier and pre-amplifier modules and power supply components. Output per channel into 15Ω —13 watts R.M.S. Price £38.4.0 Net

STEREO 25 WATTS PER CHANNEL
 Supplied in kit form with complete amplifier, pre-amplifier and regulated power supply modules. Output per channel into 15Ω —28 watts R.M.S. Price £58.15.0 Net

Brief specification: Total harmonic distortion 1KHz, 11.5W, 15Ω 0.1%.

Inputs:

- Magnetic, RIAA 3.5mV
- Ceramic 35mV
- Tape 100mV
- Radio 100mV

Signal to noise ratios:

Better than 60dB all inputs.

ENGLEFIELD CABINET to house either above assemblies (as illustrated) £6.0.0.

OTHER PEAK SOUND PRODUCTS AS ADVERTISED.

FETS n-channel

Low cost general-purpose type 2N5163, 25V 5/- only. Audio/r.f. Texas 2N3819, 25V 9/-.

NEW PLESSEY INTEGRATED CIRCUIT POWER AMPLIFIER TYPE SL403A

Operates with 18V power supply. Sensitivity 20mV into 20M.ohms.

Output 3.0 watts into 7.5 ohms.

only 57/-

ZENER DIODES

3V to 27V 5%, 400mW. All preferred voltages.

each 4/6

SINCLAIR IC.10 INTEGRATED CIRCUIT AMP. & PRE-AMP.

This remarkable monolithic integrated circuit amplifier and pre-amp is now available for dispatch from stock. It is the equivalent of 13 transistor/18 resistor circuit plus 3 diodes and the first of its kind ever. It is D.C. coupled and applicable for an unusually wide range of uses, all of which are detailed in the manual provided with it. Sinclair IC.10 as advertised, post free

59/6
 NETT

BARGAINS IN NEW TRANSISTORS

All power types supplies with free insulating sets

2N696	5/6	2N2147	18/9	2N4289	2/11	AF118	16/6	BCY31	12/6	BSX20	4/6
2N697	6/-	2N2369A	6/9	2N4291	2/11	AF124	7/6	BD121	18/-	MJ480	21/-
2N706	3/5	2N2646	9/6	2N4292	2/11	AF127	7/-	BD123	24/3	NKT211	5/11
2N1132	13/-	2N2924	4/3	40406	16/3	AF139	8/-	BD124	16/-	NKT214	4/2
2N1302	4/-	2N2925	5/3	40408	14/6	BA102	6/6	BF115	7/6	NKT217	12/-
2N1303	4/-	2N3053	5/6	AC126	6/6	BC147	4/3	BF167	8/6	NKT274	4/3
2N1304	4/-	2N3054	15/6	AC128	6/-	BC148	3/3	BF178	10/6	NKY403	14/10
2N1305	4/-	2N3055	16/6	AC176	6/3	BC149	4/3	BF180	12/-	NKT404	14/6
2N1306	6/9	2N3391A	5/6	ACY22	3/3	BC157	3/6	BF194	7/-	NKT405	15/-
2N1307	6/9	2N3708	2/9	ACY40	3/6	BC158	3/3	BFX29	12/3	NKT713	5/5
2N1308	8/9	2N3904	9/-	AD140	19/-	BC159	3/6	BFX85	8/3	NKT773	5/3
2N1309	8/9	2N3906	9/-	AD149	17/6	BC177	6/-	BFX88	7/9	NKT781	6/-
2N1613	6/6	2N3794	2/11	AD161	14/- pr.	BC178	5/3	BFY50	4/9	P346A	5/9
2N1711	7/4	2N4286	2/11	AD162		BC179	5/9	BFY51	4/3	V405A	7/9

METAL OXIDE RESISTORS

Electrosil type TR5, 2%, 1/2 watt rating. Very low noise, low temperature coefficient, low drift. A Professional resistor! All E24 preferred series of values from 10Ω to 1MΩ. Price: 1 to 24, 10d. each; 25 to 99, 9d. each; 100 up, 8d. each. (Resistance values may be mixed to obtain quantity reductions.)

POTENTIOMETERS

Carbon track. Long plastic spindles:

Single gang linear: 220Ω, 470Ω, 1K, etc. to 2.2MΩ	each	Dual gang linear: 4K7, 10K, 22K, etc. to 1MΩ	each
Single gang log: 4K7, 10K, 22K, etc. to 2.2MΩ	2/6	Dual gang log: 4K7, 10K, 22K, etc. to 1MΩ	8/6
Any type with 1/2 amp double pole mains switch: extra 2/3.	2/6	Dual gang log/anti-log: 10K, 47K, 1MΩ only	8/6

CARBON SKELETON PRE-SETS

Small high quality, type PR: Linear only, 100Ω, 220Ω, 470Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1MΩ, 2M2, 5M, 10MΩ vertical or horizontal mounting, 1/- each.

CAPACITORS CERAMIC DISC

Mi-K, all ±20% tolerance: 1,000pF, 2,000pF, 5,000pF, 500V; 0.01μF, 0.02μF, 0.05μF, 50V, 4d. each.

LARGE CAPACITORS

High ripple current types: 2,000μF 25V, 7/-; 2,000μF 50V, 9/3; 5,000μF 25V, 10/3; 5,000μF 50V, 17/6. S-Dec, 30/6; 2-DeC DeCstore, 69/6; 4-DeC, 119/6.

MEDIUM RANGE ELECTROLYTICS

Axial leads. Values (μF/V): 50/50, 1/6; 100/25, 1/6; 100/50, 2/-; 250/25, 2/-; 250/50, 3/3; 500/25, 3/3; 1,000/10, 4/-.

MULLARD C426 SERIES ELECTROLYTICS

Sub-miniature axial leads. Values: (μF/V): 0.64/64; 1/40; 1.6/25; 2.5/16; 2.5/64; 4/10; 4/40; 5/64; 6.4/6.4; 6.4/25; 8/4; 8/40; 10/2.5; 10/16; 10/64; 12.5/25; 16/40; 20/16; 20/64; 25/6.4; 32/4; 32/10; 32/40; 32/64; 40/16; 40/2.5; 50/6.4; 50/25; 50/40; 64/4; 64/10; 80/2.5; 80/16; 80/25; 100/6.4; 125/4; 125/10; 160/2.5; 200/6.4; 200/10; 250/4; 320/2.5; 320/6.4; 400/4; 500/2.5. All 1/3 each.

MINIATURE (μF/V): 5/10; 10/10; 25/10; 50/10; 9d. each. 25/25; 50/25; 100/10; 200/10, 1/- each. 50/50; 100/25; 1/6 each. 100/50; 250/25, 2/- each.

COMPONENT DISCOUNTS

10% on orders for components for £3 or more.
 15% on orders for components for £10 or more.
 (No discount on NET items.)

POSTAGE AND PACKING

Free on orders for £1 and over.
 Please add 1/- if order under £1.
 Overseas orders welcome: carriage charged at cost.

CATALOGUE price 1/6 (U.K. post free)

Our catalogue contains technical data on many of our stock semi-conductors and other components and as such is a useful reference book.

ELECTROVALUE

DEPT. WW.11, 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY,
 Telephone: Egham 5533 (STD 0784-3)

BI-PRE-PAK LIMITED

FULLY TESTED AND MARKED

AC107	3/-	OC170	3/-
AC126	2/6	OC171	4/-
AC127	2/6	OC200	3/6
AC128	2/6	OC201	7/-
AC176	5/-	2G301	2/6
ACY17	3/-	2G303	2/6
AF114	4/-	2N711	10/-
AF115	3/6	2N1302-3	4/-
AF116	3/8	2N1304-5	5/-
AF117	3/6	2N1306-7	6/-
AF239	12/6	2N1308-9	8/-
AF186	10/-	2N3819 F.E.T.	9/-
AF139	10/-	Power Transistors	
BFY50	4/-	OC20	10/-
BSY25	7/6	OC23	10/-
BSY26	3/-	OC25	8/-
BSY27	3/-	OC26	5/-
BSY28	3/-	OC28	7/6
BSY29	3/-	OC35	5/-
BSY95A	3/-	OC36	7/6
OC41	2/6	AD149	10/-
OC44	2/6	2N2287	20/-
OC45	2/6	2N3055	15/-
OC71	2/6	Diodes	
OC72	2/6	AAY42	2/-
OC73	3/6	OA95	2/-
OC81	2/6	OA70	1/9
OC81D	2/6	OA79	1/9
OC83	4/-	OA81	1/9
OC139	2/6	IN914	1/6
OC140	3/6		

TRY OUR X PACKS FOR UNEQUALLED VALUE

XA PAK
Germanium PNP type transistors, equivalents to a large part of the OC range, i.e. 44, 45, 71, 72, 81, etc.
PRICE £5 PER 1000
POST & PACKING 4/6 U.K.

XB PAK
Silicon TO-18 CAN type transistors NPN/PNP mixed lots, with equivalents to OC200-1, 2N706A, BSY27/29, BSY95A.
PRICE £4-5 PER 500
PRICE £8 PER 1000
POST & PACKING 2/6 U.K.

XC PAK
Silicon diodes miniature glass types, finished black with polarity marked, equivalents to OA200, OA202, BAY31-39 and DK10, etc.
PRICE £4-10 PER 1000
POST & PACKING 2/6 U.K.

ALL THE ABOVE UNTESTED PACKS HAVE AN AVERAGE OF 75% OR MORE GOOD SEMICONDUCTORS. FREE PACKS SUSPENDED WITH THESE ORDERS. ORDERS MUST NOT BE LESS THAN THE MINIMUM AMOUNTS QUOTED PER PAK.

FREE!
PACKS OF YOUR OWN CHOICE UP TO THE VALUE OF 10/- WITH ORDERS OVER £4

NEW TESTED & GUARANTEED PAKS

B2	4	PHOTO CELLS, SUN BATTERIES, INC. BOOK OF INSTRUCTIONS	10/-
B77	2	AD161—AD162 NPN/PNP TRANS. COMP. OUTPUT PAIR	10/-
B79	4	IN4007 SIL. REC. DIODES 1000 PIV 1 AMP. MINIATURE	10/-
B81	10	REED SWITCHES MIXED TYPES LARGE & SMALL	10/-
B89	2	5 SP5 LIGHT SENSITIVE CELLS LIGHT RES. 400 Ω DARK 1 M Ω	10/-
B91	8	NKT163/164 PNP GERM. TO -5 EQUIVALENT TO OC44, OC45	10/-
B92	4	NPN SIL TRANS. AO6=BSX20. 2N2369. 500MHZ. 360mW	10/-
B93	5	GET113 TRANS. EQUIV. TO ACY17-21 PNP GERM.	10/-
B99	200	CAPACITORS. ELECTROLYTICS. PAPER, SILVER MICA, ETC. POSTAGE ON THIS PAK 2/6	10/-
B96	5	2N3136 PNP SIL TRANS. TO-18 HPE100-300 IC. 600mA, 200MHZ	10/-
B98	10	XB112 & XB102 EQUIV. TO AC126 AC156, OC81/2, OC71/2, NKT271, ETC.	10/-
H4	250	MIXED RESISTORS POST & PACKING 2/-	10/-

Return of the unbeatable P.1 Pak. Now greater value than ever

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

Please ask for Pak **P.1**. Only **10/-** 2/- P & P on this Pak.

Make a Rev. Counter for your Car. The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a perfectly linear and accurate rev. counter for any car. **20/- each**

FREE CATALOGUE AND LISTS for: —
ZENER DIODES TRANSISTORS, RECTIFIERS FULL PRE-PAK LISTS & SUBSTITUTION CHART

MINIMUM ORDER 10/- CASH WITH ORDER PLEASE. Add 1/- post and packing per order. OVERSEAS ADD EXTRA FOR AIRMAIL.

MULLARD DATA BOOK
SEMICONDUCTOR & VALVE DATA & EQUIVALENTS POSTAGE 6d **3/6 EACH**

HUGE CLEARANCE OF UHF/VHF TUNER UNIT REJECTS STOCKS ALMOST EXHAUSTED! PLACE YOUR ORDERS NOW!!! FANTASTIC TRANSISTOR VALUE

TU.2. CONTAINING 2 AF186's & 2 AF178's PRICE 10/- EACH UNIT
TU.3. CONTAINING 2 AF186's & 2 AF178's PLUS WAVEBAND SLIDER SWITCH PRICE 12/6 EACH UNIT P & P 2/6d. EACH UNIT.
All the Units have many other components e.g. Capacitors, Resistors, Coils and Tuning Condensers etc.
ALL TUNER UNITS ARE SUPPLIED WITH CONNECTION DATA

NEW UNMARKED UNTESTED PAKS

B78	12	INTEGRATED CIRCUITS, DATA & CIRCUITS OF TYPES SUPPLIED WITH ORDERS	10/-
B80	8	DUAL TRANS. MATCHED O/P PAIRS NPL-SIL INTO-5 CAN	10/-
B82	10	OC45, OC81D & OC81 TRANS. MULLARD GLASS TYPE	10/-
B83	200	200 TRANSISTORS, MAKERS REJECTS. NPN-PNP, SIL & GERM.	10/-
B84	100	SILICON DIODES DO-7 GLASS EQUIV. TO OA200, OA202 HIGH QUALITY GERM.	10/-
B86	150	DIODES MIN. GLASS TYPE SIL. DIODES SUB. MIN. IN914 & IN916 TYPES	10/-
B87	100	GERM. PNP TRANS. EQUIV. TO OC44, OC45, OC81, ETC. SIL TRANS. NPN, PNP, EQUIV. TO OC200/1, 2N706A, BSY95A, ETC.	10/-
B88	50	7 WATT ZENER DIODES. MIXED VOLTAGES	10/-
B60	10		10/-
H5	16	1 AMP. PLASTIC DIODES 50-1000 VOLTS	10/-
H6	40	250mW. ZENER DIODES DO-7 MIN. GLASS TYPE	10/-

FREE! A WRITTEN GUARANTEE WITH ALL OUR TESTED SEMICONDUCTORS

BI-PRE-PAK LTD DEPT. B, 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX TELEPHONE: SOUTHEND (0702) 46344

HENRY'S RADIO LTD. ENGLAND'S LEADING COMPONENT AND EQUIPMENT CENTRES

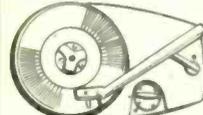


BUILD A QUALITY 4 TRACK TAPE RECORDER

To get the best out of your MAGNAVOX DECK, you need a MARTIN RECORDAKIT. This comprises a special high quality 6 valve amplifier and pre-amplifier which comes to you assembled on its printed circuit board — in fact everything for making a superb Tape Recorder. You need no experience or technical skill to bring this about. THE INSTRUCTIONS MANUAL MAKES BUILDING EASY, AND SUCCESS IS ASSURED.
Kit comprises: Deck, Amplifier, Cabinet and speaker, with microphone, 7" 1200 ft. tape, and spare spool.
ASK FOR BROCHURE 6. TODAY'S VALUE £60.
PRICE 39 gns. p.p. 22/6. NOTHING ELSE TO BUY

SCOOP! STAAR RECORD PLAYER

Deck plays 33, 45, 78, R.P.M. records 9 volt operated, with mono cartridge BRAND NEW as illustrated.



PRICE 59/6.
p.p. 3/6.
Send for leaflet No. 2.

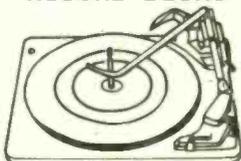


MULLARD 1 WATT AMPLIFIER

Portable Transistor Unit—Ideal for Intercoms, Baby Alarms, Telephone, Record Players or Guitar Practice. 9 Volt 5 transistors with volume control, output 3 ohms. Ideal for use with STAAR RECORD DECK.
PRICE 45/- p.p. 2/6.

OTHER ITEMS. Suitable 7 x 4 inch. 3 ohm speaker 17/6 p.p. 1/6. Resine covered cabinet 12 x 9 x 4 12/6 p.p. 2/6. P.P. 9 volt battery 3/9. Write for leaflet No. 2.

GARRARD RECORD DECKS

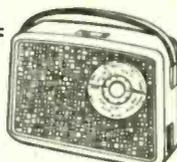


All the latest models BRAND NEW and guaranteed — TERRIFIC SAVINGS!

- *2025 STEREO £ 7.19.6
- *2025TC DIAMOND. 9TAM.C. £ 9.19.6
- *3000 STEREO 9TAM.C. £ 9.19.6
- *SP 25 Mk.II £11.19.6
- *SL 55 £11.19.6
- *A70 Mk.II. £12.10.0
- *AT 60 K.II. £13.10.0
- *SL 65 £14.14.0
- AP 75 £19. 0.0
- 401 £28. 7.6
- SL 75 £29. 0.0
- SL 95 £35. 0.0
- GL 75 GOLDRING £33. 0.0
- GL 75 P £46.15.0

ALSO IN STOCK — THORENS — Lenco — B.S.R. Carriage/insurance 7/6 extra on any model. WB4 BASES £3.19.6. PERSPEX COVERS £3.10.0.
*Special offer base and cover available for these models at £4.15.0. Carriage 5/-. Complete range of Cartridges/Pilnths/Covers. SEND FOR 8 PAGE BROCHURE 16/17 TODAY.

BUILD YOURSELF A QUALITY RADIO



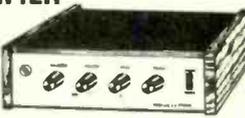
New printed circuit design with full power output. Fully tuneable on both mw/lw bands. 7 Mullard transistors. Fitted 5" speaker, Room Filling Power. Easy to build with terrific results. All local and continental stations. Complete detailed instructions.
TOTAL COST £6.19.6. p.p. 4/6.
Ask for Leaflet No. 1.

TRANSISTORS DIODES RECTIFIERS

WE HAVE THE MOST COMPREHENSIVE STOCK IN GREAT BRITAIN. NEW 1969 LIST OF 1000 TYPES. SEND FOR FREE COPY TODAY (LIST 36) Whether you require one or 1000, devices we can fulfill your order from stock!
For quantity quotations telephone: (01) 723 0401 Ex. 4. or (01) 402 6823.

HENELEC 5-5 STEREO AMPLIFIER

Excellent low priced British designed Stereo Amplifier for use with Record Decks, Mike, Tuners. 16 transistor mains operated. Output 5+5 watts for 8-15 ohm speakers. Black, silver and wood finish, size 13" x 3" x 6".
PRICE £13.10.0. p.p. 7/6. (Leaflet on request). Complete Stereo System 5-5. Garrard 2025 stereo, 5-5 Amplifier, Plinth/Cover, Two 10 watt speakers with tweeters in polished cabinets.
Usual price £47.0.0. OUR PRICE £39.10.0. p.p. 20/-. ASK FOR BROCHURE 13



SINCLAIR EQUIPMENT

The SINCLAIR IC-10 is the worlds first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself has an output power of 10 watts, yet with an overall size of 1 x 0.4 x 0.2 in.



IC-10 Integrated Circuit Amplifier	59/6	OTHER TYPES OF INTEGRATED CIRCUITS			
Z30 Stereo 60	89/6	RCA. CA 3014	29/6	G.E. PA246*	52/6
PZ15 Power Supply	£9.19.6	RCA. CA 3018	22/6	SL402 Plessey	45/0
O16 Loud Speaker	£8.19.6	RCA. CA 3020	29/6	S.G.S. UL910	49/6
Z12 Amplifier	89/6	RCA. CA 3036	18/6	S.G.S. UL900	10/0
PZ 4 Power unit	99/6	Sinclair I.C.10.	59/6	S.G.S. UL914	11/0
Stereo 25	£9.19.6	G.E. PA230*	22/6	Mullard TAA263	15/0
O14 Speaker system	£7.19.6	G.E. PA234*	20/0	*Data sheets 3/6 set for these, for others see catalogue.	
All post paid, delivery from stock.					

BUILD THIS VHF FM TUNER

5" MULLARD TRANSISTORS. 300 kc/s BANDWIDTH. PRINTED CIRCUIT. HIGH FIDELITY REPRODUCTION MONO & STEREO. A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it — VHF FM gives the REAL sound.

PARTS TOTAL COST £6.19.6. DECODER £5.19.6. ASK FOR LEAFLET No. 3. (FOR STEREO)



HENRY'S RADIO Fully Illustrated CATALOGUES

ALL TYPES OF ELECTRONIC COMPONENTS TEST EQUIPMENT KITS BUILT UNITS



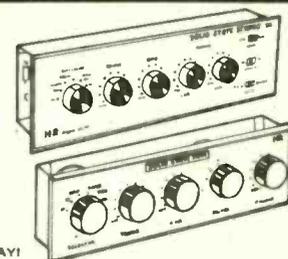
HIGH FIDELITY & GENERAL AUDIO EQUIPMENT CATALOGUE

COMPREHENSIVE · CLEAR · CONCISE · CATALOGUES
A Over 300 pages fully detailed and illustrated with more than 6,000 stock items. Everything for amateur and professional use. Complete with 5 vouchers. 10/- value, for use with purchases.
ORDER AS CATALOGUE A PRICE 7/6. p.p. 2/-.
B New audio and high fidelity catalogue, 120 pages containing ideas and equipment for every application. Special low prices for all leading makes Plus 12/6 extra discount voucher.
ORDER AS CATALOGUE B PRICE 5/- p.p. 1/-.

WHY NOT SEND AWAY TODAY!

AUDIO EQUIPMENT

Mono or Stereo Audio equipment developed from Dinadate Mk.II — each unit or system will compare favourably with other professional equipment selling at much higher prices. COMPLETE SYSTEMS AND MIXERS from £11.12.6. to £38.17.6. (all units available separately).



THE FINEST VALUE IN LOW COST HIGH FIDELITY — CHOOSE A SYSTEM TO SUIT YOUR NEEDS AND SAVE YOURSELF POUNDS.

SEND FOR BROCHURES No. 12/14 and 21 TODAY!

Hi-Fi equipment to suit EVERY POCKET

HIGH FIDELITY AUDIO EQUIPMENT CATALOGUE 5/- p.p. 1/-



VISIT OUR NEW HI-FI CENTRE AT 309 EDGWARE ROAD, for all leading makes of — AMPLIFIERS, TUNERS, DECKS, SPEAKERS, MICROPHONES, TEST EQUIPMENT. ALL WITH DISCOUNTS — IT WILL PAY YOU TO PAY US A VISIT. AUDIO SYSTEMS £40 — £300 TO SUIT EVERY POCKET. DEFERRED TERMS AVAILABLE. SEND FOR ILLUSTRATED BROCHURE 16/17. TWO DEMONSTRATION ROOMS

ELECTRONIC ORGANS

COMPLETE KITS FOR THE HOME CONSTRUCTOR

START BUILDING FOR AS LITTLE AS £10. MODELS FROM £99 — £350.

STAR FEATURES:
*ALL TRANSISTOR PRINTED CIRCUIT DESIGNS.
*BRITISH DESIGN. *STEP BY STEP DETAILED INSTRUCTIONS. *SAVES UP TO 50% ON COMMERCIAL EQUIVALENT. *EVERYTHING SUPPLIED DOWN TO THE LAST ITEM. *FULL AFTER-SALES SERVICE & ADVICE. *CREDIT SALE & H.P. TERMS AVAILABLE.

We are pleased to offer the choice of FOUR British designs from a single manual portable to £99 THE MAYFAIR for light or classical music — to a two manual five octave deluxe model with OAK CONSOLE from £285 for the serious musician.

These kits are the result of years of research and design and offer the best that is essential to good organ designs, coupled with excellent value are within the reach of most pockets. No technical skill or knowledge is required in construction, with the aid of the STEP BY STEP illustrated manuals will produce an instrument that will be a delight to own and use and will give years of trouble free entertainment for the whole family.



SEND FOR ILLUSTRATED BROCHURES 9/10/11 TODAY! When in LONDON... CALL IN SEE, HEAR, PLAY FOR YOURSELF.

ILLUSTRATION OF GROSVENOR ELECTRONIC ORGAN

Organ Demonstration Room 1st Floor, PRACTICAL ELECTRONICS ORGAN — ORGAN COMPONENTS

We are able to supply all items for this series, details on request.

Built models available from £124.

HENRY'S RADIO LTD.

Mail Order Dept. Components, Organ Dept.
303 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 1008 9

High Fidelity and Equipment Centre
309 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 6963

OPEN MON-SAT 9am-6pm THURS 9am-1pm



QUALITY COMPONENTS AND EQUIPMENT

NEW RANGES FOR THE AMATEUR AND PROFESSIONAL USER

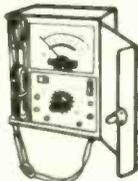


*** QUALITY PANEL METERS**
 18 Series. Face size 42 x 42mm (1 1/2 in x 1 1/2 in). 50µA, 37/6; 100µA, 35/-; 200µA, 32/6; 500µA, 27/6; 1mA, 5mA, 10mA, 50mA, 100mA, 500mA, 25/- each; 10V, 20V, 50V, 100V, 300V and 500V, 25/- each; 1A and 5A, 25/- each. "S" meters, 1mA, 29/6. VU meter, 37/6.
 65 Series. Face size 86 x 78mm (3 1/4 x 3 in). 50µA, 42/6; 100µA, 52/6; 200µA, 47/6; 500µA, 45/-; 1mA, 5mA, 10mA, 500mA, 37/6 each. "S" meter, 1mA, 42/6.
 Other ranges and sizes available. List on request with full details.



*** 50,000 OHMS PER VOLT MULTIMETER**

Recommended quality instrument with mirror scale and overload protection. 0/0.3/1/2/6/10/20/30/60/120/200V d.c. (50KΩ/V); 0/6/30/120/300/600/1200V a.c. (10KΩ/V); 0/100A/6/60/300mA, 0/12A; resistance 0/10kΩ/1/10/100MΩ. Meter movement 20µA. Polarity reversing switch. Complete with batteries, leads and instructions.
AF105 Price £8.10.0 p.p. 2/6
 Leather case 28/6

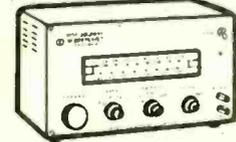


*** SINE/SQUARE WAVE AUDIO GENERATOR**



Provides audio output on 4 bands. Sine wave 20c/s to 2000c/s, output up to 7V; square wave 60c/s to 30c/s, 7V p.p. Distortion under 3%. Output impedance 1kΩ. Variable output amplitude control. Supplied with leads and instructions. A.C. mains operated.
TE22 Price £16.10.0.

*** DELUXE SINE-SQUARE WAVE RC AUDIO GENERATOR**



Weinbridge RC Audio oscillator featuring four overlapping scales covering 18c/s to 200 Kc/s. Output waveforms are sine, square and complex. Mirrored scale with smooth geared tuning control. Output 5 volts RMS or 10 volts P-P. Sinewave response: 1/2dB. Distortion under 1% at 1Kc/s. Stability: 1%. Accuracy: 2%. O/P impedance under 3kΩms. Variable Attenuator. Mains operated. With Handbook.
ORC 27A Price £28 10 0 p.p. 10/-



*** VACUUM TUBE VOLTMETER**

Features low price for such an instrument. Large 6in full view scaled meter. 28 ranges. D.C. volts: 0/1/5/15/50/150/500/1500. A.C. volts: 0/1/5/15/50/150/500/1500. A.C. voltage: 0/1/5/15/50/150/500/1500. R.F. Probe 50/- R.F. Probe 42/6
MODEL TE65
 £17.10.0 p.p. 7/6
 H.V. Probe 50/-
 R.F. Probe 42/6



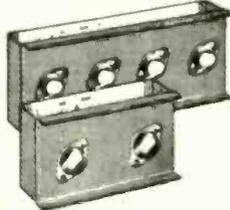
*** 20,000 OHMS PER VOLT MULTIMETER**

Popular model but with extra scale range, 20,000 ohms per volt. 0/5/25/50/250/500/2500V d.c.; 0/10/50/100/500/1000V a.c.; 0/50µA, 0/2/1/250mA. Resistance 0-6kΩ and 6MΩ. Also dB scales or capacitance.
Model 200H
 (Leather case, Price 15/-)
 77/6 pp.2/-



*** PORTABLE OSCILLOSCOPE**

Features 3in clear view tube, easy to use controls and good stability. Y amp. Sensitivity: 1V p-p/CM. Bandwidth 1.5 cps—5 MHz. Input imp. 2 meg Ω, 25 PF. X amp sensitivity: .9V p-p/CM. Bandwidth 1.5 cps—800 KHz. Input imp. 2 meg Ω, 20 PF. Time base. 5 ranges 10 cps—300 KHz. Synchronisation, internal/external. Illuminated scale. 140 x 215 x 330 mm. Weight 15 lbs. 220/240V. A.C. Supplied brand new with handbook.
TO3 Price £35 p.p. 10/-



*** TRANSISTOR POWER AMPLIFIERS**

12 watt 3 ohm 100mV Input 24 volt supply. Model MPA 12/3 £4.10 p.p. 3/-
 12 watt 12-16 ohm 100mV Input 40 volts supply. Model MPA 12/15 £5.5 p.p. 13/-
 25 watt 8-16 ohm 180mV Input 50/60 volt supply. Model MPA 25 £7.10 p.p. 4/6
 Power Supplies 24-40 volt 90/ p.p. 3/6
 50-60 volt 97/6 p.p. 4/6
 Model PA7. 7 watt Amplifier 3 ohms O.P. 7mV Input, operates 12-18 volts D.C.
 Price 72/6 p.p. 2/6

* 100 WATT AMPLIFIER—details on request.

*** GRID DIP METER**

All transistor grid dip meter, absorption wavemeter and osc. detector. Frequency range 440kc/s to 280Mc/s in 6 coils. Uses 3 transistors plus diode with 500µA meter. Internal battery.
TE15
 Price .. £11.10.0 p.p.3/6



*** DC STABILISED POWER SUPPLY**

Switched DC Stabilised Outputs UP TO 1AMP. 3-6-9 & 12 VOLTS. Indicator lamp for each voltage. Fully fused mains operated. Negligible ripple. Regulation 1%.
SE101A Price £8 15 0



*** FIELD STRENGTH METER**

5-Ranges 1—250 mc/s. Fitted 200µA meter. Earphone output. Calibrated tuning scales.
FL30HA Price 72/6 pp.2/-
 Also non-calibrated type peaking F/S meter. FSI Price 45/- pp.2/6

*** TRANSISTORISED INTERCOMMS**

2-station, £6.10.0; 3-station, £5.15.0; 4-station, £6.12.6 (2-station uses no wires) mains operated, £11.19.6. Telephone amplifier, 59/6.

*** SIGNAL INJECTOR**

New model for checking all audio and RF up to VHF. Simple to use. Battery operated. Output approx. 1kc/s, 1-4V pp. Harmonics up to VHF.
SE250B Price 35/- p.p. 1/6

*** MATCHING SIGNAL TRACER**

SE 500 Price 27/6 p.p. 1/6

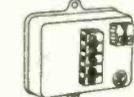
Suppliers of quality components and equipment for over 25 years

AUDIO — HIGH FIDELITY
 Complete range in stock to suit all HI-FI and Public Address requirements.
 COMPONENTS
 UK's largest supplier of components. EVERYTHING YOU NEED
 SEE CATALOGUE ON FACING PAGE



*** TRANSISTOR CHECKER**

Complete capacity for checking all transistors npn and pnp for alpha, beta and German. Also diodes complete with leads and instructions.
ZQM-2 Price £3.19.6, p.p. 3/6.



EXPERIMENTER'S MODULE

Terrific offer of brand new STC time delay electronic units. Adjustable 3-15 secs. 9-12V operated. Supplied complete with suggested uses circuits. STC Module Price 33/-.

9 & 12V 100mA STABILISED SUPPLY

Size 3" x 2" x 1 1/2"
 Fused ready to use. U.K. made Transistorised.
9V 45/- pp.2/6
12V 47/6 pp.2/6

Transistors

Huge quantities in stock for industrial users — Write for Industrial Price List. Includes all types of Semiconductor Device.

PORTABLE GEIGER COUNTERS

FOR MEASUREMENT OF RADIO-ACTIVITY.
 Supplied complete with instructions, haversack, cables and probe. List price £70. OUR PRICE, NEW, TESTED COMPLETE WITH BATTERIES
£7.10.0
 POST 10
 SPARE BATTERIES 15/- PAIR, POST 5

DOSIMETER POCKET-TYPE 0-50r 12/6



NOMBREX TRANSISTORISED Test Equipment

MODEL	£	d.	No.
29s RF. Gen.	21	0	35
29x Xtal RF Gen.	29	10	35
30 Audio Generator	19	10	24
31 R.F. Generator	12	10	25
32 C.R. Bridge	10	10	28
33 Inductance Bridge	20	0	29

STEREO HEADPHONES

Featuring soft Padded Headsets, wide frequency response. Adjustable Headbands. Fitted Jack plugs.



DHO 2/S Recommended 25C/S-15Kc/S .. £1.19.6
 SE2B Built in Tweeters and Volume Controls .. £9.19.6
 KOSS, KO727 £16.10.0. PRO-4A .. £3.0.0
 SP-3JC .. £11.15.0

CALL FOR DEMONSTRATION

Mono Switched 8/16 ohms and 4K ohms; Price £4.4.0
 Stereo Headphone Amplifiers Inputs for PU/Tuner, Battery Model Mains Operated High Quality
 Eagle HA10 .. £8.19.6
 Shure SA2/E .. £18.18.0

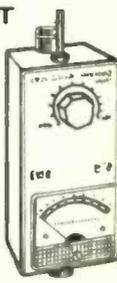
GRAVINER FIRE DETECTOR UNIT

The Detector Unit consists essentially of a highly sensitive 931A photo-electric cell combined with a firing circuit. Incorporates a single cold cathode electronic relay, capacitors and resistors designed to fail to safety if external wiring is open or short circuited. Encapsulated in a resin which fully insulates the unit electrically and provides a high degree of mechanical and thermal shockproofing. Original price £74. OUR PRICE, BRAND NEW £6 each, with data sheet
 Limited quantity available



*** SWR ALIGNMENT METER**

Ideal for all transmitter alignment. Built-in field strength meter 100µA. Complete. Ready to use. SWR 1:1 to 1:3.
SWR 3 .. Price 69/6 p.p. 2/6



WELLER SOLDERING IRONS

8200 Gun & Iron .. 59/6
 8200 PK Gun Kit .. 79/6
 ANTEX CN Iron .. 29/6
 ANTEX Iron Kit .. 42/6

*** MULTIMETER**

Return of a popular model, 2000 ohms/V. 0/10/50/500/1000V a.c./d.c.; 0/50µA, 0/10/250µA d.c. 0/10/100kΩ/1MΩ resistance, dB and capacitance scales. Size 5in. x 3 1/2in. x 1 1/2in. Robust and easy to use. Complete with leads, batteries and instructions.
THL 33A 82/6 p.p. 2/6
 Leather case Price 22/6



*** ALL ITEMS OFFERED ARE BRAND NEW STOCK — ALWAYS IN STOCK ***

HENRY'S RADIO LTD.
 303 & 309 Edgware Rd, London W2

'303' Components/Equipment/Organ Parts also MAIL ORDER DEPT. 01-723-1008/9
 '309' Test Gear/High Fidelity etc. 01-723 6963

ALL MAIL ORDERS TO '303'
 SHOP HOURS 9 a.m.—6 p.m. THURSDAY 1 p.m.
 OPEN ALL DAY SATURDAY.

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1

THE VALVE SPECIALISTS Telephone 01-722-9090

GLOUCESTER ROAD, LITTLEHAMPTON, SUSSEX. Littlehampton 6743

Please forward all mail orders to Littlehampton

Save postal costs! Cash and carry by callers welcome.

0A2	5/9	6BR8	8/	6U4GT	12/	19A25	4/9	302	16/8	DL35	4/9	ECH42	10/
0B2	6/	6B87	10/6	6U7G	7/	19H1	4/0	303	15/	DL92	4/9	ECH81	5/9
0Z1	4/3	6BW6	12/9	6V6G	3/6	20D1	13/	305	16/8	DL94	5/8	ECH83	8/
1A3	4/8	6BW7	11/	6V6GT	6/	20D4	20/5	306	13/	DL96	7/	ECH84	7/
1A5	5/	6C4	2/9	6X4	3/6	20F2	14/	307	11/	DM70	6/	ECL80	6/6
1A7GT	7/	6C6	3/9	6X6GT	5/	20L1	13/	306	2/	DM71	7/6	ECL82	6/
1C6	4/9	6C9	11/	6Y6G	8/	20P1	17/6	1821	10/6	DW4/350		ECL83	9/
1D6	6/9	6CD6G	10/6	6Y7G	12/6	20P3	18/	5763	10/	DW4/500		ECL84	12/
1D6	6/9	6CH6	10/6	6Y8	10/6	20P4	18/6	6060	5/8	DW4/500		ECL85	11/
1FD1	6/	6CL5	8/6	7B7	7/	20P5	18/	7193	10/6	DW4/500		ECL86	12/6
1FD9	7/8	6C4W4	12/	7C8	6/	25L2GT	5/6	7475	4/	DY86	5/9	ECL89	10/
1G6	6/	6D3	7/6	7F8	12/6	25Y5	6/	A1834	20/	DY87	5/9	EL22D	10/
1HG7	7/	6D6	3/	7H7	5/6	25Y5G	8/6	A2134	10/	E80F	24/	EF22	12/6
1L4	2/6	6F1	8/9	7H7	12/	25Z4G	6/	A3402	15/	E83F	24/	EF36	3/6
1LD5	5/	6F6	12/6	7V7	5/	32Z5	7/	AC2PEN		E88CC	12/	EF37A	7/
1LN6	5/	6F8G	10/	7Y4	6/6	32Z5G	10/	AC2PEN		E180F	17/8	EF39	6/
1NG7	7/9	6I2	5/	8Y4	6/6	30C1	6/6	AC2PEN		E180C	10/6	EF40	8/9
1R5	5/6	6I3	3/6	9B6W6	6/	30C15	13/6	DD	19/6	E450	1/6	EF41	9/6
184	4/9	6I4	15/	10C1	12/6	30C17	12/6	AC6PEN/4	E476	13/	EF42	3/6	
185	3/9	6I5	9/6	10C2	10/	30C18	8/9	AC/PEN (5)	E48C80	6/	EF54	10/	
1U4	5/9	6I8	7/8	10D1	8/	30F3	3/8	AC/PEN	(7)	E48C91	3/9	EF78	6/6
1U5	6/9	6I23	13/5	10D2	14/7	30F11	15/	AC/PEN	(7)	E48C92	8/9	EF80	4/8
2D21	5/6	6P24	11/9	10F1	15/	30F12	16/	AC/TH1		E48C93	7/8	EF83	9/6
3A4	3/6	6P25	11/9	10F9	9/	30F14	12/6	AC/TH1		E48C94	5/3	EF84	20/
3A5	10/	6P28	20/6	10F18	7/6	30L1	6/			E48C95	2/3	EF86	6/
3B7	5/	606G	2/6	10LD11	10/	30L15	13/9	AC/TP		E48C96	4/9	EF89	4/9
3D6	3/9	6I6GT	1/9	10P13	13/6	30L17	13/	AC/TP		E48C97	5/9	EF91	5/3
3Q4	6/8	6J50	3/9	10P14	12/6	30P1	12/	ARF3		E48C98	2/6	KT2	5/
3QG7	6/	6J6	3/	10P14	12/6	30P4MR	ATP4	2/3	EBC91	5/6	EF97	10/	
384	4/9	6J7G	4/9	12A8	3/6	17/6	AZ1	8/	EBC92	6/	EF98	10/6	
3V4	5/6	6J7GT	6/6	12A8	3/6	30P12	13/	AZ31	8/9	EBC93	8/		
5R4G	8/9	6K6GT	5/	12A8E	7/8	30P19	12/	AZ41	7/8	EBC94	6/3		
5U4G	4/9	6K7G	2/	12AT6	4/6	30P11	15/	BL93	10/	EBC95	12/		
5V4G	7/8	6K7GT	2/	12AT6	4/6	30P11	15/	BL93	10/	EBC96	12/		
5Y3GT	5/6	6K8G	3/	12AT7	4/9	30P14	15/	CV6	10/6	EBC97	4/		
5Z3	8/	6K8GT	7/	12AUG	3/9	30P15	15/	CY1	10/6	EBC98	4/9		
5Z4G	9/9	6L1	7/8	12AUG	3/9	35A3	9/	CY31	7/8	EBC99	10/6		
6/30L2	12/8	6L8GT	10/6	12AX7	4/6	35A5	15/	D63	5/	EBC99	6/6		
6A8G	5/8	6I8GT	12/6	12AX7	4/6	35D5	15/	D77	2/8	EBC99	15/8		
6AC7	3/	6L16	5/	12AY7	9/9	35L2GT	6/	DAC32	7/	EBC99	4/		
6A25	3/6	6L19	10/	12BA6	6/	35W4	4/8	DAF91	3/9	EBC99	29/1		
6AK5	4/6	6LD20	6/6	12B6	5/9	35W4	4/8	DAF96	6/	EBC99	29/8		
6AK6	6/	6N7GT	6/6	12BH7	6/	35Z4GT	4/9	DOC90	10/	EBC99	4/8		
6AL5	2/3	6P1	12/	12D1	10/	35Z4GT	4/9	DOC90	10/	EBC99	4/8		
6AM4	18/8	6P25	12/	12J7GT	6/6	50B3	6/3	DF33	7/9	EBC99	4/8		
6AM6	3/3	6P28	12/	12K5	10/	50C6	6/3	DF91	2/9	EBC99	4/8		
6AQ5	4/9	6P28	25/	12K7GT	5/6	50D6G	4/1/	DF96	6/	EBC99	5/8		
6AR6	20/	6Q7G	6/	12Q7GT	4/9	50L6GT	9/	DF97	10/	EBC99	5/8		
6AT6	4/	6Q7GT	6/6	12S4GT	7/2	6/8	DH63			EBC99	7/		
6AU6	5/	6R7G	7/	12R8C	4/	85A3	8/	DH74	4/8	EBC99	8/		
6AV6	6/8	6R7	11/	12R8C	4/	85A3	8/	DH77	4/	EBC99	12/6		
6BG9	2/6	6RA7GT	7/	12Q4G	3/	90AG	6/7/8	DH81	10/9	EBC99	27/		
6BA6	4/6	6SCTGT	6/8	12SH7	3/	90AV	6/7/8	DK32	7/	EBC99	8/		
6BE6	4/3	6S6G	3/	12R37	4/8	90CC	3/4/	DK40	10/	EBC99	6/8		
6BH6	7/6	6SH7	3/	12R37	4/8	90CC	3/4/	DK40	10/	EBC99	6/8		
6BS6	6/9	6R7	6/8	12R37GT	6/8	90CL	6/	DK92	7/6	EBC99	12/6		
6BQ5	4/6	6R8K	4/9	14H7	15/6	150R2	14/8	DK92	7/6	EBC99	12/6		
6BQ7A	7/	6R8TGT	4/6	14H7	15/6	150R2	14/8	DK96	7/	EBC99	12/6		
6BR7	8/6	6R9GTGT	18	12/6	301	20/	DL33	6/	EBC99	5/9			

EY87	8/	PCU189	9/8	H17	17/8	U50	5/8	AAZ13	3/8	BCY33	5/	GTT118	4/
EY88	7/6	PCF80	6/8	H18	9/6	U52	4/9	AC107	3/	BCY34	4/6	GTT119	4/
EY91	3/	PCF82	6/	R19	6/6	U76	4/9	AC113	5/	BCY38	5/	GTT120	2/6
EZ35	5/	PCF84	8/	R20	11/9	U78	3/8	AC114	8/	BCY39	4/6	GTT587	8/6
EZ40	7/3	PCF86	9/	R52	7/8	U107	13/6	AC127	2/	BCZ11	3/6	GTT588	19/
EZ41	7/8	PCF87	7/	RK34	7/8	U191	12/6	AC154	5/	BC107	1/6	GTT589	3/
EZ42	4/8	PCF89	8/	SP13	12/	U251	18/	AC155	6/6	BC108	3/6	GTT590	11/6
EZ81	4/6	PCF805	8/9	SP42	12/6	U281	8/	AC158	4/	BC113	5/	GTT591	10/
EZ90	3/6	PCF806	11/6	SP61	3/3	U289	8/	AC157	5/	BC115	3/	GTT8810	10/
FW4/500/6		PCF808	12/6	TD22A	12/6	U301	11/	AC163	5/	BC116	5/	GTT887	4/8
FW4/500		PCL81	9/	TH4B	10/	U329	18/	AC168	5/	BC118	4/6	GTT888	4/8
G230	7/	PCL82	6/	TR233	7/	U403	6/8	AC173	3/	BC119	9/	GTT890	4/8
G232	9/	PCL84	7/6	UAB280	5/9	U404	7/6	AC168	7/8	BCY60	4/	GTT894	4/6
G233	12/6	PCL85	8/3	UAF42	9/8	U400	9/8	AC176	11/	BCY61	4/6	GTT897	4/6
G234	10/	PCL86	8/6	UB41	6/8	VP2	3/6	AC177	5/8	BCY62	4/6	GTT898	4/6
G235	14/6	PCL88	15/	UBC41	7/8	VP2B	9/8	AC178	5/8	BCY63	4/6	GTT899	4/6
G236	8/	PCL89	8/	UBC81	7/	VP43	10/6	ACY18	3/6	BCY64	4/	GTT900	4/6
G237	7/6	PEN45DD		UBF80	5/9	VP13C	7/	ACY19	3/9	BCY65	4/	GTT901	4/6
G238	10/	PEN45DD		UBF89	6/9	VP23	2/6	ACY20	3/6	BCY66	4/	GTT902	4/6
G239	10/	PEN45DD		UBL21	9/	VP41	7/8	ACY21	3/9	BCY67	4/	GTT903	4/6
G240	10/	PEN45DD		UC92	5/8	VP75	24/	ACY22	3/8	BCY68	4/	GTT904	4/6
G241	10/	PEN45DD		UC88A	8/	VP105	5/	ACY28	4/	BCY69	4/	GTT905	4/6
G242	10/	PEN45DD		UC88B	8/	VP105	5/	ACY28	4/	BCY70	4/	GTT906	4/6
G243	10/	PEN45DD		UC88C	8/	VP105	5/	ACY28	4/	BCY71	4/	GTT907	4/6
G244	10/	PEN45DD		UC88D	8/	VP105	5/	ACY28	4/	BCY72	4/	GTT908	4/6
G245	10/	PEN45DD		UC88E	8/	VP105	5/	ACY28	4/	BCY73	4/	GTT909	4/6
G246	10/	PEN45DD		UC88F	8/	VP105	5/	ACY28	4/	BCY74	4/	GTT910	4/6
G247	10/	PEN45DD		UC88G	8/	VP105	5/	ACY28	4/	BCY75	4/	GTT911	4/6
G248	10/	PEN45DD		UC88H	8/	VP105	5/	ACY28	4/	BCY76	4/	GTT912	4/6
G249	10/	PEN45DD		UC88I	8/	VP105	5/	ACY28	4/	BCY77	4/	GTT913	4/6
G250	10/	PEN45DD		UC88J	8/	VP105	5/	ACY28	4/	BCY78	4/	GTT914	4/6
G251	10/	PEN45DD		UC88K	8/	VP105	5/	ACY28	4/	BCY79	4/	GTT915	4/6
G252	10/	PEN45DD		UC88L	8/	VP105	5/	ACY28	4/	BCY80	4/	GTT916	4/6
G253	10/	PEN45DD		UC88M	8/	VP105	5/	ACY28	4/	BCY81	4/	GTT917	4/6
G254	10/	PEN45DD		UC88N	8/	VP105	5/	ACY28	4/	BCY82	4/	GTT918	4/6
G255	10/	PEN45DD		UC88O	8/	VP105	5/	ACY28	4/	BCY83	4/	GTT919	4/6
G256	10/	PEN45DD		UC88P	8/	VP105	5/	ACY28	4/	BCY84	4/	GTT920	4/6
G257	10/	PEN45DD		UC88Q	8/	VP105	5/	ACY28	4/	BCY85	4/	GTT921	4/6
G258	10/	PEN45DD		UC88R	8/	VP105	5/	ACY28	4/	BCY86	4/	GTT922	4/6
G259	10/	PEN45DD		UC88S	8/	VP105	5/	ACY28	4/	BCY87	4/	GTT923	4/6
G260	10/	PEN45DD		UC88T	8/	VP105	5/	ACY28	4/	BCY88	4/	GTT924	4/6
G261	10/	PEN45DD		UC88U	8/	VP105	5/	ACY28	4/	BCY89	4/	GTT925	4/6
G262	10/	PEN45DD		UC88V	8/	VP105	5/	ACY28	4/	BCY90	4/	GTT926	4/6
G263	10/	PEN45DD		UC88W	8/	VP105	5/	ACY28	4/	BCY91	4/	GTT927	4/6
G264	10/	PEN45DD		UC88X	8/	VP105	5/	ACY28					

SERVICE TRADING CO

Postage and Garrage shown below at inland only. For Overseas please ask for quotation. We do not issue a catalogue or list.



MINIATURE UNISELECTOR
3 banks of 11 positions, plus homing bank. 40 ohm coil. 24-36 v. D.C. operation. Carefully removed from equipment and tested. 22/6, plus 2/6 P. & P.

UNISELECTOR SWITCHES NEW

4 BANK 25 WAY FULL WIPER
25 ohm coil, 24 v. D.C. operation. £5.17.6, plus 2/6 P. & P.

6 BANK 25 WAY FULL WIPER
25 ohm coil, 24 v. D.C. operation. £6.10.0, plus 2/6 P. & P.

8-BANK 25-WAY FULL WIPER
24 v. D.C. operation, 47/12/6, plus 4/- P. & P.



RELAYS

BULK PURCHASE ENABLES US TO OFFER THE FOLLOWING NEW SIEMENS PLESSEY, etc. MINIATURE PLUG IN RELAYS AT A HIGHLY COMPETITIVE PRICE



COIL	WORKING D.C. VOLT	CONTACTS	PRICE
170	9-12	4 c/o H.D.	14/6
170	9-12	3 c/o + 1 H.D.	12/6
280	6-12	2 c/o incl. base	14/6
280	9-18	4 c/o incl. base	15/6
700	12-24	2 c/o incl. base	12/6
700	16-24	4 c/o incl. base	15/6
700	16-24	4M 2B incl. base	12/6
1250	20-40	2 c/o H.D. incl. base	12/6
2500	30-50	2 c/o H.D. incl. base	12/6
9000	40-70	2 c/o incl. base	10/-

H.D. = Heavy Duty POST PAID

MINIATURE RELAYS

9-12 volt D.C. operation. 2 c/o 500 M.A. contacts. Size 1in. x 1/2 x 1/2 in. Price 11/6 Post paid.
30-36 v. D.C. operation. 2 c/o 500 M.A. contacts. 3.200 ohm coil. Size only 1 x 1/2 x 1/2 in. 8/6 post paid.

230 VOLT AC RELAYS

230 volt AC Coil. Three c/o 5 amp. contacts, 17/6 Post paid.
LONDEX four c/o 3 amp contacts, 18/6, incl. base. Post Paid.



A.C. AMMETERS 0-1, 0-5, 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/-

SANWA MULTI RANGE TESTERS

NEW MODEL UD-50 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. 2.5 v., 10 v., 50 v., 250 v., 1,000 v. D.C. current: 5µA., 0.5 mA., 5 mA., 50 mA., 250 mA. Size: 5 1/2 x 3 1/2 x 1 1/2 in. Complete with batteries £7.5.0 Post paid and test prods.



RING TRANSFORMER

Functional Versatile Educational
This multi-purpose Auto Transformer, with large centre aperture, can be used as a Double wound current Transformer, Auto Transformer, H.T. or L.T. Transformer, by simply hand winding the required number of turns through the centre opening. E.g. Using the RT.100 V.A. Model the output could be wound to give 8V., 12 1/2V., 4V., 25V., 2V., @ 50A., etc.
Price: RT.100VA 3.18 turns per volt, £2 5 0 + 3/6 p. and p.
RT.300VA 2.27 turns per volt, £4 4 0 + 5/6 p. and p.
RT.1KVVA 1.82 turns per volt, £6 10 0 + 6/6 p. and p.



DEMONSTRATION TRANSFORMER (STENZLY TYPE)

Two removable coils are tapped at 0, 110, 220 volts, and 6, 12, 36 volts respectively. A composite apparatus designed for class demonstration. Electro magnetic induction, jumping ring, induction lamp, relationship between field intensity and ampere turns, induction melting, are just a few of the possible experiments. New modified model. £14/10/- P. & P. 10/-



L.T. TRANSFORMERS

All primaries 220-240 volts.

Type No.	Sec. Taps	Price	Carr.
1	30, 32, 34, 36 v. at 5 amps.	£4 5 0	6/-
2	30, 40, 50 v. at 5 amps.	£6 5 0	6/6
3	10, 17, 18 v. at 10 amps.	£4 10 0	4/6
4	6, 12 v. at 20 amps.	£5 17 6	6/6
5	17, 18, 20 v. at 20 amps.	£6 12 6	6/6
6	6, 12, 20 v. at 20 amps.	£7 5 0	7/6
7	24 v. at 10 amps.	£4 15 0	5/6
8	4, 6, 24, 32 v. at 12 amps.	£6 10 0	6/6

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: 100 WATT 1 ohm 10A., 5 ohm 4.7A., 10 ohm 3A., 25 ohm 2A., 50 ohm 1.4A., 100 ohm 1A., 250 ohm 7A., 500 ohm 45A., 1,000 ohm 280mA., 1,500 ohm 230mA., 2,500 ohm 2A. Diameter 3 1/2 in. Shaft length 3/4 in. dia. 1/2 in., 27/6. P. & P. 1/6.
50 WATT 1/5 (10/25/50/100/250/500/1,000/1,500/2,500 ohm. All at 21/-, P. & P. 1/6.
25 WATT 10/25/50/100/250/500/1,000/1,500/2,500 ohm. All at 14/6, P. & P. 1/6.
Black Silver Skirted knob calibrated in Nos. 1-9. 1 1/2 in. dia. brass bush. Ideal for above Rheostats, 3/6 each.

STROBE! STROBE! STROBE!

★ THREE EASY TO BUILD KITS USING XENON WHITE LIGHT FLASH TUBES. SOLID STATE TIMING + TRIGGERING CIRCUITS. PROVISION FOR EXTERNAL TRIGGERING. 230-250V. A.C. OPERATION. The Strobe is one of the most useful and interesting instruments in the laboratory or workshop. It is invaluable for the study of movement and checking of speeds. Many uses can be found in the psychiatric and photographic fields, also in the entertainment business. It is used a great deal in the motor industry and is a real tool as well as an interesting scientific device.
★ EXPERIMENTERS "ECONOMY" KIT 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube + instructions £5.5.0 plus 5/- P. & P.
★ NEW INDUSTRIAL KIT Ideally suitable for schools, laboratories etc. Roller tin printed circuit. New trigger coil, plastic thyristor 1-80 f.p.s. Price 9 gns. 7/6 P. & P.
★ HY-LYCHT STROBE This strobe has been designed for use in large rooms, halls and the photographic field. It has 4 times the light output at 30 f.p.s. and utilizes a silica tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Light output approx 4 joules. Price £10.17.6. P. & P. 7/6.
★ 7-INCH POLISHED REFLECTOR. Ideally suited for above Strobe Kits. Price 10/6 + 2/6 p. & p. or post paid with kits.

PARVALUX TYPE SD19 230/250 VOLT AC REVERSIBLE GEARED MOTORS

30 r.p.m. 40 lb. ins. Position of drive spindle adjustable to 3 different angles. Mounted on substantial cast aluminium base. Ex-equipment. Tested and in first-class running order. A really powerful motor offered at a fraction of maker's price. 6 gns. P. & P. 10/-



BODINE TYPE N.C.1 GEARED MOTOR

(Type 1) 71 r.p.m. torque 10 lb. in. Reversible 1/70th h.p. 50 cycle. 38 amp. (Type 2) 28 r.p.m. torque 20 lb. in. reversible 1/80th h.p. 50 cycle. 28 amp. The above two precision made U.S.A. motors are offered in "as new" condition. Input voltage of motor 115v. A.C. Supplied complete with transformer for 230/240v. A.C. Input Price, either type £2.17.6 plus 6/6 P. & P. or less transformer £2.2.6 plus 4/6d. P. & P. These motors are ideal for rotating aerials, drawing curtains, display stands, vending machines etc.



LARGE DIGIT 12 v. D.C. MAGNETIC COUNTER

4in. drum, calibrated 1-9. Figures 1 1/2 in. high 3/4 in. wide. Set of 1m, 1b, 1c/o contacts operated by drum cam. The units can be used in pairs and are ideally suited for batch or lap recording or for the many purposes where large easily read numerals are required. Price 18/6, P. & P. 2/6.

VEEDER ROOT COUNTER

230 v. A.C. 50 cycle 5 figure counter (non resettable). 18/6, P. & P. 1/6.

230 v. GEARED MOTOR (as illustrated)

6 R.P.M. or 10 R.P.M. 230 v. A.C. non-reversible, approx. 1.7lb.in. Price 45/-, plus 3/6 P. & P.



LIGHT SENSITIVE SWITCHES

Kit and parts including ORP.12 Cadmium Sulphide Photo cell. 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.



220/240 A.C. MAINS MODEL

Incorporates mains transformer rectifier and special relay with 2 x 5 amp. mains c/o contacts. Price inc. circuit 47/6, plus 3/6 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 £2/15/0 plus 3/6 P. & P.



INSULATED TERMINALS

Available in black, red, white, yellow, blue and green. New 17/- per doz. P. & P. 2/-.



SANGAMO WESTON

Dual range voltmeter. 0-5 and 0-100 v. D.C. FSD 1 mA. In carrying case with tests prods and leads. 32/6. P. & P. 3/6.



RADIO ALTIMETER

This precision instrument is based on a 24 v. D.C. LOW INERTIA (Integrating) Motor. The Motor drives two precision pots through close tolerance gear-trains, including slipping clutch. Offered at fraction of manufacturer's price: 32/8, plus 6/- P. & P.



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.

AUTO TRANSFORMERS

Step up, step down. 110-200-220-240 v. Fully shrouded. New. 300 watt type £3/10/- each, P. & P. 4/6. 500 watt type £4/12/6 each, P. & P. 6/6. 1,000 watt type £5/15/- each, P. & P. 7/6.

COPPER LAMINATE PRINTED CIRCUIT BOARD.

Large sheet 15 1/2 x 5 1/2 in. 3 for 10/- post paid. (3 minimum order).

SEMI-AUTOMATIC "BUG" SUPER SPEED MORSE KEY

7 adjustments, precision tooled, speed adjustable 10 w.p.m. to as high as desired. Weight 2 1/2 lb. £4/12/6 post paid.



NEW MODEL HIGH FREQUENCY TRANSFORMERISED MORSE OSCILLATOR

Adjustable tone control. Fitted with moving coil speaker, also earpiece for personal monitoring. Complete with morse key. 45/- plus 3/6d. p. & p.

NICKEL CADMIUM BATTERY

1.2 v. 35 AH. Size 8 1/2 high x 3 x 1 1/4. 30/- each, plus 4/- P. & P.
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.

DRY REED SWITCHES

2 x lamp Dry Reeds (makes contacts) mounted in 870 ohm 9-18v coil. Size 3 1/2 in. x 3 1/2 in. x 1/2 in. New. Price 8/6 per pair. Post Paid.
6 of the above mentioned units (12 Reeds, 6 coils) fitted in metal box. Size 4 1/2 in. x 3 1/2 in. x 1 1/2 in. Mfg. by Elliott Bros. New 45/- each. Post Paid.
Telephone Dials (New) 14/6d. Post Paid.

250 v. A.C. SOLENOID

Heavy duty type. Approx. 3lb. pull. 17/6 plus 2/6 P. & P.

12 v. D.C. SOLENOID

approx. 1lb. pull. 10/6, P. & P. 1/6.

50 v. D.C. SOLENOID

approx. 1lb. pull. 10/6, P. & P. 1/6.

50 v. D.C. SOLENOID

approx. 2lb. pull. 12/6, P. & P. 1/6.



PRECISION INTERVAL TIMER

From 0-30 seconds (repetitive). Jewelled balanced movement. Lever re-set. Operates 230 v. A.C. 5 amp. c/o micro-switch. Ex. equipment; tested. 17/6, plus 2/6 P. & P.



CONDENSERS

New at a fraction of maker's price.
2,500 mfd. 100 v... 12/6 4,000 mfd. 25 v... 10/-
10,000 mfd. 35 v... 15/- 4,000 mfd. 50 v... 15/-

ALL MAIL ORDERS. ALSO CALLERS AT:

57 BRIDGMAN ROAD, LONDON, W.4. Phone: 995 1560
Closed Saturdays.

SERVICE TRADING CO.

SHOWROOMS NOW OPEN
AMPLE PARKING

PERSONAL CALLERS ONLY

9 LITTLE NEWPORT STREET, LONDON, W.C.2.
Tel.: GER 0576

ADMIRALTY B.40 RECEIVERS

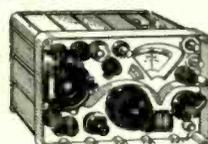


High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s-30 Mc/s. I.F. 500/Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator I.F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 10 1/2 x 13 1/2 x 1 1/2 in. Weight 114lb. Offered in good working condition. £22/10/0, carr. 30/-. With circuit diagrams. Also available B41 L.F. version of above. 15 Kc/s-700 Kc/s. £17/10/-. Carr. 30/-.
 11 valve high grade communication receiver suitable for tropical use. 1-20 Mc/s. on 4 bands. AM/CW/FM operation. Incorporates precision variable drive, B.P.O. Aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked. £15.00 Carr. 20/-.

HAMMARLUND SP600 JX COMMUNICATION RECEIVER

Frequency range 540 Kc/s to 54 Mc/s in 6 Bands. Few available in excellent condition, tested and checked. £100 each.

R209 Mk. II COMMUNICATION RECEIVER



11 valve high grade communication receiver suitable for tropical use. 1-20 Mc/s. on 4 bands. AM/CW/FM operation. Incorporates precision variable drive, B.P.O. Aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked. £15.00 Carr. 20/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES BARGAIN



An excellent general purpose D/B oscilloscope. T.B. 2 cps-750 Kc/s. Bandwidth 5.5 Mc/s. Sensitivity 33 Mv/cm. Operating voltage 0/110/200/250 v. A.C. Supplied in excellent working condition. £22/10/-. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.

MARCONI CT44 TF956 AF ABSORPTION WATTMETER



1 μ watt to 6 watts. £20. Carr. 20/-.

SOLARTRON CD. 1016. OSCILLOSCOPE

Double beam. D.C. To 5 Mc/s. Excellent condition. £55 each. Carr. 20/-.

CLASS D. WAVEMETERS



A crystal controlled heterodyne frequency meter covering 1.7-8 Mc/s. Operation on 6 v. D.C. Ideal for amateur use. Available in good used condition £25.19.8 Carr. 7/8. Or brand new with accessories £27.19.8 Carr. 7/8.

CLASS D WAVEMETERS No. 2

Crystal controlled. 1.2-19 Mc/s. Mains or 12v. D.C. operation. Complete with calibration charts. Excellent condition £12/10/0. Carr. 30/-.

EDDYSTONE V.H.F. RECEIVERS

770R. 19-165 Mc/s. £150. Both types in excellent condition.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

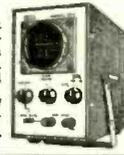
0-20 Kc/s. Output 5K or 500 ohms. 200/250 v. A.C. Offered in excellent condition. £12/10/-. Carriage 10/-.

RACAL MA.168 TRANSISTORISED DIVERSITY SWITCH

Brand new condition £15. Carriage 10/-.

TO-2 PORTABLE OSCILLOSCOPE

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPB-1 MHz. Input imp. 2 meg Ω. 25 PF. Illuminated scale. 2" tube. 115 x 180 x 230 mm. Weight 8lbs. 220/240v. A.C. Supplied brand new with handbook. £22/10/-. Carr. 10/-.



TO-3 PORTABLE OSCILLOSCOPE. 3" TUBE

Y amp. Sensitivity. 1v p-p/CM. Bandwidth 1.5 cps-1.5 MHz. Input imp. 2 meg Ω. 25 PF. X amp sensitivity. 9v p-p/CM. bandwidth 1.5 cps-800 KHz. Input imp. 2 meg Ω. 20 PF. Time base. 5 ranges 10 cps-300 KHz. Synchronisation. Internal/external. Illuminated scale. 140 x 215 x 330 mm. Weight 15 1/2 lbs. 220/240 V. A.C. Supplied brand new with handbook. £35/- Carr. 10/-.



SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

An extremely high quality oscilloscope with time base of 10 μ sec. to 20 m/sec. Internal Y amplifier. Separate mains power supply. 200/250 V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. £8/19/6. Carr. 30/-.

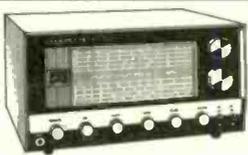
UNR-30 4 BAND COMMUNICATION RECEIVER

Covering 550 Kc/s-30 Mc/s. Incorporates BFO. Built-in speaker and phone jack. Metal cabinet. Operation 220/240 v. A.C. Supplied brand new, guaranteed with instructions. 13gns. Carr. 7/6.



LAFAYETTE SOLID STATE HA600 RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE. 150 Kc/s-400 Kc/s AND 550 Kc/s-30 Mc/s. F.E.T. front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● 8 Meter ● 24 1/2 in. Bandspread ● 230 v. A.C./12 v. D.C. neg earth operation ● RF gain control. Size 15 1/2 x 9 1/2 x 8 1/2 in. Wt. 18 lbs. EXCEPTIONAL VALUE £45. CARR. 10/- S.A.E. FOR FULL DETAILS.



TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 500 Kc/s to 30 Mc/s, continuous and electrical bandspread on 10-15, 20, 40 and 80 meters. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. 88B-CW ● ANL ● Variable BFO ● 8 meter. ● Sep. Bandspread dial ● IF 455 Kc/s ● audio output 1.5 w. ● Variable BP and AF gain controls. 115/250 v. A.C. mains. Beautifully designed. Size 7 1/2 x 15 x 10 in. With instruction manual and service data. £42. Carriage paid Trio Communication Type Headphones. Normally £5.19.6. Our price £3.15.0 if purchased with above receiver.



TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £12. IN STOCK!

TRIO JR-500SE 10-80 Metre AMATEUR RECEIVER

Covers all the amateur bands in 7 separate ranges between 3.5 and 29.7 Mc/s, 7 valves, 2 transistors and 5 diodes plus 8 crystals: output 8 and 500 ohm and 5,000 ohm phone jack. Crystal controlled oscillator. Variable BFO. VFO. AVC. ANL. 8 meter. 88B-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. 115/250 v. A.C. mains. Superb modern styling. Size 7 x 13 x 10 in. With instruction manual and service data. £69.10.0. Carr. Paid.



RCA COMMUNICATIONS RECEIVERS AR88D

Latest release by ministry BRAND NEW in original cases. 110/230v. A.C. operation. Frequency in 6 Bands. 535 Kc/s-32 Mc/s continuous. Output impedance 2.5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price £87.10.0. Carr. £2.



LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

A completely new transistorised receiver covering 152-174 Mc/s. Fully tuneable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INT. FILTERED CIRCUITS. Built-in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone jack. Operation 230 v. A.C./12 v. D.C. Neg. earth. £37/10/- Carr. 10/-.



SOLARTRON CD711S.2 DOUBLE BEAM OSCILLOSCOPE

An extremely high quality oscilloscope originally costing £400. Switched beam. Identical Y1, Y2 Amplifiers D.C. to 9 Mc/s. Sensitivity 3mV/CM to 100 V/CM. Time base 10 μ sec. to 10 M/sec. Calibrator. X amplifier D.C. to 2.5 Mc/s. Z Modulation. 110/250 v. A.C. Supplied in good working order. £85. Carriage 50/-.



SEW PANEL METERS

Type MR.38P. 1 2 1/2/3 1/2 in. square fronts.

50 μA	40/-	50mA	27/8
50-0-50 μA	37/8	100mA	27/8
100 μA	37/8	150mA	27/8
100-0-100 μA	35/-	200mA	27/8
200 μA	35/-	300mA	27/8
500 μA	30/-	500mA	27/8
500-0-500 μA	27/8	750mA	27/8
1mA	27/8	1 amp	27/8
1-0-1mA	27/8	2 amp	27/8
2mA	27/8	5 amp	27/8
5mA	27/8	3V. D.C.	27/8
10mA	27/8	10v. D.C.	27/8
20mA	27/8	20V. D.C.	27/8
		VU meter	42/-

FULL RANGE OF OTHER SIZES IN STOCK—SEND SAE FOR LEAFLET

LAFAYETTE STEREO AMPLIFIER MODEL STEREO 10

Completely transistorised 5 watts per channel I.H.F. music power. Inputs for gram and tuner. Separate volume controls and variable tone control for Bass and Treble. A compact size, big performance stereo amplifier ideal for limited space systems. Beautifully finished in grey and aluminium. Size 7 1/2 in. x 9 1/2 in. x 5 1/2 in. A.C. 220/240v. Price £11.19.6 Carr. 7/6.

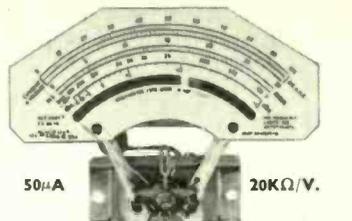


POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. 1/4 in. dia. shafts. Bulk quantities available. 25 WATT. 10/25/50/100/200/500/1000/1500/2500 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. 27/8. P. & P. 1/6.



AVOMETER MOVEMENTS



Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New and Bored 69/6 P. & P. 3/6

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: 0.1/0.3/1.3/3/10/30/100/300 v. R.M.S. 4 cps-1.2 Mc/s. Decibels -40 to +80 dB. Supplied brand new complete with leads and instructions. Operation 230 v. A.C. £17/10/- Carr. 5/-.



TE-65 VALVE VOLTMETER

High quality instrument with 28 ranges. D.C. volts 1.5-1,500 v. A.C. volts 1.5-1,500 v. Resistance up to 1,000 megohms. 220/240v. A.C. operation. Complete with probe and instructions £17/10/0. P. & P. 6/- Additional Probes available: R.F. 35/- H.V. 42/6.



COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

D.C. coupled. Band width 1 Kc/s. Perfect order. £25. Carr. 30/-.

AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the Ministry by Airmeq. Frequency coverage 20-80 Mc/s. AM/CW/FM. Incorporates precision level meter, precision attenuator 1/2 V-100 Mv. dial, level meter, precision attenuator 1/2 V-100 Mv. A.C. Size 12 x 8 1/2 x 9 in. Supplied in brand new condition complete with all connectors, fully tested, £45. Carr. 30/-.



GEARED MAINS MOTORS

Parallax type 3D19 230/250 v. A.C. Reversible. 30 r.p.m. 40 lb. ins. Complete with capacitor. Excellent condition. 99/6. Carr. 10/-.

TE-16A TRANSISTORISED SIGNAL GENERATOR

5 Ranges 400 KHz-30 MHz. An inexpensive instrument for the handyman. Operates on 9v. battery. Wide easy to read scale. 800 KHz modulation. 5 1/2" x 5 1/2" x 3 1/2". Complete with instructions and leads. £7/19/6. P/P 4/-.



FIELD TELEPHONES TYPE L. Generator ringing, metal cases. Operate on 2 1/2 v. batteries (not supplied.) Excellent condition. £4.10.0 per pair. Carr. 10/-.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE.

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω-111 MEG Ω. G. Ranges ± 1%. L. 1 μH-111 HEN. RIES. 6 Ranges ± 2%. C. 10 PF ± 110 MFD. 6 Ranges ± 2%. TURNS RATIO 1:1/1000-1:11000. 6 Ranges ± 1%. Bridge voltage at 1,000 CF8. Operated from 9 volts. 100 μA. Meter indication. Attractive 2 tone metal case. Size 7 1/2" x 5" x 2". £20. P. & P. 5/-.



AUTO TRANSFORMERS

0/115/230v. Step up or step down. Fully shrouded 150 W. 32/8. P. & P. 3/6 300 W. 47/6. P. & P. 4/6 500 W. 54/10/0. P. & P. 6/6 1,000 W. 58/10/0. P. & P. 7/6 1,500 W. 57/19/6. P. & P. 8/6 7,500 W. 515/10/0. P. & P. 20/-.

G. W. SMITH & Co. (Radio) Ltd.
 ALSO SEE OPPOSITE PAGE

ARF-100 COMBINED AF-RF SIGNAL GENERATOR



AF SINE WAVE
20-200,000 cps. Square wave 20-30,000 cps. O/P HIGH IMP. 21 v. P/P 600 Ω 3.8 v. P/P. R.F. 100 kc/s-300 Mc/s. Variable R.F. attenuation. Int./Ext. Modulation. AF output and % mod. on R.F. 220/240 v. A.C. £30. Carr. 7/6.

VOLTAGE STABILISER TRANSFORMERS. 180-260v. Input. Output 230v. Available 150w or 225w. £12.10.0. Carr. 5/-.

TE-20RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 kc/s-200 Mc/s. on 6 bands. Directly calibrated. Variable R.F. attenuator. Operation 200/240 v. A.C. Brand new with instructions. £15.

P. & P. 7/6. S.A.E. for details.

PEAK SOUND PRODUCTS

Full range of Amplifiers, kits, Speakers in stock.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20 cps to 200 kc/s. on 4 bands. Square 20 cps to 30 kc/s. Output impedance 5,000 ohms. 200/250 v. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. £16.10.0. Carr. 7/6.



MARCONI TF885 VIDEO OSCILLATORS

0-6 mc/s Sine Square Wave £45. Carr. 20/-.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER



2 pf-2,000 mfd. 2 ohms-200 meg-ohms. Also checks impedance turns ratio insulation. 200/250 v. A.C. Brand New. £17.10 Carr. 7/6.

MARCONI TF.142E DISTORTION FACTOR METERS

Excellent condition. Fully tested £20. Carr. 15/-.

TY75 AUDIO SIGNAL GENERATOR

Sine Wave 20 CPS-200 Kc/s. Square Wave 20 CPS-30 Kc/s. High load low impedance output. Output variable up to 6 volts. 220/240 v. A.C. Brand new with instructions. £16. Carr. 7/6. Size 210 x 150 x 120 mm.



MARCONI TF195M BEAT FREQUENCY OSCILLATORS

0-40 kc/s. £20. Carr. 30/-.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s-500 Mc/s. on 6 bands. Directly calibrated. Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240v. A.C. Brand new with instructions. £15. Carr. 7/6. Size 140 x 215 x 170 mm.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons. **VM.76. VALVE VOLTMETER.** R.F. measurements in excess of 100 Mc/s and D.C. measurements up to 1000 v. with accuracy of ±2%. D.C. range 300 MV to 1 KV. A.C. range 300 MV to 300 V R.M.S. Resistance 0.02-500 M. Price £72. **VM.78. UHF MILLIVOLT METER.** Transistorised. A.C. range 10 MV-3V. D.C. current range 0.01/1A-0.3 Ma. Resistance 1 ohm-10 megohms. £125. **H.B. AUDIO SIGNAL GENERATOR.** 15 c/s-50 Kc/s. sine or square wave. Price £30. **J.B. AUDIO SIGNAL GENERATOR.** 15 c/s-30 Kc/s. Price £30. **TT18. TRANSISTOR TESTER.** £37/10/- Carriage 10/- per item.

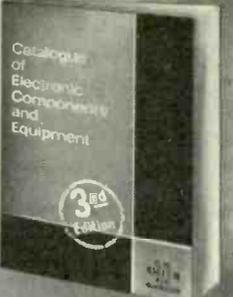
MODEL ZQM TRANSISTOR CHECKER



It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes etc. Spec: A: 0.7-0.9967. B: 5-200. Ico: 0/50 micro-amps. 0.5 mA. Resistance for diode 200 Ω +1 MEG. Supplied complete with instructions, battery and leads. £5/19/6. P. & P. 2/6.

Latest Catalogue

The latest edition giving full details of a comprehensive range of HI FI EQUIPMENT, COMPONENTS, TEST EQUIPMENT AND COMMUNICATIONS EQUIPMENT. Nearly 200 pages, fully illustrated and detailing thousands of items—many at bargain prices. FREE DISCOUNT COUPONS VALUE 10/-.



SEND NOW—ONLY 7/6 P&P!

GARRARD

Full current range offered brand new and guaranteed at fantastic savings

*8P25 Stereo	£5.19.6	*8P25 MKII	£11.19.6
*1025 Mono	£7.10.0	*8L55	£11.19.6
*1025 Stereo	£7.15.0	*A70 MKII	£12.10.0
*2025 Stereo	£7.19.6	*A760 MKII	£13. 5.0
*2025T/C Mono		*8L65	£14.14.6
Stereo	£8.17.6	AP75	£17.17.0
		401	£28. 7.6
*3000 Stereo	£9.19.6	8L75	£28.10.0
		8L95	£35. 0.0

Carriage/insurance 7/6 extra any model.

WB4 Bases £3/19/6. Perspex cover £3/10/0.

*Special offer base and cover available for these models at £4.15.0. Carr. 5/-.

Full range of Garrard accessories available

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



19 transistors. 8 diodes. IHP music power 30-watts at 8 ohms. Res. 30-30,000 ±2 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 aluminium. gold anodised extruded front panel with metal case. Size 10 1/2 in. x 3 3/4 in. x 7 1/2 in. Operation 110/230 volt A.C. £28. Carr. 7/6.

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid. High quality construction. Input 230 v. 50-60 cycles. Output full variable from 0-260 volts. Bulk quantities available. 1 amp.—£5/10/-; 2.5 amp.—£6/15/-; 5 amp.—£9/15/-; 8 amp.—£14/10/-; 10 amp.—£18/10/-; 12 amp.—£21; 20 amp.—£37



MULTIMETERS for EVERY purpose!



TE-900 20,000 Ω/VOLT GIANT MULTIMETER
Mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/3/5/10/250/1,000/5,000 v. A.C. 0/25/12.5/10/50/250/1,000/5,000 v. D.C. 0/50 μA/110/100/500 mA/10 amp. D.C. 0/2K/200K/2M/200M Ω. £15/- P. & P. 5/-.



MODEL AS-100D. 100K Ω/Volt. 5in. mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200 v. D.C. 0/5/30/120/300/600 v. A.C. 0/10 μA/15/60/300 mA/12 Amp. 0/2K/200K/2M/200M Ω. —20 to +17dB. £12/10/- P. & P. 3/6.



MODEL TE-90 50,000 O.P.V. Mirror scale overload protection. 0/3/12/60/300/600/1,200 v. D.C. 0/5/30/120/300/1,200 v. D.C. 0/3 μA/60/600 MA. D.C. 16K/160K/1.6/16 MEG Ω. —20 + 63db. £7/10/0. P. & P. 3/-.



MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200 v. D.C. 0/5/30/120/300/1,200 v. A.C. 0/30 μA/3/30/300 mA. 0/16K/160K/1.6M/16 MEG Ω. £5/10/- P. & P. 3/-.



MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000 v. A.C. 0/5/25/50/250/500/1,000 v. D.C. 0-50 μA. 5/50/500 mA. 0/6K/60K/600K/6 meg. £4/17/6. P. & P. 3/-.



MODEL TE-12. 30,000 O.P.V. 0/5/15/30/120/600/1,200/3,000/6,000 v. D.C. 0/6/30/120/600/1,200 v. A.C. 0/60 μA/6/60/600 mA. 0/6K/600K/6 MEG. 60 MEG Ω. 50 PP. 2 MPD £5/19/6. P. & P. 3/6.



TE-51. NEW 20,000 Ω/VOLT MULTIMETER, with overload protection and mirror scale, 0/6/60/120, 1,200 v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0/50 μA/12/300 mA. D.C. 0/6K/6 meg. ohm. £2/8. P. & P. 2/6.

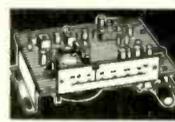


LAFAYETTE 57 Range Super 50K Ω/V. Multimeter. D.C. volts 125mV-1000v. A.C. volts 1.5v-1000v. D.C. Current 25 μA-10 Amp. Ohms 0-10 Megohm. D.B. —20 to +81 db. Overload protection. £12/10/- P. & P. 3/6.



MODEL TE-10A. 20k Ω/Volt 5/25/50/250/500/2,500 v. D.C. 10/50/100/500/1,000 v. A.C. 0/50 μA/12.5 mA/250 mA. D.C. 0/6K/6 meg. ohm. —20 to +22 db. 10-0, 100 mfd. 0.100-0.1 mfd. 69/6. P. & P. 2/6.

TRANSISTOR FM TUNER



6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6in. x 4in. x 2 1/2in. 3 I.F. stages. Double tuned discriminator, simple output to feed most amplifiers. Operates on 9 volt battery. Coverage 88-108 Mc/s. Ready built ready for use. Fantastic value for money. £8/7/6. P. & P. 2/6. STEREO MULTIPLEX ADAPTORS, 99/6.

SINCLAIR EQUIPMENT

Z12. 12 watt amplifier 89/6. PZ4. Power supply Unit 89/6. STEREO 25. Pre-amplifier £9/19/6. Q.14 Speakers 27/19/6. Micromatic Radio Kit 49/6. Built 59/6. NOW AVAILABLE IC10 . 59/6 ALL POST PAID. SPECIAL OFFER 2 Z12 amps. PZ4 Power Supply, Stereo 25. Pre-amplifier 27/19/6. Q-14 speakers 27/19/6. or with two Q.14 Speakers. £99 or £37 NEW SINCLAIR 2000 SYSTEM 35 watt Integrated Amplifier, £28. Carr. 5/- Self-powered FM Tuner, £25. Carr. 5/-.

ECHO HS-606 STEREO HEADPHONES



Wonderfully comfortable. Lightweight adjustable vinyl headband, ft. cable and stereo jack plug. 25-17,000 cps., 8 Ω imp. 67/6. P. & P. 2/6.

HOSIDEN DH45 2-WAY STEREO HEADPHONES



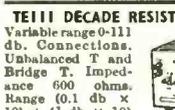
Each headphone contains a 2 1/2in. woofer and a 1/2in. tweeter. Built in individual level controls. 25-18,000 cps. 8 Ω imp. with cable and stereo plug. £5/19/6. P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM



Operative over amazingly long distances. Separate call and press to talk buttons. 9-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £8/19/6 pair. P. & P. 3/6.

TE111 DECADE RESISTANCE ATTENUATOR



Variable range 0-111 db. Connections. Unbalanced T and Bridge T. Impedance 600 ohms. Range (0.1 db x 10) + (1 db x 10) + 10 + 20 + 30 + 40 db. Frequency: DC to 200 KHZ (—3db). Accuracy: 0.05 db. ± indication db x 0.01. Maximum input less than 4 watts. Supplied in strong plastic case. Flashing rate between 60-120 per minute. 12 volt D.C. operation. Maximum load 6 amps. Size 2 1/2 in. dia. x 4 in. Supplied brand new at a fraction of original cost. 6/6 each. P. & P. 2/6. (3 for 17/6. P. & P. 4/6.)

CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset.) Housed in strong plastic case. Flashing rate between 60-120 per minute. 12 volt D.C. operation. Maximum load 6 amps. Size 2 1/2 in. dia. x 4 in. Supplied brand new at a fraction of original cost. 6/6 each. P. & P. 2/6. (3 for 17/6. P. & P. 4/6.)

RECORDING HEADS



Cosmoord 1 track heads. Post extra. Erase/Play. High imp. 65/- Erase. Low imp. 20/- Marriott 1 track heads. Post extra. Record/Playback. High imp. 65/- Erase. Low imp. 20/-

AMERICAN RECORDING TAPES



First grade quality 3in. 225ft. L.P. acetate 3/8 3 1/2in. 600ft. T.P. Mylar. 10/- 5in. 600ft. Std. plastic. 8/6 American 6in. 900ft. L.P. acetate. 10/- Brand new 6in. 1,200ft. D.P. Mylar 15/- and 6in. 1,200ft. L.P. acetate 12/6 6in. 1,200ft. L.P. Mylar 15/- 6in. 1,800ft. D.P. Mylar 22/6 6in. 2,400ft. T.P. Mylar 39/6 7in. 1,200ft. Std. acetate 12/6 7in. 1,800ft. L.P. Mylar 20/- 7in. 2,400ft. D.P. Mylar 25/- 7in. 3,600 ft. T.P. Mylar 45/-

MAXELL TAPE CASSETTES

C60-10/3; C90-14/3; C120-19/6. Post extra.

GW. SMITH & CO (RADIO) LIMITED
3 and 34, LISLE STREET, OI-437 8204
LEICESTER SQ., LONDON, W.C.2 OI-437 9155
311, EDGWARE RD., LONDON, W.2 OI-262 0387
(ALL MAIL ORDERS TO - 3, LISLE STREET, LEICESTER SQUARE, LONDON, W.C.2)

OPEN 9 a.m. to 6 p.m. every day Mon. to Sat. (Edgware Rd. 1 day Thurs.) Trade supplied.

CURRENT RANGE OF BRAND NEW L.T. TRANSFORMERS. FULLY SHROUDED (*excepted) TERMINAL BLOCK CONNECTIONS. ALL PRIMARIES 220/240v.

No.	SEC. TAPS	AMPS	PRICE	CARR.
1A	25-33-40-50	15	£9 10 0	10/6
1B	25-33-40-50	10	£6 19 6	8/6
1C	25-33-40-50	6	£5 19 6	8/6
1D	25-33-40-50	3	£3 12 6	7/6
2A	4-16-24-32	12	£6 10 0	7/6
2B	4-16-24-32	8	£4 17 6	7/6
2C	4-16-24-32	4	£3 5 0	6/-
2D	4-16-24-32	2	£2 2 6	5/-
3A*	25-30-35	40	£14 17 6	15/-
3B*	25-30-35	20	£9 7 6	9/6
3C	25-30-35	10	£6 10 0	7/6
3D	25-30-35	5	£3 15 0	6/6
3E	25-30-35	2	£2 15 0	6/6
4A*	12-20-24	30	£11 15 0	10/-
4B	12-20-24	20	£7 10 0	8/6
4C	12-20-24	10	£4 15 0	7/6
4D	12-20-24	5	£3 5 0	6/6
5A	3-12-18	30	£8 15 0	7/6
5B	3-12-18	20	£6 10 0	7/6
5C	3-12-18	10	£3 17 6	6/6
5D	3-12-18	5	£2 12 6	6/6
6A	48-56-60	2	£3 7 6	5/6
6B	48-56-60	1	£2 7 6	5/6
7A*	6-12	50	£9 7 6	9/6
7B	6-12	20	£5 10 0	7/6
7C	6-12	10	£3 10 0	6/6
7D	6-12	5	£2 10 0	5/6
8A	12-24	1	£1 9 6	5/6
9A	17-32	8	£5 12 6	5/6
10A*	9-15	2	£1 5 0	5/6
11A	6-3	15	£2 5 0	5/6
12A	30-25-0-25-30	2	£3 5 0	5/6

Note: By using the intermediate taps many other voltages can be obtained.
 Example: No. 1. 7-8-10-15-17-25-33-40-50V.
 2. 4-8-12-16-20-24-32V.
 3. 5-3-6-9-12-15-18V.

AUTO TRANSFORMERS

240v.-110v. or 100v. Completely Shrouded fitted with Two-pin American Sockets or terminal blocks. Please state which type required.

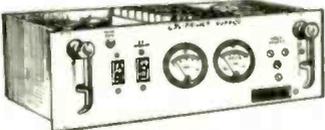
Type	Watts	Approx. Weight	Price	Carr.
1	80	2 1/2 lb	£1 17 6	4 6
2	150	4 lb	£2 7 6	5 0
3	300	6 1/2 lb	£3 7 6	6 0
4	500	8 1/2 lb	£4 15 0	6 6
5	1000	15 lb	£6 12 6	7 6
6*	1750	25 lb	£13 10 0	10 6
7*	2250	30 lb	£16 10 0	12 6

*Completely enclosed in beautifully finished metal case fitted with two 2-pin American sockets, neon indicator, on/off switch, and carrying handle.

Samson's
(ELECTRONICS) LTD.

9 & 10 CHAPEL ST., LONDON, N.W.1
01-723-7851 01-262-5125

AMERICAN HIGHLY STABILISED POWER SUPPLY UNIT



Regulation between 7-15 volts D.C. at 20 amps. Fitted 0-30 D.C. ammeter, 0-15 D.C. voltmeter and overload protection switch. Built to a very high specification. Bench or rack mounting. Size 19 x 8 x 17 ins. A.C. input 110v. 50 cycles. Ex equipment but guaranteed in perfect condition. Maker's price in excess of £200. Our price £25. Carr. 30/- 240/110 volt, 400 watts, Mains Transformer available if required. £3 extra.

SPECIAL OFFER OF L.T. TRANSFORMERS

Pri 110-120v.-200-240v. Sec. tapped 12, 18, 24, 30 v. 8a. Table top connections. Fully tropicalised. 75/- Carr. 7/6.

Pri tapped 110v. 220-250v. Sec. 55v. 24a., 14v. 10a., 60v. 2a. All windings very conservatively rated. Tropically finished. Terminal connections. Size 9 x 7 1/2 x 7 ins. Weight 65lbs. £10.19.6. Carr. 15/-.

Pri tapped 200-250v. Sec. 46v. Very conservatively rated at 29 amps. Size 11 x 7 x 7 ins. Weight 75 lbs. approx. Manufactured by Partridge. £12.19.6 Carr. 15/-.

Pri 240v. Sec. 12v. 90 amps. Open frame flying leads. Size 7 1/2 x 6 1/2 x 6 ins. £13.19.6. Carr. 15/-.

DIGITAL HOUR METERS

6 figs inc. 1/10ths, 1/100ths 40v. A.C. but complete with transformer for 240v. A.C. operation. All in plastic case. Size 6 1/2 x 6 1/2 x 3 in. Condition as new 45/- P. & P. 5/-.



SMITHS SYNCHRONOUS MOTORS
A.C. 200-240v. 4 r.p.m. 3in. dia. Length of spindle 2 1/2 in. 22/6. P. & P. 2/6. As above, 1 r.p.m. 22/6. P. & P. 2/6.

AMERICAN SYNCHRONOUS MOTORS
A.C. 230v. 50 cycles, 6 r.p.m. 2 1/2 in. dia. cog spindle. 12/6. P. & P. 2/6.

VENNER SYNCHRONOUS MOTOR
A.C. 240v. 50 cycles, 40 r.p.m. 2 1/2 in. dia. Length of spindle 1 1/2 in. 12/6. P. & P. 2/6.

BERCO SLIDING RESISTORS

1004 ohms 1 amp. Single Tube Slider. Length 18ins. 45/- P. & P. 7/6. 30 ohms 1.25 amps 5.T. Right angle geared Drive. 19/6. P. & P. 5/6. 45+12 ohms 6.5/4 amps Single Tube Fixed Length 22ins. 25/- P. & P. 7/6.

G.P.O. 3000 TYPE RELAY (New and Boxed)

20,000 ohms Heavy Duty Contacts. 2CO. 2M. 15/- P. & P. 2/- 75 ohms Normal Contacts. 3M, 1B, 1CO. 4/- P. & P. 2/- 500 ohms Heavy Duty Contacts. 3M, 3B. 8/6. P. & P. 2/- 150 ohms Heavy Duty Contacts. 2M. 6/- P. & P. 2/-.

SUNVIC TANK THERMOSTATS

Type TQP. 250v. 15 amps NC. 5 amps NO. 190-70 deg. F. Length of stem 10 1/2 ins. 25/- P. & P. 5/-.

AC 220-240v. SHADED POLE MOTORS

1,500 r.p.m. Double spindle. Length 0.9in. and 0.6in. Overall size 3 x 3 1/2 x 2ins. New and Boxed. 10/6. P. & P. 3/6.

BURGESS MICRO SWITCHES

Type MK 3BR/74. Norm closed or Norm open. 1/2 in. raised Press Button. 8/6 for three. P. & P. 2/6.

SIEMENS MINIATURE RELAY BASES

Type T.STV 24 C. 6 Contact pin. 4 Coil pins. Cartons of 20, inc. spring clips. 15/- P. & P. 2/-.

PULLEN SHUNT WOUND 24v. OC REVERSIBLE MOTORS

Type 610 H.P. 1/75 r.p.m. 3,500 Cont/R. New and boxed. 15/- P. & P. 3/6.

MAINS ISOLATION TRANSFORMERS

Pri tapped 240-220-110v. Sec. 240v. 1200 watts. Built into metal case with twin 13 amp Socket outlet, on/off switch, neon indicator and carry handle. £16.10.6. Carr. 15/-.

GARDNER'S POTTED TRANSFORMERS

Pri Tapped 200-240v. Sec. 35v. 7.2 amps. conservatively rated. 57/6. Carr. 6/6.

NEW PRICES ON NEW COMPONENTS

RESISTORS

High stability, carbon film, low noise. Capless construction, molecular termination bonding.

Dimensions (mm.): Body: 1/4W: 8 x 2.8
1/2W: 10 x 4.3

Leads: 35

10% ranges; 10 Ohms to 10 Megohms (E12 Renard Series).

5% ranges; 4.7 Ohms to 1 Megohm (E24 Renard Series).

Prices—per Ohmic value.

W	each	10 off	25 off	100 off
1/4W 10%	1/6	1/6	3/3	10/4
1/4W 5%	2 1/2	1/9	3/8	11/8
1/2W 10%	2 1/2	1/9	3/8	11/7
1/2W 5%	3d.	2/-	4/-	12/10

CAPACITORS

Subminiature Polyester film, Modular for P.C. mounting. Hard epoxy resin encapsulation. Radial leads.

±10% tolerance. 100 Volt working.

Prices—per Capacitance value (µF)

0.001, 0.002, 0.005, 0.01, 0.02	each	10 off	25 off	100 off
0.001	6d.	4/3	8/4	30/-
0.005	8d.	6/-	12/6	41/8
0.01	10d.	7/1	15/6	51/-
0.02	1/2	10/-	20/10	68/6

Polystyrene film, Tubular, Axial leads. Unencapsulated ±5% or ±1pf tolerance, 160 Volt Working.

Prices—per Capacitance value (µF)

10, 12, 15, 18, 22, 27, 33, 39, 47	each	10 off	25 off	100 off
10, 12, 15, 18, 22, 27, 33, 39, 47	5d.	3/7	7/9	24/-
56, 68, 82, 100, 120, 180, 220, 270, 330, 390	5d.	4/-	8/9	26/8
470, 560, 680, 820, 1,000, 1,500	6d.	5/-	10/10	33/4
2,200, 3,300, 4,700, 5,800	7d.	5/-	10/10	40/4
6,800, 8,200, 10,000, 15,000	8d.	6/-	13/-	49/4
22,000	9d.	6/9	18/-	45/4

POTENTIOMETERS (Carbon)

Superior grade enclosed controls. Low rotational noise. Body dia., 1in. Spindle, 2in. x 1/2in. Tolerance, 20%.

Linear: 1K to 2M. (1/4W at 40°C).

Logarithmic: 5K to 2M. (1/4W at 40°C).

Prices per ohmic value	each	10 off	25 off	100 off
2/-	18/4	41/8	150/-	

GANGED STEREO POTENTIOMETERS (Carbon)

1/4W at 70°C. Long Spindle.

Logarithmic and Linear: 5k +5k to 1M +1M.

Prices per ohmic value	each	10 off	25 off	100 off
80/-	70/-	162/6	575/-	

SKELETON PRE-SET POTENTIOMETERS (Carbon)

High quality pre-sets suitable for printed circuit boards of 0.1in. P.C.M. 100 ohms to 5 Megohms (Linear only). Miniature: 0.3W at 70°C. ±20% below 1M, ±30% above 1M. Horizontal (0.7in x 0.4in. P.C.M.) or Vertical (0.4in. x 0.2in. P.C.M.). Subminiature: 0.1W at 70°C. ±20% below 2.5M, ±30% above.

Prices—per ohmic value	each	10 off	25 off	100 off
Miniature (0.3W)	1/-	8/9	18/9	66/8
Subminiature (0.1W)	10d.	7/1	14/7	46/8

ELECTROLYTIC CAPACITORS (Mullard.) —10% to +50%.

Subminiature (all values in µF)	each	10 off	25 off	100 off
4V	8	32	64	125
6.4V	8.4	25	50	100
10V	10	18	32	64
18V	10	20	40	80
25V	10	18	25	60
40V	10	18	25	60
64V	10	18	25	60
Price	1/4	1/3	1/2	1/1

Small (all values in µF)	each	10 off	25 off	100 off
4V	800	1,250	2,000	3,200
6.4V	840	1,000	1,600	2,500
10V	400	640	1,000	1,600
18V	250	400	640	1,000
25V	160	250	400	640
40V	100	160	250	400
64V	64	100	160	250
Price	1/6	2/-	2/6	3/-

POLYESTER CAPACITORS (Mullard)

Tubular 10%, 160V: 0.01, 0.015, 0.022µF, 7d. 0.033, 0.047 µF, 8d. 0.068, 0.1 µF, 9d. 0.15 µF, 11d. 0.22 µF, 1/-, 0.33 µF, 1/3, 0.47 µF, 1/6, 0.68 µF, 2/3, 1 µF, 2/8, 400V: 1,000, 1,500, 2,200, 3,300, 4,700µF, 6d. 6,800µF, 0.01, 0.015, 0.022 µF, 7d. 0.033 µF, 8d. 0.047 µF, 9d. 0.068, 0.1 µF, 11d. 0.15 µF, 1/2, 0.22 µF, 1/6, 0.33 µF, 2/3, 0.47 µF, 2/8.

SEMICONDUCTORS: OA5, OA61, 1/9, OC44, OC45, OC71, OC81, OC81D, OC82D, 2/-, OC70, OC72, 2/3, AC107, OC75, OC170, OC171, 2/6, AF115, AF116, AF117, ACY19, ACY21, 3/3, OC140, 4/3, OC200, 5/-, OC139, 5/3, OC25, 7/-, OC85, 8/-, OC23, OC28, 8/3.

SILICON RECTIFIERS (0.5A): 170 P.I.V., 2/9, 400 P.I.V., 3/-, 800 P.I.V., 3/3, 1,250 P.I.V., 3/9, 1,500 P.I.V., 4/-, (6A): 200 P.I.V., 3/-, 400 P.I.V., 4/-, 600 P.I.V., 5/-, 800 P.I.V., 6/-.

PRINTED CIRCUIT BOARD (Vero). 0.15in. Matrix: 3 1/2in. x 2 1/2in., 3/3, 5 1/2in. x 2 1/2in., 3/11, 3 1/2in. x 3 1/2in., 3/11, 5in. x 3 1/2in., 5/6, 0.1 Matrix: 3 1/2in. x 2 1/2in., 4/-, 5in. x 2 1/2in., 4/6, 3 1/2in. x 3 1/2in., 4/6, 5in. x 3 1/2in., 5/3.

SEND S.A.E. FOR 1969 CATALOGUE

DUXFORD ELECTRONICS
97/97A MILL ROAD, CAMBRIDGE

Telephone: CAMBRIDGE (0223) 63687

(Visit us at our new Mail Order, Wholesale and Retail Premises)
MINIMUM ORDER VALUE 5/- C.W.O. Post and Packing 1/6

R.S.C. SENSATIONAL HIGH FIDELITY STEREO 'PACKAGE' OFFERS

Matching as recommended for optimum performance. Compare prices with equipment and cabinets purchased individually.

30 Watt Output

- ★ Goldring Transcription Turntable on Plinth.
 - ★ Shure or Goldring Magnetic Pick-up Cartridge.
 - ★ Super 30 Amplifier in veneered housing.
 - ★ Pair of Stanway II Loudspeaker Units.
- Special total price. Four fully wired units ready to "plug-in". Really superb performance. Send S.A.E. for leaflet. Carr. 30/-

86 Gns.



- ★ Garrard SP25 Mk. II Turntable on Plinth.
- ★ Goldring CS90 Ceramic diamond tipped Cartridge.
- ★ Super 30 Amplifier in veneered housing.
- ★ Pair of Stanway II Loudspeaker Units.

13 Watt Output

- ★ Garrard SP25 Mk. II 4-speed Player Unit, on Plinth.
 - ★ Goldring CS90 Ceramic P.U. Cartridge with diamond stylus.
 - ★ TA12 Amplifier in veneered housing.
 - ★ Pair of Dorchester Loudspeaker Units.
- Special total price. **51 Gns.**
Terms Dep. £10 and 9 monthly payments £5.11.0 (Total £59.19.0) Carr. 25/-

13 WATT 'PACKAGE' as above but with Garrard 3000 and Sonotone 9 TA cartridge in lieu of 46 Gns. SP25 and CS90. Special total price.

76 Gns.
Carr. 30/-

AUDIOTRINE HIGH FIDELITY LOUSPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Treated cone surround for low fundamental resonance. "D" indicates Tweeter. Cone providing extended frequency range up to 15,000 c.p.s. Exceptional performance at low cost. Impedance 3 or 15 ohms.

Prices include carriage. PLEASE STATE IMPEDANCE

HF 510L 5" 10W	57/9	HF 120 12"	15W 79/9
HF 50LD 8" 8W	59/9	HF 120D 12"	15W 89/9
HF 811D 8" 10W	24/4	HF 126 12"	16W 25/5
HF 102D 10" 10W	65/-	HF 128D 12"	16W 25/15
HF 100D 10" 15W	25/15		

HIGH FIDELITY LOUSPEAKER UNITS
Cabinets of latest styling Satin Teak or Afrormosia veneer. Acoustically lined or filled with woollen damping material. Ported where appropriate. Credit terms available.

DORCHESTER Size 16 x 11 x 9in. Appr. Range 45-15,000 c.p.s. Rating 8-10 watt. Fitted High flux 13 x 8in. **£8.19.9**
Dual cone speaker. Impedance 3 or 15 ohms. Carr. 7/6

STANWAY II Size 20 x 10 1/2 x 9 1/2in. Rating 10 watts. Incorporating Fane 13 x 8in. speaker with rubber cone surround and 11,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Impedance 15Ω. Gives smooth realistic sound output. Inc. carr. **16Gns.**

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Frequency range 40-20,000 c.p.s. Impedance 15 ohms. **12 1/2 Gns.**

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER

200-250V. A.C. mains operated. Frequency response 20-20,000 c.p.s. -2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble controls. Input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm speakers. Max. sensitivity 5mV. Output rating 1H.F.M. In fully enclosed enamelled case, 9 1/2 x 2 1/2 x 3 1/2in. Attractive brushed silver finish fascia plate 10 1/2 x 3 1/2in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Or factory built with 12 months' guarantee. **£8.19.9**

R.S.C. COLUMN SPEAKERS Covered in two-tone Rexine/Vynalr. Ideal for vocalists and Public Address. 15 ohm matching. TYPE C57 15 watts inc. five 7 x 4in. spkrs. **£7.19.11**. TYPE C48S, 30 watts. Fitted four 8in. high flux 6 watt speakers. Overall size approx. 42 x 10 x 5in. **16 Gns.** Or deposit 6/9 and 9 monthly pmts. **£4.9** (Total **£18.19.9**) Carr. 11/6

TYPE C42S, 50 watts. Fitted four 12in. 11,000 lines 15 watt speakers. Overall size 56 x 14 x 9in. approx. **26 Gns.** Or deposit **£5.17/8** and 9 monthly payments Carr. 15/6 of **54/8** (Total **£30.7/6**).

R.S.C. TFM1 SOLID STATE VHF/M RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. **14 Gns.**
Carr. Or factory built 18/9 Gns. Or in Teak finished cabinet as illustrated 19/9 Gns. Terms: Deposit **£5** and 9 monthly payments **£2**. Total **£23**.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 line 15 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and wide frequency range ensure surprisingly realistic reproduction. Or Senior 15 watt inc. HF 126 **£5.15.0**
15,000 line Speaker **26/15**. Carr. 5/9

HI-FI 'SPEAKER ENCLOSURES
Teak or Afrormosia veneer finish. Modern design. Acoustically lined. Prices inc. carr.
JES Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. HI-FI speaker. **£4.10**

SE8 For optimum performance with any 8in. HI-FI speaker. 22 x 15 x 9in. Ported **SE10** For outstanding results with 10in. HI-FI speaker. 24 x 15 x 10in. Ported **SE12** For high performance with 12in. HI-FI speaker and Tweeter. Size 25 x 16 x 10 1/2in. Pressurised. **£6.15**

THE 'YORK' HIGH FIDELITY 3 'SPEAKER SYSTEM

Moderate size approx. 25 x 14 x 10in. Range 30-20,000 Complete kit. c.p.s. Impedance 15 ohms. Performance comparable with units costing considerably more. Consists of (1) 12in. 15 watt bass unit with cast chassis. Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range speaker (4) High efficiency tweeter. (5) Woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions. **20 Gns.**
HEAR IT AT ANY BRANCH.

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output, with Pre-amp/Tone Control Stages. Performance figures: Hum level -70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All high grade components. Valves EF86, EF96, ECC83, 6X4, 6X5, 6X6, 6X7, 6X8, 6X9, 6X4, 6X5, 6X6, 6X7, 6X8, 6X9. Separate Bass and Treble Controls. Sensitivity 35 millivolts. Suitable for High Impedance mic. or pick-up. 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 parts wiring diag., instructions. Twin-handled perforated cover 27/8. Or factory built with EL34 output valves and 15 Gns. 12 months' guarantee for 18 Gns. Tech. figs. apply to factory built units. Carr. 12/6. TERMS: Deposit **£8.3.0** and 9 monthly payments of 24/- (Total **£21.9.0**) Send S.A.E. for leaflet.

INTEREST CHARGES REFUNDED

On Credit Sales settled in 3 months.

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 allowing mixing of "mike" and gram, etc. etc. High sensitivity. 5 valves - ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. IN. BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c.p.s. Harmonic level -60dB. SENSITIVITY 40 millivolts. For Crystal or Ceramic P.U.s. High Impedance "mikes". For Musical Instruments such as String Bass, Electronic Organs, etc. Size approx. 12 x 9 x 7 1/2in. For AC mains 200-250V. 50 c/s. Output for 3 and 15 ohm spkrs. RAE for leaflet. Complete kit. Full instructions and point-to-point wiring diagrams. Carr. 11/6 (or factory built with 12 months' guarantee for 12 Gns. 9 monthly payments of 23/- (Total **£15.6.6**). RSC A11 transistorised version of above complete kit 9 Gns. (Assembled 13 Gns.)

High Quality LOUSPEAKERS

In teak or afrormosia veneered cabinets. L13 13" x 8" 10 Watt Model. Gauss 10,000 lines. 3 or 15 ohm. **£4.19.9** Carr. 7/6
L12 12" x 10" 10 Watt Model. 15 ohm. Size 18 x 18 x 10in. Gauss 10,000 lines. Rexine. covered 10" x 8" x 7 1/2in. **£8.19.9** Carr. 8/9

TWO-WAY 'PHONE AMPLIFIER

Listen and speak with both hands free. Handsome black case. Battery operated. **59/9**

R.S.C. TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED. SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 8.5 WATTS PER CHANNEL. Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge. Radio tuner. Tape recorder. "Mike" etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250 V. A.C. mains ★ Frequency Response 30-20,000 c.p.s. -2dB ★ Harmonic Distortion 0.3% at 1000 c.p.s. Hum and Noise 70dB ★ Sensitivities (1) 300 mV (2) 50 mV (3) 100 mV (4) 2 mV ★ Handsome brushed silver finish fascia and knobs. Output ratings 1H.F.M. Complete kit of parts with full wiring diagrams and instructions. **12 1/2 Gns.** Carr. 7/9. Factory built with 12 mth. gtee. 16 Gns. Or Dep. **£25/8** and 9 mthly. pmts. **31/6** (Total **£19.8.0**). Or in Teak or Afrormosia veneer housing 19/9 Gns. Or Dep. **£5.10/6** and 9 mthly. pmts. **39/-** (Total **£23.1/6**).

R.S.C. BATTERY/MAINS CONVERSION UNITS
Type BM1. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 in. approx. Completely replaces batteries supplying 1.5 v. or 90 v. a.c. where A.C. mains 200/250 v. 50 c/s. is available. Complete kit with diagram 52/6 or. Ready for use. **59/11**

SELENIUM RECTIFIERS

P.W. Bridged 61/2V. D.C. Output Input Max. 18v. A.C. In. 4/3; 1 1/2; 5/6; 2; 6.11; 1 1/2; 3; 9; 4; 12; 9; 6; 15/9

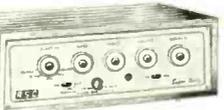
R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primaries 200-250 V. 50 c/s. Screened MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 in.

250 v., 60 mA. 6.3 v. 2 a.	18/11
200-0-250V., 60mA. 6.3v. 2a.	17/11
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250V., 60mA. 6.3v. 2a. 0-5-6.3v. 3a.	24/9
200-0-250V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	33/9
300-0-300V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	38/9
300-0-300V., 130mA. 6.3v. 4a. c.t. 6.3v. 1a.	45/9
For Mullard 510 Amplifier	45/9
300-0-350V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	38/9
330-0-350V., 150mA. 6.3v. 4a. 0-5-6.3v. 3a.	47/9
425-0-425V., 200mA. 6.3v. 4a. c.t. 5v. 3a.	75/-
425-0-425V., 200mA. 6.3v. 4a. 6.3v. 3a. 5v. 3a.	79/11
450-0-450V., 250mA. 6.3v. 4a. c.t. 5v. 3a.	93/6
TOP SHROUDED DROP-THROUGH TYPE	
200-0-250V., 70mA. 6.3v. 2a. 0-5-6.3v. 2a.	23/9
200-0-250V., 100mA. 6.3v. 3.5a.	25/9
200-0-250V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	26/9
250-0-350V., 80mA. 6.3v. 2a. 0-5-6.3v. 2a.	27/9
250-0-250V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	37/9
300-0-300V., 100mA. 6.3v. 4a. 0-5-6.3v. 3a.	37/9
300-0-300V., 130mA. 6.3v. 4a. 0-5-6.3v. 1a.	44/9
Suitable for Mullard 510 Amplifier	44/9
350-0-350V., 100mA., 6.3v. 4a. 0-5-6.3v. 3a.	37/9
300-0-350V., 150mA., 6.3v. 4a. 0-5-6.3v. 3a.	45/11
FILAMENT or TRANSFORMER POWER PACK TYPES	
6.3v. 1.5a. 7/9; 0.7v. 9/6; 6.3v. 3a. 11/8; 6.3v. 6a. 22/9; 12v. 1a. 9/6; 12v. 3a. or 24v. 1.5a. 21/9; 0-9-0-9V. 12/9; 0-5-2-2V. 2s. 31/9	
CHARGER TRANSFORMERS 0-9-15V. 1 1/2a. 16/9; 2 1/2a. 19/6; 3a. 19/11; 5a. 23/9; 6a. 27/9; 8a. 33/9	
AUTO (Step Up/Step Down) TRANSFORMERS	
0-110/120V.-200-230-250V. 60-80 watt	18/9
150 watt; 23/6; 250 watt; 49/9; 500 watt	99/9
OUTPUT TRANSFORMERS	
Standard Pentode 5,000Ω or 7,000Ω to 3Ω	8/9
Push-Pull 8 watts EL84 to 3Ω or 15Ω	13/9
Push-Pull 10 watts 6X4 to 3, 5, 8 or 15Ω	22/9
Push-Pull EL84 to 3 or 15Ω 10-12 watts	21/9
Push-Pull Ultra Linear for Mullard 510, etc.	38/9
Push-Pull 15-18 watt, sectionally wound 6L6 KT66, etc., for 3 or 15Ω	35/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66, etc. to 3 or 15Ω	59/9
SMOOTHING CHOKES	
150mA. 7-10H. 250Ω 12/9; 100mA. 10H. 200Ω 10/9; 80mA. 10H. 350Ω 8/9; 60mA. 10H. 400Ω 4/11	

R.S.C. SUPER 30 MkII HIGH FIDELITY STEREO AMPLIFIER

HIGH GRADE COMPONENTS. SPECIFICATIONS COMPARABLE WITH UNITS COSTING CONSIDERABLY MORE
TRANSISTORS: 9 high-quality types in each channel.
OUTPUT: 10 Watts R.M.S. continuous into 15Ω (Per channel) 15 Watts R.M.S. continuous into 3Ω
INPUT SENSITIVITIES: Mag. P.U. 4 m.v. Ceramic P.U. 35 m.v. Tape Amp. 400 m.v. Aux. 100 m.v. Mic. 5 m.v. Tape Head 2.5 m.v.
FREQUENCY RESPONSE: ±2dB. 10-20,000 c.p.s.
TREBLE CONTROL: +17dB to -14dB at 10 Kc/s.
BASS CONTROL: +17 dB to -15 dB at 50 c/s.
H.F. LEVEL: -30 dB.
HARMONIC DISTORTION: 0.1% at 10 Watts 1,000 c.p.s.
CROSS TALK: 52 dB at 1,000 c.p.s.



Employing Twin Printed Circuits 200/250V. A.C. mains operation.
CONTROLS: 5-position Input Selector, Bass, Treble, Vol., Bal., Stereo/Mono Sw., Tape Monitor Sw., Mains Sw.
INPUT SOCKETS: (1) P.U. (2) Tape Amp. (3) Radio (4) Mic. or Tape Head. (Operation of Input Selector assures appropriate equalisation).
CHASSIS: Strong Steel construction. Approx. 12 x 3 x 8 in.

FACIA PLATE: Attractive design in rigid Perspex. 80pin silver matching control knobs as available. COMPLETE KIT OF PARTS, point to point wiring diagrams. **22Gns.** Carr. 15/-

EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MIC. (Ceramic or Magnetic, Moving Coil, Ribbon or Crystal).
CURRENTLY AVAILABLE. SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USE WITH FIRST-RATE ANCILLARY EQUIPMENT. Unit factory built 28 Gns. or deposit **£7/5** and 9 mthly. payments **58/3** (Total **£32.11/3**) or in Teak or Afrormosia veneer housing **31 Gns.** Carr. 15/-, Terms: Deposit **£7/3/6** and 9 mthly. payments **64/-** (Total **£35.18/6**) Send S.A.E. for leaflet.

R.S.C. SUPER 15 HIGH FIDELITY AMPLIFIER

Solid state. Approx. as Super 30 but single channel. Complete kit with full constructional details and point to point wiring diagrams. **12 1/2 Gns.** Carr. 12/6
Or factory built: 15/9 Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total **£15.9/3**); or in Teak or Afrormosia veneered housing 19 Gns.

Record Playing Units MONEY SAVING UNITS Ready to plug into Amplifier

RP2C Consisting of Garrard SP25 Mk. II (with heavy turntable fitted) Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Mounted on plinth. Transparent plastic cover included. **22Gns.** Inc. carr. As above but with Goldring Lenco Q168 Transcription unit and CS90 Cartridge. Cover included. Inc. carr. **28Gns.**

Various other types with Magnetic P.U. Cartridges and 'Lift off' or 'Roll over' transparent covers at lowest prices.

R.S.C. PLINTHS for Record Playing units.

Cut for Garrard 1025, 2025, 3000, 5000, 59/9 AT60, SP25 etc. etc. Available with transparent plastic cover. Inc. carr. **6 Gns.**

1 WATT TRANSISTOR AMPLIFIERS

Miniature size battery operated for 3-5 V. Lspeakers. Brand new boxed. **37/9**

- BRADFORD** 10 North Parade (Half-day Wed.). Tel. 25349
- BLACKPOOL** (Agent) O & C Electronics 227 Church St.
- BIRMINGHAM** 30/31 Gt. Western Arcade, opp. Snow Hill Station 021-236 1279. Half-day Wed.
- DERBY** 26 Osmaston Rd. The Spot (Half-day Wed.). Tel. 41361
- DARLINGTON** 18 Priestgate (Half-day Wed.). Tel. 68043
- EDINBURGH** 133 Leith St. (Half-day Wed.). Tel. Waverley 5766
- GLASGOW** 326 Argyle St. (Half-day Tues.). Tel. City 4158
- HULL** 91 Paragon Street (Half-day Thurs.). Tel. 20505



MAIL ORDERS to: 102-106 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied S.A.E. with enquiries please. Open 'all day Sats. Mail orders MUST NOT be sent to shops.

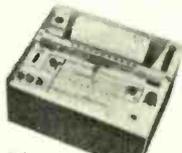
- 32 High Street** (Half-day Thurs.). Tel. 56420
- 5-7 County (Mecca) Arcade, Briggate** (Half-day Wed.). Tel. 28252
- 73 Dale St.** (Half-day Wed.). Tel. CENTRAL 3573
- 238 Edgware Road, W.2** (Half-day Thurs.). Tel. PAD 1629
- 60A Oldham Street** (Half-day Wed.). Tel. CENTRAL 2778
- 106 Newport Rd.** (Half-day Wed.). Tel. 47096
- 41 Blackett Street** (opp. Fenwicks Store) (Half-day Wed.). Tel. 21469
- 13 Exchange Street** (Castle Market Bldg.) (Half-day Thurs.). Tel. 20716
- LEICESTER**
- LIVERPOOL**
- LONDON**
- MANCHESTER**
- MIDDLESBROUGH**
- NEWCASTLE UPON TYNE**
- SHEFFIELD**

ELECTRONIC BROKERS

MEASURING INSTRUMENTS AND RECORDERS

NEW AMERICAN 3" CHART RECORDER

Good general purpose potentiometric recorder. Suitable for research and laboratory work. Range 0-10 m.v. Variable zero set, Zenor divide reference. Input impedance. Max 100 Kohms. Price £89.10.0. P. & P. 30/-.



PORTABLE AC/DC PEN RECORDER

A most versatile pen recorder. Produces a trace on a curvilinear 3 1/2 in. strip chart. Two speeds 1 in. and 6 in./hr. Limiting contacts to give alarm, and limits the current when it exceeds the high and/or low preset values. Chart speed: 1 in. and 6 in./hr. Chart width: 3 1/2 in. curvilinear. Power supply: 230V 50 Hz driving Synchronous Motor. Price: £49.10.0. Postage and packing £1 5s. 0d.



KENT STRIP-CHART INDICATING RECORDER

Chart width 9 1/2 in. 10 m.v. Sensitivity ± 0.17 of full scale. Source impedance 100 ohms. Speed of operation 33 sec. for full-scale travel. Chart speed 1/2 in., 3 in., 6 in. per hour. Single point. £49.10.0. P. & P. 30/-.

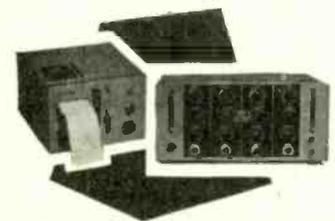


RECORDER SP 20 Series

General Purpose Single Pen potentiometric instrument for continuous recording for any input signal from 0-10mV D.C. Suitable for use with Spectrophotometer and other laboratory instruments. Chart speed 0.5 to 8.4 cm/min. Linearity ± 0.25%. Fully transistorised. Chart width 200 mm. Input impedance 10K ohms max. Available 8.P. 20 Plain Linear. 8.P. 21 Flat Bed. 8.P. 22 Linear/Log. £135 each. P. & P. 40/-.

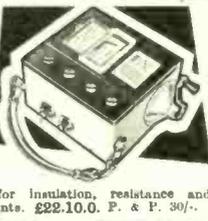
PEN RECORDER

Portable 1, 2 and 4 channel pen recorders by Kelvin Hughes. General purpose recorders providing clear instantaneous and permanent records of phenomena with comparatively high rates of change. The torsion-strip suspension of the moving-coil renders the instrument immune to the effects of vibration and acceleration. Six possible chart speeds, chart width 55 mm, length 150 ft., linearity 8 v. at 3 mA, response D.C. to 100 c/s. Single pen with amplifier £209; 2 pen with amplifier £125. 4 pen with amplifier £149. Also 3 pen recorder complete with amplifiers, specification as above but housed in cabinet £225. P. & P. extra.



EVERSHED BRIDGE MEGGER

250 volt, 50 meg. Insulation tester with built-in four decade bridges with ratio arms giving ratios of 100:10 — 1 — 0.1 + 0.01 and Selector switch for insulation, resistance and variety measurements. £22.10.0. P. & P. 30/-.



ULTRA VIOLET RECORDER

12 Channel NEP 1050. £280.

ULTRA VIOLET PHOTOGRAPHIC RECORDER

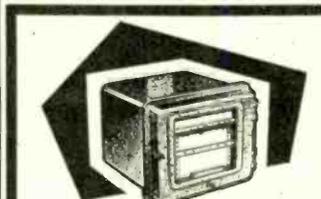
12 Channel mirror Galvanometer Honeywell 1000. £190.

24 Channel Siemens Recorder by Film & Equipments £325. Carriage extra.

NEW PORTABLE RECORDING AMMETER



Specification. Type: Moving Coil. D.C. Range: 0-5 amp. D.C. Chart Width: 100 mm. Scale Length: 127 mm. Chart Speeds: 20, 60, 180, 600, 1800 and 5400 mm/hr. Dimensions: 180h x 163 w x 245mm. Weight: 5.5kg. List price £65. Our price £35.



POTENTIOMETRIC 6 POINT STRIP CHART RECORDER BRAND NEW

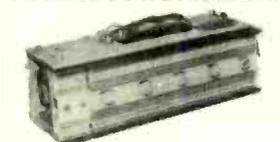
For use with thermocouples, pyrometers and other e.m.f. sources. 6 point. Range (-100) — 0 — (+100) mV; 0 — 1,600 deg. C. 6 1/2 in. chart width; pen speed 8 sec. Accuracy ± 0.5%; 10 chart speeds 20-720mm/hr. Tropicalised. Including tools and spares. Listed at over £290. Our price £79.10.0. Also available 0-100mV F.S.D. £89.10.0.

POWER SUPPLIES

AIRMEC 698B KLYSTRON POWER SUPPLY

Rack mounted (19 in.). Mains operated. Cathode volts from 1.0 to 2.4 kv. negative. Grid Volts, 0 to 220V negative. Reflector Volta, 0-500V negative. Cathode Current, 0.18mA max. Heater 4V at 1.5A. Internal Modulation—Square wave 2-4 KHz TV p.p. Saw Tooth 150-500 Hz 0-30V peak. Price £45. P. & P. 40/-.

HIGH PRECISION FULLY STABILISED TRANSISTORISED LOW VOLTAGE POWER SUPPLIES



Incorporating
• S.C.R. Panel for overload protection.
• OVERLOAD & CIRCUIT BREAKER WITH MANUAL RESET button.
• RIPPLE better than 3000 : 1.
• CHOKE OF CAPACITOR transistorised 120/130 volt A.C. INPUT.
Available in the following types:

6 Volt 9 Amp.....	£12.10.0
6 Volt 12 Amp.....	£17.10.0
6 Volt 18 Amp.....	£22.10.0
12 Volt 8 Amp.....	£22.10.0
12 Volt 16 Amp.....	£25.0.0
12 Volt 22 Amp.....	£25.0.0
20 Volt 16 Amp.....	£25.0.0
24 Volt 4 Amp.....	£22.10.0
30 Volt 8 Amp.....	£13.10.0
56 Volt 7 Amp.....	£25.0.0

Ex-equipment but fully tested in our laboratory. Carr. 30/-.

ADVANCE TRANSISTORISED DC POWER UNITS

Input Volts	Output Volts	Amps	Price
DC 4	200-245 ± 1%	12	£17/10/-
DC 3	200-245 ± 1%	12	£10/10/-

METERS

2 in. dia. mounting A.C. voltmeter 0-300 V. A.C. £1.15.0. Carriage 6/-.
2 1/2 in. dia. Electrostatic Kilo Voltmeter in wooden case. £2.15.0. Carriage 10/-.
Precision A.C. & D.C. Wattmeter. Model 8.67 certified. Accuracy to 1% up to 133 c/s. Range 250/450 V. and 0.5 to 1 A. £29.10.0. Carriage 30/-.

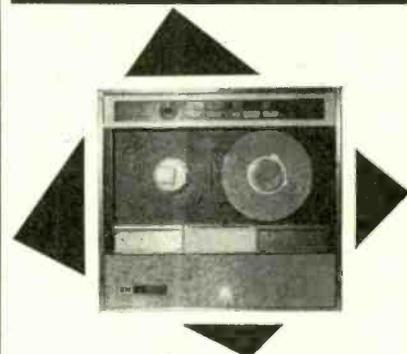
D.729 B.M. PHASEMETER AND SUPPLY UNIT

May be used as a Voltmeter, distortion of waveforms, "Q" meter, in phase and quadrature components. Gives indication of phase angle 0°-360°. Frequency range 2 c/s-100 Kc/s. £225. P. & P. extra.

BRAND NEW S.E. LABORATORIES TRANSDUCER

Amplifier/demodulator 8.E. 441/2 Frequency D.C.—60 c.p.s. Available in the following ranges: £2150, 8E50 or 8E165A.
0-25 p.s.l. 0-350 p.s.l. 0-2000 p.s.l.
0-50 p.s.l. 0-600 p.s.l. 0-3000 p.s.l.
0-200 p.s.l. 0-750 p.s.l. 0-4000 p.s.l.
Also available differential types ± 5 p.s.l. ± 10 p.s.l. List price £70+ Our price £25

COMPUTER AND PERIPHERAL EQUIPMENT



7 TRACK DIGITAL MAGNETIC TAPE STORAGE DECK

These machines originally ex-computer, are Multi-track recording units. Ideal for data storage. Record and Replay heads encased in one common unit. Low resistance heads. Frequency response approximately 30 Kc/s. to 50 Kc/s. Bit density 557 b.p.i. 1/2 in., 1 1/2 in. spools 230 V. to 380 V. A.C. Capstan Motor speed 1,500 r.p.m. 48 V. D.C. Rewind motors complete with vacuum Assembly. Finished in brush aluminium and matt-black. Size 27 in. x 26 in. x 8 in. Weight 90 lb. Price £72.10.0. Carriage extra.

MODEL 72 MAGNETIC TAPE DATA STORAGE UNIT

This unit consists of 1/2 in. 8 channel read-write heads. Can be used to record any 6 bit code. Data can be read in either a forward or backward direction plus giving search facilities. The unit consists circuits for receiving and storing instruction signals. Recording density 250 characters per inch. Tape speed 100 in. per second, price £190. Excellent condition.

1/2" 7 TRACK Ex-computer record/replay head complete with guides. Little used. Price £12.10.0 Carriage 15/-.

BRAND NEW Gresham Lion 1 in. 1 + 7 track record/replay heads. Of the highest professional quality. Cost £100 plus price £12.10.0. Carr. 15/-.

9 TRACK 1 in. Record/replay heads with sprocket drive, driven by synchronous motor. Mounted with integrated head assembly eliminating alignment problems. This can be fitted to any suitable type of transport system. Price £8.10.0. Carriage 15/-.

BRAND NEW COMPUTER TAPES AND EMPTY SPOOLS

Made by well known manufacturers	
1/2 in. certified 2,400 ft. 800 b.p.i.....	£8.10.0
1/2 in. 2,400.....	£8.10.0
1/2 in. Highest grade 2,400 ft.....	£3.0.0
1/2 in. 10 1/2 in. dia. spool and cassette.....	£1.10.0
1/2 in. 8 1/2 in. dia. spool and cassette.....	£1.10.0
1 in. metal 10 1/2 in. dia. spool and cassette.....	£3.10.0
1 in. N.A.B. centre 10 1/2 in. spool only.....	£1.0.0
Desk Size Computer. Burrough Electrodata 101.....	£625

TAPE PUNCH MODEL 25 7 HOLE

A multiwire tape punch designed for general application involving the conversion of parallel wire electrical impulses into punched paper tape at 33 characters per second. Unit completely self-contained requiring only motor power and signal supplies. Price £45.

7 HOLE NON PARITY TAPE PUNCH

New condition £45.

LOW SPEED 7 HOLE TAPE PUNCH

80 column 1400/80 model verified by well-known manufacturer. Price £45.

TELETYPE 8 HOLE PAPER PUNCH

MU27 PRICE £75. Also available 5 hole punch BRPE2 as above. This model has interchangeable heads. Complete with spooler. Price £35.

HIGH SPEED 5/7 HOLE OPTICAL READER

20 characters per second. £19.10.

CARD READERS

80 column 1500/80 model, punch } £325
80 column 1400/80 model verifier. }
Excellent condition.

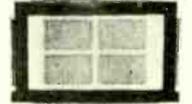
HOLLERITH 80 COLUMN CARD PUNCH TYPE HO29 & VERIFIER H129 £225.

DECODER 4 DIGIT READOUT

Can be used constituting frequency counter or Digital Voltmeter. Consists of 4 transistorised cards each containing 10 NOR gates. Circuits supplied with Decoder. £25.

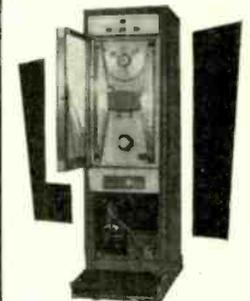
PROGRAMME BOARDS BY SEALECTRO

These boards are basically a multi pole multi throw switch device consisting of a X-Y Matrix with two contact decks in the Z Plane running at 90 degrees to each other. Contact is made by either, shorting or plugging in pins. Ideal for prototype work, etc. Boards available in 16 x 16 2 plane £45.0. 24 x 60 2 plane £12.10.0. Pins available 1/3 each.



MEMORY PLANES

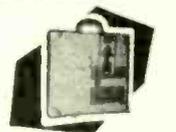
Ferrite core memory planes with wired Ferris cores. Used for building your own computer or as an interesting exhibit in the demonstration of a computer. Mounted on plastic material, frame 5 x 5 in. Consisting of matrices 40 x 25 x 4 cores each one individually addressable and divided into 2 halves with independent sense and inhibit wires. £8.10.0. P. & P. 3/-.



AMPEX FR300

Tape deck in free-standing 6 ft. cabinet less heads. Complete with auto transformer for driving capstan motors. £79.10.0. Carriage extra.

TRANSFER CASE



For sending data by personal carrier, GPO post, passenger train, etc. Ideal. Suitable for despatching tape 20/- P. & P. 6/-.

9 HOLE OPTICAL READER PRICE £35

CANCELLED EXPORT ORDER

90 Column card sorter and punch type £25/0 price on application.

SPOOLERS 1" and 1/2"

Both hand and motor drives available at £3.0.0 and £5.0.0 respectively.

BRAND NEW TAPE SPOOLER

Suitable for 1 in., 1/2 in. and 3/4 in. tapes. Fully self-contained £99.10.0.

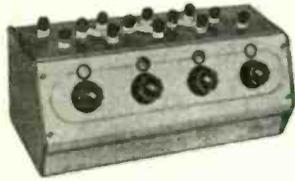
5" TAPE PUNCH

Suitable for machine control complete with 50 reels of tape £35.

LOW COST ELECTRONIC AND SCIENTIFIC EQUIPMENT AND COMPONENTS

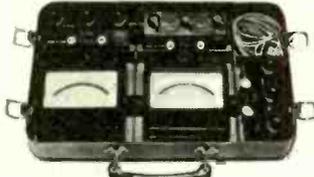
BRAND NEW LABORATORY TEST EQUIPMENT — AT LESS THAN HALF PRICE!

HIGH VALUE RESISTANCE BOX TYPE R.7003



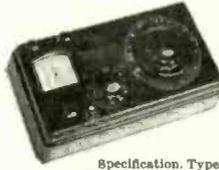
Specification. Range: 0.01-111 Meg. in 0.01 Megohm divisions. Accuracy: 0.05%. Maximum power rating: 0.1W per step. Case: Hammer finished stove enamel. List price £60. Our price £22/10/-.

SET OF MEASURING INSTRUMENTS



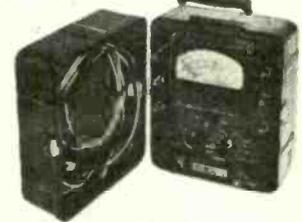
Specification Type: Moving Coil D.C. Ranges: 0-75mV, 0-3V, 3-15-150V, 3-150-450V, 0.3-0.75A, 1.5-7.5A, 15-30A. Scale Length: 82mm. Accuracy: 1.0%. Shunts: 1. 0.3-0.75 amps. 2. 1.5-7.5 amps. 3. 15-30 amps. Complete with carrying case. List price £30. Our price £8/10/6.

PORTABLE WHEATSTONE BRIDGE



Specification. Type: Moving Coil Galvanometer. Ranges: 1. 0.05 to 5 ohms. 2. 0.5 to 50 ohms. 3. 5 to 500 ohms. 4. 50 to 5,000 ohms. 5. 500 to 50,000 ohms. Scales: Switched. Slidewire: 0.5 to 50. Galvanometer Scale: 10-0-10. Case: Moulded plastic. Internal Source: 4V. Dry battery. Dimensions: 200 x 110 x 65mm. Weight: 0.9 kg. List price £25. Our price £9/10/8.

PORTABLE MULTIRANGE METER



Specification. Ranges: 0-60 & 0-300µA, D.C. 0-3, 0-30 & 0-120mA, D.C. 1.3 & 12 amps D.C. 0.6-3 & 6-30 mA. A.C. 24-120 mA, A.C. 0.34-12A, A.C. 3-12-30-300-600-1200 & 6,000 V, D.C. 0.6-3, 2.4-12, 6-30, 60-300, 120-600, 240-1,200 & 1,200-6,000 V. A.C. 3-333 ohms, 0.3-30 Kohms, 0.03-3 megohms D.C. Resistance — 12 to +78 Decibels. Frequency: 50 cps. Input Resistance D.C.: 20,000 ohms/volt. Input Resistance A.C.: 2,000 ohms/volt. Dimensions: 255 x 215 x 170 mm. Weight: 8 kg. Supplied with 2 voltage dividers, H.V. leads, spare rectifiers, 1.5 & 22.5 V. battery. List price £25. Our price £12/18/6. P. & P. 15/-.

ILLUSTRATED LEAFLETS AVAILABLE

MUTUAL INDUCTANCE BOX TYPE R.7005



Specification. Range: 0-11,100 mH in 0.002 mH divisions. Accuracy: $\pm(0.3 \times M)^{1/2}$ % where M = value of mutual inductance in mH set on the box. Frequency range: 0-2.5 K/c/s for all decades except X1-0-15 K/c/s. Maximum current: 0.5A for decades 1A for variometer (both primary and secondary dinged). Case: Polished teak. List price £65. Our price £26/10/0.

STOP PRESS

6 Pen Event Recorder, 6 in. Chart width. Available in wide range of chart speeds. Rack mounted £79.10.0. Case to suit extra.

Burrough E-102 computer. Complete with calculator. 225 word store. £450.

MUTUAL INDUCTANCE COIL TYPE R.7006

Specification. Value: 0.001 H. Accuracy: ± 0.3 %. Operating Frequency: 5 K/c/s. 10 K/c/s. Maximum current: 1A, 3A. Resistance of coils: 4 ohm, 1 ohm. Case: Moulded plastic. List price 8 gns. Our price 50/-.

MOTORS

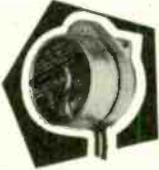
HYSTERESIS REVERSIBLE MOTOR

Incorporating two coils. Each coil when energised will produce opposite rotation of output shaft. 240V 50 Hz. $\frac{1}{2}$ r.p.m., $\frac{1}{4}$ r.p.m., $\frac{1}{8}$ r.p.m., 120V 50 Hz, 1/10 r.p.m., 6 r.p.m. 30/- each. P. & P. 3/-.

HIGH TORQUE INDUCTION MOTOR. 300Z/inch.

Available in the following speeds only 240V 50 Hz $\frac{1}{2}$ r.p.m., 1 r.p.m., 2 r.p.m., 120 V 50 Hz 20 r.p.m., 30/- each. P. & P. 3/-.

LOW TORQUE HYSTERESIS MOTOR MA23



Ideal for instrument chart drives. Extremely quiet, useful in areas where ambient noise levels are low. High starting torque enable relative high inertia loads to be driven up to 60Z/in. Available in the following speeds and ranges: 240V 50 Hz 15 r.p.m., 4 r.p.m., 2 r.p.m., $\frac{1}{2}$ r.p.m., 1 r.p.m., $\frac{1}{4}$ r.p.m., $\frac{1}{8}$ r.p.m., 1/10 r.p.m., 1/8 r.p.m., 1/6 r.p.m., 1/4 r.p.m., 1/12 r.p.m., 1/40 r.p.m., 1/80 r.p.m., 1/75 r.p.m., 1/20 r.p.m., 1/180 r.p.m., 1/15 r.p.m., 1/16 r.p.m., 1/16 r.p.m., 1/20 r.p.m., 1/30 r.p.m., 1/60 r.p.m., 1/120 r.p.m., 1/240 r.p.m., 1/300 r.p.m., 1/720 r.p.m. 25/- each. P. & P. 3/-.

HYSTERESIS CLUTCH MOTOR

with integral clutch allowing the motor to drop out of engagement with the gear train, thereby facilitating easy resetting when used in timers or in conjunction with a light switch. 6 oz. torque at 1 r.p.m., 240 v., 50 c/s. L = left, R = right, 15 r.p.m. L, 8 r.p.m. B & L, 6 r.p.m. L, 4 r.p.m., 1, 1, 1 r.p.m. L, 1/5 r.p.m., 1/6 r.p.m., B & L, 1/10 r.p.m., 1/12, 1/15 r.p.m. L. Also 120 v. 50 c/s 2, 1/6, 1/12, 5/12, 4/11, 1/10 r.p.m. 25/- P. & P. 3/-.

HIGH PRECISION MAINS MOTOR

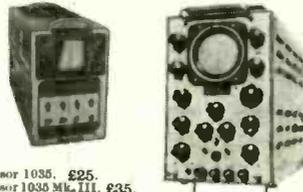
230V 50 Hz 1/8 h.p. continuously rated, 3000 r.p.m. Made by Croydon Engineering Model KA 60 JPB. Suitable for capstan motor. Size 8 in. dia, 4 1/2 in. diameter with 6 in. diameter flange and 4 fixing holes. £4.10.0 each. £1.5.0 postage and packing.

HI-SPEED QUICK RESET ELECTRO MAGNETIC COUNTERS

Push button reset 6 digits. 48 V. D.C. 3.5 watts. 20 counts per second. Size 3.875 x 2.825 in. Panel mounting. List £8. Our price 59/6.



OSCILLOSCOPES



Cosmor 1035. £25.
Cosmor 1035 Mk.III. £35.
Cosmor 1049 Mk.III. £40.
Solatron AD 513.2 L.F. & Servo & CD 2238.2 Long Persistent Tube. £49.10.
Purcell 0.100. £25.
Almreec 249. £25.
Solatron AD 357 Pulse & Radar Field. £55.

Solatron CD 7118.2 Double Beam D.C.7 Mtg. £85.
Mullard L 10/3 Double Beam. £99.10.
Radar Field. £55.

REPEAT CYCLE TIMERS

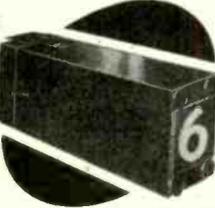
These timers repeat a set cycle of switching operations via a cam and micro switch, for as long as the motor is energised! Single Cam BB 21 in. 2 min., 3 min., 4 min., 5 min., 6 min. cycles @ 45/-.
Twin Cam RD 22 in. 1 min., 2 min., 3 min., 4 min., 5 min. cycles @ 55/-.
4 Cam RD 24 in. 4 min., and 5 min. cycles @ 75/-.
6 Cam RD 26 in. 1 min., 2 min., 3 min., 4 min., 5 min. cycles @ 95/-.
8 Cam RD 28 in. 1 min., 2 min., 3 min., 4 min., 5 min. cycles @ 115/-.
All + p. & p. 5/-.

UNISELECTOR

8 and 4 Banks, 25 contact per bank, 2 sets of wipers 2 in. radius. Complete with surge capacitor. 25/- and 45/- respectively.

MINIATURE DIGITAL DISPLAY

Operates on a rear projection 6.3 pilot lamp. The lamp projects the corresponding digit on the condensing lens through a projector lens, on to the viewing screen at the front of the unit. 1 in. width, 3 1/4 in. deep, 1 1/4 in. high. Weight 3 1/2 oz. Character size 1 in. high, 0.9 with 8 digit hand decimal point and degree. Available to special order, words or other characters or colour, at cost of artwork or plates. List price 6 gns. Our price 49/6.



PRECISION POTENTIOMETERS

TEN TURN 360° ROTATION BRAND NEW

Res. Ohms	Linearity Per cent	Manufacturer	Model	Price
100/100/100	0.5	Beckman	A	180/-
100	0.5	Beckman	A.S	60/-
200	0.5	Beckman	A	80/-
500	0.1	Beckman	S	70/-
500	0.1	Colvern	2501	45/-
500	0.1	Fores	PX 4	40/-
500	0.1	Colvern	2610	50/-
2K	0.5	Beckman	SA1101	80/-
2K	0.5	Beckman	7218	80/-
2K	0.5	Reliance	GPM16	40/-
10K	0.5	Beckman	A	80/-
10K	0.1	Beckman X	A	70/-
15K	0.5	Beckman	GPM15	50/-
15K	0.5	Beckman	A	80/-
20K	0.5	Beckman	A	80/-
30K	0.1	Beckman	2402	30/-
30K	0.1	Beckman	8A95C	80/-
30K	0.1	Beckman	A.SR	70/-
30K	0.5	Beckman	SA 1692	60/-
30K	0.25	Beckman	SA 1692	65/-
50K	0.1	Reliance	07.10	45/-
50K	0.1	Colvern	07.5	45/-
50K	0.1	Colvern	2503	45/-
50K	0.5	Beckman	PX 4	45/-
50K	0.1	Beckman	A	70/-
100K/100K	0.1	Ford	A	100/-
100K	0.1	Beckman	A	70/-
100K	0.5	Beckman	A	60/-
100K	0.1	Colvern	2610	45/-
100K	0.1	Colvern	2610	45/-
298K	0.1	Beckman	8A3902	70/-
300K	0.1	Beckman	A	70/-

THREE TURN 780° ROTATION

100/100	0.5	Beckman	A	60/-
300	0.5	Beckman	A	45/-
10K	0.5	Beckman	C.88	45/-
20K/20K	0.1	Beckman	C.8	60/-
10K/10K	0.1	Beckman	C	60/-
50K	0.5	Beckman	C.8	35/-

FIFTEEN TURN 5400° ROTATION

25K/25K	Beckman B	10 watts	£8.10s
46K/46K	Beckman B	10 watts	£8.10s

TWENTY TURN 7200° ROTATION

250 ohms	General Controls	PXM130	80/-
1 Meg	General Controls	PXM130	80/-
50K	Reliance		40/-

156 TURN 56, 160° ROTATION

460 ohms	Kevin Hughes	KTP0701	£9.10s
----------	--------------	---------	--------

FIVE TURN 1800° ROTATION

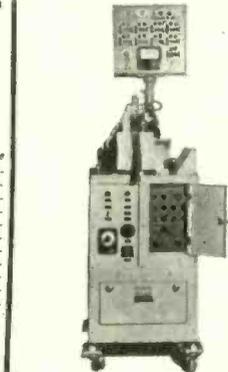
500 ohms	Colvern	CLB 2605	40/-
U1.5K	Colvern	CLB 2605	40/-

SINE COSINE

Kelvin & Hughes 8CP5	14-4K	£17.10.0
Colvern 8601		£17.10.0
CLB 9602—Cam Corrected	25K	£17.10.0
8CP4	32K	£17.10.0
8CP1	38K	£17.10.0

PRECISION BECKMAN 40 TURN 14,400° ROTATION

Wirewound Precision Potentiometer. SE 107A 200 watts at 40°C. 3 1/4" Diameter. Serru Mounting. 200 K. Brand New £12.10s. List Price £30.



AUTOMATIC CRYSTAL THICKNESS SORTING MACHINE Fully automatic dice gauging and sorting system, eliminates all manual operations. This instrument is of extreme interest to manufacturers of semi-conductors. It is offered in good condition at a quarter of its original list price. It is suitable for the sorting of germanium and silicon discs. The unit can sort up to 2,400 pieces an hour. Our price £750. Further information available on request. Complete with manual and spares.

TRANSFER FUNCTION ANALYSER OS103/VP 253

Frequency range 0.1 c/s to K/c/s covering electro-mechanical applications and servo-mechanisms. Resolves network response signals simultaneously into in-phase or quadrature components. Permits direct polar diagram plotting of a servo system frequency response using cartesian co-ordinates. High sensitivity 50 mV/resd. High accuracy measurement of true R.M.S. volts. List price £1,600. Our price £585.

OSCILLATORS

DAWE 43B AUDIO SWEEP OSCILLATOR AND CONTROLLER (NEW)

Meets the need for a low sweep oscillator covering the entire audio range. Providing constant o/p voltage and logarithmic frequency scale. Suitable for automatic measurement and recording of frequency response curves of four terminal network, audio amplifier, tape recorders, studio and concert halls, etc. Frequency Range 20 Hz to 20 KHz $\pm 1\%$ ± 1 Hz. Frequency Response ± 0.5 dB at 1 W output into matching impedance. £98.10.0.

DAWE 44C AUTOMATIC L.F. SWEEP OSCILLATOR (NEW)

Amplitude 0-10V. Frequency Range 5Hz-5 KHz $\pm 2\%$ ± 0.5 Hz. 18 Sweep Rates of 10 octaves/min. Frequency Response 0.5 dB. £98.10.0. Carriage extra.

ALL ORDERS ACCEPTED SUBJECT TO OUR TRADING CONDITIONS A COPY OF WHICH MAY BE INSPECTED AT OUR PREMISES DURING TRADING HOURS OR WILL BE SENT ON APPLICATION THROUGH THE POST.

1. ULTRASONIC CLEANERS



(Burndept B.E.352) 60 watt model. Supplied Brand New complete with stainless steel tank 9 1/2 x 6 1/2 x 4 1/2 in. £60. Carr. 20/-.

2. **FAST NEUTRON MONITORS** (Burndept 1407C) for measuring neutrons in the energy range 0.15-15 meV. £100.

3. **Radiation Monitors** (Burndept BN 110 MK. V) 0-5/50/500/5k. c.p.s. Brand new. £100. Alpha and Beta Gamma probes available at extra cost.

4. **PORTABLE RADIATION MONITORS** (Burndept BN 132) 0-5/50/500/5k c.p.s. With built-in Gamma probe. Brand new. £50 complete with carrying harness.

S.A.E. for literature. 10% discount for Educational Authorities

SPEAKER SYSTEM (20x10x10 in.). Made to spec. from 1/2 in. board. Finished in black leathercloth. 13 x 8 in. speaker with twin tweeters complete with cross-over 50c/s-20k/c. £7.10. P.P. 10/-.

SPEAKER CABINET KIT. Above mentioned cabinet only. In kit form which you may assemble and cover to your own choice. 40/- . P.P. 5/-.

SPEAKER BARGAINS. E.M.I. 13x8 in. with double Tweeters 15 ohm, 65/- . P.P. 5/- . As above less tweeters 3 or 15 ohm, 45/- . ea. . P.P. 5/-

EXTRACTOR/BLOWER FANS (Papst)



100 c.f.m. 4 1/2 x 4 1/2 x 2 in. 2800 r.p.m. Wonderful buy at 50/- . ea. 240v. A.C.

CYLINDRICAL FANS (Solartron). Overall size 16 x 5 1/2 x 3 1/2 in. air outlet 12 x 1 1/2 in 240v A.C. 50/- . each. P.P. 7/6 (New).

LEVEL METERS (1 1/2 x 1/2 in.). 200 micro-amp. Made in Germany. 15/- . each.

PHOTOMULTIPLIERS 6262 and 6262b. £15 ea.

RELAYS H.D. 2 pole 3 way 10 amp. contacts. 12v.w. 7/6 ea.

LIGHTWEIGHT RELAYS (with dust-proof covers) 4 c/o contacts. 24v. 500 ohm 7/6 ea.

HIGH SPEED MAGNETIC COUNTERS



(4x1x1 in.) 4 digit. 6/12v. 24/48v. (state which), 6/6 ea. P.P. 1/-.

PYE OHMMETER TYPE 10B. 500v. test. .3 meg. ohm—20 k. meg. ohm. 200/250v. A.C. Brand new instrument £30. P.P. 30/-.

POT CORES TYPE LA 3. 10/- . ea.

71 WAY PLUG & SOCKET (Painton Series 159) Gold plated contacts with hood & retaining clips. 30/- . pair.

50 WAY PLUG & SOCKET (U.C.L. miniature). Gold plated contacts 20/- . pair. 34 way version 15/- . pair.

VALVE MILLIVOLTMETER (Marconi TF899) 0-2v. complete with R.F. probe £8/10/- . p.p. 10/-.

LOGIC BOARDS with 31 ACY40s—38 diodes etc 20/- . ea. P.P. 2/6.

CO-AX RELAYS (magnetic devices) 1 change-over 12 v.w. 20/- . ea.

ELECTRONIC ORGAN BUILDERS. We now have in stock P.C. boards built to computer standards. Each board is a complete 4 octave divider (4 1/2 x 3 in.). All connection data supplied. 30/- . each. Set of 13 (gives 5 octaves to keyboard) £16.

DIODE LOGIC BOARDS contains 10 diode gating circuits which convert any one of 10 inputs into an equivalent binary code, 10/- . each.

TRANSFORMERS

E.H.T. TRANSFORMER 2100-0-2100v. 40m/a. 75/- . P.P. 10/-

E.H.T. TRANSFORMER (Parmeko 'Neptune') 3,000v 280 m.a. £12/10/0. P.P. 50/-

L.T. TRANSFORMER 60v. 8 amp. £5. P.P. 15/-

L.T. TRANSFORMER 20v. 1.5 amp. 15/- . P.P. 2/6.

L.T. TRANSFORMERS Prim. 200/250v. Sec. 0-1/0-3/0-9/0-27v. 30 amp. £7.10. 15 amp. £5. P.P. 15/-.

L.T. TRANSFORMER Prim. 200/250v. Sec. 0/25/35v 30 amp. £7.10. P.P. 20/-.

STEP-DOWN TRANSFORMERS Prim. 200/250v. Sec. 115v. 1.25 amps, 25/- . ea. P.P. 5/-.

L.T. TRANSFORMERS Prim. 240v. Sec. 8/12/20/25v. 3.5 amp models 20/- .; 5 amp model 25/- . P.P. 5/6.

L.T. TRANSFORMERS Prim. 240v. Sec. 14v. 1 amp 10/- . ea. P.P. 2/6.

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/-.

COPPER LAMINATE PRINTED CIRCUIT BOARD

(8 1/2 x 5 1/2 x 1/16 in.), 2/6 sheet, 5 for 10/- . Also 11 x 9 in., 4/- . ea., 3 for 10/- .

BULK COMPONENT OFFERS

100 Capacitors (latest types) 50pF to 5µF.
250 Resistors 1/2 and 1 watt.
250 Resistors 1/2 and 1 watt.
150 Hi-Stab Resistors, 1/2 and 1 watt.
25 Vitreous W/W Resistors, 5%.
12 Precision Resistors .1% (several standards included).
12 Precision Capacitors 1 and 2% (several standards included).
12 Electrolytics (miniature and standard sizes).
ANY ITEM 12/6. ANY 5 ITEMS 50/- .

TELEPHONE DIALS (New) 20/- . ea.



RELAYS (G.P.O. '3000'). All types. Brand new from 7/6 each. 10 up quotations only

EXTENSION TELEPHONE (Type 706) Black or 2 tone Grey. 65/- . P.P. 5/- .

UNISELECTORS (Brand new) 25-way 75 ohm, 8 bank 1/2 wipe 65/- . 10 bank 1/2 wipe 75/- .

REED RELAYS 4 make 9/12v. (1,000 ohm.) 12/6 ea. 2 make 7/6 ea. 1 make 5/- . ea. Reed Switches (1 1/2 in.) 2/- . ea. £1 per doz

SUB-MINIATURE REED RELAYS (1in. x 1/2in.). Weight 1/2 oz. Type 1, 960 ohm, 3/9v. 1 make. 12/6 ea. Type 2, 1800 ohm, 3/12v. 1 make. 15/- . ea.

PRECISION CAPACITANCE JIGS. Beautifully made with Moore & Wright Micrometer Gauge. Type 1, 18.5pF-1220pF. £10 ea. Type 2, 9.5pF-11.5pF. £6 ea.

STC CRYSTAL LOCKED OSCILLATOR (Synthesiser). 1K/c-20M/c. Output 0 dbm. 80 db att. in 1 db steps. Precision crystal oven. Locks oscillator to each 100K/c. Separate locked oscillator from 0-100K/c. £150 in excellent condition.

PATTRICK & KINNIE

81 PARK LANE · ROMFORD · ESSEX
ROMFORD 44473

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED In Every Pak, or money back.

Pak No.	Description	Price
U1	120 Glass Sub-min. General Purpose Germanium Diodes	10/-
U2	60 Mixed Germanium Transistors AF/RF	10/-
U3	75 Germanium Gold Bonded Diodes sim. OA5, OA47	10/-
U4	40 Germanium Transistors like OC81, AC128	10/-
U5	60 200mA Sub-min. Sil. Diodes	10/-
U6	40 Silicon Planar Transistors NPN sim. BSY95A, 2N706	10/-
U7	16 Silicon Rectifiers Top-Hat 750mA up to 1,000V	10/-
U8	50 Sil. Planar Diodes 250mA OA/200/202	10/-
U9	20 Mixed Volts 1 watt Zener Diodes	10/-
U10	30 PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U11	12 Silicon Rectifiers EPOXY BY126/127	10/-
U12	30 PNP-NPN Sil. Transistors OC200 & 28104	10/-
U13	140 Mixed Silicon and Germanium Diodes	10/-
U14	30 NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U15	10 3-Amp Silicon Rectifiers Stud Type up to 1000 PIV	10/-
U16	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U17	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U18	30 Silicon NPN Transistors like BC108	10/-
U19	12 1.3-amp Silicon Rectifiers Top-Hat up to 1,000 PIV	10/-
U20	30 A.F. Germanium alloy Transistors 2G300 Series & OC71	10/-
U21	10 1-amp Glass Min. Silicon Rectifiers High Volts	10/-
U22	30 Mat's like MAT Series PNP Transistors	10/-
U23	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	10/-
U24	25 300Mc/s NPN Silicon Transistors 2N708, BSY27	10/-
U25	30 Fast Switching Silicon Diodes like IN914 Micro-min.	10/-
U26	28 Experimenters' Assortment of Integrated Circuits, untested Gates, Flip-Flops, Registers, etc., 8 Assorted Pieces	20/-
U27	10 1 amp SCR's TO-5 can up to 600 PIV CB81/25-600	20/-
U28	15 Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U29	30 Sil. Planar NPN trans. low noise Amp 2N3707	10/-
U30	25 Zener diodes 400mW D07 case mixed Volts, 3-18	10/-
U31	15 Plastic case 1 amp silicon rectifiers 1N4000 series	10/-
U32	30 Sil. PNP alloy trans. TO-5 BCT26, 28302/4	10/-
U33	25 Sil. Planar trans. PNP TO-18 2N2906	10/-
U34	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	10/-
U35	30 Sil. alloy trans. 80-2 PNP, OC200 2832	10/-
U36	20 Fast Switching Sil. trans. NPN, 400Mc/s 2N3011	10/-
U37	30 RP Germ. PNP trans. 2N1303/5 TO-5	10/-
U38	10 Dual trans. 6 lead TO-5 2N2960	10/-
U39	10 RP Germ. trans. TO-18 OC45 NKT72	10/-
U40	10 VHF Germ. PNP trans. TO-18 NKT667 AF117	10/-

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

BI-PAK SEMICONDUCTORS

(DEPT. WWW)

TESTED SCR'S

PIV 1 A	7A	16A	30A
25	—	—	30/-
50	7/6	8/6	10/6 35/-
100	8/6 10/-	15/-	45/-
200	12/6 15/-	20/-	55/-
300	15/-	25/-	—
400	17/6 25/-	35/-	80/-
500	30/-	40/-	95/-
600	—	40/-	50/-

SIL. RECTS TESTED

PIV 750mA 3A	10A	30A
50 1/1	2/9	4/3 9/6
100 1/3	3/3	4/6 15/-
200 1/9	4/1	4/9 20/-
300 2/3	4/6	6/6 22/-
400 2/6	5/6	7/6 25/-
500 3/-	6/-	8/6 30/-
600 3/3	6/9	9/- 37/-
800 3/6	7/6	11/- 40/-
1000 5/-	9/3	12/6 50/-
1200 6/6	11/6	15/-

FULL RANGE OF ZENER DIODES

VOLTAGE RANGE 2-18V. 400mV (DO-7 Case) 2/8 ea. 1-5W (Top-Hat) 3/6 ea. 10W (80-10 Stud.) 5/- . ea. All fully tested 5% tol. and marked. State voltage required.

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed —

Pak No.	EQVT
T1	8 2G371A OC71
T2	8 2G374 OC75
T3	8 2G374A OC81D
T4	8 2G381A OC81
T5	8 2G382T OC82
T6	8 2G344A OC44
T7	8 2G345A OC45
T8	8 2G378 OC78
T9	8 2G398A 2N1302
T10	8 2G417 AF117

All 10/- . each

2N260 NPN Sil. DUAL TRANS. CODE D1899 TEXAS. Our price 5/- . ea.

120 VCB NIXIE DRIVER TRANSISTOR Sil. B8X21 & C407. 2N1893 FULLY TESTED AND CODED ND120. 1.24 3/6 ea. TO-5 N.P.N. 25 up 3/- . ea.

OTHER MONOLITHIC DEVICES

BF242, Zero voltage switch, 8/6 each

This device is a monolithic I.C. that acts a combined threshold detector and trigger circuit for controlling a triac. It is designed to pulse the gate of a thyristor at the point of zero supply voltage, and therefore eliminate radio frequency interference when used with resistive loads.

DI3D1 Silicon Unilateral switch 10/- . each

A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

CA3020 RCA (U.S.A.) LINEAR INTEGRATED CIRCUITS

Audio Power Amplifier, 30/- . each.

FREE

One 10/- . Pack of your own choice free with orders valued £4 or over.

PLEASE NOTE. To avoid any further increased Postal Charges to our Customers and enable us to keep our "By Return Postal Service" which is second to none, we have re-organized and streamlined our Despatch Order Department and we now request you to send all your orders together with your remittance, direct to our Warehouse and Despatch Department, postal address: BI-PAK SEMICONDUCTORS, Despatch Dept., P.O. Box 6, WARE, HERTS. Postage and packing still 1/- . per order. Minimum order 10/- .

INTEGRATED CIRCUITS BI-PAK MONOLITHIC DIGITAL CIRCUITS

BP305A, 6-input AND gate, 9/6 each.

BP314A, 7-input NOR gate, 9/6 each.

BP315A, Dual 3-input NOR GATE, 9/6 each.

BP316A, Dual 2-input NOR gate (expandable), 9/6 each.

BP320A, J-K-Binary element, 11/6 each.

OC72 Transistors

BP332A, Dual 3-Input OR gate, 9/6 each.

BI-PAK MONOLITHIC AMPLIFIERS (TO-5 lead)

BF709C, Operational amplifier, 15/- . each.

BF701C, Operational amplifier (with Zener output), 12/6 each.

BF702C, Operational amplifier (with direct output), 12/6 each.

BF501, Wide band amplifier, 18/- . each.

BP321, Logarithmic wide band amp., 14/- . each.

BP210C, General purpose amplifier (TO-5 lead), (voltage or current amp.), 12/6 each.

FAIRCHILD (U.S.A.)

BTUL MICROLOGIC INTEGRATED CIRCUITS

Epoxy case 78-5 lead temp. range 15°C. to 55°C.

UL900, Buffer, 10/8 each.

UL914, Dual two-input gate, 10/8 each.

UL923 J-k-flip-flop, 14/- . each.

Complete data and circuits for the Fairchild I.C.'s available in booklet form priced 1/6.

MULLARD I.C. AMPLIFIERS

TAA243, Operational amplifier, 70/- . each.

TAA203, Linear AF amplifier, 3/6 each.

TAA293, General purpose amplifier, 21/- . each.

QUALITY-TESTED PAKS

6 Matched Trans. OC44/48/81/81D	10/-
20 Red Spot AF Trans. PNP	10/-
16 White Spot RF Trans. PNP	10/-
6 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. 29303 PNP	10/-
4 Zener Diodes 250mW 3-12V	10/-
3 200 Mc/s Sil. Trans. NPN BSY26/27	10/-
3 Zener Diodes 1W 33V 5% Tol.	10/-
4 High Current Trans. OC42 Evt.	10/-
2 Power Transistors 1 OC26 1 OC35	10/-
5 Silicon Rects. 400 PIV 250mA	10/-
4 OC75 Transistors	10/-
1 Power Trans. OC20 100V	10/-
10 OA202 Sil. Diodes Sub-min.	10/-
2 Low Noise Trans. NPN 2N929/30	10/-
1 Sil. Trans. NPN VCB 100 2T86	10/-
8 OA81 Diodes	10/-
4 OC72 Transistors	10/-
4 OC77 Transistors	10/-
4 Sil. Rects. 400 PIV 500mA	10/-
6 GET884 Trans. Evt. OC44	10/-
5 GET883 Trans. Evt. OC45	10/-
2 2N708 Sil. Trans. 500 Mc/s NPN	10/-
3 GT51 L.L. Low Noise Germ. Trans. PNP	10/-
6 1N914 Sil. Diodes 75 PIV 75mA	10/-
8 OA95 Germ. Diodes Sub-min. 1.69V	10/-
3 NPN Germ. Trans. NKT773 Eqvt. AC130	10/-
2 OC22 Power Trans. Germ.	10/-
2 OC25 Power Trans. Germ.	10/-
4 AC128 Trans. PNP High Gain	10/-
4 AC127/128 Comp. pair PNP/NPN	10/-
3 2N1307 PNP Switching Trans.	10/-
7 CG82H Germ. Diodes Evt. OA71	10/-
3 AF116 Type Trans.	10/-
12 Assorted Germ. Diodes Marked	10/-
4 AC126 Germ. PNP Trans.	10/-
4 Silicon Rects. 100 PIV 750mA	10/-
7 OC81 Type Trans.	10/-
3 OC171 Trans.	10/-
5 2N2926 Sil. Epoxy Trans.	10/-
7 OC71 Type Trans.	10/-
2 2N701 Sil. Trans. Top-Hat	10/-
2 12 Volt Zeners 400mW	10/-
2 10 A 600 PIV Sil. Rects. 1845R	10/-
3 BC108 Sil. NPN High Gain Trans.	10/-
1 2N910 NPN Sil. Trans. VCB 100	10/-
2 1000 PIV Sil. Rect. 1.5 A R5310 AF	10/-
3 BS170A Sil. Trans. NPN 200 Mc/s	10/-
10 OC200 Sil. Trans.	10/-
2 Sil. Power Rects. BYZ13	15/-
1 Sil. Power Trans. NPN 100mc/s. TK201A	15/-
6 Zener Diodes 3-15V Sub-min.	15/-
1 2N1192 PNP Epitaxial Planar Sil.	15/-
3 2N697 Epitaxial Planar Trans. Sil.	15/-
4 Germ. Power Trans. Evt. OC16	15/-
1 Unijunction Trans. 2N2646	15/-
2 Sil. Trans. 200 Mc/s. 60Veb 2T83/84	15/-
1 Tunnel Diode 4EY11 1050 Mc/s	15/-
2 2N712 Sil. Epoxy Planar BFE225	15/-
8 BY 100 Type Sil. Rects.	20/-
25 Sil. and Germ. Trans. Mixed, all marked, New	30/-

BI-PAK GUARANTEE SATISFACTION OR MONEY BACK

SUPER-BARGAIN STOCKTAKING SALE!!

Use form below for your order. **CONDENSERS MUST BE ORDERED BY STOCK NUMBER ONLY.**
 If any sale item is 'sold-out' when order received we shall substitute items of equal value.

ELECTROLYTIC CAPACITORS

Stock No.	Capacity	Voltage	Price s. d.	No. Required	£ s. d.	Stock No.	Capacity	Voltage	Price s. d.	No. Required	£ s. d.
1	1 uf	6	4			39	100 uf	275	2	6	
2	4 uf	25	4			40	30 uf	10	7	6	
3	4 uf	4	4			41	2000/2000	25	7	6	
4	6 uf	6	4			42	16 uf	50 REV	2	0	
5	3 uf	25	4			43	16/16	275	2	0	
6	64 uf	9	4			44	16	275	1	0	
7	20 uf	6	4			45	350	12	9	0	
8	20 uf	50	6			46	20/4	275	1	0	
9	30 uf	15	6			47	250	50	2	0	
10	8 uf	12	4			48	500	25	1	6	
11	8 uf	6	4			49	400	15	1	0	
12	1 uf	350	6			50	400	2.5	3	3	
13	8/8/8	350	1	0		51	64	275	1	9	
14	50 uf	6	4			52	32/32	350	2	6	
15	100/200	275	6	0		53	8/8/8	275	1	9	
16	32	150	9			54	500	6	6	6	
17	64	2.5	3			55	64	275	1	3	
18	100/200/200/50	275	7	6		56	25	6	3	3	
19	50/80	300	3	0		57	100	9	6	6	
20	150/200	275	6	0		58	400	50	2	0	
21	24	275	1	0		59	400	30	1	6	
22	10	25	3			60	500	4	3	3	
23	125	2.5	3			61	150	30	1	6	
24	2	150	3			62	64/32/8	275	2	6	
25	16/32	350	2	6		63	200	275	2	6	
26	32	275	1	6		64	40	6.4	3	3	
27	350	12	6			65	50	25	6	6	
28	75/75/75/75	150	2	6		66	250	50	1	9	
29	1	20	3			67	30	6	3	3	
30	12.5	40	9			68	100/100/50	275	5	0	
31	640	2.5	3			69	50/50/50	350	4	0	
32	3,000	35	7	6		70	40/40/20	275	2	0	
33	3,000	15	3	0		71	400	6.4	3	3	
34	3,000	30	7	0		72	320	10	3	3	
35	250	70	2	0		73	32/32	275	2	6	
36	2,500	9	2	0			+ 25	25	2	6	
37	32	50	9								
38	750	12	1	9							

Total:

RESISTORS. 5% EXCELLENT QUALITY.

7/6d. per 100 of any one value. 2/- per dozen of any one value.

Tick the values required.

13 ohms	560 ohms	3.3 k ohm	10 k ohm	39 k ohm	91 k ohm	1.2 meg ohm	8.2 meg ohm
22 ohms	750 ohms	3.6 k ohm	16 k ohm	43 k ohm	130 k ohm	1.5 meg ohm	9.1 meg ohm
36 ohms	1 k ohm	4.3 k ohm	18 k ohm	47 k ohm	360 k ohm	1.8 meg ohm	10 meg ohm
47 ohms	1.5 k ohm	4.7 k ohm	22 k ohm	51 k ohm	430 k ohm	3.6 meg ohm	
91 ohms	1.8 k ohm	5.6 k ohm	24 k ohm	62 k ohm	470 k ohm	5.1 meg ohm	
220 ohms	2.2 k ohm	6.8 k ohm	27 k ohm	75 k ohm	560 k ohm	6.2 meg ohm	
470 ohms	2.4 k ohm	7.5 k ohm	30 k ohm	82 k ohm	620 k ohm	7.5 meg ohm	
or our selection (mixed) 6/6d. per 100.							

Total:

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS

10/- per 100 of any one value. 3/- per dozen of any one value.

Available in following values. Tick those required.

2 pf	5 pf	12 pf	25 pf	50 pf	80 pf	135 pf	180 pf	250 pf	680 pf	1,000 pf	2,500 pf
3.9 pf	6 pf	15 pf	27 pf	58 pf	82 pf	140 pf	190 pf	330 pf	800 pf	1,100 pf	2,700 pf
4 pf	8 pf	18 pf	30 pf	62 pf	100 pf	158 pf	200 pf	420 pf	820 pf	1,500 pf	3,000 pf
4.7 pf	10 pf	22 pf	39 pf	72 pf	125 pf	170 pf	240 pf	600 pf	900 pf	2,200 pf	6,200 pf

Total:

COMPARE THESE PRICES!!

MULLARD POLYESTER CONDENSERS

	No.	Price
1,000 pf	3d. each	400V
1,500 pf	3d. each	
1,800 pf	3d. each	
2,200 pf	3d. each	
.15 uf	6d. each	160V
.22 uf	6d. each	160V
.27 uf	6d. each	160V
1 uf	1/- each	125V

Total:

25% discount lots of 100 per type.
 50% discount lots of 1,000 per type.

TRANSISTOR BARGAIN! THEY CAN'T GET ANY CHEAPER! ! ! !
 P.N.P. Audio. Untested, unmarked. MAINLY O.K. .. 10/- per 100
 N.P.N. Silicon. R.F. types unmarked ALL USEABLE .. 10/- per 50
 POWER OUTPUT (Similar OC35) ALL TESTED .. 4/- each £2 dozen

SILICON PLANAR TRANSISTORS. ALL TESTED. NO LEAKS OR SHORTS. Gain of 20/50 6d. each, 50/100 9d. each, 100/200 1/- each.
 Transistors similar to OCP 71 (Light sensitive) 2/- each.

THYRISTORS. 400 volt BTY 79 7/6d. each. SCR 51 (10 amp) £1 each.
RECTIFIERS. Latest type. All marked. 800 volt peak, 1 amp mean current type IN4006. 2/6 each, 24/- dozen, £7/10/- 100. S.T.C. 3/4 (400 volt) 2/6 each, 24/- dozen, £7/10/- 100. BYZ 13 or 19 (6 amp) 2/6 each, 24/- dozen, £7/10/- 100.

RECORDING TAPE GIVE-AWAY!

ALL BRITISH MADE, BEST QUALITY. 5" 600' 7/3d. 5 1/2" 900' 9/-, 7" 1,200' 12/-, 3" 'odd-ends'—may be standard, long or double play—but minimum 150'—2/3d.

MAINS DROPPER TYPE RESISTORS. Hundreds of types from .7 ohm upwards. 1 watt to 50 watts. A large percentage of these are Multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered "assorted". 10/- per dozen.

GIANT SELENIUM SOLAR CELLS. Last few to clear at half price! Circular, 67 mm. diameter 5/- each. 50 mm. x 37 mm. 3 for 10/-.

GANGED STEREO POTS. 250K 2/6d. each.

SKELETON PRESETS. Mixed. 6/- dozen.

VOLUME CONTROLS. 1/2 meg. 1 meg. with D.P. switch. 2/- each.

TELEVISION REMOTE CONTROLS. Philips. Contain 11' 7-way cable, 1 double pot., 5 resistors, two condensers, 10/- each. (Cost £3/3/-)

THIN CONNECTING WIRE. 10 yds 1/-, 100 yds 7/6d., 1,000 yds. 50/-

CO-AXIAL CABLE. Black. 6d. yard, £1 50 yds.

CRYSTAL MIKES. 10/- each.

RECORD PLAYER CARTRIDGES

ACOS GP67/2 15/- (Mono) GP94/1 30/- (Stereo, ceramic)
 ACOS GP91/3 20/- (Compatible) ACOS GP93/1 with diamond needle 32/6d.
 ACOS GP93/1 25/- (Stereo) ACOS GP94/1 with diamond needle 37/6d.

TRANSISTORISED FLUORESCENT LIGHTS. 12 VOLT
 8 watt 12" tube, Reflector type 59/6 15 watt 18" tube, Batten type 79/6
 Complete with tube. Postage 3/-

TRANSISTORISED SIGNAL INJECTOR KIT 10/-
TRANSISTORISED SIGNAL TRACER KIT 10/-
TRANSISTORISED REV. COUNTER (CAR) 10/-

VERO-BOARD

2 1/2" x 1" x .15	..	..	1/3	17" x 3 3/4" x .15	..	..	14/8
3 1/2" x 2 1/2" x .15	..	..	3/3	3 1/2" x 2 1/2" x .1	..	..	4/2
3 1/2" x 3 1/2" x .15	..	..	3/11	3 1/2" x 3 1/2" x .1	..	..	4/9
5" x 2 1/2" x .15	..	..	3/11	5" x 2 1/2" x .1	..	..	4/7
5" x 3 1/2" x .15	..	..	5/6	5" x 3 1/2" x .1	..	..	5/6
17" x 2 1/2" x .15	..	..	11/-				

Spot Face Cutter 7/6d. Pin Insert Tool 9/6d. Terminal Pins 3/6d. for 36. Spot Face Cutter and 5 2 1/2" x 1" boards 9/9d.

These prices cannot be repeated. Order now. Don't forget to add your name and address!

Please include suitable amount to cover post and packing. Minimum 2/-.

G. F. MILWARD, DRAYTON BASSETT, near TAMWORTH, STAFFS. Phone: TAMWORTH 2321

BRAND NEW SEMICONDUCTORS & COMPONENTS GUARANTEED

TRANSISTORS Brand new and fully guaranteed. PLEASE NOTE:—A large number of our transistors have now been reduced in price. Many more semi-conductors in stock. Please enquire for types not listed.

Table listing various semiconductor components including transistors (e.g., 2C301, 2C302, 2C303), diodes (e.g., 2N3055, 2N3056), and other parts with their respective specifications and prices.

SILICON RECTIFIERS table listing PIV, current ratings (100, 200, 400, 600, 800, 1000, 1200), and prices for various models like 1A, 3A, 6A, 10A, 17A.

DIODES & RECTIFIERS table listing various diode models (e.g., 1N461, 1N914, 1N4007) and their specifications.

ICA INTEGRATED CIRCUITS table listing various IC models (e.g., ICA3005, ICA3011, ICA3012) and their functions.

FAIRCHILD and MOTOROLA integrated circuits table listing models like L900 Buffer, L914 Dual Gate, L702C, L923 JK Flip Flop, L709 Op Amp.

THYRISTORS table listing PIV ratings (50, 100, 200, 300, 400) and various models (e.g., 1A, 3A, 5A, 7A, 25A).

GENERAL ELECTRIC table listing various electronic components like PA230 Low Level Amplifier, PA234 Audio Amplifier, PA237 2 Watt Audio Amplifier, PA246 5 Watt Audio Amplifier.

MULLARD I.C.'s table listing various integrated circuit models (e.g., FCH 211, FCI 101, TAA 241, TAA 243, TAA 263, TAA 320).

VEROBOARD table listing board sizes (e.g., 2 1/2" x 3 1/2", 2 1/2" x 5", 3 1/2" x 3 1/2") and prices.

RESISTORS table listing Carbon Film and Wire Wound resistors with various wattage and resistance values.

CAPACITORS. Polyester, ceramics, Polystyrene, silver mica, tantalum, trimmers etc.

Table listing various capacitor types (Electrolytics, MFD, V, MFD, V) and their specifications.

THERMISTORS table listing various models (e.g., VA1005, VA1034, VA1037, VA1038, VA1039, VA1033) and their specifications.

SPECIAL OFFER (Limited to last Saturday in October)

To encourage personnel callers we are happy to offer a discount of 5% to all our customers on Saturdays only. We are happy to quote for quantity supplies to manufacturers etc. Post and Packing in U.K. 1/6; Europe 5/-; Commonwealth (Air) 13/-.

PANEL METERS table listing various meter models (e.g., 38 Series—FACE SIZE 42 x 42 mm) and their specifications.

CARBON POTENTIOMETERS table listing various models (e.g., Log. and Lin. Less switch, Log. and Lin. With switch) and their specifications.

Telephone: 01-452 0161/2/3. A. MARSHALL & SONS LTD. CALLERS WELCOME. Hours 9-5.30 Mon.-Sat.

L.S.T. ELECTRONIC COMPONENTS LTD.

AA119	2/-	BC142	15/-	BY25	31/9	NKT217	13/-	OC24	10/-	2G302	3/9	2N2369	5/6
AA119	2/1	BC143	15/-	BY142	3/9	NKT218	5/3	OC25	6/9	2G339A	3/-	2N2369A	6/-
AAZ12	17/6	BC147	4/7	BYZ10	9/-	NKT221	5/6	OC26	12/-	2G374	5/-	2N2435	58/6
AC107	14/6	BC148	3/3	BYZ12	6/-	NKT222	4/-	OC28	12/-	2G381	5/-	2N2477	18/-
AC126	6/6	BC149	4/7	BYZ13	5/-	NKT223	6/-	OC29	15/-	2G371	4/-	2N2484	14/-
AC127	6/-	BC154	12/-	C106F1	9/-	NKT223A	3/6	OC35	9/6	2G371B	3/-	2N2613	8/3
AC127Z	8/6	BCY10	7/6	C111	18/-	NKT224	4/6	OC36	13/-	2N174	24/-	2N2614	7/6
AC128	4/-	BCY12	7/6	C111E	12/-	NKT225	3/6	OC41	3/6	2N301	8/-	2N2646	10/-
AC151	8/8	BCY30	7/2	C400	9/-	NKT226	10/-	OC42	4/-	2N109	13/6	2N2894	13/9
AC176	7/6	BCY31	9/2	C426	8/3	NKT227	5/6	OC43	4/-	2N127	7/6	2N2904A	15/6
AC187	12/-	BCY32	20/5	CG66	2/-	NKT228	6/-	OC44	3/-	2N352	15/-	2N2924	5/-
AC188	12/-	BCY33	4/11	CG63	4/-	NKT261	4/3	OC45	3/-	2N386	12/-	2N2925	5/6
ACY17	5/9	BCY34	6/6	D1371	10/-	NKT270	3/6	OC70	3/-	2N384	17/-	2N3036	39/2
ACY18	3/6	BCY38	8/-	EA403	3/6	NKT271	5/-	OC71	3/-	2N385A	15/-	2N3053	8/-
ACY19	4/5	BCY39	26/1	EA401	5/-	NKT272	5/-	OC72	4/6	2N388A	4/6	2N3054	15/-
ACY20	3/7	BCY40	16/-	EC402	4/8	NKT273	4/-	OC73	3/-	2N370	15/-	2N3055	15/-
ACY21	4/-	BCY42	4/-	EB383	3/6	NKT274	5/-	OC75	5/-	2N404	4/2	2N3394	6/-
ACY22	2/11	BCY43	4/-	GET102	6/-	NKT275	5/-	OC76	2/6	2N410	6/-	2N3702	3/6
ACY30	9/-	BCY54	17/4	GET103	4/6	NKT276	3/6	OC77	9/3	2N456A	20/-	2N3703	3/3
AD140	15/-	BCY70	4/4	GET104	5/-	NKT279A	2/6	OC81D	3/-	2N458A	3/9	2N3704	3/9
AD149	11/8	BCY71	6/8	GET105	8/-	NKT281	5/-	OC81	4/4	2N511A	50/3	2N3705	3/4
AD161	6/-	BCY72	4/8	GET114	5/-	NKT301	16A	OC82	4/6	2N513A	118/5	2N3706	3/10
AD162	6/-	BCY87	86/9	GET875	6/-	NKT302	11/2	OC82D	3/-	2N514B	192/-	2N3707	4/-
ADT140	12/6	BCZ11	10/8	GET573	7/6	NKT303	10/2	OC83	4/-	2N599	12/-	2N3708	2/5
AF102	18/-	BD119	15/-	GMO290	13/5	NKT304	9/8	OC84	4/-	2N601	5/-	2N3709	3/9
AF114	4/4	BD121	18/6	GPO378	11/-	NKT351	8/-	OC123	7/-	2N657	15/4	2N3710	3/10
AF115	4/15	BF184	7/6	HPF151	4/-	NKT352	7/6	OC139	8/-	2N696	5/3	2N3711	3/3
AF116	4/4	BD124	15/-	K8/15	4/-	NKT402	24/-	OC140	12/-	2N697	5/3	2N3819	8/-
AF117	4/4	BF152	13/6	K8/30	9/-	NKT403	16/-	OC169	6/-	2N698	4/6	2N3820	18/9
AF118	16/6	BF154	9/-	K3/50	8/3	NKT404	13/8	OC170	4/-	2N706	3/-	2N3826	6/-
AF124	6/-	BF159	15/-	MAT100	5/-	NKT405	15/-	OC171	6/-	2N706A	3/-	2N3906	7/6
AF126	3/9	BF163	5/6	MAT101	5/6	NKT451	5/6	OC200	10/10	2N708	4/6	2N4058	7/9
AF127	4/1	MAT120	6/6	MAT120	5/6	NKT452	13/4	OC201	10/-	2N711	7/6	2N4284	3/-
AF139	8/-	BF173	6/2	MAT121	5/6	NKT453	12/-	OC202	18/10	2N711A	7/6	2N4285	3/-

PRICES FOR QUANTITIES IN EXCESS OF 100 PIECES ON APPLICATION

FIRST GRADE + FAST SERVICE

When enquiring for types not listed please enclose a STAMPED ADDRESSED ENVELOPE

AF181	12/-	BF178	14/-	ME4103	6/-	NKT674	6/-	OC203	8/3	2N715	7/6	2N4286	3/-
AF186	11/-	BF179	12/-	MEJ520	15/-	NKT675	5/-	OC204	8/-	2N716	7/6	2N4287	3/-
AF239	12/-	BF180	6/-	MPF102	9/-	NKT676	5/-	OC205	9/6	2N718	7/2	2N4288	3/-
AFZ11	14/-	BF181	7/-	MPF103	9/-	NKT677	5/-	OC206	10/6	2N743	5/-	2N4289	3/-
AFZ12	11/9	BF184	7/6	MPF104	9/-	NKT678	8/-	OC207	7/6	2N744	5/6	2N4290	3/-
ASV26	4/5	BFX13	4/10	MPF105	9/-	NKT713	7/6	ORP12	9/6	2N753	5/-	2N4291	3/-
ASV27	6/-	BFX29	8/-	MPS3638	6/-	NKT773	6/-	ORP60	8/-	2N863	12/-	2N4292	3/-
ASV28	4/5	BFX44	6/5	MJ480	21/-	NKT774	5/4	ORP61	8/-	2N811	7/6	2N4303	15/-
ASV29	6/-	BFX87	6/-	MJ481	27/-	NKT0013	12/6	ORP63	9/-	2N914	4/3	2N4487	6/9
ASZ21	11/-	BFY50	4/6	MPF1491	30/3	NKT10419	13/8	ORP93	24/-	2N918	15/-	25002	15/-
ATZ10	4/0	BFY10	3/9	NKT121	10/11	NKT10519	12/6	OC309	12/-	2N929	5/6	25004	23/-
AFY19	16/10	BFY52	4/6	NKT122	7/9	NKT10339	10/3	P346A	6/-	2N930	6/8	25017	15/-
BA110	6/-	BSX20	3/4	NKT123	6/2	NKT10429	11/3	RAS310AF	6/-	2N1131	9/6	25018	12/6
BA111	6/-	BSX21	8/-	NKT124	9/8	NKT20329	12/6	RAS508AF	15/-	2N1132	7/6	25020	15/-
BA112	18/-	BSY27	4/-	NKT125	6/2	NKT16229	11/-	ST2	9/9	2N1143	26/2	25024	23/-
BA115	2/8	BSY95A	3/4	NKT126	6/-	OA5	3/8	ST140	3/-	2N1177	14/-	25034	12/6
BA130	3/-	BTX39	120/-	NKT129	5/10	OA10	1/6	ST141	5/-	2N1302	4/6	25102	10/-
BAY31	2/6	600R	120/-	NKT141	6/11	OA70	1/6	TIS43	6/9	2N1303	4/6	25104	10/-
BAY38	3/-	BTX40	120/-	NKT142	5/10	OA73	1/6	U23AAA	5/-	2N1305	5/-	25302	7/7
BC107	2/9	600R	120/-	NKT143	5/4	OA79	1/6	V405A	9/3	2N1306	6/6	25304	15/-
BC108	2/9	BTY87	31/-	NKT144	8/-	OA81	1/6	XA102	6/-	2N1307	6/6	25320	12/6
BC109	2/9	BTY91	31/-	NKT152	3/4	OA85	1/6	XA702	15/3	2N1308	8/-	25322	8/-
BC113	5/-	BTY91	31/-	NKT161	5/8	OA90	1/6	ZT22	19/2	2N1309	8/-	25701	10/-
BC114	7/5	300R	47/-	NKT162	5/8	OA91	1/6	ZT86	27/6	2N1507	4/8	25702	12/-
BC115	7/11	BY100	5/-	NKT163	5/4	OA95	1/6	ZT2270	19/6	2N1613	6/6	25711	23/3
BC116	9/-	BY125	3/6	NKT164	5/4	OA200	2/-	IN23A	20/-	2N1496	34/6	25712	30/3
BC118	5/-	BYX10	3/-	NKT165	5/8	OA202	2/-	IN4A	4/-	2N1711	7/6	25733	9/9
BC125	12/-	BYX36/150	2/6	NKT211	6/-	OA210	6/4	IN60	4/-	2N2147	17/-	40361	13/3
BC126	12/-	BYX36/300	3/10	NKT212	6/-	OA211	9/-	IN64	4/-	2N2148	12/6	40362	12/6
BC134	5/-	BYX36/600	3/8	NKT213	6/-	OC19	5/-	IN82A	9/6	2N2160	14/9	TZ22	19/-
BC136	7/11	BYX36/1600	3/8	NKT214	4/-	OC20	33/-	IN87A	4/6	2N2218	12/-	TB86	27/6
BC137	8/6	BYZ21	25/-	NKT215	10/5	OC22	13/-	IN191	5/-	2N2243	23/7	TB86	27/6
BC138	12/-	BYZ23	26/3	NKT216	10/5	OC23	15/-	1544	1/6	2N2368	6/6	TZ2270	19/6

COMPONENTS

RESISTORS 1/2 or 1 Watt 5% LOW NOISE CARBON FILM. 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 ohms and decades (x10, x100, x1,000, x10,000) 1 Meg etc. to 8.2 Megohms (10% tolerance). PRICES: 1-25 4d, 26-99 3d, 100+2d (your selection 1 and/or 2 Watt mixed).

SKELETON PRESET POTS. 20% Tol. Linear. Low noise. Available in sub-miniature or standard size, horizontal or vertical, 100, 250, 500, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 Meg, 2.5 Meg, 5 Meg. NEW PRICE: 1/- each or any selection of 12 pieces 10/-.

ELECTROLYTIC CAPACITORS (Mullard). -10% to +50% tol. Subminiature (all values in µF).

4V	8	32	64	125	250	400
6.4V	4	25	50	100	200	320
10V	4	16	32	64	125	200
16V	2.5	10	20	40	80	125
25V	1.6	6.4	12.5	25	50	80
40V	1	4	8	16	32	50
64V	0.64	2.5	5	10	20	32
Price	1/6	1/3	1/2	1/-	1/1	1/2

MIN. POLYESTER CAPACITORS. Printed circuit type 250 Vdc working. 0.01, 0.015, 0.022, 7d each; 0.033, 0.047, 8d each; 0.068, 0.10, 9d each.

VEROBOARD 0.15" Matrix FLUX COATED 21 x 31, 31 x 51, 31 x 71, 31 x 91, 31 x 111, 31 x 131, 31 x 151, 31 x 181, 31 x 211. BARGAIN PACK of 36 square inches all good size pieces only 10/- pack.

VEROBOARD 0.1" Matrix, 31 x 21, 3/9.

VEROPINS for 0.15", 36 pieces 3/-.

VEROCUTTER 9/- (including free sample pieces).



S-DeCs Single "DeC" with accessories and project manual ... 25/6

"2-DeC" kit contains two "DeCs" component tray accessories, instruction book, all packed in attractive plastic box ... 49/6

"4-DeC" kit contains four "DeCs", accessories, manual, etc. ... 117/6

BOOKS FROM STOCK

General Electric Transistor Manual, 660 pages of data and circuits ... 29/6

RCA Transistor Manual, 554 pages, Includes SCR circuits ... 28/-

Designers' Guide to British Transistors. Excellent data book lists over 1,000 common types plus Computer-selected substitution chart. (ADD 2/6 POST & PACKING FOR ALL BOOKS) ... 25/-

NEONS

Signal neons for many types of circuit, type "N" Price 1/6 each or 16/- dozen.

HEATSINKS. Suitable for 2 x OC35, etc. As used in commercial equipment. Type 10D ... 6/-

ALUMINIUM CHASSIS

6 x 4 x 2 1/2" with reinforced corners 6/9 each (P & P 1/6). Ally panel to fit 1/6. Pasolin panel to fit 2/-. Many other sizes in stock up to 12 x 8 x 2 1/2" (see catalogue).

ZENER DIODES. 400mW 10% Tolerance. Complete range preferred values 3 volt to 30 volt, each ... 3/6

SOLAR CELLS

B2M 0.2-0.4 volts @ 2mA Selenium type ... 12/6

B3M 0.2-0.4 volts @ 1 1/2-2mA Selenium type ... 15/3

S1M 0.3-0.4 volts @ 10-16mA Silicon ... 19/-

S4M 0.3-0.4 volts @ 25-40mA Silicon ... 33/6

2N3819 Texas FET 8/-

25 + 6/9 100 + 5/9

2N4871 MOTOROLA Unijunction 6/9

25 + 5/9 100 + 4/9

u LOGIC

1-6	7-11	12+
uL900 9/9	9/-	8/-
uL914 9/9	9/-	8/-
uL923 13/-	12/-	11/-

Plastic Spreader 1/6

Five Page Data and Circuits article 2/6

Larger quantity prices (100+ and 1,000+) on application.

SILICON RECTIFIERS

PIV	200mA	750mA	2 Amp	10 Amp
50	6d	1/-	2/3	—
100	9d	1/6	2/3	4/6
200	1/3	2/-	2/9	5/-
400	—	2/6	4/-	8/-
600	—	3/-	4/6	9/6
800	—	3/9	5/-	11/3
1000	—	6/-	6/6	14/-

ULTRASONIC TRANSDUCERS

Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive.

FREE: With each pair our complete transmitter and receiver circuit.

PRICE £5.18.0 Pair (Sold only in pairs)

2N3055 115 WATT POWER 15/-

25 + 13/- 100 + 11/-

56CAY Gallium Arsenide Infra-Red emitter 29/6 each. (Incl. data)

BF180 MULLARD UHF AMPLIFIER 6/-

25 + 4/11 100 + 4/3

2N2614 RCA LOW NOISE AUDIO 4/9

25 + 4/- 100 + 3/-

THYRISTORS-SCRs

PIV	1A	3A	10A	30A	100A
50	7/6	9/-	7/6	25/-	20/-
100	—	10/-	10/-	30/-	22/-
200	8/6	—	12/6	42/-	35/-
300	—	11/-	—	51/-	—
400	9/6	12/6	15/-	60/-	45/-
600	—	—	20/-	84/-	120/-
800	—	—	—	—	—

ALL GOODS GUARANTEED

CONVERTOR/BATTERY CHARGER. Input 240v 50 c/s, output 12v 5 amp DC. Input 12v DC, output 240v AC. 170 watt max. With fuse and indicator lamps. Size 9 1/2 x 10 x 4 1/2 in. Weight 19lb. An extremely compact unit that will give many years' reliable service. Supplied with plug and lead. Only £4/10/-, P. & P. 15/- extra. As above—fully serviceable—perfect interior but soiled exterior cases. £3. P. & P. 15/- extra.

RACAL EQUIPMENT

RA 17 Receiver £165. RA 4 Receiver £25. One KiloWatt Linear PA complete with power supplies in 6 ft. enclosed cabinet. 1.5 to 25 meg cycles requiring 100 milli watt drive. In brand new condition. Complete with spares. Full details on request. £550. Digital Frequency Counters SA20; SA21B; SA28. Prices £30; £45; and £65.

G.M. TUBES. Brand new. G24/G38/G60 at 27/6 ea. G58/1, brass cased, £6 ea.

PHOTOMULTIPLIERS. 6097B at £5 ea. EMI 6097X at £8/10/- ea.

SOLARTRON stab. P.U. type AS516 300v 50mA. £3/10/-; AS517 300v 100mA. £6. P. & P. 10/- extra.

TRANSISTOR OSCILLATOR. Variable frequency 40 c/s to 5 kc/s. 5 volt square wave o/p. for 6 to 12v DC input. Size 1 1/4 x 1 1/4 in. Not encapsulated. Brand new. Boxed. 11/6 ea.

TIMER UNIT, consisting standard mains input transformer 200/240v 50 c/s; output 18v 4 amp (conservative); GEC bridge rectifier; detachable accurate 1 sec timer subchassis with transistor STC type T82. 2 x 12AU7; one 500 ohm relay heavy duty contacts 2 make; lamps, fuse, switch, etc. In case. Size 10 x 10 x 5 1/2 in. Ideal battery charger, one second timer, transistor power supply, etc. Tested and guaranteed working. £2/15/- ea. P. & P. 15/-.

OSCILLOSCOPES

Comor DB 1035, £20; 1035 Mk. 2, £25; 1035 Mk. 3, £32/10/-; 1049, £22/10/-; 1049 Mk. 3, £30; CT52, £15.

HARTLEY 13A. £18/10/-.

All scopes carefully serviced and in excellent condition. Carriage 30/- extra.

ADVANCE Signal generator type D.1. 2mc/s to 190mc/s. Sine and square mod. With original charts. Excellent condition. £12/10/-, P. & P. £1.

RELAYS

Omron/Schrack octal based plug-in relays. 2 pole c/o 5A, 230v and 6v. State which. Brand new. Boxed. 12/6 ea.

G.E.C. 4 pole c/o 6/12v operation 180 ohms. Platinum contacts. Brand new. Boxed 12/6 ea.

Min. VARLEY type VP4. 4 pole c/o 430 ohm or 15 K/ohm. Brand new 6/6 ea.

3,000 series. 500 ohms 2 pole c/o and 2 make. As new condition. 4/6.

S.T.C. sealed 2 pole c/o 48V. 2,500 ohm 3/6 ea.

CARPENTERS polarised single pole c/o 20 and 65 ohm coil as new, complete with base 9/6 ea. Single pole c/o 680, 1,110 and 1,570 ohm coil. As new 6/6 ea. Synchronous chopper AEI type CK4. As new 17/6 ea. Top connector 2/6 ea.

COLVERN Pots. Brand new. 10; 50; 100; 250; 500 ohms; 1; 2.5; 5; 10; 25; 50k all at 2/6 ea. Special Brand new **MORGANITE** 250K Lin. sealed. Normal price 9/-, our price 3/6 ea.

INSTRUMENT POTENTIOMETERS. 3" Colverns. 5, 25, 50, 100 ohms; 2.5, 25K. All at 7/- ea.

HIGH RESOLUTION Potentiometer. 25K. 80 turns. Complete with knob. 6/6 each.

ALMA precision resistors. 100K; 400K and 998K 0.1%, 5/6 each.

3.25 K 0.1% 4/- ea.

DUBILIER Electrolytic Capacitors. 32mfd 350v. DC. Brand new, 1/9 ea.

EL84 VALVES. Ex. eq. Tested. 7/- pair.

PANEL SWITCHES. All high quality. SP, 1/- ea.; DP, 2/- ea.; DP 2w, 3/6 ea.

COURTENAY timer unit. Accurate 1 sec timer. Variable mark space ratio. Input 12v AC or DC. Heavy duty relay contacts to switch external equipment, ex., flashing lights. Chassis mounting. Size 6 x 3 1/2 x 3 1/2 in. Tested with circuit diagram. 22/6 ea.

TRANSISTORISED stabiliser unit. High quality. Input 24v raw DC, output 20v smoothed, and 12v 1 amp. Brand new. Superb value at 25/- ea.

Geared Motors. 240v 50c/s synchronous. Geared down to 60 r.p.m. Brand new. 50/- ea. P. & P. 7/6 ea.

Mullard OG 35's. 4/- ea.

Photocells, equivalent OCP 71, 2/6 ea.

E.H.T. Condensers. 7.5kV working. 0.1 mfd, 5/6 ea.; 0.25 mfd, 8/6 ea.

Brand new 5kV 0.25mfd at 10/6 ea.; 10kV 0.05mfd 7/6 ea.

VISCONOL E.H.T. Condensers. Brand new. 0.002 15kV, 8/6 ea.; 0.0005 25kV, 16/- ea.

BURGESS Micro Switches V3 5930. Brand new 6/6 ea.

BULGIN panel mounting Lamp holders. Red. Brand new 2/3 ea.

Brand new **PLESSEY** plugs and sockets. Mark 4 and 7. Your requirements please.

TRANSISTOR Stabilised Power Unit. 48v, 4 amp. Manufactured by E.M.I. Open chassis. Brand new. Highest quality. Size 10 1/2 x 5 1/2 x 6 1/2 in. high. £6 ea.

AMERICAN TX tuning units. TU7B 4.5-6.2 Mc/s. TU8B 6.2-7.7 Mc/s. Only 35/- ea. Carriage 7/6 extra.

VALVE VOLTMETERS. Marconi TF899, £7/10/-, carriage 10/-; TF428B, £3/15/-, carriage 10/-; Airmec 784, £8, carriage 15/-.

Cash with order.

Post paid over 10/-

FOR CALLERS. Always a large quantity of components, transformers, chokes, valves, capacitors, odd units, etc., at 'Chiltmead' prices. Callers welcome 9 a.m. to 10 p.m. any day.

CHILTMEAD LTD.

22 SUN STREET · READING · BERKS,

Off Cumberland Road (Cemetery Junction) Tel. No. Reading 65916 (9 a.m. to 10 p.m.)

POLARAD SPECTRUM ANALYSER. 5" display. 3 plug in tuning units. 20 mc/s to 44,000 mc/s. Superb condition. Write or phone for details.

ATTENUATORS. STC push-button 0/100 Dbs in 1 Db steps. DC 50 Mc/s. 75 ohm imp. £12 ea.

19in. Rack Mounting **CABINETS.** 6ft. high. 2ft. deep. Side and rear doors. Fully tapped; complete with base and wheels. Excellent condition. £12/10/- Carriage at cost.

SOLARTRON Storage Oscilloscope type QD910. Exceptional condition. Carefully checked. £175 each.

SPECIAL OFFER

V.H.F. Receiver, type 715 by BCC. Complete tested and working (less crystal). 12v DC input. Ideal conversion 2 and 4 meters. In good condition. Supplied with conversion data. Only £3/10/-, P. & P. 7/6 ea.

LABORATORY OSCILLOSCOPE. Solartron CD 643. 5in. tube. DC. 12Mc/s. Rise time 30 M Micro/s. TG 100 M sec/cm to 0.1 Micro/s/cm with no expansion; with expansion 20 M Micro/s/cm. Fine condition. NOW only £80.

SOLARTRON EQUIPMENT

D.B. Oscilloscope. Type CD 7118.2, £55. S.B. Oscilloscope. Type CD 513. £35. Pulse generator. Type OPS 100C. 50 c/s to 1 Mc/s. £25. Laboratory Amplifier. Type AWW51A. 15c/s to 350 kc/s. £40. Stabilised P.U. Type SRS 152. £12/10/-.

MIC-O-VAC type 22 (CT54) Volts; Current; Ohms. DC to 200mc/s with probe, leads etc. As new £8.10.0. P. & P. 10/-.

CINTEL Microsecond Counter Chronometer. 6 digit. Start-stop terminals. In fine condition £20. Carr. 25/-.

CINTEL Transistorized Nucleonic Scales with adjustable discriminator, count of 10 to the 5. In as new condition. £37/10/- each. Carr. 15/-.

AIRPEC Counter type 885. 8 decades; bright vertical display; gate facilities. Very good condition. £30. Carr. 25/-.

MULLARD Transistorized Analogue to Digital Converter Model L 281. As new. £30. Carr. 15/-.

SUNVIC DC Chopper Amplifier type DCA 1. Superb condition. £22/10/- each. Carr. 20/-.

ELLIOTT Dynamometer Model 5999. Accuracy 0.5 fcd. Perfect condition. £12/10/- ea. P. & P. 15/-.

Special discount to Universities, Schools, etc.

MARCONI Audio Frequency Absorption Wattmeter type TP956 (CT41). Large 6" scale. 1 micro watt to 6 watt. Excellent condition. £15. P. & P. 10/-.

BC221 Frequency Meter. £17.10.0; with built-in Stab. P.U. £22.10.0. Carriage 15/- With Charts.

METERS

TAYLOR 100-0-100 micro amp. Scale size 4 x 2in. Internal lamp scaled -8 -0 -8. £2 ea.

E.H.T. Electrostatic. Ernest Turner, etc. 0/750v. £2 ea. 0/5kV. £3/10/- each. 0/7.5kV. £4/5/- ea.

GRIFFEN & GEORGE. 3in. round. In sloped opened case with terms. AC 50 c/s 3 types available: 0/20; 0/100; and 0/250v. £1 ea.

TRANSFORMERS.

All standard inputs. 18v 6 amp and 12v 4 amp. Sep. windings. 18/6 ea.

18v 12 amp at £3 ea.

3kV 4.5mA. 4v 0.5 amp x 2. 4v 1.1 amp. Brand new. £5 ea. ex. eq. £3/10/- ea. 350-0-350 75mA. 5v 2 amps x 2. 21/- ea.

Gardners 6.3v 2A; 6.3v 1.5A; 6.3v 0.1A. Size 3 x 1 1/2 x 4 1/2 in. As new. 14/- ea.

Gardners. Potter. Multi 6.3's combine to give 48v at 4 amps or 8.3 at 45A. With 350-0-350 at 50mA. As new. £2/10/- ea.

Parmeko/Gardners. Potted. 475-80-0-80-475 at 160 mA; separate winding 215-0-215 at 45mA; 6.3v 5A; 6.3v 0.75A; 5v 3A. As new. £3 ea.

Gardners 400-350-0-350-400 at 250MA; 0/4/6.3v 4 amp x 2; 0/4/6.3 2 amp; 0/4/5 3.5A. In original boxes. £4/10/- incl. post. Gardiners 2kV 10MA. As new. £3 incl. postage.

Gardiners 2kV 10MA and 4 volts x 2. £4/10/- ea incl. postage.

Parmeko 6.3v at 2 amp x 4. 22/6 ea.

Parmeko 65v 1 amp. Separate 0-18-24v at 0.5 amp. 30/- ea. Gard/Part. 450-400-0-400-450. 180 MA. 2 x 6.3v. £3 each.

E.H.T. Brand new 6kV 5MA with rectifier heater winding. Size 3 x 3 x 3 1/2 in. 27/6 ea.

ADVANCE Constant Voltage Transformers. 6 volts 50 Watt. As new £3 ea. P. & P. 10/-.

Gardners 4V 30 amps. Brand new. £1/10/- incl. postage. 3 for £3/10/- incl. postage. Special price bulk.

CHOKES. 5H; 10H; 15H; up to 120mA. 8/6 ea. Up to 250mA 12/6 ea.

Large quantity LT, HT, EHT transformers. Your requirements, please.

PULSE AMPLIFIER. Type 1480A. Head amp etc. 20 c/s to 3 Mc/s. £25. Carriage 30/-.

SERVOMEX. Stabilised D.C. Power supplies type DC3. 0-30 Volts, 0-7 amps. Separate voltage and current meters. £40. Type 38, bench mounting, 0-15 Volts, 0-2.5 amps. Separate voltage and current meters £30.

PLUGS & SOCKETS. Quantity Brand New Cannon. Electromethods. Belling, Amphenol, etc. Many of American manufacture. The Lot £140.

THE HI-FI AND TAPE RECORDER HANDBOOK

by Gordon J. King

40/- Postage 2/-

SERVICING WITH THE OSCILLOSCOPE by Gordon J. King. 28/- Postage 1/-.

THE SEMICONDUCTOR DATA BOOK by Motorola. 60/- Postage 5/-.

POWER CIRCUITS D.C. TO MICRO-WAVE by RCA. 20/- Postage 1/-.

MODERN RELAY TECHNIQUES by M. L. Gayford. 50/- Postage 1/6.

PRACTICAL INTEGRATED CIRCUITS by A. J. McEvoy 18/- Postage 1/-.

SOURCEBOOK OF ELECTRONIC CIRCUITS by John Markus. 172/6. Postage Free.

FET PRINCIPLES, EXPERIMENTS AND PROJECTS by Edward M. Noll. 40/- Postage 1/-.

RADIO COMMUNICATION HANDBOOK by R.S.G.B. 63/- Postage 4/6.

SCR MANUAL by International General Electric Company. 25/- Postage 2/-.

CATALOGUE 2/-

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST of British and American Technical Books

19-21 PRAD STREET, LONDON, W.2

Phone PAQdington 4185

Closed Sat. 1 p.m.

WW-141 FOR FURTHER DETAILS

Television Origination, Equipment

2 Complete E.M.I. Type 404 Telecine comprising:

- A. 2 x 35 MM. Type GK 37 Modified. 1 x 16 MM. Type EL 5001 Modified. Vidicon Camera. Type 201. Waveform Monitor. Type 302. Picture Monitor. Type 301. 405/625. Optical and Magnetic Sound. Camera & Interconnecting Cables. Pedestal Mounted. Power Supplies, etc.

- B. Similar to above. Slide Projector Type 408. In Place of 16 MM.

E.M.I. Industrial Camera, Cable, Power Supply.

- 2 x E.M.I. Stabilising Amplifiers.
- 2 x E.M.I. Sync Pulse Generators.
- Control Panel, Power Supplies.
- E.M.I. Oscilloscope WM8, Trolley.

All First Class Condition.

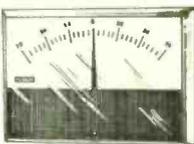
Please reply to Box W.W. No. 2559

Electro-Tech Sales

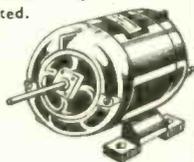
NEW HYSTERESIS MOTORS BY WALTER JONES. Type 14050/12, 240v. 50 c/s 1500 RPM cont. rating, output 2.0 oz./in. Size: Length (less spindle) 3 1/2". Width 2 1/2" x 2 1/2". Spindle 1" x 3/16". Weight 3 lb. Maker's price in region of £22.10.0. Our price £7.15.0 each. P. & P. 5/-



New 75-0-75 Micro-ammeter by Sifam. 750 ohm movement, clear reading, 5µa divisions x 1/2"; plastic front, projection 3/4" (tapering forward). Size: 4 1/2" x 3 1/2". 57/6 each. P. & P. 2/6.



New "Croydon" 1/50th HP, cont. rating 240v. A.C. motor, 1500 RPM, foot mounted. Size: 3 1/2" high x 5" long + spindle length 1 1/2" x 1/4" dia. A really beautiful motor at less than half maker's original price. £6.10.0 each. P. & P. 5/-.



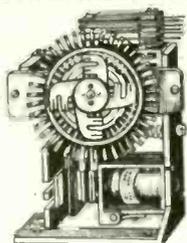
Robust M.E.S. Dual-circuit Panel Lamp by Thorne, adjustable length with press-to-test dome. 1" fixing hole. Available red, green, amber. 10/6 each. P. & P. free.



Isolation Transformers. 1 to 1. 250v. input, 250v. centre tapped out, at 2 K.V.A., mounted in metal case measuring 8 1/2" x 8 1/2" x 11" high. Weight 65lb. £18.10.0. P. & C. 25/-.

We have a large quantity of Mullard Pot Cores, certain types only, also a very large quantity of Denco Neosid iron-dust cores. These items are suitable for industrial users and we would be pleased to give details upon request. Also in stock very large quantity of Torroid rings. Samples upon request.

SCHRACK ROTARY STEPPING RELAY RT304 48v. coil (28 ohm). The relay has 48 basic segments shorted in step by the 4 sweep contacts to 4 pole-plates (banks of 12). There are 2 secondary switches: (1) one c/o H/Duty contact set which changes over and back with each step; (2) two H/Duty changeovers which changeover on each 12th step and return on the following pulse. Size: Base 3 1/2" x 1 1/2" x 4 1/2" high. New in maker's packing, limited supply, also few only, as above, but 110v. (1,290 ohm coil), £6.10.0 each. P. & P. free.

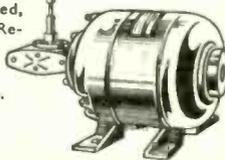


Precision Motor-driven Potentiometer By "Precision Line" (U.S.A.). Continuous track with 2 platinum contact wipers set at 90° C.W. resistance 300 ohm only, ± 5% LIN ± 0.5%, ball bearing spindle column. Size: dia. 1 1/32", height 1 1/32", spindle length 1 1/32" by 1/4" dia. These potentiometers were purchased by the importer at a cost of approx. £25 each. Our price £6.15.0 each. P. & P. free



Berco Rotary "Regavolt," variable voltage transformers input 240v. 50/60 cps., output 120-0-120v. at 6 amps. Not new, but in 1st class condition. Few only, £9.10.0. P. & C. 10/-.

"Parvalux" Reversible 100 RPM Geared Motor Type S.D.14, 230/250v. A.C., 22 lb./in. Standard foot mounted, variable angle final drive. Removable 9-tooth chain spigot on 3/16" spindle. 1st class condition. £7.10.0 each. P. & P. 10/-.

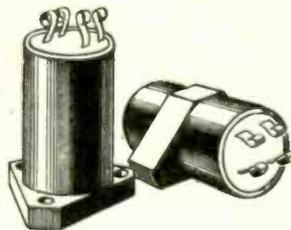


K.L.G. Sealed Terminals. Type TLS1 AA, overall length 1 1/16", box of 100, 25s. Type TLS1 BB, overall length 1", box of 100, 35s. P. & P. Free.

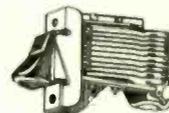


MINIATURE "LATCHMASTER" RELAY

Either 6, 12, or 24v. D.C. operation. One make one break, contacts rated 5 amps at 30 volts. Once current is applied, relay remains latched until input polarity is reversed. Manufactured for high acceleration requirements by Sperry Gyroscope Co. Size: Length 1", dia. 9/16" (including mount). Actual size as illustrated. Please state vertical or horizontal mount. £3.10.0 each. P. & P. free.



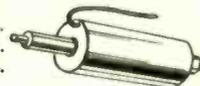
New beautifully-made 3 change-over Key-Switch. Neat action, either locking or spring-return, as required determined by reversing fixing-plate. Attractive plastic prestle. Available red, green, grey, cream. Limited number only. 17/6 each. P. & P. 1/6.



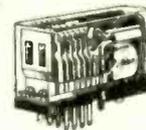
New "Magnetic Devices" solenoid 240v. A.C. Type 42117, 1 to 3 lb. pull, frame size 1 1/2" x 1 1/2" x 1". 20/- each. P. & P. free.



4 1/2v. to 9v. Solenoid. 1" pull. Very powerful, length 1 1/2", dia. 1 1/16". 9/6 each. P. & P. 1/-.



"AUTOMATIC ELECTRIC" ENCLOSED RELAYS
6v. 50Ω 2 c/o, 14/6
24v. 470Ω 4 c/o, 15/6
48v. 2,780Ω 4 c/o, 15/6
48v. 1,260Ω 6 c/o, 18/6
P. & P. free.



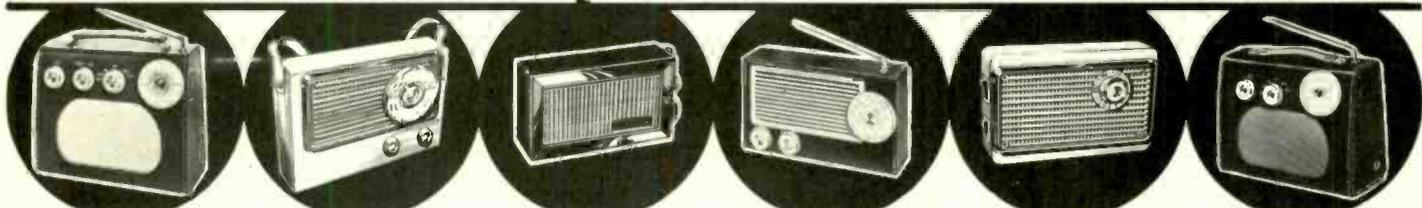
MINIATURE B.P.L. 500-0/500 Micro-Ammeter. 13/16" Diam. scale. Through-Panel mounting. 45/- P. & P. free.

LABORATORY EQUIPMENT. We have a very wide range of laboratory equipment of all kinds; centrifuges, ovens, balances, etc.; all types of lab. glassware far too diverse to advertise or to enter into correspondence over. All new equipment but well under maker's prices. Callers only. We are sure you will be delighted with the variety of items available to you at our newly acquired premises at:
264 Pentonville Road, N.1 (one min. from Kings X Station). Tel. TERminus 7401/2

ELECTRO-TECH SALES

WW-130 FOR FURTHER DETAILS

BUILD YOURSELF A QUALITY TRANSISTOR RADIO !



NEW! ROAMER EIGHT Mk 1 WITH TONE CONTROL SEVEN WAVEBANDS— MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. 8 transistors and 3 diodes. Ferrite rod aerial and telescopic aerial. Socket for car aerial 7 x 4 in. Speaker. Airspaced ganged tuning condensers. Earpiece socket and earpiece. Selectivity switch. Size 9 x 7 x 4 in. Total Building Costs £6.18.6 P. & P. 7/8 Plans and Parts list 5/- (free with parts).

ROAMER SIX, 6 WAVEBANDS— MW1, MW2, SW1, SW2, LW AND TRAWLER BAND. 6 transistors and 2 diodes. Ferrite rod and telescopic aerials, speaker. Size 7 1/2 x 5 1/2 x 1 1/2 in. Building Costs 79/6 P. & P. 4/8 Plans and Parts list 2/- (free with parts). Carrying Strap 1/8 extra.

POCKET FIVE, MED. AND LONG WAVES & TRAWLER BAND to approx. 50 metres WITH SPEAKER AND EARPIECE. 5 transistors and 2 diodes, ferrite rod aerial, tuning condensers, moving coil speaker, etc. 5 1/2 x 1 1/2 x 3 1/2 in. Total Building Costs 44/6 P. & P. 3/6. Plans and Parts list 1/8 (free with parts).

NEW! TRANSEIGHT WAVEBANDS. MW, LW, 3 SHORT WAVES AND TRAWLER BAND. 8 Improved type transistors and 3 diodes Ferrite rod and telescopic aerials. 3in. speaker. Push pull output. Size 9 x 5 1/2 x 2 1/2 in. Total Building Costs 89/6 P. & P. 5/8 Plans and Parts list 5/- (free with kit). Personal earpiece with switched socket for private listening 5/- extra.

TRANSONA FIVE MED. AND LONG AND TRAWLER BAND to approx. 50 metres WITH SPEAKER AND EARPIECE. 5 transistors and 2 diodes, ferrite rod aerial, moving coil speaker, 6 1/2 x 4 1/2 x 1 1/2 in. Total Building Costs 47/6 P. & P. 3/8. Plans and Parts list 1/8 (free with parts).

ROAMER SEVEN Mk 4.7 WAVE BANDS— 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 4 in. speaker. Airspaced ganged tuning condensers etc. Size 9 x 7 x 4 in. Total Building Costs £5/19/6 P. & P. 7/8 Personal earpiece with switched socket for private listening 5/- extra. Plans and Parts list 3/- (free with parts).

RADIO EXCHANGE CO. LTD. Dept WW. 61 High Street, Bedford. 'Phone 0234 52367

• Open 10-1, 2.30-4.30, Sat. 9-12.

WW-131 FOR FURTHER DETAILS

SPECIAL MONEY SAVING DISCOUNTS

on the Best Hi-Fidelity Equipment on the Market Today

AMPLIFIERS

	Rec. Retail Price	Discount Price
ARENA F210 2 x 10 watts Stereo Amplifier teak case	£34 13 0	£29 10 0
DULCI 207 Stereo Amplifier	£25 0 0	£17 5 0
DULCI 207M as above but accepts magnetic cartridge	£30 0 0	£21 15 0
GOODMANS Maxamp teak or walnut	£54 0 0	£42 15 0
LEAK Stereo 30 plus chassis model	£53 0 0	£43 10 0
LEAK Stereo 30 plus teak case	£59 10 0	£48 12 6
Leak Stereo 70 chassis model	£63 0 0	£50 15 0
Leak Stereo 70 plus teak case	£69 10 0	£55 15 0
NIKKO TRM 40B	£46 10 0	£39 10 0
NIKKO TRM 120	£95 0 0	£84 10 0
ROGERS RAVENSBROOK teak case	£64 0 0	£54 10 0
ROGERS RAVENSBROOK chassis model	Limited Quantity	£34 10 0
ROGERS RAVENSBROOK in teak case	£46 10 0	£39 10 0
SANSUI AU 222	£62 17 7	£56 10 0
SANSUI AU 555	£80 9 7	£69 10 0
TRUVOX TSA200 teak case	£54 12 0	£45 5 0
ROGERS Cadet Mark III teak case	£37 10 0	£34 10 0
QUAD 33 Control Unit and 303 Power Amplifier	£98 0 0	£92 10 0
TELETON 203E	£28 7 6	£22 10 0

FM TUNERS

ARENA F211 with Decoder	£39 18 0	£34 15 0
DULCI FMT7 Mono tuner	£22 1 0	£18 10 0
DULCI FMT7S Stereo tuner	£29 8 0	£23 10 0
GOODMANS Stereoamx teak stereo tuner	£82 10 5	£70 10 0
LEAK Stereo Troughline tuner chassis mounting	£51 10 6	£39 10 0
LEAK Stereo Troughline teak case	£59 13 10	£48 10 0
QUAD Stereo Tuner	£50 0 0	£45 15 0
TRUVOX FM200 Iest Decoder	£37 12 11	£32 10 0

TUNER AMPLIFIERS

ARENA TI500 teak only	£64 1 0	£57 10 0 (add 7 gns. for decoder)
ARMSTRONG 425	£79 14 9	£71 10 0
ARMSTRONG 426	£88 19 0	£79 10 0
B & O Beomaster 1000	£101 15 0	£94 10 0
GOODMANS 3000	£77 14 7	£67 10 0 (with decoder)
NIKKO FAM 12F	£68 8 3	£59 10 0
NIKKO ST 701	£136 3 11	£120 0 0
SANSUI 350	£129 1 0	£114 10 0
SANSUI 2000	£162 3 0	£147 10 0
SANSUI DC60 2 x 30 watts rms	£99 0 0	£89 10 0 (with decoder)
TELETON F2000 2 x 5 watts rms	£43 0 0	£37 10 0 (with decoder)
TELETON R8000 Tuner/Amplifier with 2 speaker enclosures	£70 19 0	£49 10 0 (with decoder)

SPEAKERS

(Prices quoted for single speaker unless otherwise specified)

ARENA HT14 bookshelf type in teak	£14 3 0	£12 10 0
ARENA HT10 teak or rose-wood	£19 19 0	£17 10 0
CELESTION Dition 10	£21 13 1	£17 15 0
CELESTION Dition 15	£31 3 7	£26 5 0
GOODMANS Maxim	£20 15 6	£16 15 0
GOODMANS Mezzo II	£30 18 0	£25 10 0
GOODMANS Magnum K	£40 2 0	£29 15 0
LEAK Sandwich	£43 10 0	£37 10 0
LEAK Mini Sandwich	£29 15 0	£25 5 0
LOWTHER Accoustas PM6	£45 10 0	£40 10 0
LOWTHER Accoustas PM7	£55 10 0	£50 10 0
KEF Celeste	£29 0 0	£25 0 0
KEF Concord	£43 10 0	£37 10 0
QUAD Electrostatic	£66 0 0	£59 10 0
WHARFEDALE Denton per pair	£33 12 0	£29 10 0
WHARFEDALE Super Linton per pair	£42 0 0	£37 10 0
WHARFEDALE Dovedale III.	£39 10 0	£32 19 6
WHARFEDALE Unit 3 Speaker Kit	£10 17 6	£9 5 0

PLAYING DECKS

	Rec. Retail Price	Discount Price
GARRARD 401	£31 14 2	£27 0 0
GARRARD AP75	£23 16 7	£17 15 0
GARRARD SP25 Mark II	£15 11 11	£11 5 0
GARRARD SRP22	£6 12 10	£5 10 0
GARRARD SL95	£45 9 1	£34 10 0
GARRARD SL75	£35 12 5	£30 10 0
GARRARD SL65	£18 8 4	£14 17 6
GARRARD SL55	£13 17 9	£11 12 6
GARRARD 60 Mark II	£17 5 10	£14 19 6
GARRARD 3500	£12 4 10	£10 19 6
GARRARD 2025 T/C	£11 3 11	£10 10 0
GARRARD 1025	£10 6 2	£9 10 0
GOLDRING GL68	£22 7 2	£17 15 0
GOLDRING GL75	£35 15 5	£28 15 0
GOLDRING GL75P	£46 18 8	£37 10 8
THORENS TD150	£29 8 1	£26 10 0
THORENS TD150A	£35 14 6	£31 10 0
THORENS TD150AB	£39 16 9	£35 10 0
THORENS TD125	£63 4 9	£54 5 0

Plinths, tops and accessories of above available at 10% discount on retail price.

STEREO CARTRIDGES

AUDIO TECHNICA AT66	£6 6 0	£5 10 0
SHURE M3DM	£7 8 3	£6 2 6
SHURE 31E	£12 19 5	£11 10 0
SHURE 21E	£12 0 11	£10 15 0
SHURE 55E	£16 13 6	£13 19 0
SHURE 44E	£14 16 6	£12 19 6
SHURE M75E	£25 18 10	£23 5 0
SHURE V13 Mk II	£40 15 3	£35 0 6
GOLDRING C590	£5 4 0	£4 2 6
GOLDRING 800	£13 0 0	£11 12 6

STEREO TAPE DECKS AND RECORDERS

AIWA TP 1006H professional stereo tape recorder	£207 18 0	£169 10 0
AIWA TP 1011 professional stereo 3 head tape deck	£164 6 0	£139 10 0
SANYO MR910 4 track stereo tape recorder	£83 10 0	£74 10 0
SANYO MR929 4 track stereo tape recorder, 2 detachable speakers	£100 16 0	£89 10 0
SANYO MR801 stereo tape deck	£79 0 0	£67 10 0

BATTERY/MAINS PORTABLE TAPE RECORDERS

GRUNDIG C 2200	£97 19 0	£72 10 0
NATIONAL RQ4015	£40 11 9	£34 10 0
NATIONAL RQ1135	£22 10 0	£18 0 0
NATIONAL RQ335	£34 12 0	£28 10 0
NATIONAL RQ1585	£75 12 0	£59 10 0
NATIONAL Cassette Recorder	£31 10 0	£26 10 0
TOSHIBA Recorder	£39 18 0	£34 10 0
PHILIPS EL3002	£31 10 0	£26 5 0 (mains unit extra)

COMPLETE HI-FI SYSTEMS

PHILIPS GF818 Philips auto-change player, integrated 2 x 4 watts amplifier, 2 separate speakers, all in teak finish	£51 9 0	£45 0 0
RADON 404 SYSTEM Garrard SP25, separate 2 x 8 watt amplifier, 2 bookshelf type speakers, teak or blond oak	£57 4 0	£49 10 0
WINDSOR 1500 Garrard 2025 T/C, integrated 2 x 4 watt amplifier, 2 separate speakers, all finished in teak	£57 15 0	£49 19 6
TOSHIBA SOPHIA Transcription turntable, magnetic cartridge, integrated tuner amplifier, with stereo decoder, fitted hinged perspex top, 2 separate speakers, walnut finish	£82 19 0	£75 0 0
SANYO DC534E Transcription turntable, magnetic cartridge, integrated tuner/amplifier, 2 x 12 watts rms, decoder, fitted hinged perspex top	£132 10 0	£119 10 0
Matching SANYO SX/X speakers per pair	£37 16 0	£32 10 0

NEW TITLES FROM BUTTERWORTHS—ILIFFES—NEWNES

Electromagnetic Theory: Problems and Solutions Volume 1

By K. Foster, MA, and R. Anderson, BSc.

This book provides in convenient form a number of carefully selected problems and solutions which the student often finds lacking in his other teaching books. The authors believe that the subject of electromagnetism cannot be thoroughly understood until the student has been able to spend some time solving problems on the subject matter. The selection of problems has been made with various criteria in mind: techniques the student must acquire, representative problems from exam papers, development of the necessary elusive 'feeling for the subject' and practical examples based on experimental results derived from field plotting equipment. This volume should admirably meet the needs of students who are undergoing the first year of a course of electromagnetic theory for an engineering, physics or mathematics degree.

1969 212 pages illustrated limp 30s.

Radio and Line Transmission—Vol. 1 2nd Edition

By G. L. Danielson, MScTech, BSc, CEng, MIEE.

This volume and its sequel (coming shortly) are written with the intention of providing a broadly-based introduction to the subject of communications and to the basic theory necessary to its understanding. In this second edition, the opportunity has been taken of bringing the material of the book into line with recent developments and with changes in the major syllabuses, particularly that of the City and Guilds.

1969 276 pages 239 illustrations 25s.

Television Engineering Principles and Practice Volume 3: Waveform Generation

By S. W. Amos, BSc, CEng, MIEE, D. C. Birkinshaw, MBE, MA, CEng, FIEE, and K. H. Green, CEng, MIERE.

The first edition of this textbook written by members of the BBC Engineering Division was very well received. New sections, such as information on circuits based on transistors, have now been added to the original material which deals with the application to television of sinusoidal, rectangular, sawtooth and parabolic waves. Also, sections dealing with the generation of waves have been extensively re-written. Television engineers and engineering students should find this volume most helpful.

1969 268 pages 15c illustrations 70s.

Available from your bookseller or:

THE BUTTERWORTH GROUP
88 Kingsway
London WC2
WW135—FOR FURTHER DETAILS

All goods are in manufacturer's sealed cartons and are insured against loss or damage in transit. Guaranteed "by return" service. Add 7/6 to all orders for p. & p. Send cash/cheque with order to:

Smith's Radio Service (Wolverhampton) Ltd.

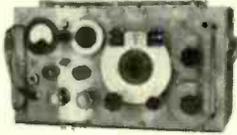
Mail Order Department, 26 Victoria Street, Wolverhampton, Staffs. Tel: Wolv. 29246

GENUINE ONCE A YEAR CLEARANCE SALE

25 ONLY TO CLEAR. All brand new and in original CASES & PACKING. Currently being advertised at £85-0-0 for used ones. **OUR PRICE while they last £25-0-0 P. & P. 30/-.** And these are NEW with money back guarantee.

TRADE ENQUIRIES FOR QUANTITY RATE

MARCONI TF801-A SIGNAL GENERATOR
10=300 mc/s in 4 bands. Internal mod at 400 c/s 1 Kc/s. External 50 c/s to 10 Kc/s. Output 0-100db. Below 200 mv at 75 Ω source. Complete with full kit of spares. All leads and instruction book.



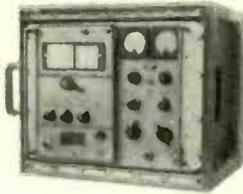
12 only to clear in mint condition.
RACAL Frequency Counter Type S.A.20.
0-100 Kc/s. Auto or Man. count.

OUR PRICE £25 P. & P. £1-0-0

TRADE ENQUIRIES FOR QUANTITY

6 ONLY LEFT TO CLEAR AT £50 EACH

This signal generator is currently advertised at double this figure. Ours are in mint condition and complete with all leads. (Money back if not satisfied.) Marconi A.M. F.M. signal generator T.F.937 (CT218). 56 F.T. film scale, 85 Kc/s=30 mc/s in 8 ranges. Output: 1uv-100mv at 75 ohms. High level output of 1v. Internal modulation 400 c/s=1 Kc/s=1.6 Kc/s=3 Kc/s. A.M. 15 Kc/s=90 Kc/s. Deviation F.M. Extnl.=50 c/s=12 Kc/s. Built-in crystal calibrator.



We also have 5 T.F.948 models left at the same ridiculous price of £50, which are the same as above, but freq. range 20-80 mc/s in 2 bands with F.M. deviation up to 600 Kc/s.

We hold very large stocks of test equipment, teleprinter and telegraph equipment. Millions of new condensers. Industrial valves and components. (Trade enquiries invited.) Send 2/6 for stock list.

THE TRADING POST

TECHNICAL DIVISION

4 CASTLE STREET, HASTINGS, SX. Telephone: Hastings 2875

WW-132 FOR FURTHER DETAILS



EDDYSTONE COMMUNICATION RECEIVERS

FROM £59-10-0

COVERING 10KHZ-870MHZ

ILLUSTRATED LEFT-830/7 HIGH GRADE G.P. HF/MF RECEIVER COVERING 300KHZ-30MHZ IN 9 RANGES. DOUBLE CONVERSION FROM 1.5 MHZ. PANORAMIC UNIT FOR VISUAL DISPLAY

SEND 6d. STAMP FOR GENERAL RECEIVER LEAFLET OR SPECIFY FREQUENCY COVERAGE REQUIRED.

SOUTH COAST EDDYSTONE CENTRE COSH & HAMMOND

29 BEACH RD., LITTLEHAMPTON, SUSSEX. TEL: 4477

EXPORT WELCOMED—RANGE IN STOCK—COMPONENTS

WW-133 FOR FURTHER DETAILS



SANWA MULTI TESTERS

USED THROUGHOUT THE WORLD, SANWA'S EXPERIENCE OF 30 YEARS ENSURES ACCURACY, RELIABILITY, VERSATILITY. UNSURPASSED TESTER PERFORMANCE COMES WITH EVERY SANWA

6 Months' Guarantee - Excellent Repair Service	
Model P-1B	£3 7 6
Model JP 5D	£5 10 0
Model U-50D	£7 5 0
Model 360-YTR	£7 17 6
Model AT-1	£11 7 6
Model 380-CD	£13 5 0
Model F-80TRD	£13 15 0
Model 430-ES	£19 0 0
Model EM-700	£51 0 0

MODEL U-50D

PLEASE WRITE FOR ILLUSTRATED LEAFLETS OF THESE SANWA METERS

SOLE IMPORTERS IN U.K.

QUALITY ELECTRONICS LTD.

47-49 HIGH STREET, KINGSTON-UPON-THAMES, SURREY. Tel: 01-546 4585

WW-134 FOR FURTHER DETAILS

LATEST RELEASE OF

RCA COMMUNICATION RECEIVERS AR88



BRAND NEW and in original cases—A.C. mains input. 110V or 250V. Freq. in 6 bands 535 Kc/s-32 Mc/s. Output impedance 2.5-600 ohms. Complete with crystal filter, noise limiter, B.F.O., H.F. tone control, R.F. & A.F. variable controls. Price £87/10/- each, carr. £2.

Same model as above in secondhand cond. (guaranteed working order), from £45 to £60, carr. £2.

*SET OF VALVES: new, £3/10/- a set, post 7/6; **SPEAKERS:** new, £3 each, post 10/-; *HEADPHONES: new, £1/5/- a pair, 600 ohms impedance. Post 5/-.

AR88 SPARES. Antenna Coils L5 and 6 and L7 and 8. Oscillator coil L55. Price 10/- each, post 2/6. RF Coils 13 & 14; 17 & 18; 23 & 24; and 27 and 28. Price 12/6 each. 2/6 post. By-pass Capacitor K.98034-1, 3×0.05 mfd. and M.980344, 3×0.01 mfd., 3 for 10/-, post 2/6. Trimmers 95534-502, 2-20 p.f. Box of 3, 10/-, post 2/6. Block Condenser, 3×4 mfd., 600 v., £2 each, 4/- post. Output transformers 901666-501 27/6 each, 4/- post.

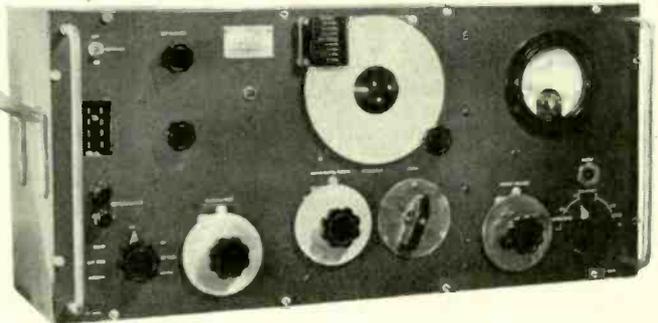
* Available with Receiver only.

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



MARCONI SIGNAL GENERATORS

TYPE TF-144G

Freq. 85Kc/s-25Mc/s in 8 ranges. Incremental: +/- 1% at 1Mc/s. Output: continuously variable 1 microvolt to 1 volt. Output Impedance: 1 microvolt to 100 millivolts, 10 ohms 100mV-1 volt-52.5 ohms. Internal Modulation: 400 c/s sinewave 75% depth. External Modulation: Direct or via internal amplifier. A.C. mains 200/250V, 40-100 c/s. Consumption approx. 40 watts. Measurements: 19½×12½×10 in. The above come complete with Mains Leads, Dummy Aerial with screened lead, and plugs. As New, in Manufacturer's cases, £40 each. Carr. 30/-. DISCOUNT OF 10% FOR SCHOOLS, TECHNICAL COLLEGES, etc.

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. Complete HRO 5T SET (Receiver, Coils and Power Unit) for £30, plus 30/- carr.

COMMAND RECEIVERS; Model 6-9 Mc/s., as new, price £5/10/- each, post 5/-.

COMMAND TRANSMITTERS, BC-458: 5.3-7 Mc/s., approx. 25W output, directly calibrated. Valves 2 x 1625 PA; 1 x 1626 osc.; 1 x 1629 Tuning Indicator; Crystal 6,200 Kc/s. New condition—£3/10/- each, 10/- post.

(Conversion as per "Surplus Radio Conversion Manual, Vol. No. 2," by R. C. Evenson and O. R. Beach.)

AIRCRAFT RECEIVER ARR. 2: Valve line-up 7 x 9001; 3 x 6AK5; and 1 x 12A6. Switch tuned 234-258 Mc/s. Rec. only £3 each, 7/6 post; or Rec. with 24 v. power unit and mounting tray £3/10/- each, 10/- post.

RECEIVERS: Type BC-348, operates from 24 v D.C., freq. range 200-500 Kc/s, 1.5-18 Mc/s. (New) £35.0.0 each; (second hand) £20.0.0 each, good condition, carr. 15/- both types.

MARCONI RECEIVER 1475 type 88: 1.5-20 Mc/s, second-hand condition £10.0.0 each. New condition £25.0.0 each, carr. 15/-.

RACAL EQUIPMENT: RA. 17 Outer Metal case for receiver available, as new, £10 each, carr. £1. Frequency Meter type SA20: £35 each, carr. £1. Frequency Counter type SA21: £65 each, carr. 30/-. Diversity Switching Unit type MA. 168: £35 each, post 10/-. Receiver Converter SA.80: 25 Mc/s-160 Mc/s, £40 each, carr. £1.

ROTARY CONVERTERS: Type 8a, 24 v D.C., 115 v A.C. @ 1.8 amps, 400 c/s 3 phase, £6/10/- each, 8/- post. 24 v D.C. input, 175 v D.C. @ 40mA output, 25/- each, post 2/-.

CONDENSERS: 150 mfd, 300 v A.C., £7/10/- each, carr. 15/-. 40 mfd, 440 v A.C. wkg., £5 each, 10/- post. 30 mfd, 600 v wkg. D.C., £3/10/- each, post 10/-. 15 mfd, 330 v A.C. wkg., 15/- each, post 5/-. 10 mfd, 1000 v, 12/6 each, post 2/6. 10 mfd, 600 v, 8/6 each, post 5/-. 8 mfd, 1200 v, 12/6 each, post 3/-. 8 mfd, 600 v, 8/6 each, post 2/6. 4 mfd, 3000 v wkg., £3 each, post 7/6. 2 mfd, 3000 v wkg., £2 each, post 7/6. 0.25 mfd, 32,000 v, £7/10/- each, carr. 15/-. 0.25 mfd, 2Kv, 4/- each, 1/6 post. 0.01 mfd. MICA 2.5 Kv. Price £1 for 5. Post 2/6. Capacitor: 0.125 mfd, 27,000v wkg. £3.15.0 each, 10/- post.

AVO MULTIRANGE No. 1 ELECTRONIC TEST SET: £25 each, carr. £1.

OSCILLOSCOPE Type 13A, 100/250 v. A.C. Time base 2 c/s.-750 Kc/s. Bandwidth up to 5 Mc/s. Calibration markers 100 Kc/s. and 1 Mc/s. Double Beam tube. Reliable general purpose scope, £22/10/- each, 30/- carr.

COSSOR 1035 OSCILLOSCOPE, £30 each, 30/- carr.

COSSOR 1049 Mk. 111, £45 each, 30/- carr.

RELAYS: GPO Type 600, 10 relays @ 300 ohms with 2M and 10 relays @ 50 ohms with 1M., £2 each, 6/- post. 12 Small American Relays, mixed types £2, post 4/-.

Many types of American Relays available, i.e., Sigma; Allied Controls; Leach; etc. Prices and further details on request 6d.

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.

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/-.

SYNCHROS: and other special purpose motors available. British and American ex stock. List available 6d.

TCS MODULATION TRANSFORMERS, 20 watts, pr. 6,000 C.T., sec. 6,000 ohms. Price 25/-, post 5/-.

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.

FOR EXPORT ONLY: B.44 Transceiver Mk. III. Crystal control, 60-95 Mc/s. **AMERICAN EQUIPMENT:** BC-640 Transmitter, 100-156 Mc/s., 50 watt output. For 110 or 230 v. operation. ARC 27 transceivers, 28 v. D.C. input. Also have associated equipment. BC-375 Transmitter. BC-778 Dinghy transmitter. SCR-522 transceiver. Power supply, PP893/GRC 32A; Filter D.C. Power Supply F-170/GRC 32A; Cabinet Electrical CY 1288/GRC 32A; Antenna Box Base and Cables CY 728/GRC; Mast Erection Kits, 1186/GRC; Directional Antenna CRD.6; Comparator Unit, CM.23; Directional Control CRD.6, 567/CRD and 568/CRD; Azimuth Control Units, 260/CRD. Test Set URM.44, complete with Signal Generator TS.622/U.

SOLENOID UNIT: 230 v. A.C. input, 2 pole, 15 amp contacts, £2/10/- each post 6/-.

CONTROL PANEL: 230 v. A.C., 24 v. D.C. @ 2 amps., £2/10/- each, carr. 12/6.

AUTO TRANSFORMER: 230-115 v.; 1,000 w. £5 each, carr. 12/6. 230-115 v.; 300VA, £3 each, carr. 10/-.

OHMITE VARIABLE RESISTOR: 5 ohms, 5 1/2 amps; or 2.6 ohms at 4 amps. Price (either type) £2 each, 4/6 post each.

POWER SUPPLY UNIT PN-12B: 230 v. A.C. input, 395-0-395 v. output @ 300 mA. Complete with two x 9H chokes and 10 mfd. oil filled capacitors. Mounted in 19in. panel, £6/10/- each, £1 carr.

TX DRIVER UNIT: Freq. 100-156 Mc/s. Valves 3 x 3C24's; complete with filament transformer 230 v. A.C. Mounted in 19in. panel, £4/10/- each, 15/- carr.

POWER UNIT: 110 v. or 230 v. input switched; 28 v. @ 45 amps. D.C. output. Wt. approx. 100 lbs., £17/10/- each, 30/- carr. **SMOOTHING UNITS** suitable for above £7/10/- each, 15/- carr.

DE-ICER CONTROLLER MK. III: Contains 10 relays D.P. changeover heavy duty contacts, 1 relay 4P, C/O. (235 ohms coil). Stud switch 30-way relay operated, one five-way ditto, D.C. timing motor with Chronometric governor 20-30 v., 12 r.p.m.; geared to two 30-way stud switches and two Ledex solenoids, 1 delay relay etc., sealed in steel case (4 x 5 x 7 ins.) £3 each, post 7/6.

MODULATOR UNIT: 50 watt, part of BC-640, complete with 2 x 811 valves, microphone and modulator transformers etc. £7/10/- each, 15/- carr.

ADVANCE TEST EQUIPMENT: VM78 A.C. Millivoltmeter (transistorised) £55 each; TT15 Transistor Tester (CT472) £37/10/- each; VM77C Valve Voltmeter £40 each. Carr. 10/- extra per item.

NIFE BATTERIES: 4 v. 160 amps, new, in cases, £20 each, £1 10/- carr.

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/-.

UNISELECTORS (ex equipment): 5 Bank, 50 Way, 75 ohm Coil, alternate wipe, £2/5/- each, post 4/-.

FREQUENCY METERS: BC-221, meter only £30 each, BC-221 complete with stabilised power supply, £35 each, carr. 15/-. LM13, 125-20,000 Kc/s., £25 each, carr. 15/-. TS.175/U, £75 each, carr. £1. TS323/UR, 20-450 Mc/s., £78 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.

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/-.

CATHODE RAY TUBE UNIT: With 3in. tube, colour green, medium persistence complete with nu-metal screen, £3/10/- each, post 7/6.

APNI ALTIMETER TRANS./REC., suitable for conversion 420 Mc/s., complete with all valves 28 v. D.C. 3 relays, 11 valves, price £3 each, carr. 10/-.

TEST EQUIPMENT

MARCONI	TF-142F	Distortion Factor Meter	..	..	£85 each
	TF-1274	VHF Bridge Oscillator	..	..	£75 each
	TF-1275	VHF Bridge Detector	..	..	£75 each
	TF-1067/1	Heterodyne Frequency Meter	..	..	£85 each
	TF-899	Valve Millivoltmeter	..	..	£35 each
	TF-978	VHF Admittance Bridge	..	..	£85 each
	TF-894A	Audio Tester	..	..	£55 each
	TF-868	Universal Bridge	..	..	£75 each
	TF-329G	Circuit Magnification Meter	..	..	£45 each
	TF-428/2	Valve Voltmeter	..	..	£12/10/- each
	TF-428/1	Valve Voltmeter	..	..	£8/10/- each
	TF-726C	UHF Signal Generator	..	..	£65 each
	TF-934	Deviation Test Meter	..	..	£35 each
	6075A	Deviation Test Meter	..	..	£65 each
	TF-987/1	Noise Generator	..	..	£20 each
	TF-956	(CT.44) A.F. Absorption Wattmeter	..	..	£20 each
FIRZ HILL	V.200	Sensitive Valve Voltmeter	..	..	£35 each
	B.810	Incremental Inductance Bridge	..	..	£75 each
SOLATRON	CD-513	Oscilloscope	..	..	£45 each
	CD-513-2	Oscilloscope	..	..	£47/10/- each
	AW-553	Power Amplifier	..	..	£30 each
AIRMEC	Type 701	Signal Generator	..	..	£50 each
POLARAD	Type MSG-1	Microwave Signal Generator,	..	..	£100 each
	950-2400 Mc/s		..	..
PHILLIPS	Type GM-6008	Valve Voltmeter	..	..	£35 each
DAWE	Type 402C	Megohm Meter	..	..	£12 each

CANADIAN C52 TRANS/REC.: Freq. 1.75-16 Mc/s on 3 bands. R.T., M.C.W. and C.W. Crystal calibrator etc., power input 12V. D.C., new cond., complete set £50. Used condition working order £25. Carr. on both types £2/10/- Transmitter only £7/10/- (few only) Carr. 15/-. Power Unit for Rec., new £3/5/-. Used power units in working order £2/5/-. Carr 10/-.

AVOMETERS: Model 47A, £10 each, 10/- post. Excellent secondhand cond. (meters only).

DECADE RESISTOR SWITCH: 0.1 ohm per step. 10 positions. 3 Gang, each 0.9 ohms. Tolerance ±1% £3 each, 5/- post. 90 ohms per step. 10 positions, total value 900 ohms. 3 Gang. Tolerance ±1% £3/10/- each, 5/- post.

TELESCOPIC ANTENNA: In 4 sections, adjustable to any height up to 20 ft. Closed measures 6 ft. Diameter 2 in. tapering to 1 in. £5 each + 10/- carr. Or £9 for two + £1 carr. (brand new condition).

COAXIAL TEST EQUIPMENT: COAXWITCH—Mnfrs. Bird Electronic Corp. Model 72RS; two-circuit reversing switch, 75 ohms, type "N" female connectors fitted to receive UG-21/U series plugs. New in ctns., £8/10/- each, post 7/6. CO-AXIAL SWITCH—Mnfrs. Transco Products Inc., Type M1460-22, 2 pole, 2 throw. (New) £6/10/- each, 4/6 post. 1 pole, 4 throw, Type M1460-4. (New) £6/10/- each, 4/6 post.

PRD Electronic Inc. Equipment: FREQUENCY METER: Type 587-A, 0.250-1.0 KMC/SEC. (New) £75 each, post 12/6. FIXED ATTENUATOR: Type 130c, 2.0-10.0 KMC/SEC. (New) £5 each, post 4/-. FIXED ATTENUATOR: Type 1157S-1, (new) £6 each, post 5/-.

ALL GOODS OFFERED WHILST STOCKS LAST IN "AS IS" CONDITION UNLESS OTHERWISE STATED

CALLERS BY TELEPHONE
APPOINTMENT ONLY

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17

Phone: Tottenham 9213

<p>DIODES. Ex eqpt.. Silicon. 150 PIV. 10 amp. 4 for 10/- 150 PIV. 20 amp. 4 for £1.</p>	<p>MICRO SWITCHES. Miniature button type. 10/- doz. P. & P. 1/6.</p> <p>THERMOSTATS. 1" x 1/2" x 1 1/2". O.C. above 120°F. 1 1/2". 250v. 5/- ea.</p>	<p>New 750µH inductors 5/- doz.</p> <p>Mixed 1/2 and 1/4 W. resistors. 250 for 12/6.</p>
<p>COMPUTER PANELS (as shown) 2in. x 4in. 10 for 10/- + 1/6 p. & p. Guaranteed min. 35 transistors; 25 for £1 p. & p. 3/6 min. 85 transistors; 100 for 65/-, p. & p. 6/8. min. 350 transistors; 1,000 for £30 + carr.</p> <p>GIANT PANELS 5 1/2" x 4" min. 20 transistors 9 x 56 µH. Inductors, resistors, capacitors etc. 3 for £1 + 2/- p. & p.</p> <p>As above, only 21 transistors. 70 diodes, 62 min. 1/10thW resistors, 3 for 25/- P. & P. 2/-.</p>		<p>LARGE CAPACITY ELECTROLYTICS. 4in. 2in diam. Screw terminals.</p> <p>4.000µF 72V d.c. wkg. 7/6</p> <p>10.000µF 25V d.c. wkg. 7/6</p> <p>25.000µF 12V d.c. wkg. 7/6</p> <p>1 1/2" x 4 1/2" screw terminals—2500µF 55V d.c. wkg. 6/- ea.</p> <p>NEW PLESSEY CAPS.</p> <p>1 1/2" x 4 1/2" 5000µF 55V d.c. wkg. 8/- ea.</p> <p>1" x 8" 2000µF 25V d.c. wkg. 6/- ea.</p> <p>NEW SPRAGUE CAP. ACITORS. 0.22µF 250V 5/- doz. P. & P. 1/-.</p> <p>4µF 150V. 5/- doz. P. & P. 1/-.</p> <p>Tantalum—2.2µF 50V non-polar. 10/- doz. P. & P. 1/-.</p>
<p>POWER TRANSISTORS sim. to 2N174 ex. eqpt. on Flinned Heat Sink, £1 for 4 + 5/- p. & p.</p> <p>PANELS with 2 power transistors sim. to OC28 on each board + components. 2 boards (4 x OC28) 10/-, p. & p. 2/-.</p>		
<p>MINIATURE GLASS NEONS. 12/6 doz.</p>		
<p>TRIMMER POTS on 2" x 4" bds. + Ta. caps. and other components. 100 Ω, 500 Ω, 15K, 20K. Please state requirements. 5 for 10/- + 2/- p. & p.</p>		
<p>OVERLOAD CUT OUTS. Panel mounting in the following values 5/- each: 3, 4 amp.</p>		
<p>EXTRACTOR/BLOWER FANS (PAPST) 100 C.F.M. 4 1/2 x 4 1/2 x 2 1/2 in. 2800 R.P.M. 200/250 volt A.C.</p> <p>Very clean, smooth running fans, guaranteed working. 50/- ea. post free.</p>		<p>Not new but workable. Suitable for all applications. Only 19/6 each. p. & p. 5/-.</p> <p>Two for 39/6 post free. Four for 70/- post free.</p>
		
<p>DESK TELEPHONES</p> <p>Complete with dial, cradle, line, connection block, receiver etc.</p>		
<p>KEYTRONICS</p> <p>52 Earls Court Road, London, W.8.</p> <p>MAIL ORDER ONLY 01.478.8499</p>		

WW-137 FOR FURTHER DETAILS

TRANSFORMERS

COILS LARGE OR SMALL QUANTITIES

CHOKES 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-139 FOR FURTHER DETAILS

4-STATION INTERCOM



Our Price Only **£7/15/0**

Solve your communication problems with this new 4-Station Transistor Intercom system (1 master and 3 subs), in de luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Operates on one 9 v. battery. On/off switch. Volume control. Ideally suitable to modernise Office, Factory, Workshop, Warehouse, Hospital, Shop, etc., for instant inter-departmental contacts. Complete with 3 connecting wires, each 66ft. and other accessories. Nothing else to buy. P. & P. 7/6 in U.K.

INTERCOM/BABY ALARM



OUR PRICE ONLY **3 gns.**

Same as 4-Station Intercom for two-way instant conversation from MASTER to SUB and SUB to MASTER. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

7-STATION INTERCOM

(1 MASTER & 6 SUB-STATIONS) in strong metal cabinets. Fully transistorised. 3 1/2 in. Speakers. Call on Master identified by tone and Pilot lamp. Ideally suitable for Office, Hotel, Hospital and Factory. Price 27 gns. P. & P. 14/6 in U.K.

Kinver for Integrated Circuits



LINEAR INTEGRATED CIRCUITS FOR ALL YOUR REQUIREMENTS

Plessey Type SL403A 3 Watt Audio Amplifier	49/6
G. E. Type PA230 Low Level Amplifier	21/-
G.E. Type PA234 1 Watt Audio Amplifier	23/-
G.E. Type PA237 2 Watt Audio Amplifier	34/-
G.E. Type PA246 5 Watt Audio Amplifier	57/-
RCA Type CA3000 D.C. Amplifier	54/9
RCA Type CA3011 Wide Band Amplifier	20/-
RCA Type CA3020 1/2 Watt Wide Band Amplifier	32/-
RCA Type CA3028A Differential/Cascode Amplifier (120 MHz)	20/-
RCA Type CA3029 Operational Amplifier	55/2
RCA Type CA3035 Ultra High Gain Amplifier	30/-
Mullard Type TAA263 A.F. Amplifier	15/9
Mullard Type TAA293 General Purpose Amplifier	21/8
Mullard Type TAA310 Record/Playback Pre-Amplifier	32/-
Mullard Type TAA320 MOS L.F. Amplifier	13/5
G.E. Type 2N5306 Darlington Pair	11/6
G.E. Type O13T1 Programmable Unijunction Transistor	10/8

Add 1/- each to the above i.c.s. for data sheets if required. Data sheets may be purchased separately at 1/6 each post free.

Send now for our COMPONENTS CATALOGUE at only 2/- post free. This catalogue is packed with information on a host of up-to-the-minute components by leading manufacturers. Included are International Rectifier Products, Resistors, Capacitors, Veroboard, Plugs and Sockets, switches etc. Please note that all goods supplied by us are brand new and guaranteed to fully conform to the manufacturer's published specifications.

DISCOUNTS: Order Value of £5—10%; Order Value over £10—15%. Cash with order please Post and packing 1/6 per order.

ELECTRONICS LTD
Kinver

STONE LANE KINVER
STOURBRIDGE WORCS
Telephone: KINVER 2099

WW-138 FOR FURTHER DETAILS

ARE YOU QUALIFIED TO MOVE.

If you are a Design Engineer or in systems test, technical sales, production engineering, field service or technical writing, let **ELECTRONICS APPOINTMENTS** help you. They are in consultation with almost 800 companies on all aspects of electronic engineering.

Among our current vacancies are the following:—

- Senior Sales Engineer**, H.N.C. standard, with extensive selling experience in computer or computer peripheral field. **Salary £3,000.** London based.
- Senior Design Engineer**, H.N.D. or equivalent, as Assistant to Chief Engineer. Experience in modern digital control electronics and high speed counting. **£1,800.** South Herts based.

This placement service is entirely free and confidential. Phone (any time day or night) or write:

ELECTRONICS APPOINTMENTS LTD.
NORMAN HOUSE · 105/109 STRAND · LONDON · W.C.2
TEL · 01-836 5557

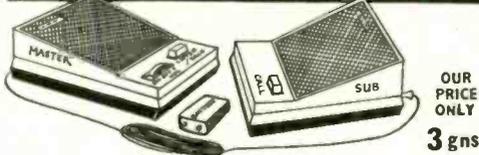
4-STATION INTERCOM



Our Price Only **£7/15/0**

Solve your communication problems with this new 4-Station Transistor Intercom system (1 master and 3 subs), in de luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Operates on one 9 v. battery. On/off switch. Volume control. Ideally suitable to modernise Office, Factory, Workshop, Warehouse, Hospital, Shop, etc., for instant inter-departmental contacts. Complete with 3 connecting wires, each 66ft. and other accessories. Nothing else to buy. P. & P. 7/6 in U.K.

INTERCOM/BABY ALARM



OUR PRICE ONLY **3 gns.**

Same as 4-Station Intercom for two-way instant conversation from MASTER to SUB and SUB to MASTER. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

7-STATION INTERCOM

(1 MASTER & 6 SUB-STATIONS) in strong metal cabinets. Fully transistorised. 3 1/2 in. Speakers. Call on Master identified by tone and Pilot lamp. Ideally suitable for Office, Hotel, Hospital and Factory. Price 27 gns. P. & P. 14/6 in U.K.

Transistor TELEPHONE AMPLIFIER



59/6

Why not increase efficiency of Office, Shop and Warehouse with this incredible De-Luxe Portable Transistor **TELEPHONE AMPLIFIER** which enables you to take down long telephone messages or converse without holding the handset. A useful office aid. A must for every telephone user. Useful for hard of hearing persons. On/off switch. Volume Control. Operates on one 9 v. battery which lasts for months. Ready to operate. P. & P. 3/6 in U.K. Add 2/6 for Battery.

Full price refunded if returned in 7 days.
WEST LONDON DIRECT SUPPLIES (W.W.),
169 Kensington High Street, London, W.8

R+TV

RADIO & TV COMPONENTS (Acton) LTD
21a High Street, Acton, London, W.3.
 also 323 Edgware Road, London, W.2.
 Goods not dispatched outside U.K. Terms C.W.O. All enquiries S.A.E.

Complete stereo system – 28 gns.

The new Duo general-purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:— Impedance 10 ohms. It incorporates Goodmans high flux 6" x 4" speaker and 2½" tweeter. Teak finish 12" x 6½" x 5½". 4 guineas each. 7/6d. p. & p.
Type 2 as type 1. Size 17½" x 10½" x 6½". Incorporating Elac 10½" x 6½" 10,000 lines and 2½" tweeter. 3 ohms impedance 5½ guineas plus 7/6d. p. & p.
 Garrard Changers from £7.19.6d. p. & p. 7/6d.
 Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.



Duetto Integrated Transistor Stereo Amplifier **9GNS.**
 plus 7/6d. p. & p.

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

SPECIFICATION:— R.M.S. power output: 3 watts per channel into 10 ohms speakers.
INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.



The Classic
TEAK FINISHED CASE
8½ GNS.
 plus 7/6 p. & p.
 Built and tested.

SPECIFICATION

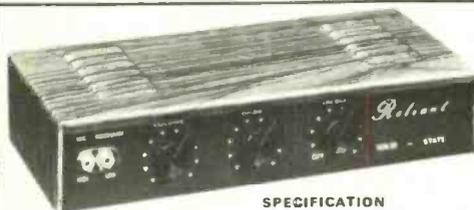
Sensitivities for 10 watt output at 1 KHz into 3 ohms. Tape Head: 3mV (at 3½ l.p.s.). Mag. P.U.: 2 mV. Car. P.U.: 80 mV. Tuner: 100 mV. Aux. 100 mV. Tape/Rec. Output: Equalisation for each input is correct to within ±2dB (R.I.A.A.) from 20 Hz to 20KHz. Tone Control Range: Bass ±13 dB at 60 Hz. Treble ±14 dB at 15 KHz. Total Distortion: (for 10 watt output) <1.5%. Signal Noise: <-60dB. AC Mains 200-250v. Size 12½" long, 4½" deep, 2½" high.



The Viscount
INTEGRATED HIGH FIDELITY TRANSISTOR STEREO AMPLIFIER
13½ GNS. + 7/6 p. & p.

SPECIFICATION

SIZE: 12½" x 6" x 2½" in teak-finished case. Built and tested.
OUTPUT: 10 watts per channel into 3 to 4 ohms speakers (20 watts) monoral.
INPUT: 6-position rotary selector switch (3 pos. mono and 3 pos. stereo). P.U. Tuner, Tape and Tape Rec. out Sensitivities: All Inputs 100 mV into 1.8M ohm.
FREQUENCY RESPONSE: 40Hz-20KHz ±2DB.
TONE CONTROLS: Separate bass and treble controls. TREBLE 13dB lift and cut (at 15KHz) BASS: 15dB lift and 25dB cut (at 50Hz).
VOLUME CONTROLS: Separate for each channel. AC MAINS INPUT: 200-240v. 50-60Hz.
Viscount Mark II for use with magnetic pick ups specification as above. Fully equalised for magnetic pick ups. Suitable for cartridges with minimum output of 4mV/cm/sec. at 1kc. Input Impedance 47k. **15 gns** plus 7/6 p.&p.



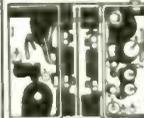
THE RELIANT MK.II
Solid State
General Purpose Amplifier
 In teak-finished case
6½ GNS.
 + 7/6 p. & p.

SPECIFICATION

OUTPUT: 10 watts into a 3 ohms speaker.
INPUTS: (1) for mike (10 m.v.). Input (2) for gram. radio (250 m.v.) individual bass and treble control.
TRANSISTORS: 4 silicone and three germanium.

MAINS INPUT: 220/250 volts.
SIZE: 10½" x 4½" x 2½".
MIKE TO SUIT (CRYSTAL): 12/6d. 1/6d. p. & p.
8" x 5" speaker 14/6d. 4/3- p. & p.
Mk. 1 5gns. + 7/6d. p. & p. less Teak-finished case.

X101 10w. SOLID-STATE HI-FI AMP
 With Integral Pre-amp.



Specifications: Power Output (into 3 ohms speaker) 10 watts. Sensitivity (for rated output): 1mV into 3K ohms (0.33 microamp) Total Distortion (at 1 KHz): At 5 watts 0.35%. At rated output 1.5%. Frequency Response: Minus 3 dB points 20 Hz and 40 KHz. Speaker: 3-4 ohms. (3-15 ohms may be used). Supply voltage: 24v D.C. at 800 mA. (6-24v may be used).

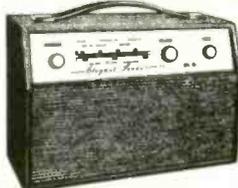
69/6 plus 2/6 p. & p.

CONTROL ASSEMBLY: (including resistors and capacitors). 1. Volume: Price 5/-. 2. Treble: Price 5/-. 3. Comprehensive bass and treble: Price 10/-. The above 3 items can be purchased for use with the X101. **POWER SUPPLIES FOR X101:** P101 M (mono) 35/- p. & p. 4/6; P101 (stereo) 42/8 p. & p. 4/6.



THE DORSET
 (600mW Output)
£55.50
 plus 7/6 p. & p.
 Circuit 2/6. FREE WITH PARTS
MAINS POWER PACK KIT:
 9/6 extra.

7-transistor fully tunable M.W.-L.W. superhet portable—with baby alarm facility. Set of parts. The latest modularized and pre-alignment techniques makes this simple to build. Sizes: 12" x 8" x 3".



ELEGANT SEVEN
MK. III
 (350mW Output)
£49.6
 plus 7/6 p. & p.
 Circuit 2/6. FREE WITH PARTS
MAINS POWER PACK
KIT: 9/6 extra.

7-transistor fully tunable M.W.-L.W. superhet portable. Set of parts. Complete with all components. Including ready etched and drilled printed circuit board—back printed for foolproof construction.

50 WATT AMPLIFIER



AC MAINS 200-250V
27 gns.
 plus 20/- p. & p.

An extremely reliable general purpose valve Amplifier—with six electronically mixed inputs. Suitable for use with: mics. guitars. gram. tuner. organ. etc. Separate bass and treble controls. Output impedance 3, 8 and 15 ohms.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.
£2.10 + 1/- p. & p.



MOTEK

3 speed 2 track Tape Deck complete with heads, takes 7in. spool. Incorporating 3 motors. A.C. mains. 240 volts. listed at £21.0.0.

Our Price £9.19.6
 plus 10/- p. & p.

SPECIAL OFFER

Complete stereo systems comprising BALFOUR 4 speed auto player with stereo head 2 DUO speaker systems size 12 x 6½ x 5½. Plinth (less cover) and the DUETTO stereo amplifier. All above items

19 GNS. plus 20/- p. & p.

Z AND AERO SERVICES LTD



INTEGRATED CIRCUIT AMPLIFIERS

CA3005 RF Amplifier with 100mc/s bandwidth. Max. dissipation 26mW. For use as RF amplifier, balanced mixer, product detector or self-oscillating mixer. 27/-

CA3012 Wide Band Amplifier (up to 20mc/s), suitable as IF Amplifier for VHF/FM receivers. 22/-

CA3020 General Purpose Audio Amplifier of 550mW output. 30/-

CA3036 Buffer Amplifier consisting of two "super-alpha" pair of transistors suitable for stereo pick-up systems. 19/-

The above four I.C.'s are in TO5 encapsulation.

PA222 Audio Amplifier providing a max. output of 1.2 watts. 65/-

PA234 Audio Amplifier providing a max. output of 1 watt. 27/6

PA237 2 watts Audio Amplifier. 40/-

The above three I.C.'s are in epoxy moulded double four-in-line package.

MC1709CG General Purpose operational amplifier in TO-99 case. 40/-

TAA263 3-stage direct coupled amplifier for use from DC to 600kc/s; 70mW dissipation. Output 10mW into 150Ω load. 15/-

TAA293 3-stage amplifier with connection brought out to the individual leads. Bandwidth 600kc/s. 160mW dissipation. Output 10mW into 150Ω load. 20/-

TAA820 MOST input stage followed by a bi-polar transistor stage. 200mW dissipation. 13/-

Data sheets are available for all the above I.C.'s.

WESTINGHOUSE EPOXY ENCAPSULATED WIRE ENDED MINIATURE RECTIFIERS
 1N5339, 1,000 p.i.v., 1.5 amps D.C.; Max. surge 50A diameter -140m. Overall length (with leads) 2.3in. 4/6
 1N5408, 1,000 p.i.v., 3 amps D.C.; max. surge 200A. Diameter -210in.; overall length (with leads) 2.875in. 6/3

ZENER DIODES

300mW wire ended, 10% tolerance

K8139A 3.9V	D814A 6.8V	D814V 9.5V
K8147A 4.7V	D814B 7.8V	D814G 11.0V
K8156A 5.6V	D814E 6.8V	D814D 12.6V

All at 7/8

5 watts Stud Mounted 15% tolerance

22V D816A	39V D816G	68V D817B
27V D816B	47V D186D	82V D817V
33V D816V	56V D817A	100V D817G

8 watts Stud Mounted 15% tolerance

4.7V D8151	8.2V D815V	15V D815E
5.6V D815A	10V D815G	18V D815Z
6.8V D815B	12V D815D	

All at 7/6

SPECIAL OFFER OF PNP GERMANIUM TRANSISTORS

AC154, large signal type, suitable for class 'B' output and oscillator applications. Max. collector-base voltage -26V. Max. dissipation 200mW. Audio power output per pair 400mW free air or 1.1W on heat sink. Price, per pair, 8/-

AC189 PNP Bias Stabilizing Transistor. Max. dissipation 60mW. Max. collector-base voltage -2V. Max. collector current 30mA. Price, each, 2/-

SILICON MATCHED DIODE PAIRS

1N4961 Two diodes in common TO92 epoxy case. Separate anode leads and joint cathode. Diodes are statically and dynamically balanced. Max. reverse voltage 20V. Max. dissipation 200mW. Suitable for TV horizontal phase discriminators and similar applications. Price 3/- each. Considerable discount for quantities.

DIGITAL VOLT-OHMMETER BK 2-6



Electro-mechanical instrument with sequential energization of electro-magnetic relays. Projection system display. Automatic range and polarity selection.

Voltage measurement range: 0.01 to 1,000V, D.C. only.
 Accuracy: ±2% ± 1 digit
 Input resistance: 1 megohm minimum
 Resistance measurement range: 100 ohms to 1999 ohms/kohms
 Accuracy: ±3% ± 1 digit
 Time of measuring cycle: 3 seconds
 Sampling: Hand-operated, local or remote
 Power supplies: 115V/230V, mains

PRICE - £128.0.0

TRIACS TYPE 40432

Gated bi-directional Silicon Thyristors with integral trigger. The triac will control up to 1440 watts at 240V mains frequency. Supplied complete with data sheet and application sheets for motor control and dimmer circuits. 37/6 each

OA2 6/8	4CX250B	6BN4 13/-	682 8/-	12AT6 5/-	30C17 16/-	310A 27/8	CBL1 16/-	EAF42 10/-	EF83 10/-	EY87 8/6	ME1400	PCL801 15/8	QY3-125A 160/-	UP9 11/-
OA3 8/-	4HA2 9/6	6BX6 8/-	684 11/-	12AT7 6/6	30C18 15/-	311A 37/8	CBL31 17/-	EAF801 9/6	EF85 7/-	EY88 8/6	PD500 30/-	PD500 30/-	QY4-250A 160/-	UP11 10/-
OB4 6/6	4THA 8/6	6BQ5 8/-	687 7/8	12A06 5/6	30F15 17/-	328A 40/-	CL4 12/-	EB34 3/-	EF86 5/6	EZ35 5/6	PE06-40N 80/-	PE06-40N 80/-	QY4-400A 230/-	UP42 18/-
OB3 10/-	5AR4 11/-	6BQ7A 7/8	687 7/8	12A07 5/6	30F16 15/-	329A 35/-	CL33 17/-	EB35 3/3	EF89 5/6	EZ40 7/8	PEN4D 8/-	PEN4D 8/-	QY4-600A 300/-	UP43 11/-
OC2 17/-	5C2 32/0	6BQ7A 7/8	687 7/8	12A07 5/6	30F17 16/-	330A 35/-	DAH41 10/-	EB33 9/-	EF91 4/6	EZ41 7/8	PEN36C 8/-	PEN36C 8/-	R10 20/-	UP85 7/6
OC3 7/-	5D21 80/-	6BR7 17/-	687 7/8	12A07 5/6	30F18 16/-	331A 37/8	DAF91 5/6	EB34 10/6	EF92 4/6	EZ50 5/6	R18 9/-	R18 9/-	R19 20/-	UP86 8/-
OD3 6/6	5R4G 5/-	6BR7 17/-	687 7/8	12A07 5/6	30F19 16/-	332A 35/-	DAF92 5/6	EB35 10/6	EF93 4/6	EZ51 5/6	R10 20/-	R10 20/-	R19 20/-	UP87 8/-
IA3 8/-	5U4G 5/-	6B87 24/-	687 7/8	12A07 5/6	30F20 16/-	333A 35/-	DAF93 5/6	EB36 10/6	EF94 4/6	EZ52 5/6	R10 20/-	R10 20/-	R19 20/-	UP88 8/-
1ADG7 5/8	5U4GB 7/8	6B87 24/-	687 7/8	12A07 5/6	30F21 16/-	334A 35/-	DAF94 5/6	EB37 10/6	EF95 4/6	EZ53 5/6	R10 20/-	R10 20/-	R19 20/-	UP89 7/6
1AGT 7/8	5V4G 8/-	6B87 24/-	687 7/8	12A07 5/6	30F22 16/-	335A 35/-	DAF95 5/6	EB38 10/6	EF96 4/6	EZ54 5/6	R10 20/-	R10 20/-	R19 20/-	UP90 7/6
1B3GT 7/8	5Y3GT 6/6	6BX6 8/-	682 8/-	12AT6 5/-	30F23 16/-	336A 35/-	DAF96 5/6	EB39 10/6	EF97 4/6	EZ55 5/6	R10 20/-	R10 20/-	R19 20/-	UP91 12/-
1B4 80/-	5Z4 9/-	6BZ6 6/8	684 11/-	12AT7 6/6	30F24 16/-	337A 35/-	DAF97 5/6	EB40 10/6	EF98 4/6	EZ56 5/6	R10 20/-	R10 20/-	R19 20/-	UP92 6/6
1C5G 8/-	5Z4G 7/8	6C4 6/-	684 11/-	12A06 5/6	30F25 16/-	338A 35/-	DAF98 5/6	EB41 10/6	EF99 4/6	EZ57 5/6	R10 20/-	R10 20/-	R19 20/-	UP93 4/-
1G4GT 8/6	5Z4GT 8/-	6C5 17/3	687 7/8	12A07 5/6	30F26 16/-	339A 35/-	DAF99 5/6	EB42 10/6	EF99 4/6	EZ58 5/6	R10 20/-	R10 20/-	R19 20/-	UP94 11/-
1G6GT 7/8	5A0L2 15/-	6C6 5/6	687 7/8	12A07 5/6	30F27 16/-	340A 35/-	DAF99 5/6	EB43 10/6	EF99 4/6	EZ59 5/6	R10 20/-	R10 20/-	R19 20/-	UP95 11/-
1H6GT 7/8	6A8G 6/6	6C6D6A 6/6	687 7/8	12A07 5/6	30F28 16/-	341A 35/-	DAF99 5/6	EB44 10/6	EF99 4/6	EZ60 5/6	R10 20/-	R10 20/-	R19 20/-	UP96 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F29 16/-	342A 35/-	DAF99 5/6	EB45 10/6	EF99 4/6	EZ61 5/6	R10 20/-	R10 20/-	R19 20/-	UP97 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F30 16/-	343A 35/-	DAF99 5/6	EB46 10/6	EF99 4/6	EZ62 5/6	R10 20/-	R10 20/-	R19 20/-	UP98 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F31 16/-	344A 35/-	DAF99 5/6	EB47 10/6	EF99 4/6	EZ63 5/6	R10 20/-	R10 20/-	R19 20/-	UP99 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F32 16/-	345A 35/-	DAF99 5/6	EB48 10/6	EF99 4/6	EZ64 5/6	R10 20/-	R10 20/-	R19 20/-	UP100 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F33 16/-	346A 35/-	DAF99 5/6	EB49 10/6	EF99 4/6	EZ65 5/6	R10 20/-	R10 20/-	R19 20/-	UP101 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F34 16/-	347A 35/-	DAF99 5/6	EB50 10/6	EF99 4/6	EZ66 5/6	R10 20/-	R10 20/-	R19 20/-	UP102 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F35 16/-	348A 35/-	DAF99 5/6	EB51 10/6	EF99 4/6	EZ67 5/6	R10 20/-	R10 20/-	R19 20/-	UP103 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F36 16/-	349A 35/-	DAF99 5/6	EB52 10/6	EF99 4/6	EZ68 5/6	R10 20/-	R10 20/-	R19 20/-	UP104 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F37 16/-	350A 35/-	DAF99 5/6	EB53 10/6	EF99 4/6	EZ69 5/6	R10 20/-	R10 20/-	R19 20/-	UP105 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F38 16/-	351A 35/-	DAF99 5/6	EB54 10/6	EF99 4/6	EZ70 5/6	R10 20/-	R10 20/-	R19 20/-	UP106 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F39 16/-	352A 35/-	DAF99 5/6	EB55 10/6	EF99 4/6	EZ71 5/6	R10 20/-	R10 20/-	R19 20/-	UP107 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F40 16/-	353A 35/-	DAF99 5/6	EB56 10/6	EF99 4/6	EZ72 5/6	R10 20/-	R10 20/-	R19 20/-	UP108 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F41 16/-	354A 35/-	DAF99 5/6	EB57 10/6	EF99 4/6	EZ73 5/6	R10 20/-	R10 20/-	R19 20/-	UP109 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F42 16/-	355A 35/-	DAF99 5/6	EB58 10/6	EF99 4/6	EZ74 5/6	R10 20/-	R10 20/-	R19 20/-	UP110 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F43 16/-	356A 35/-	DAF99 5/6	EB59 10/6	EF99 4/6	EZ75 5/6	R10 20/-	R10 20/-	R19 20/-	UP111 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F44 16/-	357A 35/-	DAF99 5/6	EB60 10/6	EF99 4/6	EZ76 5/6	R10 20/-	R10 20/-	R19 20/-	UP112 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F45 16/-	358A 35/-	DAF99 5/6	EB61 10/6	EF99 4/6	EZ77 5/6	R10 20/-	R10 20/-	R19 20/-	UP113 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F46 16/-	359A 35/-	DAF99 5/6	EB62 10/6	EF99 4/6	EZ78 5/6	R10 20/-	R10 20/-	R19 20/-	UP114 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F47 16/-	360A 35/-	DAF99 5/6	EB63 10/6	EF99 4/6	EZ79 5/6	R10 20/-	R10 20/-	R19 20/-	UP115 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F48 16/-	361A 35/-	DAF99 5/6	EB64 10/6	EF99 4/6	EZ80 5/6	R10 20/-	R10 20/-	R19 20/-	UP116 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F49 16/-	362A 35/-	DAF99 5/6	EB65 10/6	EF99 4/6	EZ81 5/6	R10 20/-	R10 20/-	R19 20/-	UP117 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F50 16/-	363A 35/-	DAF99 5/6	EB66 10/6	EF99 4/6	EZ82 5/6	R10 20/-	R10 20/-	R19 20/-	UP118 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F51 16/-	364A 35/-	DAF99 5/6	EB67 10/6	EF99 4/6	EZ83 5/6	R10 20/-	R10 20/-	R19 20/-	UP119 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F52 16/-	365A 35/-	DAF99 5/6	EB68 10/6	EF99 4/6	EZ84 5/6	R10 20/-	R10 20/-	R19 20/-	UP120 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F53 16/-	366A 35/-	DAF99 5/6	EB69 10/6	EF99 4/6	EZ85 5/6	R10 20/-	R10 20/-	R19 20/-	UP121 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F54 16/-	367A 35/-	DAF99 5/6	EB70 10/6	EF99 4/6	EZ86 5/6	R10 20/-	R10 20/-	R19 20/-	UP122 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F55 16/-	368A 35/-	DAF99 5/6	EB71 10/6	EF99 4/6	EZ87 5/6	R10 20/-	R10 20/-	R19 20/-	UP123 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F56 16/-	369A 35/-	DAF99 5/6	EB72 10/6	EF99 4/6	EZ88 5/6	R10 20/-	R10 20/-	R19 20/-	UP124 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F57 16/-	370A 35/-	DAF99 5/6	EB73 10/6	EF99 4/6	EZ89 5/6	R10 20/-	R10 20/-	R19 20/-	UP125 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F58 16/-	371A 35/-	DAF99 5/6	EB74 10/6	EF99 4/6	EZ90 5/6	R10 20/-	R10 20/-	R19 20/-	UP126 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6	30F59 16/-	372A 35/-	DAF99 5/6	EB75 10/6	EF99 4/6	EZ91 5/6	R10 20/-	R10 20/-	R19 20/-	UP127 11/-
1L4 3/6	6A84 6/6	6C6X6 23/-	687 7/8	12A07 5/6										

APPOINTMENTS VACANT

We're young, successful, and expanding —

The Dolby Audio Noise Reduction System has in only three years changed international studio practice, providing a new master recording standard. The system is briefly described in our advertisement on page 40 of this issue.

As well as designing and manufacturing professional equipment (of which 80% is exported), we research into consumer applications, and recently the first domestic tape machines using a simplified version of the system were released under license in the U.S.A. But this is only the beginning of a long line of new applications.

We are situated in south London in a modern four-storey building which includes laboratories, offices and production facilities. We are still small — just 60 people — but are expanding rapidly in all departments; the search is for people who have the capability of growing with us. Prospects are excellent and the rewards attractive. We have these immediate technical vacancies:

ELECTRONICS ENGINEERS

We are looking for several top-flight engineers under 30, with a university degree in physics or electrical engineering and at least two years' experience in electronic circuit design. The jobs involve not only research and development, but in addition the design of both professional and consumer products, based on Dolby noise reduction techniques. Where products are concerned, the designer will liaise with the production department during all stages of manufacture.

Candidates should be familiar with modern techniques — ICs and FETs, for example — and should be experienced in both linear and non-linear circuitry as applied in the frequency range dc to 20 MHz.

Salaries from £1,800 to £2,500. Write or phone with brief details to David Robinson, Chief Engineer.

ELECTRONICS ENGINEER (PRODUCTION)

The candidate will be a graduate engineer under 30, with a university degree in physics or electrical engineering. He will be responsible to the Production Manager for electronic aspects of production. These will include the design and introduction of specialized test equipment and procedures, together with the provision of general technical advice to the electronic test department. He will liaise with the engineering department on technical matters and will have the opportunity of investigating and introducing new production techniques. He will have a minimum of two years' design experience and preferably experience also in giving technical support in a production department.

Salary from £1,800 to £2,500. Write or phone with brief details to Bob Tallon, Production Manager.

DESIGN DRAUGHTSMAN

Flexibility is the keynote in our requirement for a design draughtsman under 30 for a position in the Design Department, which is responsible for all design aspects of the company.

His primary duties will be to interpret details from design schemes and prepare complete mechanical manufacturing drawings for the production of light electro-mechanical units. In due course, he will be expected to produce his own design schemes from initial sketches or proposals. He must have some understanding of electronic circuits and be capable of developing, from initial circuit information, the necessary tape masters and associated details for printed circuit production.

The candidate must also have an artistic inclination, for as a secondary activity he will assist in the layout and preparation of artworks for advertising, technical literature and exhibitions.

It is essential that his draughting and presentation should be of the highest standard.

Salary from £1,500 — £2,200. Write or phone with brief details to Ron Free, Senior Designer.



DOLBY LABORATORIES

346 Clapham Road,
London, S.W.9

Telephone: 01-720 1111

**ELECTRONICS
AUTHORS
ARE
V.I.P.
AT
REDIFON**

if they know something about radio transmitters, receivers, ancillaries or systems.

If you have been in the business anywhere from two to twenty years we've a place for you at our Communications Division, London, S.W.18.

For details of our red carpet treatment ring Ted Jackson, our top man in handbooks, at 01-874 7281 (he *thinks* he is ex-directory so try 01-399 1917 if it's more convenient out of office hours).



A Member Company of the Rediffusion Organisation

2540

**SERVICE
ENGINEERS**

Our Instruments Company is currently expanding its activities and range of products.

Senior and Intermediate vacancies exist at the Service Department situated in Reading Berks.

The Department is furnished with modern test and fault finding equipment and the work is varied and interesting. Equipments are modern analogue and digital devices incorporating the latest techniques in instrumentation.

Previous servicing experience is desirable but our main requirement calls for an enthusiastic sound approach to the servicing of our wide range of products.

Applications in writing please to:



Mr. L. A. Jemmett,
Racal Instruments Ltd.,
Bennet Road,
Reading,
Berks.

2538

**computer
engineering**

NCR requires additional ELECTRONIC, ELECTRO MECHANICAL ENGINEERS and TECHNICIANS to maintain medium to large scale digital computing systems in London and provincial towns.

Training courses will be arranged for successful applicants, 21 years of age and over, who have a good technical background to ONC/HNC level, City and Guilds or radio/radar experience in the Forces.

Starting salary will be in the range of £900/£1,250 per annum, plus bonus. Shift allowances are payable, after training, where applicable. Opportunities also exist for Trainees, not less than 19 years of age, with a good standard of education, an aptitude towards and an interest in, mechanics, electronics and computers.

Excellent holiday, pension and sick pay arrangements. Please write for Application Form to Assistant Personnel Officer NCR, 1,000 North Circular Road, London, NW2 quoting publication and month of issue.

Plan your future with



Rank Precision Industries Limited

BROADCAST DIVISION

RANK CINTEL

The Cintel section is rapidly expanding its Development and Research Departments of professional television studio equipment. To strengthen their teams the following engineers are required.

senior electronic design engineer

To work on development work on T.V. studio equipment. Successful applicant should have experience in this field together with B.Sc. or Dip. Tech. qualification. Salary up to £2,500.

senior mechanical designer

To work on colour telecine machines and other allied broadcasting equipment. The work which is varied involves the development of small mechanisms and electromechanical devices. Salary up to £2,500.

intermediate engineers test engineers

Are also required to assist in the Cintel programmes.

works staff

Bench Testers: To work on the professional T.V. studio equipment. No special qualifications are required for these positions but some experience in the T.V. field is preferable.

TELECOMMUNICATIONS

The Telecommunications section has been in the field of communication for many years and holds major contracts. Increased activity demands new teams for work on Military Communication Equipment.

section leader— military communications

Will be required to build up a team for the following projects. New lightweight man portable equipment, H. F. and V.H.F. channel generator by frequency synthesis. Initially the work involves responsibility for design aspects of an H.F. equipment undergoing a quality assurance programme. Age immaterial. Salary up to £2,500.

senior development engineers

To assist the section leader on the above projects. Successful applicants should have experience in this field together with the ability to lead in an objective fashion.

intermediate engineers test engineers

Are also required to assist in the Telecommunications programmes.

works staff

Testers: To work in the Test and Inspection department on the Telecommunications programmes. Experience in this field is necessary for most positions.

These positions carry good salaries together with the excellent fringe benefits available to all Rank Organisation employees. Sick Pay entitlements and holiday entitlements have recently been increased.

Location initially at Welwyn Garden City, moving to the new factory at Ware, Herts. before June 1970.

Applications to:

**Personnel Manager,
Rank Precision Industries Ltd.,
Bessemer Road,
Welwyn Garden City, Herts.
Tel: Welwyn Garden City 23434**

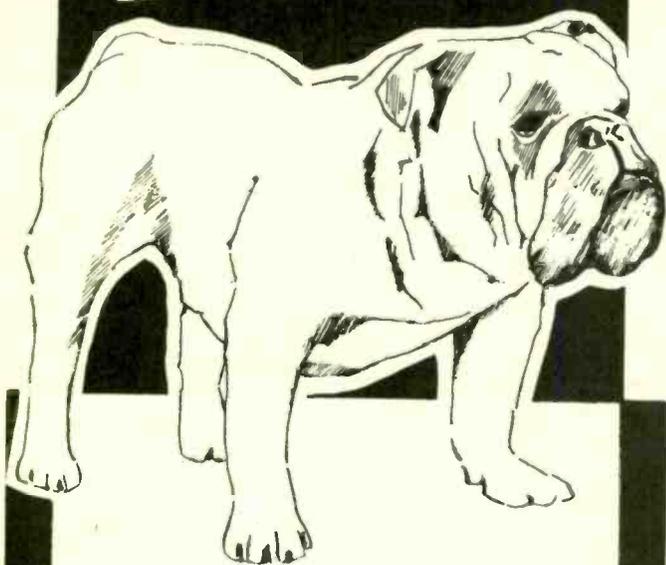
 **The Rank Organisation**

Holders of The Queen's Award to Industry for 3 successive years.



 **RANK
PRECISION
INDUSTRIES**

TOP DOGS



That's Burroughs. And choosy about the company we keep. Are YOU a top dog? With the right sort of pedigree? Degree in engineering, (Honours Graduate or Ph.D.) with inbred ability and the stamina to hold your top place in a highly competitive field? Then BURROUGHS is the place for you.

DEVELOPMENT ENGINEERS

(Mechanical or Electronic)

to join one of the foremost companies in Britain's fastest growing industry. In addition to your degree you will have a minimum three to five years' experience in one or more branches of a light engineering industry and require to have the ambition and talent to go to the top in one of the world's greatest companies.

The positions on offer give an opportunity for top dogs to get in at the beginning of an engineering expansion programme in Burroughs, Cumbernauld and further develop personal engineering skills and promotion prospects.

Salary is no stumbling block—we know we have to pay top salaries for top dogs.

Our plant is located in the green belt between Stirling, Edinburgh and Glasgow. You can readily commute from a rural village or market town with facilities for golf, angling, yachting or ski-ing and still be within easy reach of excellent schools and universities.

Please write or telephone (reverse charges) to:—

Tom Bennett,
Engineering Division,
Burroughs Machines Ltd.,
Cumbernauld,
Scotland.

Tel. 22111 (ext. 29)



2533

DESIGN ENGINEERING

New opportunities in electronics

E.M.I. Limited offer worthwhile careers to experienced Design Engineers in the following categories:—

MICROELECTRONIC DESIGN

Working in close liaison with Production Engineers with the responsibility for the design of new tooling methods. A good knowledge of Jig and Tool work is required.

TELEVISION DESIGN

The work involves the design of custom-built T.V. Studio and Outside Broadcast Vehicle Equipment and would be of interest to persons familiar with Commercial Quantity Production Methods.

JIG & TOOL DESIGN

A vacancy has occurred for an experienced Jig and Tool Designer to undertake Jig and Tool Design in all its aspects.

SPECIAL PURPOSE MACHINERY DESIGN

For interesting and varied work on the design of new special purpose Machinery and Tools.

There are also vacancies for Draughtsmen to carry out the design of printed circuit boards from diagrams and experience of packaging techniques would be an advantage.

For all the above positions a minimum of O.N.C. or equivalent qualification is required. Starting salaries are attractive, being commensurate with qualifications and experience.

Working conditions are excellent and full social and welfare facilities including a contributory pension scheme with free life assurance are available.

Apply in writing stating area of Interest to:



M. A. JONES
PERSONNEL OFFICER,
GROUP PERSONNEL DEPARTMENT, E.M.I. LTD.,
BLYTH ROAD, HAYES, MIDDLESEX.

EMICAREERS

RADIO ENGINEER FOR UGANDA

We have a vacancy for a well trained radio engineer with a good knowledge of electrical and electronic problems.

The person we are looking for should be a good organiser, must have real interest in his work and must be willing to train local staff. There are unlimited opportunities as the successful applicant will receive on the spot training in our medical and X-ray dept. This will necessitate regular journeys to all parts of Uganda. Our terms of service are good, the climate is wonderful and the work unusual. We offer good local and overseas leave facilities.

Those interested should write to:

Twentsche Overseas Trading Co. (Uganda) Ltd.,
P.O. Box 7160,
KAMPALA,
Uganda,

giving details of previous experience, age and marital status.

2580

THE DEPARTMENT OF CIVIL AVIATION, ZAMBIA
Require

Radio Engineers

Salary in scale up to £2782.
Tour of 36 months offered.
Generous leave on full salary.
25% End-of-Tour gratuity.

Commencing salary according to experience in scale Kwacha 2736 (£Stg.1596) rising to Kwacha 3216 (£Stg.1876) a year, plus an Inducement Allowance of £Stg.568 - £Stg.615. A Direct Payment of £Stg.268 - £Stg.291 is also payable direct to an officer's U.K. Bank account. Both gratuity and direct payment are normally TAX FREE. Free passages. Quarters at low rental. Children's education allowances. Generous leave on full salary or terminal payment in lieu. Pension scheme available under certain circumstances. Candidates must be under 55 years of age and should possess 8 years relevant experience following:—

- (i) an apprenticeship of 5 years, or
- (ii) possession of a Service Trade Certificate, or
- (iii) possession of an I.C.A.O. certificate or
- (iv) equivalent.

In addition, candidates should have a sound experience of the theoretical principles of and experience in the maintenance of the first two and at least one other of the following groups of communications and navigational aid systems:

1. Medium powered H.F. Transmitters and associated Receivers;
Frequency Shift Keying; S.S.B. and D.S.B. Equipment;
Medium Frequency Non-Directional Radio Beacons.

2. Low and High powered V.H.F., A.M. Equipment.
3. V.H.F. Omni range; Automatic VHF Direction Finders. Distance Measuring Equipment.
4. Instrument Landing System.
5. Radar X Bank Terminal and P.P.1 Talk Down Equipment.
6. Audio and Remote Control Equipment; Public Address Equipment; Airport Magnetic Tape Recorders; Inter Office Communication; Underground Control Cables; Impulse and D.C. Switching System.
7. Teleprinter Telegraphy (torn tape) and associated Page Printers; Tape Recorders (autoheads); Semi-Automatic Message Switching System.

Duties include the maintenance, overhaul and installation of ground terminal radio communication equipment and navigational aids at Airports and Flight Information Centre. Possession of a valid driving licence will be an advantage.

Apply to **CROWN AGENTS, 'M' Division, 4 Millbank, London, S.W.1, for application form and further particulars stating name, age, brief details of qualifications and experience and quoting reference number M2Z/690315/WF.**

2532

BBC television requires **ENGINEERS**

with one of the following qualifications:

- B.Sc.
- H.N.D.
- H.N.C.
- C. & G. Full Tech.
(Telecommunications)

Based at Television Centre and other London studios and Outside Broadcast bases. Applicants must have normal colour vision and be permanently resident in this country.

SALARY: £1,205-£1,775 p.a.

TRAINING: Full-time residential training course on television engineering techniques given on appointment.
Excellent opportunities for promotion.
3-4 weeks annual leave (according to salary). Generous shift allowances paid.

For application form and further details write to:

The Engineering Recruitment Officer,
BBC • Broadcasting House • London • W1A 1AA
quoting reference 69.E.4037 W.W.



2559



join the men
who lead

Device Technology Engineer

A qualified man is urgently required to work as a senior member of a team at present engaged on the aspects of choice and design of solid state devices. These include microcircuits and hybrid circuits for use in high reliability equipment.

Applications are invited from Electronics Engineers or Physicists with a sound knowledge of microcircuit technology and design. At least three years' experience in the application of the above mentioned devices is essential.

Please write or phone for an application form, quoting Ref. 1462, to:
Mr. E. Buckmaster,
1462 Personnel Department,
British Aircraft Corporation, Guided Weapons Division,
Stevenage, Herts. Tel: Stevenage 2422.



BRITISH AIRCRAFT CORPORATION
the most powerful aerospace company in Europe

**RESEARCH
and
DEVELOPMENT**

**ELECTRONIC
ENGINEERS**

... OUR WORK

Expanding exports and the increasing complexity of our products have intensified our development programmes for digital and analogue computers, linkage and special purpose computer peripherals. We wish to establish new teams of electronic engineers and if you are interested in joining us ...

... YOUR QUALIFICATIONS

should include a degree, H.N.C. or equivalent. You should have relevant experience, coupled with enthusiasm and ability and ...

... YOUR REWARDS

with Redifon will be a good salary, stability of employment, a wide range of interesting work and an opportunity to expand your experience into new fields in ...

... OUR COMPANY

We design and manufacture flight simulators and electronic teaching machines for world-wide markets. The laboratories are situated in a pleasant part of Sussex at Crawley, mid-way between London and the South Coast.

Application forms may be obtained from:

H. C. Hall, Personnel Manager,
REDIFON LIMITED,

**Flight Simulator Division,
Gatwick Road, Crawley, Sussex.
Telephone: Crawley 28811**



A Member Company of the Rediffusion Organisation 4507

**TESTERS
AND TEST
TECHNICIANS**

We require all grades of Test Engineers who are experienced in the testing and fault-finding of complex electronic equipment, including control systems. We offer Staff positions to suitable applicants and four weeks holiday after three years service. High rates of pay, good working conditions, canteen, social and sports club.

Please write or phone:

The Personnel Officer (Ref. 170),

ULTRA ELECTRONICS LTD.,
Western Avenue, Acton, London, W.3
Tel.: 01-992 3434



**Computicket
want**

MAINTENANCE TECHNICIANS

Computicket are moving rapidly towards the full implementation of their entertainment seat booking system. This service, which operates in real-time, will ultimately involve hundreds of on-line C.R.T. terminals sited in a wide variety of public places.

Computicket are now recruiting Maintenance Technicians for the Greater London area to perform a vital role in this exciting new service.

Applicants should have had experience in the maintenance of electro-mechanical and electronic equipment situated in the field and should be happy to find themselves part of a technically advanced but none-the-less consumer orientated team.

Conditions of employment are attractive and salary will be in the region of £1,500 p.a.

Write with resumé of career to: Colln Roberts, Chief Engineer,



Computicket Limited

30 FINSBURY SQUARE, EC2
Member company of International Publishing Corporation

Electrical Engineers

Rolls-Royce and Associates Limited is engaged in an extensive programme of design, development and procurement of nuclear propulsion plant. We have immediate vacancies for:-

Electronic Engineers

to be responsible for the design, development and engineering of nuclear reactor control and instrumentation systems. Applicants should be of graduate status.

Electrical Designers

to be responsible for the preparation of design schemes. Applicants should have H.N.C. in Electrical Engineering and have completed an engineering apprenticeship. A minimum of 2 years' drawing office experience is essential.

Salaries are commensurate with age, qualifications and experience. A generous proportion of relocation costs will be met by the Company with special assistance for house purchase where necessary.

Please apply in writing, or by telephone for an application form to The Personnel Manager,

**Rolls-Royce and Associates Limited,
P.O. Box 31, Derby DE2 8BJ or telephone Derby 61461 extension 213.**

University of Reading DEPARTMENT OF PSYCHOLOGY Electronic Engineer (A.E.O.)

Applications are invited for the post of ASSISTANT EXPERIMENTAL OFFICER in the Department of Psychology. Applicants must have an H.N.C. in Electronics or equivalent qualification. The successful applicant will be expected to be familiar with the design and assembly of simple analogue and digital electronic equipment, such as Timers, Logic for automation of experiments, High Sensitivity Audio and D.C. Amplifiers for electrophysiological work. Experience in the use of semi-conductor devices and integrated circuits would be an asset. The applicant will be expected to supervise the servicing of existing equipment; there will be a good opportunity to gain experience in servicing a small computer. The initial appointment will be made at A.E.O. level. Salary £872-£1,454 per annum. The point of entry will depend on qualifications and age. **Applications, quoting M.62, to Assistant Bursar (Personnel), University of Reading, Reading, Berks.**

2556

HENRY'S RADIO LTD.

303 EDGWARE ROAD, LONDON, W.2
HAVE THE FOLLOWING VACANCIES
IN THEIR ORGANISATION

ORGAN DEPARTMENT

Young man interested in Electronic Musical Instruments with a good general knowledge of electronics required for this expanding Dept. Write, or Telephone 723-1008/9 Extn. 1 or 2.

SALES ASSISTANTS

Young man with a good general knowledge of HIGH FIDELITY EQUIPMENT required for our retail HI-FI SALES DEPT. Please contact MR. STEVEN, Telephone 723-6963. 2585

CHIEF TELEPHONE ENGINEER OVERSEAS

International Aeradio Ltd are a thriving world-wide organisation of some 3500 employees engaged in the fields of communications and with 18 overseas subsidiary and associate companies. Major expansion has created the requirement for a Chief Telephone Engineer for one of the group's associated Telephone companies in the Arabian Gulf area. He will supervise a team of expatriate engineers and be responsible for the engineering administration and short-term carrying functions. A good theoretical background is essential together with specialist practical knowledge in at least two of the following fields:

- Electronic Common Control Exchanges.
- Local junction and subscriber's distribution network.
- Subscriber's apparatus including PABX's.
- Telex systems.
- Coaxial cable transmission systems.
- VHF radio relay transmission systems.

The position offers unusually good career prospects to the right man. A substantial tax-free starting salary will be offered including in addition, free furnished accommodation, marriage, child and educational allowances, free leave passages and medical attention, and concessions on holiday air fares after a year's service.

Please apply stating briefly details of age and qualifications to:

**General Manager Personnel,
INTERNATIONAL AERADIO LIMITED,
Aeradio House, Hayes Road, Southall, Middlesex.**



PYE TVT the leaders in closed circuit television

PYE TVT the experts in sound engineering-PYE TVT

leaders in broadcasting equipment-PYE TVT sound amplification

Supervisory Test Engineers Studio Equipment—Audio

Two competent men are required for sections engaged on fault-finding and testing to specification of a wide range of professional audio equipment including mixing desks, power amplifiers and ancillary units for O.B. vehicles.

Good experience with solid state amplifiers and ability to carry out measurement are essential.

We offer attractive salaries and conditions of employment. Local housing may be made available.

Please apply with brief details of experience to:



Personnel Officer,
PYE TVT LIMITED
Coldhams Lane, Cambridge,
Telephone Cambridge (0223) 45115

QUAD

If you think:

- You'd like to work for Quad,
- You have the right qualifications,
- It would be better to work in Huntingdon* than in the big city rat-race,

drop us a line. We urgently need technicians and engineers for both Audio and VHF, and would be pleased to discuss the prospects with you.

Write initially, giving full details of your training and experience to:

Mr. J. H. Walker,
The Acoustical Mfg. Co. Ltd.,
St. Peter's Road,
Huntingdon.

* Look it up on the map: Quad helped to put it there!

2553

THE GENERAL POST OFFICE has VACANCIES for RADIO OPERATORS II at its COAST RADIO STATIONS

Applications are invited from men between 21 and 35 years of age who must hold either the Postmaster General's First or Second Class Certificate of Competence in Radiotelegraphy or an equivalent Certificate issued by a Commonwealth Administration or the Irish Republic.

SALARIES HAVE BEEN INCREASED and the scale now begins at £807, for those entering at the age of 21, rising to a maximum of £1,188. There will be a further increase on 1st January, 1970.

The posts will be temporary in the first place but successful applicants will be eligible to enter the open competitive selection for permanent appointment.

Applicants should write to: **The Inspector of Wireless Telegraphy, Union House, St. Martin's-le-Grand, London, E.C.1** or telephone **01-432 5628** for further information.

2554

Ex-Service TECHNICIANS

A number of ex members of H.M. Services have joined us recently as prototype engineers working successfully on complex electronic equipment. We have three more vacancies and would like to hear from those who have left H.M. Service or are about to leave.

Apply:

Personnel Officer,
Pye TVT Limited,
Coldhams Lane,
Cambridge.

Telephone Cambridge (0223) 45115

2557

THE UNIVERSITY OF HULL AUDIO-VISUAL CENTRE SOUND SUPERVISOR

The Audio-Visual Centre in the University is engaged in the production, to fully professional standards, of television programmes, films and sound recordings for educational purposes. Applications are invited for the post of Sound Supervisor. Preference will be given to candidates with an H.N.C. or equivalent qualification together with experience in the operational and maintenance aspects of professional sound broadcasting and recording equipment. The duties will be to assist in both operations and maintenance of the equipment used in the Centre.

Salary range: £1,578-£2,006.

Further particulars may be obtained from the Registrar to whom applications (3 copies) should be sent by 27th October, 1969.

2592

CONTINUOUS EXPANSION

Standard Telephones & Cables, Micro-wave and Line Division based at Basildon are growing fast. In order to keep pace with this consistent growth rate we require the following

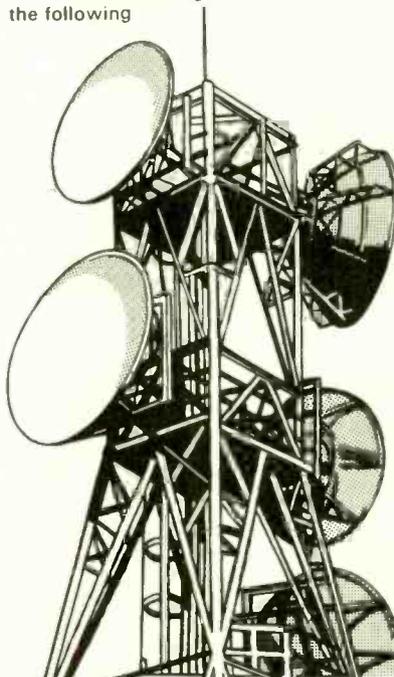
Installation Engineers Technicians & Testers

Ref. 25720

To test and commission Multiplex, Co-axial Line and Microwave Radio Systems.

Ideal candidates will be less than 45 years of age with practical experience on some of the above equipment. These challenging posts call for drive, initiative and common sense. It is necessary for applicants to be prepared to work anywhere in the U.K.

*Applications should be addressed to
The Personnel Officer,
STC Chester Hall Lane,
Basildon, Essex.*



Test Technicians

Ref. 27221

The diversity of products manufactured at the Basildon Plant demands experienced testing staff for work on complex transmission systems.

Candidates should hold an ONC in electrical engineering and be able to offer considerable practical experience in the field of testing and fault clearing all types of land-unit, pcm and microwave equipment.

STC

2605

University of Birmingham Department of Medicine ELECTRONICS TECHNICIAN

required for work concerning the development and maintenance of electronic and physical apparatus used in medical research. Qualifications: O.N.C. or equivalent. Experience in digital forms of data acquisition desirable but not essential.

Salary: £773—£1,077.

Apply: Assistant Secretary (Personnel), Personnel Office, University of Birmingham, P.O. Box 363, Edgbaston, Birmingham, 15, quoting reference: 417/T/143. 2555

TEST ENGINEERS AND INSPECTORS

Owing to rapid expansion due to large export orders on Marine Radar we have urgent vacancies for

TEST ENGINEERS

with a good electronic background, and preferably with radar experience.

ELECTRO MECHANICAL INSPECTORS MECHANICAL INSPECTOR

Please apply in writing to the Personnel Officer
The Plessey Company Limited
Martin Road, West Leigh, Havant
Hampshire
quoting ref. HAV/169/B

2560



RADIO & TELEVISION SERVICING RADAR THEORY & MAINTENANCE

This private College provides efficient theoretical and practical training in the above subjects. One-year day courses are available for beginners and shortened courses for men who have had previous training.

Write for details to: The Secretary, London Electronics College, 20 Penywern Road, Earls Court, London, S.W.5. Tel.: 01-373 8721. 84

CAREERS IN RECORDING

PHILIPS PHONOGRAPHIC INDUSTRIES in Baarn, Holland, offer excellent career possibilities to young men between 22 and 30 years of age to join the Classical Recording Department as trainees.

Candidates will be required to reside in Holland and should have a thorough knowledge of at least one European language, ideally German or French.

A good musical knowledge is essential and experience in the audio field would be an advantage.

Duties will include editing recorded tapes according to instructions in the score and responsibility for the installation and maintenance of recording equipment.

Please apply in writing, sending brief details of age, education and work experience to:—

**The Personnel Officer,
Philips Records Limited,
Stanhope House,
Stanhope Place,
LONDON, W.2.**

Initial interviews will be held in London.

2571

PYE T.V.T. the leaders in closed circuit television

PYE T.V.T. the experts in sound engineering. PYE T.V.T. leaders in broadcasting equipment. PYE T.V.T. sound amplification

Electronic Design Engineer

Pulse and Logic Circuitry

A vacancy of exceptional interest for a young design engineer has arisen. He will join a team working on television studio equipment using digital techniques of an advanced nature.

Applicants will be of at least H.N.C. standard and have three years or more of design experience using transistor and integrated circuits

Age preferably 24/30.

Attractive conditions of employment and commencing salary will be offered.

Please apply with brief employment details to:



Personnel Officer,

PYE T.V.T. LIMITED

Coldhams Lane, Cambridge.

Telephone: Cambridge (0223) 45115

2543

Test Engineers

Due to expansion there are excellent opportunities for Test Engineers in our laboratories and production departments, testing Radio, Navigator and Survey equipment.

Applicants with first-class background of T.V. and Radio Servicing or Telecommunications, Electronic and Control Circuiting should apply giving details of experience. Conditions are excellent and salaries will be commensurate with ability and experience.



Apply quoting Ref. NAV/29/C to
The Personnel Officer,
The Decca Navigator
Company Ltd.,
88 Bushey Road, Raynes Park,
London, S.W.20.
Tel : Wimbledon 8011.

2541

THE UNIVERSITY OF LEEDS

British National Cosmic Ray Experiment, Haverah Park, Near Leeds.

Required immediately an EXPERIMENTAL OFFICER to assist with the design and development of electronic apparatus. Minimum qualifications: degree or equivalent in physics or electronic engineering.

Salary in range £995-£1,460. Applications should be made in writing, giving details of qualifications and experience, to the Administrative Assistant, Physics Department, University of Leeds, Leeds, LS2 9JT.

2581

DUBLIN

BROADCAST ENGINEER

With experience of maintenance and development of TV and sound studio equipment.

Required for radio and TV production and training studios.

Applications with a resumé of relevant experience should be sent to the Director, The Communications Centre, Booterstown Avenue, Co Dublin. Terms of contract negotiable.

2583

ELECTRONICS TECHNICIAN

to be responsible to Group Engineer for maintenance, calibration and installation of a wide range of electronic equipment used in medical and engineering fields of Hospital work. Qualifications to level of H.N.C. desirable with wide experience in maintenance and calibration of electronic equipment.

Salary range £1030 to £1365 p.a. Starting salary may be above minimum. Post offers ideal opportunity for man to join vital and growing service with prospects for advancement.

Application forms from Group Engineer, Reading and District Hospital Management Committee
3 CRAVEN ROAD • READING • BERKS.

2584

TECHNICAL ASSISTANT

Men under 30 with science or engineering degree or equivalent required to work in London office of large firm of patent agents, to deal with inventions covering a wide range of subjects and to be trained to join the surprisingly highly-paid ranks of Chartered Patent Agents.

Write Mr. R. L. Andrews, 28 Southampton Buildings, Chancery Lane, London, W.C.2, or telephone 405 5611.

2588

URGENTLY REQUIRED

ALL TYPES OF RADIO TELEPHONE EQUIPMENT

ESPECIALLY PYE CAMBRIDGE AND VANGUARD MOBILES. ALSO BASE STATIONS ANY CONDITION, WORKING OR NOT. Top prices paid.

WE ALSO REPAIR ALL TYPES OF RADIO TELEPHONE EQUIPMENT

SOUTHERN RADIO & T.V. SERVICE

1 BACK HAMILTON STREET SALFORD 7 LANCS.

Telephone 061-792 4929

GOVERNMENT OF UGANDA

REQUIRES

BROADCASTING ENGINEERS

to serve on contract for one term of 21-27 months in the first instance. Salary according to experience in scale Uganda Shg.21120-27780 (£Stg.1232-1620) a year, plus an Inducement Allowance, normally tax free, of £Stg.778-886 a year, paid direct into the officer's bank in U.K. Gratuity 25% of total emoluments drawn. Liberal paid leave. Accommodation provided at reasonable rental. Outfit and education allowances. Free passages. Contributory pension scheme available in certain circumstances.

Candidates must possess the City and Guilds Final Certificate in Telecommunications (with Radio) or an equivalent qualification and have wide practical ex-

perience of technical broadcasting equipment including transmitting and studio control equipment.

The officer will be required to undertake senior operational duties including the maintenance of broadcasting equipment in transmitting stations and studios; outside broadcasts and recordings in remote districts, and to give assistance with the training of junior engineering staff.

Apply to CROWN AGENTS, 'M' Division, 4 Millbank, London, S.W.1, for application form and further particulars stating name, age, brief details of qualifications and experience and quoting reference number M2K/690995/WF.

CLARKE & SMITH MANUFACTURING CO. LTD.

have vacancies for

Audio Electronics and Small Mechanism Design Engineers

to work on Language Laboratory Systems and Electronic Equipment for Education Projects.

Good salaries and progressive positions. Applicants, who should have qualifications equivalent to H.N.C. standards, should apply to:

Mr. T. A. Julian,
Wallington,
Surrey.
Tel: 01-669 4411

2589

West Sussex County Education Committee

BOGNOR REGIS COLLEGE of EDUCATION

Upper Bognor Road · Bognor Regis · Sussex

Applications are invited for the post of

TECHNICIAN

for Closed Circuit Television

Person appointed will be expected to have sound practical knowledge of cameras, control and recording equipment used in Closed Circuit Television and be capable of carrying out day to day maintenance. Applications will be considered from those with relevant experience in the electronics field who desire to extend this to Television. Salary scale: £930-£1,095 per annum, according to experience. Additional remuneration payable in respect of certain specialist qualifications.

Application form and further details from the Administrative Officer at the College.

2590

Radio Technicians INSTALLATION AND MAINTENANCE £1,100-£1,500

YOUR WORK

Will be concerned with the maintenance and installation of equipment at airfields, inland and marine mobile networks and on North Sea drilling rigs. You will be based at Southall and London Airport and you may also be required to make brief trips overseas.

OUR REQUIREMENT

You should have experience in one or more of the following types of equipment—

- * VHF/UHF Base Station Mobile Equipment;
- * HF Receivers and Transmitters up to 1 KW using SSB, ISB and FSK techniques;
- * Remote control systems operating over G.P.O. landlines;
- * Teleprinters and Telegraph machines and error correction equipment.

You must have a U.K. driving licence and be willing to work outside working hours on a call-out roster basis.

OUR OFFER

Includes membership of an excellent contributory pension and life assurance scheme and concessions on holiday air fares can be obtained at nominal cost to most parts of the world, after a year's service. Salary will be negotiated and range from £1,100-£1,500.

YOUR FUTURE

Excellent long-term career prospects are offered for both U.K. and Overseas employment.

IAL are a fast-expanding world-wide Company, engaged in the field of communications, aviation services and engineering with over 3,000 employees around the world.

Please write stating briefly age and experience to the

Personnel Officer (R),

IAL

INTERNATIONAL AERADIO LIMITED

AERADIO HOUSE · HAYES ROAD · SOUTHALL · MIDDLESEX

PYE TVT the leaders in closed circuit television

PYE TVT the experts in sound engineering · PYE TVT

Electronic Test Engineers TV Broadcast Equipment

leaders in broadcasting equipment · PYE TVT sound amplification

Due to rapid expansion we have several additional vacancies for test engineers to work on a variety of units making up an advanced system of TV broadcast equipment.

Applicants will preferably have several years' experience of testing TV transmission broadcast equipment and be thoroughly familiar with the use of complex oscilloscopes for critical measurements of test parameters.

Attractive conditions of employment and commencing salary will be offered.

Please apply with brief employment details to:

Personnel Officer



PYE TVT LIMITED

Coldhams Lane, Cambridge.
Telephone Cambridge (0223) 45115

2544

Electrical Engineer

The Industrial Applications Department of the Electrical Research Association has a vacancy for an Electrical Engineer.

The successful applicant will be working with a group required to make investigations into the generation, propagation and measurement of high frequency transient disturbances in control and computer systems.

QUALIFICATIONS required are a degree, H.N.C. or equivalent in Electrical Engineering, with preferably industrial or research experience, in high frequency pulse techniques or electronic circuitry.

SALARY: this appointment will be in a grade with a salary range of £1,110-£1,750, the commencing salary depending on qualifications and age which is likely to be between 22 and 28 years.

Please apply to:
The Personnel Officer, Ref: 1A2,
Electrical Research Association,
Cleeve Road, Leatherhead, Surrey.

2534

THE UNIVERSITY OF HULL AUDIO-VISUAL CENTRE STUDIO ENGINEER

(Videotape and Telecine)

Applications are invited for the post of Studio Engineer (Videotape and Telecine) in the Television Studios of the University's Audio Visual Centre. Preference will be given to candidates with an H.N.C. or equivalent qualification, together with experience in the maintenance and operational aspects of magnetic recording equipment (either one inch helical scan or two inch broadcast) and/or Telecine equipment. The duties will be to operate and maintain videotape recording and Telecine equipment used in the Centre and if necessary further training will be given.

Salary range: £1,056-£1,311.

Further particulars may be obtained from the Registrar to whom applications (3 copies) should be sent by 27th October, 1969. 2593

UNIVERSITY OF BIRMINGHAM Department of Electron Physics Electronics Engineer

required to join the space research group in the Department of Electron Physics. The work is concerned with the design of electronic instrumentation for scientific rockets and satellites. The successful candidate will be expected to follow a project from initial design through environmental testing and space vehicle installation to pre-launch count down. This programme involves travel within the U.K. and to overseas launch sites. The post requires specialist experience in complex analogue solid state circuits and applicants should possess Grad. I.E.E.E., H.N.D., H.N.C. or equivalent qualifications. Those wishing to see something of the work before making a formal application are invited to telephone Professor J. Sayers, 021-472 1301, Ext. 1801. Salary £1380-£2045.

Applications should be sent to the Assistant Secretary (Personnel), Personnel Office, University of Birmingham, P.O. Box 363, Birmingham 15, reference 105/TO/155. 2561

RADIO AND INSTRUMENTATION ENGINEERS

Required for WEST AFRICAN PROJECTS

C.O.D.E.C.O.

62 STEPHYNS CHAMBERS · BANK COURT
MARLOWES · NEMEL HEMPSTEAD · HERTS
2403

DEPUTY SUPERINTENDENT OF POLICE

(Signals Branch)

Government of Brunei

Candidates, must have City and Guilds Telecommunications Intermediate Certificate, with not less than five years' experience. Experience in a Police Force or Armed Forces is desirable.

The Officer is to assist the Force Signals Officer in installation, maintenance and servicing of V.H.F. and H.F. equipment, supervision of Signals Stores and Workshops and Staff.

Salary range £2,125-£2,518 P.A. plus inducement allowance (£441-£474) P.A. The Appointment is on contract with gratuity for one tour of three years.

Candidates, who should be Nationals of the United Kingdom or Republic of Ireland, should apply quoting RC216/28/02 giving full name, age, qualifications and experience to:

The Appointments Officer,
MINISTRY OF OVERSEAS DEVELOPMENT,
Room E301, Eland House,
Stag Place, London, S.W.1. 2600

THE COLLEGE OF AERONAUTICS

The following appointments are to be made in the High Frequency Section of the DEPARTMENT OF ELECTRICAL AND CONTROL ENGINEERING and are open to candidates who have experience in waveguide techniques.

TECHNICAL OFFICER LABORATORY STEWARD

The vacancies are in the high frequency and radar laboratories which are concerned with postgraduate teaching and research in radar, radio and microwaves. Experience in the aviation field is not an essential requirement.

The TECHNICAL OFFICER will supervise the day-to-day activities in the laboratories and be responsible for the construction of specialised experimental equipment. Candidates should have passed the graduation examination of the I.E.E., I.E.R.E., or possess a H.N.C. or equivalent qualification. Salary in scale rising to £1,623 p.a.

The LABORATORY STEWARD, who should have relevant training and experience, will be appointed in a scale rising to £1,077 with a supplementary allowance of £50 p.a. for possession of a H.N.C. or equivalent qualification.

37 hour week of five days, generous holidays, staff superannuation and sick pay schemes.

Application form from Staff Records Officer, The College of Aeronautics, Cranfield, Bedford.

2601

SITUATIONS VACANT

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., 303 Edgware Rd., London, W.2. [67]

ASSISTANT MAINTENANCE ENGINEER required by the CENTRAL OFFICE OF INFORMATION for their Radio Division. Candidates should have had wide experience in maintenance of professional tape recording and studio equipment. Theoretical knowledge to City and Guild Intermediate level would be an advantage, as would experience in sound recording. Salary according to experience and qualifications on a range £1,215 to £1,560 p.a. Five-day week of 41 hours (inclusive of meal breaks). 18 days' paid annual leave. Please send postcard for application form to Manager (PEA/274/EW), Wireless World, Department of Employment and Productivity, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.1. Closing date for completed application forms, 30 October, 1969. [2602]

AUDIO DEVELOPMENT ENGINEER. Electro-Musical Industry. Watkins Electric Music Ltd., 66 Offey Road, London, S.W.9. Tel. 01-735 6568. Please write in first instance. [2574]

CHESTER. Experienced TELEVISION ENGINEER with a liking for the occasional quality Hi Fi job required for inside work. Also vacancy for experienced TV field mechanic, 5-day 40-hour week. Independent firm. Please write giving past experience to Mr. P. K. Caveen, PETERS (ELECTRICAL) LTD., 2 Charles Street, Hoole, Chester. [2570]

NORTH STAFFORDSHIRE COLLEGE OF TECHNOLOGY

A Constituent College of the Proposed North Staffordshire Polytechnic. ENGINEERING DEPARTMENT (Electrical and Electronic Division). Applications are invited from candidates with a University Degree or an equivalent qualification for the following posts: (a) SENIOR LECTURER IN ELECTRICAL ENGINEERING; (b) LECTURER GRADE II IN ELECTRICAL ENGINEERING. The successful candidate for post (a) will be responsible for subjects in the field of communications engineering, including Telecommunications, Television and Radio. He will be required to undertake the organisation of short courses in Telecommunications, Colour TV and allied subjects. In addition, he

GEC-Marconi Electronics

ELECTRONIC TECHNICIANS

are required to work on calibration, fault-finding and testing of telecommunications measuring instruments. The work is varied and will enable technicians with experience of r.f. circuits to broaden their knowledge of the latest techniques employed in the electronics and telecommunications industries by bringing them into contact with a wide range of the most advanced measuring instruments embracing all frequencies up to u.h.f.

Entrants may be graded as Testers, Test Technicians or Senior Test Technicians according to experience and qualifications. Our expanding production programme geared to our recognised export achievement provides security of employment combined with good prospects of advancement, not only within these grades, but into other technical and supervisory posts within the Company.

Salaries are attractive and conditions excellent. A Pension Scheme includes substantial life assurance cover provided by the Company. Assistance with removal may also be given in appropriate cases. Please apply in writing, giving brief details including age, experience and salary to:

The Recruitment Manager,
Marconi Instruments Ltd.
Longacres, St. Albans, Herts.



Member of GEC-Marconi Electronics Limited

2530

For some of our distributors in AFRICA we require

SERVICE MANAGERS

They will be responsible for the organisation, administration and promotion of our distributors' Service Departments, including spare parts management.

A good practical and theoretical technical background in radio and television is necessary and the experience of service and spare parts administration is important.

Further requirements are a background in Service Workshop management and training of repairmen.

Products to be serviced include television, radio and household appliances. Salary commensurate with qualifications and experience.

Applicants should submit full background details.

Apply to Box No. W.W.2558.

MICROWAVE ENGINEERS

OVERSEAS

THE POSTS

Excellent career opportunities exist for Microwave Engineers to join the International Aeradio world-wide organisation for overseas employment.

OUR REQUIREMENTS

The men selected will be responsible for the maintenance of a solid set wideband multihop microwave system. Applicants should have experience in the following:

- ★ Overall system appreciation.
- ★ Alignment and testing procedures of solid state microwave systems and the associated supervisory and terminal carrier channelling equipment.
- ★ Preventive maintenance procedures and rapid and accurate fault diagnosis on the above types of system.

YOUR FUTURE

IAL offers first-class career prospects. The company is fast expanding with over 3,000 employees engaged in the fields of telecommunications at more than 50 bases around the world. The present turnover is in the region of £8 million per annum and is expected to exceed the £19 million mark within 10 years.

OUR OFFER

Includes a substantial tax-free salary; marriage, children's and educational allowances, free furnished accommodation, medical attention and leave passage.

To apply for one of these positions please write giving brief details of age, qualifications and career to date to:

General Manager Personnel,

IAL INTERNATIONAL AERADIO LIMITED
AERADIO HOUSE · HAYES ROAD · SOUTHALL · MIDDLESEX



TEST ENGINEER ELECTRONICS

To undertake testing and fault finding on UHF and VHF communication equipment. Qualifications to O.N.C. standard or similar experience as ex-regular H. M. Forces. Excellent opportunity for promotion within a small team working to rigid specifications. Free transport from approximately a 15-mile radius. Pension and life assurance scheme.

Write giving details to—
Personnel Officer,
AIRTECH LIMITED, Haddenham, Near Aylesbury, Bucks.

will be expected to encourage research in these fields and to accept a share of the departmental administrative duties. The successful candidate for post (b) will be required to teach Radio and Television Servicing subjects, and should have some experience in Colour TV work. In addition, he will be expected to assist with the normal range of Telecommunications and Electronic subjects covered by the Department. Salary Scale: Senior Lecturer, £2,417-£2,752; Lecturer II, £1,827-£2,417. Further details and application forms may be obtained from the Registrar, North Staffordshire College of Technology, College Road, Stoke-on-Trent. [2577]

ELECTRONIC PROTOTYPE WIREMAN, wide technical knowledge, seeks position overseas; permanent or contract.—Reply Rex. W. Harris, 36 Clifton Road, London, N.8. [2603]

RADIO ENGINEER for installation/service Yacht R.T., Automatic Pilots, some Radar. Clean driving licence essential. Must live in or near London. Knowledge and liking of boating an advantage. Telesonic Ltd., 243 Euston Road, N.W.1. 01-387 7467. [2573]

REDIFON LTD. require fully experienced TELECOMMUNICATIONS TEST ENGINEERS and ELECTRONICS INSPECTORS. Good commencing salaries. We would particularly welcome enquiries from ex-Service personnel or personnel about to leave the Services. Please write giving full details to—The Personnel Manager, Redifon Ltd., Broomhill Road, Wandsworth, S.W.18. [26]

SERVICE ENGINEER. We specialise in the repair and maintenance of 16 mm Sound Projectors, Tape Recorders and similar Visual Aids Equipment. We need another engineer with some knowledge of Audio Amplifiers. Must be able to drive. Write: Burgess Lane & Co. Ltd., Thornton Works, Thornton Avenue, Chiswick, London, W.4. [2578]

TAPE RECORDER ENGINEER required for workshop repair of DICTATING MACHINES in Central London. Write to PAXDICTATOR (SOUTHERN) LTD., Lysons Ave., Ash Vale, Aldershot. [2576]

THE UNIVERSITY OF LEEDS: Department of Physics. Electronics Technician required for post in electronics workshop involving maintenance and building of a wide range of prototype apparatus. Qualifications: O.N.C. or equivalent. Salary on scale £773-£1,077. Please apply in writing, giving details of qualifications and experience, to the Administrative Assistant, Physics Department, The University, Leeds, LS2 9JT. [2564]

WE HAVE VACANCIES for Four Experienced Test Engineers in our Production Test Department. Applicants are preferred who have Experience of Fault Finding and Testing of Mobile VHF and UHF Mobile Equipment. Excellent Opportunities for promotion due to Expansion Programme. Please apply to Personnel Manager, Pyc Telecommunications Ltd., Cambridge Works, Haig Road, Cambridge. Tel. Cambridge 51351, Extn. 327. [77]

15 MeV LINEAR ACCELERATOR. Assistant to help to operate and maintain. General electrical and mechanical knowledge; accelerator experience not essential. Salary up to £1,200. Applications to Secretary, Department of Radiotherapeutics, University of Cambridge, Tennis Court Road, Cambridge. [2575]

ARTICLES FOR SALE

BRAND NEW ELECTROLYTICS, 15/16 volt 0.5, 1, 2, 5, 6, 8, 10, 15, 20, 30, 40, 50, 100, 200 mfd., 8d. Mullard 25 volt 6.4, 12.5, 25, 50, 80 mfd., 10d., 1-6, 160 mfd., 1/-. Minimum order 7/6., postage 1/- per order.—The C.R. Supply Co., 127 Chesterfield Road, Sheffield, S8. [2587]

BUILD IT in a DEWBOX quality plastics cabinet. 2 2 in. X 2 1/2 in. X any length. D.E.W. Ltd. (W), Ringwood Rd., FERNDOWN, Dorset. S.A.E. for leaflet. Write now—Right now. [76]

COLOUR T.V. Large-Screen Projectors, Cintel Model 20630, 6-ft. picture from RGP video inputs. 2 units plus spare CRTs. Partly dismantled for storage. £400 lot as seen or offers. Box W.W. 2569 Wireless World.

COLOUR T.V. PARTS for W.W. Colour Set; large range of specialist parts.—Forgestone Components, Ketteringham, Wymondham, Norfolk. [2586]

HOW to Use Ex-Govt. Lenses and prisms. Booklets. Nos. 1 & 2, at 2/6 ea. List Free for S.A.E. H. W. ENGLISH, 469 RAYLEIGH RD., HUTTON, BRENTWOOD, ESSEX. [87]

INTEGRATED CIRCUITS at lowest price. GE Type PA 234, 1 Watt Audio Amplifier 17/6 each inc. data. Newest GE Silicon NPN planar transistor 2N5172, 25 Volt, 200 mW, hfe 100 min. Epoxy for economy. Passivated for reliability, 1/9 each. C.W.O. P. & P. 1/- per order. JEP ELECTRONICS, 12 York Drive, Grappenhall, Warrington, Lancs. Mail Order Only. [2565]

SOLARSCOPE OSCILLOSCOPE, Type CD 513.2. £40. Ring 01-723 4143, weekday evenings. [2594]

TELESCOPIC AERIAL MAST, ex Government, all brass, winds up 30 ft. Weight 65 lbs.. Bargain, £14. Buyer collects. ROPER, 84 Goldthorn Hill, Wolverhampton. [2567]

UFO DETECTOR CIRCUITS, data, 10s. (refundable). Paraphysical Laboratory (UFO Observatory), Downton, Wilts. [396]

UHF KITS and T.V. SERVICE SPARES. Suitable for Colour: Leading British Makers dual 405/625 six position Push button transistorised tuners £5 5s. 0d., 405/625 transistorised sound & vision IF panels £2 15s. 0d. incl. circuits and data, P/P 4/6. Basic dual purpose 405/625 transistorised tuners incl. circuit £2 10s. 0d., P/P 4/6. UHF list available on request. UHF tuners, PLESSEY incl. valves 55/-, P/P 4/6. EKCO/FERRANTI 4 position push button type incl. valves, leads, knobs £5 10s. 0d., P/P 4/6. SOBELL/GEC UHF tuner kit incl. valves, right angle slow motion drive assy, leads, fittings, knobs, instructions £5 18s. 6d., P/P 4/6. SOBELL/GEC 405/625 IF & out put chassis incl. circuit 32/6, P/P 4/6. Ultra 625 IF amplifier plus 405/625 switch assy incl. circuit 25/-, P/P 4/6. New VHF tuners, Cydon C 20/-, Ekco 283/330 range 25/-, Pyc CTM 13 ch. incremental 25/-, P/P 4/6. Many others available incl. large selection channel coils. Fireball tuners, used good cond. 30/-. Push button tuners RGD 612/619 type used good cond. 30/-, P/P 4/6. LOPTs. Scan coils, Frame output transformers, Mains droppers etc., available for most popu-

Commercial Product Engineer for Gas Discharge Tubes

This vacancy should prove attractive to a professionally qualified engineer with industrial experience, preferably in development and production or the design of electronic equipment, who now wishes to embark on a commercial career.

He would be responsible to the Commercial Product Manager for the Technical/Commercial product policy for a wide range of hot and cold cathode gas discharge tubes and similar devices, such as Numerical Indicators, Counters, Thyratrons and Reed Inserts. He should be prepared to travel frequently, both within the U.K. and overseas. Expected to negotiate on technical and commercial matters, he must be able to work together with Market, Production, Development and Research Personnel at all levels. This job is located at Mitcham, Surrey.

Please write to the Personnel Manager, Mullard Limited, Mullard House, Torrington Place, London, W.C.1., quoting reference RBT/1019

Mullard



UNIVERSITY OF CAMBRIDGE CAVENDISH LABORATORY

ELECTRONICS ENGINEER

To collaborate with physicists in design, construction and implementation of electronic circuitry incorporated in experimental apparatus in the Surface Physics research group of the laboratory.

Experience in solid state circuitry essential.

Degree or equivalent in electronic engineering or physics desirable.

Salary in range up to £1,400 p.a. depending on experience, qualifications and age.

Applications to:

**The Secretary,
Cavendish Laboratory,
Free School Lane,
Cambridge.**

2582

OXLEY

Applications are invited for the position of

Assistant to the Works Director

of Oxley Developments Company Ltd., Ulverston.

Applicants must be about 30 years of age and have Higher National Certificate or a degree in Science. Preference will be given to someone with all or part of the following experience or qualifications:-

- (1) Knowledge of modern manufacturing methods in electronics, small mechanical components and mechanisms.
- (2) Assistant or deputy to a Works Manager in a thriving concern.
- (3) Experience in dealing with people, production control, and shop floor conditions; experience in cost accounting.

Oxley Developments is a vigorous and expanding Company offering scope and opportunity for the right man. The Works are located in open countryside at the southern end of the Lake District.

Applications giving details of education, qualifications, experience and salary and including copies of two references or names and addresses of referees to be addressed to:

**The Personnel Manager,
Oxley Developments Company Ltd.
PRIORY PARK · ULVERSTON · NORTH LANCASHIRE**

2563

NCR SYSTEMS TESTERS

To bring-up, fault find and prove functions of electronic systems used in complex business machines by logical diagnosis. Candidates should possess an O.N.C. (Electrical) or R.T.E.B. Certificate, or City and Guilds Certificate (Subjects 47, 48 or 49) and have experience in one of the following areas:-

Computers, Radar, Tele-communications, Radio and T.V., etc.

These are Staff appointments carrying attractive salaries which are fully commensurate with qualifications and experience. Other employment conditions include 3 weeks' Annual Holiday, Pension Plan, etc. Effective assistance with housing will be provided.

NAME..... AGE.....
 ADDRESS.....
 QUALIFICATIONS.....
 W.W.2551

For Application Form return coupon to:-

**The Personnel Department,
THE NATIONAL CASH REGISTER CO.
(Manufacturing) LTD.,
Kingsway West,
DUNDEE DD1 9 QY**



THE CIVIL SERVICE

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.Ac.S.

Age: 23 and normally under 35 on 31st December, 1969 (extension for H.M. Forces or Overseas Civil Service).

Starting Salary (Inner London) may be as high as £2,218, depending on qualifications and experience. Pensionable appointments. Good prospects of promotion.

Application Forms are obtainable by writing to the Civil Service Commission, Savile Row, London, W1X 2AA, or by telephoning 01-734 6010, ext. 229 (after 5.30 p.m. 01-734 6464 "Ansafone" service). Please quote S/85/ASO.

2545

CLOSED CIRCUIT TELEVISION ENGINEER MARCONI MARINE

MARCONI MARINE is a major supplier of shipborne television installations and equipment and an engineer is required in the Company's Television Section at Chelmsford for the system planning of closed circuit and entertainment television systems.

Applications are invited from Engineers with practical experience of closed circuit television systems and in particular it would be desirable that this experience has been obtained with a major equipment manufacturer.

Additionally, experience in the development of television broadcast equipment would be advantageous coupled with experience in system costing.

Qualifications of H.N.C. level are necessary but the prime requirement is to produce practical results at the right price.

Applications, in strictest confidence, to:

**Personnel and Operating Manager,
The Marconi International Marine Co. Ltd.,
Elettra House, Westway,
Chelmsford, Essex**

2552

AIR FORCE DEPARTMENT RADIO TECHNICIANS

Starting pay according to age, up to £1,189 p.a. (at age 25) rising to £1,500 p.a. with prospects of promotion.

**Vacancies at RAF Sealand, Near Chester
RAF Henlow, Bedfordshire
and RAF Carlisle, Cumberland**

Interesting and vital work on RAF radar and radio equipment.

Minimum qualification, 3 years' training and practical experience in radio engineering.

5-day week—good holidays—help with further studies—opportunities for pensionable employment.

Write for further details to:

**Ministry of Defence, CE3h (Air),
Sentinel House,
Southampton Row,
London, W.C.1.**

Applicants must be UK residents.

2535

lar makes. TV signal boosters transistorised PYE/Labgear B1/B3, or UHF battery operated 75/-. UHF mains operated 97/6, UHF masthead 85/-. post free. Enquiries invited. COD despatch available. MANOR SUPPLIES, 64 GOLDERS MANOR DRIVE, LONDON, N.W.11. CALLERS 589B, HIGH ROAD, N. FINCHLEY, N.12 (near GRANVILLE RD.). Tel. 01-445 9118. [60]

BUSINESS OPPORTUNITIES

QUALIFIED experienced Design Engineer seeks Financial Support to develop small company manufacturing high reliability control equipment. Possible optoelectronics specialisation Initially. Policy: IC designs for assembly/servicing ease: continuous research and expansion. Box No. W.W. 2569 Wireless World.

TEST EQUIPMENT — SURPLUS AND SECONDHAND

MARCONI TF890A/4 Radar Test Set 8500-9680 mc/s incorporating: Klystron Signal Generator, Thermistor Power Monitor, Spectrum Analyser, Directive Feed Assembly, brand new, makers' guarantee. 021-454 8305.

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. Lpy. 4986. [64]

[2566]

RECEIVERS AND AMPLIFIERS — SURPLUS AND SECONDHAND

HERO Rx5s, etc., AR88, CR100, BRT400, G209, S640, etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Lpy. 4986. [65]

NEW GRAM AND SOUND EQUIPMENT

CONSULT first our 76-page illustrated equipment catalogue on HI-FI (6/6). Advisory service, generous terms to members. Membership 7/6 p.a.—Audio Supply Association, 18 Blenheim Road, London, W.4. 01-995 1661. [27]

GLASGOW—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343 Argyle St., Glasgow, C.2. [11]

TAPE RECORDING ETC.

IF quality, durability matter, consult Britain's oldest transfer service. Quality records from your suitable tapes. (Excellent tax-free fund raisers for schools, churches.) Modern studio facilities with Steinway Grand.—Sound News, 18 Blenheim Road, London, W.4. 01-995 1661. [28]

TAPE to disc transfer, using latest feedback disc cutters; EPs from 22/-; s.a.s. leaflet.—Deroy, High Bank, Hawk St., Carnforth, Lancs. [70]

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A. Boxmakers, 75a Godwin St., Bradford. 1. [10]

FOR HIRE

FOR hire CCTV equipment including cameras, monitors, video tape recorders and tape—any period.—Details from Zoom Television, Amersham 5001. [75]

ARTICLES WANTED

PYE Radiotelephones, AM10D, AM10B, AM25T. Austen, 1 Valebridge Rd., Burgess Hill. Phone 3409. [2579]

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Lpy. 4986. [63]

[2491]

WANTED—Earliest Marconi wireless equipment, Marconi Magnetic Detector, Fleming Valve; also Hallcrafters Dual Diversity model DDI, circa 1930.—R. Hanselman, 914 Columbian, Oak Park, Illinois, U.S.A., 60302. [2595]

WANTED—small quantity PYE Vanguards—AM25B with connecting cables and cradles, must be clean and serviceable. Price and details please to: Raymond McAker, Radio Engineer, Main Street, Garvagh, Co. Londonderry, N. Ireland. [2568]

WANTED, televisions, tape recorders, radiograms, new valves, transistors, etc.—Stan Willetts, 37 High St., West Bromwich, Staffs. Tel. Wes. 0186. [72]

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. [62]

SERVICE & REPAIRS

YOU MAKE IT, let us install and maintain it. South of Ireland.—Box No. WW395 Wireless World.

CAPACITY AVAILABLE

AIRTRONICS, Ltd., for coil winding, assembly and wiring of electronic equipment, transistorised sub-unit sheet metal work.—3a Walerand Rd., London, S.E.13. Tel. 01-852 1706. [61]

ELECTRONIC and Electrical Manufacture and Assembly. Prototypes and short production runs. East Midlands Instrument Co. Ltd., Summergangs Lane, Gainsborough, Lincs. Tel. 3260. [88]

METALWORK, all types cabinets, chassis, racks, etc., to your own specification, capacity available for small milling and capstan work up to 1in bar.—PHILPOTT'S METALWORKS, Ltd., Chapman St., Loughborough. [17]

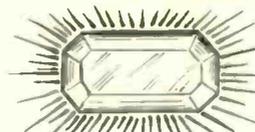
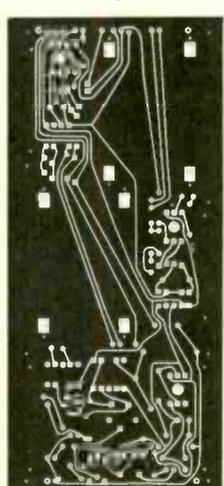
PLASTIC Injection Moulding Specialists in short runs up to 1 oz. Low tooling costs.—K.T. Plastics Ltd., Dept. 10, 23 Hunters Hill South Ruislip, Middx. 01-845 2824. [90]

FANTASTIC SPEAKER BARGAIN
 Famous English, 12" high flux, heavy cone, 10 watts speaker with built-in tweeter, 3 or 15 ohms, 12-month guarantee. **39/6**
 2 for 70/- (P. & I. 6/9) (P. & I. 4/9)
NEW RELEASE HI-FI COLUMN SPEAKER CABINET
 Beautifully made. Suitable for 7-12" speakers. Rosewood finish. Screwed and glued. Attractive grey cloth front measures 24" x 13" x 10" with tweeter hole above. Mark II de luxe model (Carr. 10/-). With 12" speaker as advertised above **95/-**
ELECTRAMA
 Dept WW80, 15 High St. Hailsham, Sussex

VACUUM
 OVENS, PUMPS, PLANT, GAUGES, FURNACES, ETC., GENERAL SCIENTIFIC EQUIPMENT EX-STOCK, RECORDERS, PYROMETERS, OVENS, R. F. HEATERS. FREE CATALOGUE.
V. N. BARRETT & CO. LTD.
 1 MAYO ROAD, CROYDON, CRO 2QP. 01-684 9917-8-9

WE PURCHASE
 COMPUTERS, TAPE READERS AND ANY SCIENTIFIC TEST EQUIPMENT. PLUGS AND SOCKETS, MOTORS, TRANSISTORS, RESISTORS, CAPACITORS, POTENTIOMETERS, RELAYS TRANSFORMERS, ETC.
ELECTRONIC BROKERS LTD.
 49 Pancras Road, London, N.W.1. 01-837 7781

Grampian
 for good
SOUND EQUIPMENT
GRAMPIAN REPRODUCERS LTD
 Hanworth Trading Estate, Feltham, Middlesex
 WW-143 FOR FURTHER DETAILS

THERE ARE GEMS IN IRELAND
 This is one 
 THIS is another 
 IF YOU WANT A REAL GEM CONTACT  **TECLARE LTD**
 ENNIS, CO. CLARE. Phone: 21559
 AFTER ALL, WE'RE IN THE EMERALD ISLE
 WW-144 FOR FURTHER DETAILS

PRINTED CIRCUITS
 Small quantities are not expensive, we have full artwork and assembly facilities.
 Let us quote you for any quantity.
OFRECT ELECTRONIC SYSTEMS LTD.
 Hookstone Park, Harrogate Harrogate 86258
 Telex 57962

R & R RADIO
 51 Burnley Road, Rawtenstall
 Rossendale, Lancs
 Tel.: Rossendale 3152
VALVES BOXED, TESTED & GUARANTEED

EBF80 3/-	PCC84 3/-	PY82 3/-
EBF89 3/6	PCF80 3/-	U191 4/6
ECC82 3/-	PCF82 3/6	U301 4/6
ECL80 3/-	PCL82 4/-	6F23 5/-
EF80 1/6	PCL83 4/-	10P14 3/-
EF85 3/-	PCL84 5/-	20P5 3/-
EF183 3/6	PL36 5/-	30F5 2/6
EF184 3/6	PL81 4/-	30L15 5/-
EY86 4/-	PL83 4/-	30P12 4/6
EL41 5/-	PY33 5/-	30C15 5/-
EZ40 4/6	PY81 3/6	30PL13 5/6
EBC41 4/6	PY800 3/6	30PL14 5/6

POST, ONE VALVE 9d. TWO TO SIX 6d. OVER SIX POST PAID.

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

GEARED MOTORS
 Microswitches, Timers, Meters, Potentiometers, Capacitors, all new
 6d. stamp for catalogue.
F. HOLFORD & CO.
 6 IMPERIAL SQUARE, CHELTENHAM

NEONS. PRINTED CIRCUIT BOARDS. INSTRUMENT CASES. MOULDED REED SWITCHES and PIDAM logic modules. CONTIL and BRIGHTLIFE products are all ex-stock. For details see August and October 1969 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, MIDDX.
 Telephone: Northwood 24941

FOR YOUR...
SYNCHRO & SERVO REQUIREMENTS!
SERVO & ELECTRONIC SALES LTD.
 43 HIGH ST., ORPINGTON, KENT. Tel: 31066, 33976
 Also at CROYDON. Tel: 01-688 1512 and LYDD, KENT. Tel: LYDD 252

TELFORD RANGE OF OSCILLOSCOPE CAMERAS

modules designed to meet every application

The Telford range of Oscilloscope Cameras includes many unique features not normally found in Oscillography. Their modular construction allows the user to select the camera and interchangeable accessories to meet his exact need.

Type A Polaroid Pack back parallax-free viewer—other types available. ● Viewing systems include parallax-free viewing during exposure ● Adaptors for all popular scopes ● Lenses f1.5, f1.9, f2.8, f3.5, with choice of object/image ratios ● Accessories include solenoid operation and data recording ● Film backs: Polaroid 10 second prints: roll, pack or cut film, all conventional materials including 35mm.

TELFORD PRODUCTS LTD
 4 WADSWORTH ROAD GREENFORD MIDDLESEX ENGLAND
 THE **DAVALL** PHOTO-OPTICAL COMPANY OF THE BENTIMA GROUP

*Registered trade mark of Polaroid Corp. of U.S.A.
 Write now for full technical 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:

- ★ 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 AND ELECTRONIC COURSES

Build your own 5-valve receiver, transistor portable, signal generator, multi-meter and valve volt meter—all under expert guidance.

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**

**A WHOLE WORLD
OF KNOWLEDGE
AWAITS YOU!**

International Correspondence Schools
(Dept. 230), Intertext House, Stewarts Road,
London, S.W.8.

NAME _____
Block Capitals Please
ADDRESS _____

10/69

WW-145 FOR FURTHER DETAILS

DIOTRAN SALES

P.O. BOX 5
WARE, HERTS
TEL. WARE 3442

S.C.R.'s 16AMP (unplated)
100 PIV 1.24 25.99
400 PIV 9/6 7/6
14/- 12/-
All tested perfect functional
guaranteed.

100 up
6/-
10/-

We will also buy
your surplus stock
—Send us your
lists.

**OVER 3 MILLION SILICON ALLOY & GERM. TRANSISTORS AVAILABLE FOR IMMEDIATE DELIVERY.
MANUFACTURERS END OF PRODUCTION SURPLUS.**

TRANSISTORS Type and Construction	Qty. Price	Qty. Price	Qty. Price	Qty. Price
A 1 Germ. A.F. PNP TO-1	100	500	1,000	2,000
A 2 Germ. A.F. PNP TO-5	£3.10	£15	£25	£200
A 3 Germ. A.F. PNP TO-1	£1	£3	£5	£40
A 4 Germ. R.F. PNP TO-1	£1.10	£4.10	£7.10	£60
A 5 Germ. R.F. PNP TO-5	£1.10	£4.10	£7.10	£60
A 6 Germ. V.H.F. PNP TO-1	£3.10	£15	£25	£200
A 7 Assorted Germ. A.F.-R.F. PNP mixed cans, general purpose 15a.	£2.10	£4	£7	£22
A 8 Germ. A.F. 50-2 PNP	£2.37	£9	£12	£100
A 9 Sil. Alloy PNP TO-5	£2.30	£9	£12	£100
A10 Sil. Alloy PNP 50-2	£2.32	£9	£12	£100

1/- TESTED TRANSISTORS 1/- each
ONE PRICE ONLY PNP, NPN, each SILICON PLANAR 1/- EACH

BC108	2N696	2N1132	2N2220	2S733
BC109	2N697	2N1613	2N3707	2N3391
BFY50	2N706	2N1711	2N3711	T1544
BFY51	2N708	2N2904	2S102	2N2906
BFX84	2N929	2N2905	2S103	2N2907
BFX86	2N930	2N2924	2S104	2N2909
BFX88	2N1131	2N2926	2S732	2N2906

GERM. PNP AND NPN TRANSISTORS TESTED, UNMARKED SIM. TO: 1/6 EACH

AC125	AC126	AC127	AC128	AC129	AC130	AC131	AC132	AC133	AC134	AC135
AC125	AC126	AC127	AC128	AC129	AC130	AC131	AC132	AC133	AC134	AC135

TO-5 METAL CAN SILICON PLANAR TRANSISTORS. VERY HIGH QUALITY 99% good type.
2N697, BFY51, 2N1893, each per 500 pieces, £13/0/0 for 1,000 pieces.

HIGH QUALITY SILICON PLANAR DIODES. SUB-MINIATURE DO-7 Glass Type, suitable replacements for OA200, OA202, BAY38, IS130, IS940, 200,000 to clear at £4 per 1,000 pieces. GUARANTEED 80% GOOD.

FULLY TESTED DEVICES AND QUALITY GUARANTEED—SURPLUS TO REQUIREMENTS

OA202 Silicon Diode, Fully Coded.
150 PIV 250mA Qty. Price £30 per 1,000 pieces.
BY100 SIL. RECT'S 800 PIV 500 mA.
1-49 2/6 each; 50-99 2/3 each; 100-999 2/- each; 1,000 up 1/10 each. Fully Coded. 1st Qty.

PLASTIC PNP SILICON TRANSISTORS. Manufacturers' seconds from 2N3702-3 family. Ideal cheap trans. for manufacturing etc. £8 500, £13.10 1,000 pieces.

PLASTIC NPN SILICON TRANSISTORS. Manufacturers' seconds from 2N3707-3711 family. Ideal cheap trans. for manufacturing etc. £7.10 500, £12.10 1,000 pieces.

TO-18 METAL CAN SILICON PLANAR TRANS. Very high quality 99% good. Type 2N706, B5Y27. £8 per 500 pieces, £13 per 1,000 pieces.

TOP HAT SILICON RECTIFIERS. All good. No short or open circuit devices. Voltage range 25-400V, 750mA. £3 per 100, £12.10 per 500.

TEXAS 2G71 A/B Evt. OC71 Germ. Gen. Purpose Trans.
1-99 1/6
100-499 1/3
500-999 1/-
1000 up 9d.
All Brand New and Coded.

TRANSISTOR EQVT. BOOK
2,500 cross references of transistors—British, European, American and Japanese. A must for every transistor user. Exclusively distributed by DIOTRAN SALES. 15/- EACH.

Vast mixed lot of subminiature glass diodes. Comprising of Silicon, Germ. Point Contact and Gold Bonded types plus some Zeners. 500,000 available at Lowest of Low Price.
1,000 pieces £3.0.0, 5,000 pieces £13.10.0, 10,000 pieces £23.

Post and Packing costs are continually rising. Please add 1/- towards same. CASH WITH ORDER PLEASE. QUANTITY QUOTATIONS FOR ANY DEVICE LISTED BY RETURN.

OVERSEAS QUOTATIONS BY RETURN SHIPMENTS TO ANYWHERE IN THE WORLD AT COST.

AMATRONIX LTD (WW)

TRANSISTORS—MINT, NO SECONDS, NO RE-MARKS. GUARANTEED TO SPEC.

AD161	162	15/-	BFY51	4/-	2N3055	16/6
AF239	10/-	IS44	1/4	2N3707	4/-	
B-5000Q	11/3	IS557	3/-	2N3794	4/-	
BD121	18/-	MC140	4/-	2N3983	5/8	
BC107B	3/-	SF115	3/-	2N4058	4/6	
BC168B	2/3	T1818	7/-	2N4285	3/6	
BC169C	2/6	T1S60M	4/8	2N4289	3/6	
BF178	5/3	T1S61M	4/11	2N4291	3/6	
BF178	9/-	2N706	2/7	2N4292	3/6	
BF224	4/-	2N2926G	2/6	2S8187	2/-	

NOTES. Our AD161/2 are comp. matched prs. with hFE=80 min. at IC=500mA. SF115 is epoxy BF115; 2N3794=mini 3704; 2N4291=mini 3702; 2N4289 is hi-gain Si pnp; 2N4285 is hi-reverse VEB Si pnp substitute for Ge types; IS557 is 800 p.l.v. 500mA TV rect.; MC140 is 3W npn Si with insulated collector for easy heat sinking.

MOSFETS . . . hi-slope, low cross mod., N-chan, depletion, 40468A, improved 40468, 7.5mA/V typ. at 100MHz. 7/6. MEM564C, ruggedised 3N140 dual-gate; 12mA/V typ., NF 3.5dB typ. at 200MHz. Slim. Mullard BFS28. Only 16/- (For WW communications Rx.)

INTEGRATED CIRCUITS—PA234, new dual-in-line 1W audio amp, with data, 24/-; CA3020, TO-5 push-pull amp., usable to 6MHz, 28/-; TAA320, MOST-input impedance converter, 15/-; TAB101, transistor quad for ring modulator, 21/-; TAA263, 3-stage low level a.f. amp., 16/8.

AMPLIFIER PACKAGES—Component kits for efficient transformerless class B power amps. Low standby current, reversible polarity, simple circuitry, no adjustments.

AX2 9V, 300mW in 10-20 ohms, other loads usable, 12/6; AX3 9V, 800mW in 8 ohms, 20mV in 20K input, 22/6; AX4 24V, 5W in 8 ohms, 4W in 15 ohms, input 100mV in 40K. Operable 18V with 12mA standby current and 2-3W output. Uses AD161/2 output pair with silicon low-level stages. Still only 30/-, AX5, 12V, 3W in 3 ohms, 39/6.

MINI MAINS TRANSFORMERS—1" x 1" x 1 1/2" Osborn MTS, 9-0-9V 80mA, 12/6. Eagle MT6, 6-0-6V, 100mA, 13/8; MT12, 12-0-12V, 50MA, 13/6. A comprehensive data sheet giving regulation curves for all these transformers with push-pull, bridge, and v.d. rects and covering outputs of 5-80V supplied free with orders. Tiny Se bridge, suits all these, 3/6. Mail order only. Cash with order. List 6d., free with orders. U.K. post free on orders over 10/-.

396 Selsdon Road, South Croydon, Surrey, CR2 0DE

WW-146 FOR FURTHER DETAILS

OSMABET LTD.

WE MAKE TRANSFORMERS AMONGST OTHER THINGS

AUTO TRANSFORMERS. 0-110-200-220-240 v a.c. up or down, fully shrouded fitted terminal blocks. 50 w 31/-; 75 w 37/-; 100 w 45/-; 150 w 57/6; 200 w 71/6; 300 w 90/-; 400 w 112/6; 500 w 127/6; 600 w 135/-; 750 w 172/6; 1000 w 210/-; 1500 w 345/-; 2000 w 400/-; 3000 w 580/-; 4000 w 750/-.

MAINS ISOLATION TRANSFORMERS. Input 200-240 v a.c. 1:1 ratio, 50 w 80/-; 100 w 90/-; 200 w 150/-; 500 w 300/-.

MAINS TRANSFORMERS. Prim 200-240 v a.c. TX1, 425-0-425 v 250 Ma, 6.3 v 4 a, CT, 6.3 v 2 a, CT, 0-5-6.3 v 3 a, 135/-; TX2 250-0-250 v 150 Ma, 6.3 v 4 a, CT, 0-5-6.3 v 3 a 67/8; TX3 250-0-250 v 100 Ma, 6.3 v 2 a, CT, 6.3 v 1 a, 58/8; TX4 300-0-300 v 300 Ma, 6.3 v 2 a, CT, 6.3 v 1 a, 58/8; TX5 300-0-300 v 120 Ma, 6.3 v 1 a, 6.3 v 2 a, CT, 6.3 v 2 a, 67/8; TX6 260-0-250 v 65 Ma, 6.3 v 1.5 a, 32/6; MT2 250 v 45 Ma, 6.3 v 1.5 a, 25/-.

INSTRUMENT TRANSFORMERS. Prim 200/250 v a.c., OMT4/1 tapped sec., 5-20-30-40-60 v, giving 5-10-15-20-25-30-35-40-55-60, 10-0-10, 20-0-20, 30-0-30 v a.c. 1 amp 40/-; ditto tran 2 amp OMT4/2 60/-; OMT5/1 tapped sec., 40-50-60-80-90-100-110, 10-0-10, 20-0-20, 30-0-30, 40-0-40, 50-0-50 a.c. 1 amp, 60/-.

HEATER TRANSFORMERS. Prim 200/250 v a.c. 6.3 v 1.5 a 11/6; 3 a 18/8; 6 a CT 30/-; 12 v 1.5 a 18/8; 3 a CT 30/-; 6 a 58/-; 24 v 1.5 a 27/8; 3 a 56/-; 5 a 75/-; 8 a 108/-; 12 a 150/-.

MIDGET MAINS TRANSFORMERS. FW rectification, size 2 x 1 1/2 x 1 1/2 in. prim 200/250 v a.c., output PT1 20-0-20 v 0.15 a; PT2 12-0-12 v 0.25 a; PT3 9-0-9 v 0.3 a, all at 19/6 each.

OUTPUT TRANSFORMERS. Mullard 5/10 UL 67/8; 7 watt stereo UL 58/-; 3 watt PP3 30/-; PP 11K/3-7.5-15 ohm 21/-; Multi ratio 7.10 watt 20/- 30 watt (KT66 etc.) 3-15 ohm 75/-; 50 watt (KT66 etc.) 135/-; 100 watt 210/-; auto matching transformer 10 watt, 3-7.5-15 ohm, up or down 11/6.

CHOKES. Inductance 10 H, 65 Ma 12/-; 85 Ma 15/-; 150 Ma 21/-.

W.W. COLOUR TELEVISION RECEIVER
Transformers and choke as specified.
Choke L1 80/-; Transformer T1 57/6; Field OP transformer 60/-.

Carriage extra on all transformers 4/6 minimum.

BULK TAPE ERASERS. 200/250 v a.c. Immediate and complete erasure of any size pool of magnetic tape, also suitable for tape head demagnetization. 42/6. P. & P. 3/-.

FLUORESCENT LIGHTING. 12 v LT. complete fittings, 12 ins. 8 watt 110/-; 21 ins. 13 watt 130/-; special offer 18 ins. 15 watt 95/-.

LOUDSPEAKERS. Complete range, famous make, 25 watt 107/-; 35 watt 130/-; 50 watt 320/-, etc. etc. P. & P. 6/- illustrated lists.

LOUDSPEAKERS. Ex-equipment, perfect, 3 ohms. Elac, Goodman, etc. 8 ins. 15/-; 6 ins. 10/-; 5 ins. 7/6. P. & P. 3/6 min.

Carriage extra on all orders.

S.A.E. ALL ENQUIRIES PLEASE. MAIL ORDER ONLY.

46 KENILWORTH ROAD, EDGWARE, MIDDX, HA8 8YG. Tel: 01-958 9314

WW-154 FOR FURTHER DETAILS

NEW! HSL 700 Mono Transistor Amplifier

A really high fidelity monaural amplifier with performance characteristics to suit the most discriminating listener. 6 transistor circuit with integrated pre-amplifier assembled on special printed sub panel. AD-161-AD162 operating in asymmetric complementary pair. Output transformer coupled to 3 ohm and 15 ohm speaker sockets. Standard phono input sockets. Full wave bridge rectifier power supply for A.C. mains 200-240 v. Controls: Bass, Treble, Volume/on/off. Function selector for PU1, PU2, Tape, Radio. The HSL 700 is strongly constructed on rigid steel chassis, bronze hammer enamel finish, size 9 1/2 in. x 5 in. x 4 1/2 in. high. Performance figures:
Sensitivity—PU1-50 mV, 50K input impedance.
PU2-110 mV, 1 meg. input impedance.
Tape—110 mV, 1 meg. input impedance.
Radio—110 mV, 1 meg. input impedance.
Output power measured at 1 Kc-6.2 watts RMS into 3 ohms, 5.8 watts RMS into 15 ohm. Overall frequency response 30 c/s-18 Kc/s; Continuously variable tone controls: Bass, + 6db to 12 db at 100 c/s. Treble, + 10 db to -10 db at 10 Kc/s. The HSL 700 has been designed for true high fidelity reproduction from Radio Tuner, Gramophone deck and Tape Recorder pre amp but is also capable of being used in conjunction with a guitar by connecting to PU1 socket and the peak output power will then be in the region of 15 watts.
Supplied ready built and tested, complete with knobs, attractive anodised aluminium front escutcheon panel, long spindles (can be cut to suit your housing requirements), full circuit diagram and operating instructions. **OUR SPECIAL PRICE £71/0/6. P. & P. 7/6.**

BRAND NEW! PARMEKO MAINS TRANSFORMERS

Primary 110v-250v Secondary 330-0-330v. 100mA and 6.3v. at 2 amps, 6.3v. at 2 amps and 6.3v. at 1 amp. Conservatively rated. Fully impregnated. Electrostatic screen. Suitable for vertical or drop through mounting. Overall size 4 1/2 in. x 3 1/2 in. x 3 1/2 in. Weight 8lbs. Limited number only at 37/6 P. & P. 8/-.

Transistor Stereo 8+8 Mk. II

Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W, mono), 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 ±3dB, 20-20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to -16dB. Negative feedback 18dB. over main amp. Power requirements 25V. at 6 amps.
PRICES: Amplifier Kit £10/10/0; Power Pack Kit £3/0/0; Cabinet £3/0/0. ALL POST FREE.
Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.).

SPECIAL OFFER!

HI FI CELESTION SPEAKER UNIT. Size 6in. x 4in. Powerful 11,000 line magnet with specially treated cone surround. 10-12 ohm impedance. Few only at 20/- P. & P. 3/6.

QUALITY RECORD PLAYER AMPLIFIER MK. II

A top-quality record player amplifier employing heavy duty double wound mains transformer. ECC83, EL84, E280 valves. Separate bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7 1/2 in. x 3 1/2 in. d. x 6 1/2 in. h. Ready built and tested. **PRICE 75/-.** P. & P. 6/-. **ALSO AVAILABLE** mounted on board with output transformer and speaker ready to fit into cabinet below. **PRICE 97/6.** P. & P. 7/6.

DE LUXE QUALITY PORTABLE R-PLAYER CABINET MK. 2 Uncut motor board size 14 1/2 x 12 1/2 in. clearance 2in. below, 6 1/2 in. above. Will take amplifier above and any B.S.R. or GARRARD Autochanger or single Player Unit (except AT90 or SP25). Size 18 x 15 x 8in. **PRICE 79/6.** Carr. 9/6.

3-VALVE AUDIO AMPLIFIER MODEL HA34 MK. II

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 1/2 in. d. x 4 1/2 in. h. Incorporates ECC83, EL84, E280 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and new with improved wide range tone controls giving bass and treble lift and cut. 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 **£4/15/-.** P. & P. 6/-.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural 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 speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up: 2 EL84s, ECC83, EF86, and E280 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.

HARVERSON SURPLUS CO. LTD.
170 HIGH STREET, MERTON, LONDON, S.W.19
Telephone: 01-540 3985

S.A.E. all enquiries.

Open all day Saturday (Wednesday 1 p.m.)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

SURPLUS HANDBOOKS

- 19 set Circuit and Notes 8/6 p/p 6d.
- 1155 set Circuit and Notes 8/6 p/p 6d.
- H.R.O. Technical Instructions 5/6 p/p 6d.
- 38 set Technical Instructions 5/6 p/p 6d.
- 46 set Working Instructions 5/6 p/p 6d.
- 88 set Technical Instructions 7/- p/p 6d.
- BC.221 Circuit and Notes 5/6 p/p 6d.
- Wavemeter Class D Tech. Inst. 5/6 p/p 6d.
- 18 set Circuit and Notes 5/6 p/p 6d.
- BC.1000 (31 set) Circuit and Notes 5/6 p/p 6d.
- CR. 100/B.28 Circuit and Notes 10/- p/p 6d.
- R.107 Circuit and Notes 7/- p/p 6d.
- AR.88D Instruction Manual 12/6 p/p 6d.
- 62 set Circuit and Notes 8/6 p/p 6d.
- Circuit Diagram 5/- each post free. R.1116/A, R.1224/A, R.1356, R.F. 24, 25 and 26, A.1134, T.1154, CR.300, BC.312, BC.342, BC.348J, BC.348 (E.M.P.), BC.624, 22 set.
- 52 set Sender and Receiver circuits 7/6 post free.
- Colour Code Indicator 2/6, 5/p 6d.

S.A.E. with all enquiries please.
Postage rates apply to U.K. only.
Mail order only to:
INSTRUCTIONAL HANDBOOK SUPPLIES
Dept. W.W. Talbot House, 28 Talbot Gardens, LEEDS 8

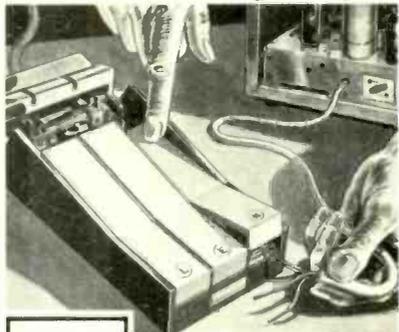
50% OFF OUR BUYING PRICE.

Ex-distributor offers remainder of stock. **TO CLEAR—in new condition.**
T.C.C. CAPACITORS.
Electrolytic, paper, mixed dielectric
Send for stocklist or telephone your enquiries to—

JAMES SCOTT (ELECTRONIC AGENCIES) LIMITED,
90 WEST CAMPBELL STREET,
GLASGOW C.2.
041-221 3866 Ext. 309.

WW—147 FOR FURTHER DETAILS

MAINS Keynector
A REVOLUTIONARY NEW PRODUCT
cuts out plugs



It's the Newest, Safest and Quickest way to connect Electrical Equipment to the mains

No plugs—no sockets—no risk of bare wires. To connect anything electrical, from an oscilloscope to an electric drill, simply open the fuse housing, depress the keys, insert the wires and close the housing. A neon light on the front of the Keynector glows to indicate proper connection. Multi-parallel connections can be made up to 13 amps. Keys are colour coded and lettered LEN for quick identification. The Keynector casing is in two-tone plastic and measures 5in. x 3in. x 1 1/2 in.

issued by **E.B. INSTRUMENTS**
DIVISION OF ELECTRONIC BROKERS LTD.
49-53 Pancras Road, London, N.W.1. Telephone: 01-837 7781

39/6
+5/-p&p

WW—148 FOR FURTHER DETAILS

EXCLUSIVE OFFER

AMPEX

MODEL FR-100 A

DATA TAPE

RECORDER-REPRODUCERS

COMPLETELY FITTED IN 6 ft. TOTALLY ENCLOSED CABINETS with recording and reproducing Amplifiers, electronic frequency control and all Power Supplies.

- ★SIX SPEEDS 1 1/2", 3 1/2", 7 1/2", 15", 30" and 60" per second.
- ★INTERCHANGEABLE HEADS.
- ★1" TAPE, 5 TRACKS.
- ★UP TO 14" REEL CAPACITY.
- ★DC-FM-PCM-NEZ SYSTEMS.
- ★DC to 30,000 cycles.
- ★UP TO 10,000 Pulse Rate.
- ★DRIFT FREE WITHIN 1%.
- ★SERVO CONTROL to 0.75 μs.
- ★TRACK TIMING 5 μs.
- ★ACCURACY 10⁻⁶ per week.
- ★ELECTRONICS IN MODULES FRONT ACCESS TO ALL PARTS.
- ★POWER INPUT 105/125v 48 to 500 w/c.



★Made in U.S.A. these fine units cost the American Government \$9,000 each before devaluation.

Full details on application.

FREE

40-page list of over 1,000 different items in stock available—keep one by you.

- ★Marconi HR 110 Communications Receivers 1.5 to 31.0 m/cs £45 0
 - ★Candlestick microphones with push to talk switch £2 0
 - ★G.B.C. Plastic Punching and Binding machines £40 0
 - ★Lattice lightweight steel triangular Aerial Masts 12 to 16 inch sides up to 200 ft. high According to height
 - ★10 feet high triangular Lattice Mast Sections, galv. 8 inch sides with mating lugs for joining £6 0
 - ★Universal Demultiplexers £125 0
 - ★I.C. Testers with plug boards £95 0
 - ★Candlestick Microphones £1 0
 - ★McElroy Tape Pullers £4 10
 - ★Tinsley Phase-splitting Potentiometers £75 0
 - ★E.M.I. WM-3 Measuring Oscilloscopes £32 10
 - ★Marconi TF-1055 Noise Measuring Sets £150 0
 - ★54 inch dia. Meteorological Balloons £1 10
 - ★Micrometer Wavemeters General Electric 900/1530 and 1530/4000 m/cs each £22 0
 - ★455 k/cs Mechanical Band Pass Filters £3 10
 - ★7 track 1" tape head assemblies with rollers £30 0
 - ★1" New Magnetic Recording Tape made by E.M.I. (USA) 3600 ft on N.A.B. Spools £5 10
 - ★1" Used ditto "Scotch" Brand 4800 ft £4 0
 - ★M.E. 11 E.F. Wattmeters up to 500 m/cs £42 10
 - ★T.D.M.S. Sets send/receive in cabinets £280 0
 - ★Collins 500 w. Radio Telephone Transmitters Autotune 2 to 18 m/cs 230v. input new P. U. R.
 - ★8 Track Data High Speed Tape Readers £40 0
 - ★Mason Illuminated Drawing Tables 50" x 36" £17 10
 - ★Amphenol Connector Assembling Machines £8 10
 - ★Stelmis Telegraph Distortion Monitors £25 0
 - ★51t. Motorola enclosed Cabinets 19" £12 10
 - ★Teletype Model 14 Tape Punches £29 10
 - ★TS-497/URR Signal Generators 2/400 m/cs £85 0
 - ★Sarah Trans/Receivers and Aerials £3 0
 - ★Sigma 12000 ohm. DPDT Sealed Relays £1 0
 - ★Frels Airport "Weather Man" Masts £25 0
 - ★75 foot high Lattice Triangular Wind up Masts £295 0
 - ★Uniselectors 10 bank 25 way ex. new £1 15
 - ★Precision Mains Filter Units new £1 10
 - ★Marconi HR.22 SSB Receivers 2/32 m/cs £75 0
 - ★Avo Geiger Counters new £7 10
- Carrier extra at cost on all above.
All goods are ex-Government stores.

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
BH16 6ER
WESTBOURNE 65051

Quartz Crystal Units



ECONOMICAL!
ACCURATE!
RELIABLE!



Write for illustrated Brochure & Price List

THE QUARTZ CRYSTAL CO. LTD.
Q.C.C. Works, Wellington Crescent,
New Malden, Surrey (01-942 0334 & 2988)
WW-149 FOR FURTHER DETAILS

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 Bitstock shank.
All models available from stock
AKURATE ENGINEERING CO. LTD.
Cross Lane, Hornsey, London, N.8
TEL. 01-348 2670

WW-150 FOR FURTHER DETAILS

LONDON CENTRAL RADIO STORES

WIRELESS SET No. 38 A.F.V. Freq. range 7.3 to 9.0 Mc/s. Working range 1 to 2 miles. Size 10 1/2 x 4 x 6 1/2 in. Weight 6 1/2 lb. Includes power supply 51b, and spare valves and vibrator also tank aerial with base. £7 per pair or £3 10 0 single. P.P. 25/-.

MODERN DESK PHONES, red, green, blue or topaz, 2 tone grey or black, with internal bell and handset with 0-1 dia. £4/10/-, P.P. 7/6.

10-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box handset. Thoroughly overhauled. Guaranteed. £6/10/- per unit.

20-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box. Thoroughly overhauled. Guaranteed. £7/15/- per unit.

TELEPHONE COILED HAND SET LEADS, 3 core, 5/6. P.P. 1/-.

ELECTRICITY SLOT METER (1/- 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. P.P. 0/-.

8-BANK UNISELECTOR SWITCHES. 25 contacts, alternate wiring £2/15/-; 8 bank half wipe £2/15/-; 6 bank half wipe, 25 contacts 47/6. P.P. 3/6.

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

BAILEY 30 WATT AMPLIFIER

10 Tr's as spec'd and Fibreglass Pcb	£6.76
20 Tr's as spec'd and 2 Fibreglass Pcb's	£12.10.0
BC125/126/40361 12/-	40362 16/-
MJ481 26/-	MJ491 30/-
R1-R27 (5% low noise) & P. 10/6 CI-C6 (Mullard) 7/6	
Mullard C431 2500mF/64Vw with clip	15/-
AlI H/Sink (Drilled 2 x TO3) 4 x 4 1/2 in.	10/-
Silicon F.W. Bridge Rectifier 200 p.i.v./2.5A	22/6
Mains Trans. Varn. Impreg'd 45v/1 1/2 A or 80v/1 1/2 A	49/6

LINSLEY HOOD CLASS A AMP

Set 10 C.F. R's 5/-	Set 5 Capacitors 22/6
MJ480 (Matched for <0.1% T.H.D.)	per pair 42/6
MJ481 (Matched for <0.1% T.H.D.)	per pair 52/6
2N3906/2N4058/2N697/2N1613	6/6
BC109 4/-	MPP103 8/6
Pair of H/Sinks as spec'd for Mono 5 x 4 in.	21/-
Lektrokrit Pinboard 4 x 4 1/2 in. pins & Layout	5/6
MJ480 16/6	Hunts KA112BT 2500mF/50Vw
1250mF/40Vw 9/-	2500mF/50Vw 3/-
500mF/50Vw 5/9	Mains Trans. Varn. Impreg'd 40v/2A or 30v/2 1/2 A
A.E.I. Silicon Bridge Rect. 200 p.i.v./5A	25/-

Send SAE for Lists inc'g. **OCT WW 15W AMP**
A.1 FACTORS, 72 BLAKE ROAD, STAPLEFORD, NOTTS.

AMERICAN TEST AND COMMUNICATIONS EQUIPMENT

★ GENERAL CATALOGUE AN/104 1/6 ★
Manuals offered for most U.S. equipments

SUTTON ELECTRONICS

Salthouse, Nr. Holt, Norfolk. Cley 289

BAILEY PRE-AMPLIFIER

High quality pre-amplifier circuit described by Dr. A. R. Bailey in the December, 1966, "Wireless World". This is a low distortion circuit of great versatility with a maximum output of 2-volts making it suitable for driving Bailey 20W and 30W Amplifiers, Linsley Hood Class A Amplifier and many others. All normal pre-amplifier facilities and controls are incorporated. A new Printed Circuit Board containing latest modifications 7in. by 3 1/2in. features edge connector mounting, roller tinned finish and silk screened component locations. This board is available in S.R.B.P. material or fibreglass and the complete Kit for the unit contains gain grade BC.109 transistors, polyester capacitors and metal oxide resistors where specified.

BAILEY 30W AMPLIFIER

All parts are now available for the 60-volt single supply rail version of this unit. We have also designed a new Printed Circuit intended for edge connector mounting. This has the component locations marked and is roller tinned for ease of assembly. Size is also smaller at 4 1/2in. by 2 1/2in. Price in SRBP material 11/6d. in Fibreglass 14/6d.

BAILEY 20W AMPLIFIER

All parts in stock for this Amplifier including specially designed Printed Circuit Boards for pre-amp and power amp. Mains Transformer for mono or stereo with bifilar wound secondary and special 218V primary for use with CZ6 Thermistor, 35/6d., post 5/-.

Trifilar wound Driver Transformer, 22/6d., post 1/-.
Power Amp., 12/6d., post 9d.
Reprint of "Wireless World" articles, 5/6d. post free.

DINSDALE 10W AMPLIFIER

All parts still available for this design.
Reprint of articles 5/6d., post free.

LINSLEY HOOD CLASS A AMPLIFIER

Parts now available for this unit including special matt black anodised Metalwork and all power supply components.

PLEASE SEND S.A.E. FOR ALL LISTS.

HART ELECTRONICS,

321 Great Western St., Manchester 14
The firm for quality.

Personal callers welcome, but please note we are closed all day Saturday.

PRINTED CIRCUITS

and ELECTRONIC EQUIPMENT MANUFACTURERS

Large and small quantities. Full design and Prototype Service, Assemblies at Reasonable Prices. G.P.O. Approved

Let us solve your problems

K. J. BENTLEY & PARTNERS

18 GREENACRES ROAD, OLDHAM
Tel: 061-624 0939

LAWSON BRAND NEW TELEVISION TUBES

- 12" Types £4.10.0
 - 14" Types £4.19.0
 - 17" Types £5.19.0
 - 19" Types £6.19.0
 - 21" Types £7.15.0
 - 23" Types £9.10.0
 - 19" Panorama £8.10.0
 - 23" Panorama £11.10.0
 - 19" Twin Panel £9.17.6
 - 23" Twin Panel £12.10.0
- Carriage and insurance
12"-19"—12/6
21"-23"—15/0

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 1947-1968. Complete fitting instructions are supplied with every tube.

2 YEARS FULL REPLACEMENT GUARANTEE
WW-151 FOR FURTHER DETAILS



LAWSON TUBES

18 CHURCHDOWN ROAD
MALVERN, WORCS.
Tel. MAL 2100

YUKAN SELF-SPRAY

50 PROFESSIONAL THE YEAR AEROSOL WAY

Get these air drying **GREY HAMMER** NOW! OR **BLACK WRINKLE (CRACKLE)** finishes

Yukan Aerosol spraykit contains 16 oz. fine quality durable easy instant spray. No stove baking required. Hammers available in grey, blue, gold, bronze. Modern Eggshell Black Wrinkle (Crackle) all at 15/11 at our counter or 16/11 carriage paid. per push-button self-spray can. Also Durable, heat and water resistant Black. Matt finish 12 oz. self-spray cans only 13/11 carriage paid.

SPECIAL OFFER: 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11, carriage paid. Choice of 13 self-spray paint colours and primer (Photocopy quality) also available. Please enclose cheque or crossed P.O. for total amount direct to:

Dept: **YUKAN**, 307A, EDGWARE ROAD, LONDON, W.2

We supply many Government Departments, Municipal Authorities, Institutes and Leading Industrial Organisations - we can supply you too.

Closed ALL DECEMBER for annual holiday

RS RS RS RS RS RS RS symbol of quality trade only

for electronic components - by return

24-hour Mail Order Service. Callers welcome.
(With appointment from 9 a.m. to 9 p.m.)

PUCKA ENTERPRISES

Electronic Valves & Equipment Co.
Guaranteed Valves

AZ31	8/8	EN91	U26	15/6	68L7GT	6/4	
AZ41	8/-	9P21	6/6	U191	15/-	68N7GT	6/4
CB131	18/1	YV51	7/6	UABC80	6/6	6V6GT	6/4
CE135	6/6	YV56	7/6	UAC41	9/6	6X4	4/6
CY1	8/6	YV87	8/7	UAF42	10/2	6X5GT	5/3
CY31	7/6	EZ40	8/-	UBC41	8/-	7C3	14/6
DAF40	10/6	EZ41	9/-	UBC91	9/-	7Q7	9/8
DAF41	10/6	EZ80	5/4	UBF90	7/-	7R7	13/-
DAF91	4/6	EZ81	5/4	UBF98	7/6	787	24/-
DAF92	6/1	EZ80	7/6	UCX55	7/6	7Z7	8/-
DAF96	7/6	EZ84	10/2	UGH42	10/2	10D1	8/6
DC50	8/7	GZ34	10/9	UCH81	7/-	10D2	8/6
DK40	10/9	KT96	21/-	UCL92	7/6	10P1	19/-
DK91	6/6	KT88	31/6	UCL83	10/3	10P9	10/9
DK92	9/-	MSFENT	10/-	UF80	7/6	10L1	8/-
DK96	8/-	N78	30/6	UF88	7/6	12AC8	7/6
DE91	5/4	FABC80	8/-	UI41	10/2	12AD6	6/6
DL92	6/5	PC86	12/-	UL34	7/-	12AH7GT	5/-
DL93	4/3	PC88	12/-	UM80	5/4	12AT6	4/9
DL95	6/-	PC900	9/4	UY41	7/6	12AT7	6/3
DY86	8/6	PC84	6/5	UY86	6/6	12AU7	6/-
DY87	7/-	PC98	8/-	OA2	5/4	12AX7	5/9
EABC80	6/3	PC98	8/3	OB2	6/5	12B7GT	6/11
EAF42	9/9	PC189	10/9	OC3	6/9	20D1	9/8
EB41	9/-	PCF80	7/-	OD3	6/5	20P1	19/-
EB81	5/6	PCF82	6/8	IC8GT	3/2	20P4	20/-
ECF90/		PCF84	8/7	114	4/4	20P5	20/6
6B18	6/10	PCF86	9/1	1R5/DK91	6/5	2BL6GT	6/9
ECB81	5/6	PCF801	9/8		6/5	2Z4GT	11/9
ECB83	8/8	PCF802	9/8	184	5/4	30A5	7/8
EC186	8/6	PCF805	15/-	185	4/9	30C1/PCF80	7/8
EF39	8/7	PCF806	13/-	1T4	4/3	30C1/PCF80	7/8
EF40	9/9	PCF808	13/6	1U4	6/5	30C15	15/-
EF41	9/9	PCL81	9/8	X2B/E19	7/6	30C17	16/-
EF42	13/-	PCL82	7/6		7/6	30C18/PCF	15/-
EF46	5/6	PCL83	10/9	2D21	6/6	30C15	17/-
EF83	10/2	PCL84	6/7	3A4	3/3	30P5	11/-
EF85	7/6	PCL85	9/1	3Q4	8/-	30PL1	18/-
EF96	6/6	PCL86	9/1	384	6/3	30PL12	18/6
EF99	5/4	PD500	32/6	3V4	7/-	30PL13	8/6
EF91	4/3	PPL200	14/-	8U40	5/9	30PL14/PCF	18/-
EF92	8/-	PL86	10/9	8V40	8/-	808	15/6
EF93	4/3	PL81	8/-	8Y3GT	9/9	30P1/PC84	6/5
EF183	6/6	PL82	8/7	8Z40	7/6	30L12	17/-
EF184	7/6	PL83	7/6	8/30L2	15/-	30L15	17/-
EH90	7/6	PL84	7/-	6A7	4/-	30P17	16/-
EL34	10/2	PL600	14/6	8BR6	8/8	30P19/30P4	15/-
EL41	10/2	PL61	16/1	8BR7	17/3	30P15	18/-
EL42	10/9	PL609	35/-	8BW6	14/6	30PL1	18/-
EL41	9/9	PY32	10/9	8BW7	12/11	30PL13	18/6
EL83	8/-	PY33	12/6	8C4	5/10	30PL14	15/-
EL84	4/9	PY80	6/-	8C9	18/6	35A3	9/8
EL85	8/-	PY81	5/10	6J5GT	5/9	35L6GT	8/8
EL86	8/7	PY82	5/4	6J6/Ecc91	16/3	35W4	4/8
EL90	6/6	PY83	5/4	6J6	3/8	35Z3	10/9
EL95	5/4	PY88	8/-	6J7	8/6	35Z4G	4/3
EM34	7/6	PY800	9/7	6K6GT	9/6	50L6GT	8/-
EM80	10/9	PY801	9/7	6I7	8/8	2050	16/-
EM81	8/-	U25	15/6	9Q7	7/6	8763	12/11

Many others in stock. Please enquire with a.s.s. P. & P. 9d. per valve/2 sh. per f. Insurance 6d. extra. Terms: Only cash. P.O. cheques with the order.

2076 Belsize Road, London, N.W.6
Tel.: 01-228-6123. Business hours: 9 a.m. to 6.30 p.m.

BAKER "SUPERB" 20 WATT 12in. LOUDSPEAKER

BRITISH MADE THROUGHOUT

Suitable for all Hi-Fi Systems. Provides rich clear sound recreating the musical spectrum virtually flat $\pm 5dB$, 20-17,000 cps. Latest double cone with massive "ferroba" ceramic magnet. Flux density 16,500 gauss. Bass resonance 22-26cps. Plastic Cone Surround. Coils available 8 or 15 ohms.



Price £15 Post Free

EMI TAPE MOTORS

(200-240v. A.C.)

Clockwise 1,360 R.P.M. off load
Heavy duty 4 pole 100mA.
Spindle $1\frac{1}{2} \times \frac{1}{8}$ in. diameter.
Size $3\frac{1}{2} \times 2\frac{1}{2} \times 2\frac{1}{2}$ in.

BARGAIN PRICE 17/6 Post 2/6



TRANSISTOR AMPLIFIER WITH LOUDSPEAKER

A self-contained portable mini. p.a. system. Many uses—Parties, Baby Alarm, Intercom, Telephone or Record Player Amplifier, Attractive rexine covered cabinet size 12x9x4 in., with powerful 7 x 4 in. speaker and four transistor one watt power amplifier. Uses PP9 battery. Brand new in Maker's carton with full maker's guarantee.



All for only **75/-** Post 4/6

THE INSTANT BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 A.C. **42/6** Post 2/6
Leaflet S.A.E.



EXTENSION SPEAKER

Smart plastic cabinet speaker with 20ft. lead for transistor radio, Intercom, mains radio, tape recorder, etc. **30/-** Post 2/6
Size: 7 1/2 in. x 5 1/2 in. x 3 in.



RETURN OF POST DESPATCH - CALLERS WELCOME
HI-FI STOCKISTS - SALES - SERVICE - SPARES
RADIO COMPONENT SPECIALISTS
337 WHITEHORSE ROAD, CRQYDON. Tel: 01-684 1665

Thanks to a bulk purchase we can offer

BRAND NEW P.V.C. POLYESTER & MYLAR RECORDING TAPES

Manufactured by the world-famous reputable British tape firm, our tapes are boxed in polythene and have fitted leaders, etc. Their quality is as good as any other on the market, in no way are the tapes faulty and are not to be confused with imported, used or sub-standard tapes, 24-hour despatch service.

Should goods not meet with full approval, purchase price and postage will be refunded.

S.P.	{ 3in. 160ft. 2/-	5in. 600ft. 6/-
	{ 5 1/2 in. 900ft. 8/-	7in. 1,200ft. 9/-
L.P.	{ 3in. 225ft. 2/6	5in. 500ft. 8/6
	{ 5 1/2 in. 1,200ft. 10/-	7in. 1,800ft. 13/-
D.P.	{ 3in. 350ft. 4/6	5in. 1,200ft. 12/-
	{ 5 1/2 in. 1,800ft. 16/-	7in. 2,400ft. 20/-

Postage on all orders 1/6

COMPACT TAPE CASSETTES AT HALF PRICE

60, 90, and 120 minutes playing time, in original plastic library boxes.
MC 60 9/- each. MC 90 12/6 each. MC 120 18/3 each.

STARMAN TAPES

28 LINKSCROFT AVENUE
ASHFORD, MIDDIX.
Ashford 53020

WW-153 FOR FURTHER DETAILS

TECHNICAL TRAINING

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]

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. [13]

RADIO officers see the world. Sea-going and shore appointments. Trainee vacancies during 1970. Grants available. Day and boarding students. Stamp for prospectus. Wireless College, Colwyn Bay. [80]

TECHNICAL TRAINING IN Radio, TV and Electronics through world-famous ICS. For details of proven home-study courses write: ICS, Dept. 443, Intertext House, Stewarts Road, London, S.W.8. [24]

TV and radio A.M.I.E.R.E., 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]

TUITION

ENGINEERS.—A Technical Certificate or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C.Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.), City & Guilds, A.M.I.M.I., A.I.O.B., and G.C.E. Exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto, Electronics, Radio, Computers, Draughts, Building, etc.—For full details write for FREE 132-page guide: British Institute of Engineering Technology (Dept. 151K), Aldermaston Court, Aldermaston, Berks. [14]

KINGSTON-UPON-HULL Education Committee. College of Technology. Principal: E. Jones, M.Sc., F.R.I.C.
FULL-TIME courses for P.M.O. certificates and the Radar Maintenance certificate.—Information from College of Technology, Queen's Gardens, Kingston-upon-Hull. [18]

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.e. for list, over 70 types.—W. H. Bailey, 167a Moffat Road, Thornton Heath,

SITUATIONS VACANT

GEC-Marconi Electronics

TEST ENGINEERS at Marconi, Wembley

Electronics and Telecommunications Engineers are required to undertake testing and fault finding of a wide range of Communications Transmitters and Receivers, Data Handling Equipment and a variety of Electronic Aids.

Applications are invited from Test Engineers with previous experience of Product Testing and from ex-Regular Service Technicians with the appropriate Forces training and experience.

This is an opportunity to work in a rapidly expanding industry; we offer attractive salaries, good conditions of service, canteen, pension scheme, and we are situated within easy reach of rail and road services. A 37-hour, five-day week is worked (8.30 am—4.24 pm).

Marconi



Please call, telephone or apply by letter giving age, education, experience and present salary, quoting reference WW/WW/2 to: The Assistant Personnel Officer, The Marconi Company Limited, Wembley Works, Lancelot Road, Wembley, Middlesex. Tel: 01-902 9421.

Member of GEC-Marconi Electronics 2562

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

TRANSFORMER LAMINATIONS enormous range in Radiometal, Mumetal and H.C.R., also "C" & "E" cores. Case and Frame assemblies.

MULTICORE CABLES screened and unscreened from 2 way to 25 way.

Large selection of stranded single p.v.c. covered Wire 7/0048, 7/0076, 14/0076 etc. P.T.F.E. covered Wire, and Silicon rubber covered wire, etc.

J. Black

44 GREEN LANE, HENDON, N.W.4
Tel: 01-203 1855. 01-203 3033

ELECTRONICS COMPONENTS

Guest-Resistors, Capacitors, Newmarket-Transistors, Amplifiers, etc., in stock, from official distributors.

G.S.P.K. (Electronics) Limited
HOOKSTONE PARK, HARROGATE
Tel: Harrogate 86258

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 115-130

A1 Factors.....	PAGE 134	Gilfillan, R., & Co., Ltd.....	PAGE 62	Racal Instruments, Ltd.....	PAGE 43
Acoustical Mfg. Co. Ltd.....	7	Goldring Manufacturing Co. Ltd.....	24	Radio & TV Components, Ltd.....	113
Adcola Products Ltd.....	Cover iii	Gramplan Reproducers, Ltd.....	131	Radio Components Specialists.....	135
AEI Semiconductors Ltd.....	29	Greenwood, W. (London), Ltd.....	9, 11	Radio Exchange Co.....	107
Akurate Eng. Co., Ltd.....	134	G.S.P.K. (Electronics), Ltd.....	136	Radiospares, Ltd.....	134
Amtronix.....	132			Rediffusion Industrial Services Ltd.....	44
Anders Electronics, Ltd.....	4, 42			Rendar Instruments.....	62
A.N.T.E.X., Ltd.....	69	Harris Electronics (London), Ltd.....	58	Reslo Mikes.....	48
A.P.T. Electronics.....	24	Harris, P.....	133	Roband Electronics Ltd.....	34
Armstrong Audio, Ltd.....	32	Hart Electronics.....	134	Rola Celestion Ltd.....	50
Arrow Electric Switches, Ltd.....	15	Harversons Surplus Co., Ltd.....	133	Ralfe, P. F.....	85
Avo Ltd.....	1	Hatfield Instruments, Ltd.....	37	R.R. Radio.....	131
Avon Communications & Electronics, Ltd.....	62	Henry's Radio, Ltd.....	92, 93	R.S.C. Hi-Fi Centres, Ltd.....	99
		Henson.....	136	R.S.T. Valves.....	108
		Hi-Fi Year Book/Radio Year Book.....	Loose insert		
Barnet Factors, Ltd.....	28	Holford, F., Co., Ltd.....	131		
Barrett, V. N.....	131	Howells Radio, Ltd.....	81		
Batey, W., & Co.....	42			Samsons (Electronics), Ltd.....	98
Bentley Acoustical Corporation, Ltd.....	94	I.C.S., Ltd.....	73*, 132	Scott, James (Electronic Agencies Ltd.).....	133
Bentley, K. J.....	134	I.M.O. (Electronics), Ltd.....	35	S.E. Laboratories (Eng.) Ltd.....	73
B.I.E.T.....	13	Impection Ltd.....	55	Service Trading Co.....	94, 95
Bi-Pak Semiconductors.....	102	Industrial Instruments, Ltd.....	58	Servo & Electronic Sales, Ltd.....	131
Bi-Pre-Pak, Ltd.....	91	Instructional Handbook Supplies.....	133	Sinclair Radionics, Ltd.....	75, 76, 77, 78
Black, J.....	131, 136	International Rectifier Co. Ltd.....	21	S.M.E. Ltd.....	63
Bowthorpe Hellerman, Ltd.....	8			Smith, G. W., (Radio), Ltd.....	96, 97
Bradley, G. & E., Ltd.....	16, 17, 18, 19	Keytronics.....	112	Smith, H. L., Co. Ltd.....	38
Brenell Eng. Co., Ltd.....	58	Kinver Electronics, Ltd.....	112	Smith, J., Ltd.....	37
Britec, Ltd.....	56			Smiths Radio Services (W'ton) Ltd.....	109
Brown, N. C., Ltd.....	54	Lasky's Radio, Ltd.....	88, 89	S.N.S. Communications Ltd.....	40
Buckingham Press.....	73*	Lawson Tubes.....	134	Solartron Electronic Group Ltd.....	67
Bulgin, A. F., & Co., Ltd.....	Edit. 545	Ledon Instruments, Ltd.....	81	Special Products Ltd.....	40
Bullers Ltd.....	22	Levell Electronics, Ltd.....	14	Specialist Switches, Ltd.....	62
Butterworth & Co. (Pub.), Ltd.....	109	Light Soldering Developments, Ltd.....	14	Starman Tapes.....	135
		Livingston Hire Ltd.....	38	S.T.C. Communications.....	Cover iv
		Lloyd, J. J., Instruments Ltd.....	29	S.T.C. (Star).....	70
Calan Electronics Ltd.....	54	London Central Radio Stores.....	134	Sugden, J. E.....	62
Chiltnead Ltd.....	106	L.S.T. Components.....	105	Super Electronics, Ltd.....	80
Clubmans Club.....	Loose insert	L.T.V. Ling Altec Ltd.....	36	Sutton Electronics.....	134
Computer Training Products.....	60	Lyons, Claude, Ltd.....	12		
Cosh & Hammond Ltd.....	108			Teclare Ltd.....	131
Cossor Electronics, Ltd.....	74*	Mainline Electronics, Ltd.....	82	Teiequipment Ltd.....	64
C.R.E.I. (London).....	2	Marconi (Communications) Ltd.....	72	Telcon Metals Ltd.....	27
		Marshall, A., & Son (London), Ltd.....	104	Telemeter.....	106
Daystrom, Ltd.....	31, 39	McMurdo Instrument Co., Ltd.....	45	Telford Products Ltd.....	131
Dependable Relays, Ltd.....	60	Mills, W.....	110, 111	Teonex, Ltd.....	26
Diotran, Ltd.....	132	Milward, G. F.....	103	Thorn A.E.I. (Radio Valve & Tubes), Ltd.....	74
Dolby Laboratories Inc.....	40	Modern Book Co.....	106	Tinsley, H., & Co.....	25, 27
Drake Transformers Ltd.....	33	Monks, K., Audio, Ltd.....	56	Trading Post.....	108
Duxford Electronics.....	98	Morganite Resistors Ltd.....	10	Trend Electronics Ltd.....	50
Dynamco, Ltd.....	23	M.R. Supplies, Ltd.....	32	Trio Corporation.....	30
		Mullard Ltd.....	66	Trio Instruments Ltd.....	60
E.B. Instruments.....	133	Multicore Solders Ltd.....	Cover iv	T.R.S. Radio Components Specialists.....	83
Electrama.....	131	Myall, W. H.....	80		
Electronic Brokers.....	100, 101, 131			United-Carr Supplies, Ltd.....	54
Electronics (Croydon), Ltd.....	84	Newmarket Transistors Ltd.....	22, 36		
Electrosil, Ltd.....	71			Vairadio, Ltd.....	32, 36
Electrovalue.....	90	Ofrect Electronic Systems, Ltd.....	131	Vero Electronics Ltd.....	48, 52
Electro-Tech Sales.....	107	Omron Precision Controls.....	35	Vitality Bulbs, Ltd.....	48
Electro-Winds, Ltd.....	112	Osmabet Ltd.....	132	Vortexion, Ltd.....	6
Elektronmodul.....	49	Oxley Developments Co., Ltd.....	60		
Elstone Electronics Ltd.....	44			Watts, Cecil E., Ltd.....	55
E.M.I. Electron Tube-Vidicons.....	59	Patrick & Kinnie.....	102	Wayne Kerr, The, Co. Ltd.....	51, 61
E.M.I. Tape Ltd.....	68	P.C. Radio, Ltd.....	87	Webber, R. A., Ltd.....	56
English Electric Valve Co., Ltd.....	3, 5	Peak Sound (Harrow), Ltd.....	79	Wellbrook Eng. & Electronics.....	41
Erie Electronics, Ltd.....	53	Pembridge College, The.....	110	West Hyde Developments, Ltd.....	131
		Politechna (London), Ltd.....	42	West London Direct Supplies.....	112
Farnell Instruments, Ltd.....	37	Proops Bros. Ltd.....	86	Wilkinsons, L., (Croydon), Ltd.....	56, 80
Ferroglyph, The, Co. Ltd.....	46, 47, 57	Pucka Enterprises.....	135		
Futuristic Aids Ltd.....	80	Pyc Telecommunications, Ltd.....	20		
Fyde Electronic Laboratories.....	81			Yukan.....	134
		Q Max (Electronics), Ltd.....	52		
Garex, Ltd.....	81	Quality Electronics, Ltd.....	108	Z. & I. Aero Services, Ltd.....	114
General Eng. Co. Ltd.....	11	Quartz Crystal Co. Ltd.....	134		

Printed in Great Britain by Southwark Offset, 25 Lavington Street, London, S.E.1. and Published by the Proprietors, I.P.G. ELECTRICAL-ELECTRONIC PRESS, LTD., Dorset House, Stamford St., London, S.E.1, telephone 01-928 3333. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14. **CONDITIONS OF SALE AND SUPPLY:** This periodical is sold subject to the following conditions, namely that it shall not, without the written consent of the publishers first given, be lent, re-sold, hired out or otherwise disposed of by way of Trade at a price in excess of the recommended maximum price shown on the cover; and that it shall not be lent, re-sold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

CLEARWAY to lower production costs with ADCOLA Precision Tools

For increased efficiency find out more about our extensive range of ADCOLA Soldering Equipment—and we provide:

★ THREE DAY REPAIR SERVICE ★ INTER-CHANGEABLE BITS—STOCK ITEMS ★ SPECIAL TEMPERATURES AVAILABLE AT NO EXTRA COST.

ADCOLA TOOLS have been designed in co-operation with industry and developed to serve a wide range of applications. There is an ADCOLA Tool to meet your specific requirement. Find out more about our extensive range of efficient, robust soldering equipment.

◀ No. 107. GENERAL ASSEMBLY TYPE

Fill in the coupon to get your copy of our latest brochure:

ADCOLA PRODUCTS LTD

Adcola House · Gauden Road · London · SW4
Tel. 01-622 0291/3 Grams: Soljoint, London SW4



Please rush me a copy of your latest brochure:

NAME

COMPANY

ADDRESS

.....

WW

WW-002 FOR FURTHER DETAILS



...and tomorrow there will be thousands more

Throughout the world leading electronic manufacturers are continually emptying reels of Ersin Multicore 5 core solder, to make reliable soldered joints. Some reels contain 3,752 feet (1,144 metres). It's the solder they have depended on for consistent high quality for more than 30 years.

If in Britain or overseas you make or service any type of equipment incorporating soldered joints and do not already use ERSIN MULTICORE SOLDER it must be to your advantage

to investigate the wide range of specifications which are available.

Besides achieving better joints—always—your labour costs will be reduced and substantial savings in overall costs of solder may be possible. Solder Tape, Rings, Preforms and Pellets—Cored or Solid—and an entirely new type of cored disc, can assist you in high speed repetitive soldering processes.



NEW! EXTRUSOL

The first oxide free high purity extruded solder for printed circuit soldering machines, baths and pots, is now available to all international specifications, together with a complete range of soldering fluxes and chemicals.

Should you have any soldering problems or require details on any of our products please contact us at:



MULTICORE SOLDERS LTD.,
Hemel Hempstead, Herts.
Phone: Hemel Hempstead 3636
Telex: 82363