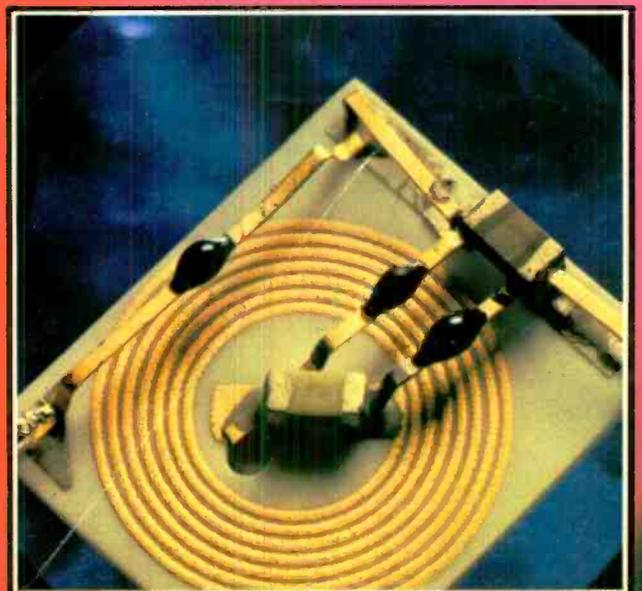
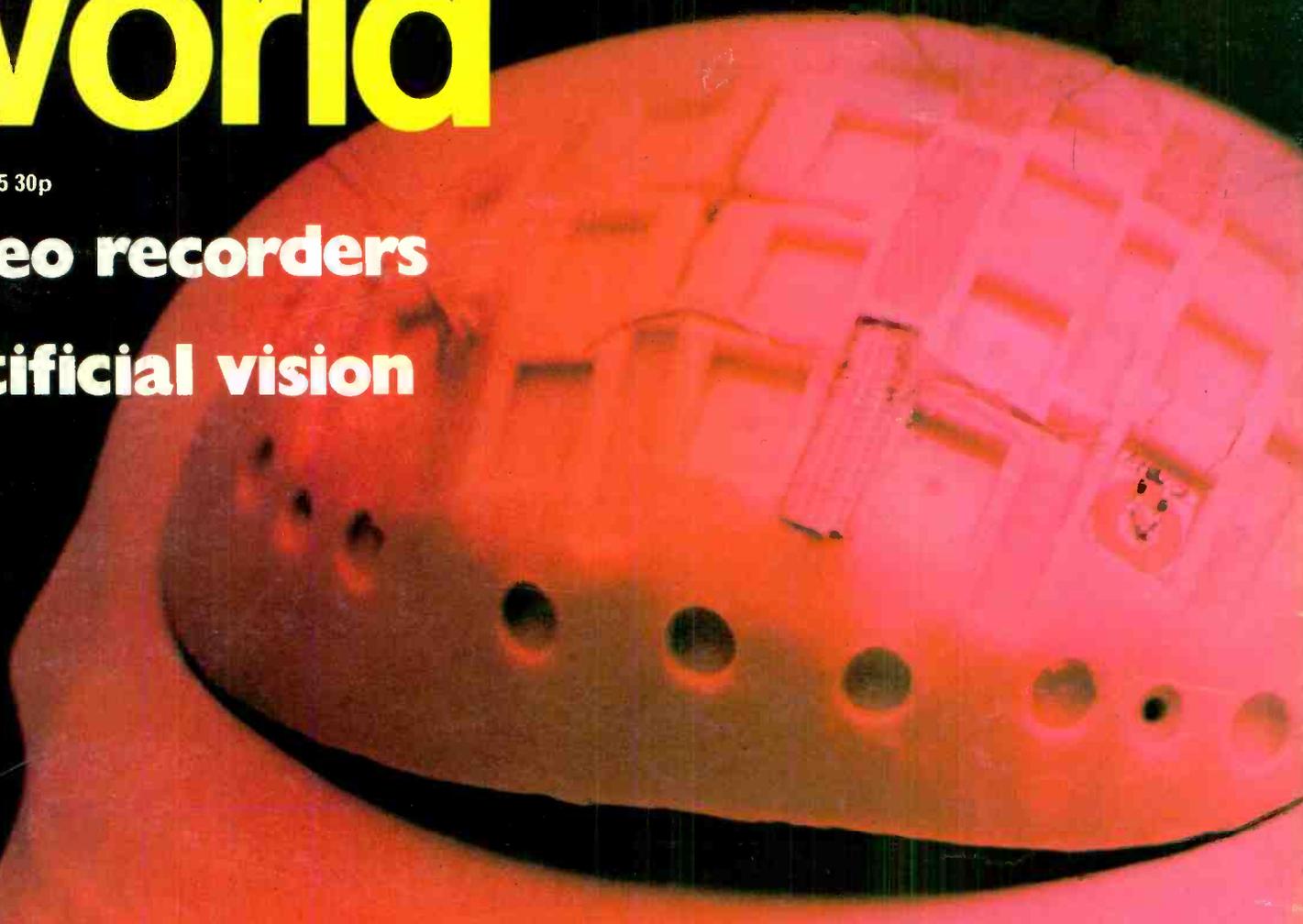


wireless world

APRIL 1975 30p

Video recorders

Artificial vision



Australia	80 Cents	Malaysia	M \$2.60
Belgium	Fr. 52.00	New Zealand	78 Cents
Canada	\$1.10	Norway	Kr. 7.50 inkl Moms
Denmark	Kr. 9.00	South Africa	77 Cents
Finland	Fmk 4.50	Spain	Ptas 65.00
Germany	Dm 4.00	Sweden	Kr. 5.35 inkl Moms
Holland	Dfl 3.75	Switzerland	Fr. 4.70
Israel	1 £3.95	U.S.A.	\$1.10
Italy	L. 700		

A cricket bat is shown vertically, with its blade facing right. The blade is covered in handwritten text in black ink, listing various testing procedures. At the top of the blade, the word 'SPECIAL' is written in large, bold letters. Below it, the following items are listed: Quality Assurance, Standards & Laboratory, Design Engineering, Vibration Test, Sub Assembly, Auto Test, Corrosions, Component Test, Production Engineering, Mechanical Life Test, Inspection, Packaging Test, and Final Test. The handle of the bat is visible at the top, and the background is a light, textured surface.

Test Series

There's no fun in being an **mi** product. Long before it begins its working life – way back as a design prototype, in fact – it's being vibrated, bumped, sent hot and cold, and subjected to other horrid experiences. And very much the same sort of things have happened to its components long before they got anywhere near it at all.

That's only the start. For instance during

production, an instrument may undergo as many as 60 separate electrical and mechanical inspections – adding up to 120 hours on inspection alone – after having endured 500 hours of those shock tactics at design and trial batch stages.

That's typical **mi** thoroughness for you. In fact, when it comes to reliability you can be quite sure of one thing: at **mi** we're not playing at it.

mi: THE PERFECTIONISTS

MARCONI INSTRUMENTS LIMITED

Longacres • St. Albans • Hertfordshire AL4 0JN • England • Telephone: St. Albans 59292 • Telex: 23350

A GEC-Marconi Electronics company.

WW-001 FOR FURTHER DETAILS

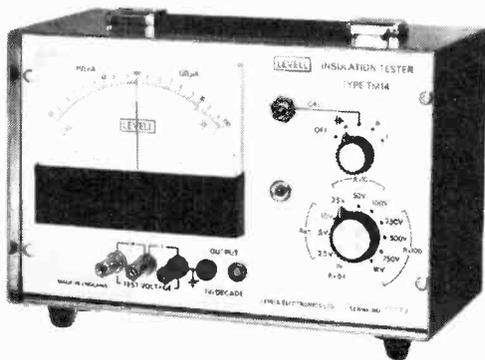
www.americanradiohistory.com

LOW COST TESTERS



LEVELL
PORTABLE INSTRUMENTS

INSULATION TESTER



A logarithmic scale covering 6 decades is used to display either insulation resistance or leakage current at a fixed stabilised test voltage. The current available is limited to a maximum value of 3mA for safety and capacitors are automatically discharged when the instrument is switched off or to the CAL condition. The instrument operates from a 9V internal battery.

RESISTANCE RANGES

10M Ω to 10T Ω (10^{13} Ω) at 250V, 500V, 750V and 1kV.
1M Ω to 1T Ω at 25V, 50V and 100V.
100k Ω to 100G Ω at 2.5V, 5V and 10V.
10k Ω to 10G Ω at 1V.

Accuracy $\pm 15\% + 800 \Omega$ on 6 decade logarithmic scale.
Accuracy of test voltages $\pm 3\% \pm 50\text{mV}$ at scale centre.
Fall of test voltages $< 2\%$ at 10 μA and $< 20\%$ at 100 μA .
Short circuit current between 500 μA and 3mA.

CURRENT RANGE

100pA to 100 μA on 6 decade logarithmic scale.
Accuracy of current measurement $\pm 15\%$ of indicated value.
Input voltage drop is approximately 20mV at 100pA, 200mV at 100nA and 400mV at 100 μA .

Maximum safe continuous overload is 50mA.

MEASUREMENT TIME

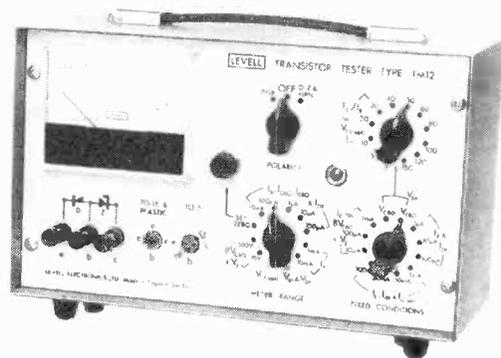
$< 3\text{s}$ for resistance on all ranges relative to CAL position.
 $< 10\text{s}$ for resistance of 10G Ω across 1 μF on 50V to 500V.
Discharge time to 1% is 0.1s per μF on CAL position.

RECORDER OUTPUT

1V per decade $\pm 2\%$ with zero output at scale centre.
Maximum output $\pm 3\text{V}$. Output resistance 1k Ω .

type
TM14 **£80**

TRANSISTOR TESTER



Tests bipolar transistors, diodes and zener diodes. Measures leakage down to 0.5 nA at 2V to 150V. Current gains are checked from 1 μA to 100mA. Breakdown voltages up to 100V are measured at 10 μA , 100 μA and 1mA. Collector to emitter saturation voltage is measured at 1mA, 10mA, 30mA and 100mA for I_C/I_B ratios of 10, 20, 30. The instrument is powered by a 9V battery.

TRANSISTOR RANGES (PNP OR NPN)

I_{CBO} & I_{EBO} : 10nA, 100nA, 1 μA , 10 μA and 100 μA f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at voltages of 2V, 5V, 10V, 20V, 30V, 40V, 50V, 60V, 80V, 100V, 120V, and 150V acc. $\pm 3\% \pm 100\text{mV}$ up to 10 μA with fall at 100 μA $< 5\% + 250\text{mV}$.

BV_{CBO} : 10V or 100V f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at currents of 10 μA , 100 μA and 1mA $\pm 20\%$.

I_B : 10nA, 100nA, 1 μA ... 10mA f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at fixed I_E of 1 μA , 10 μA , 100 μA , 1mA, 10mA, 30mA, and 100mA acc. $\pm 1\%$.

h_{FE} : 3 inverse scales of 2000 to 100, 400 to 30 and 100 to 10 convert I_B into h_{FE} readings.

V_{BE} : 1V f.s.d. acc. $\pm 20\text{mV}$ measured at conditions on h_{FE} test.

$V_{CE(sat)}$: 1V f.s.d. acc. $\pm 20\text{mV}$ at collector currents of 1mA, 10mA, 30mA and 100mA with I_C/I_B selected at 10, 20 or 30 acc. $\pm 20\%$.

DIODE & ZENER DIODE RANGES

I_{DR} : As I_{EBO} transistor ranges.

V_Z : Breakdown ranges as BV_{CBO} for transistors.

V_{DF} : 1V f.s.d. acc. $\pm 20\text{mV}$ at I_{DF} of 1 μA , 10 μA , 100 μA , 1mA, 10mA, 30mA and 100mA.

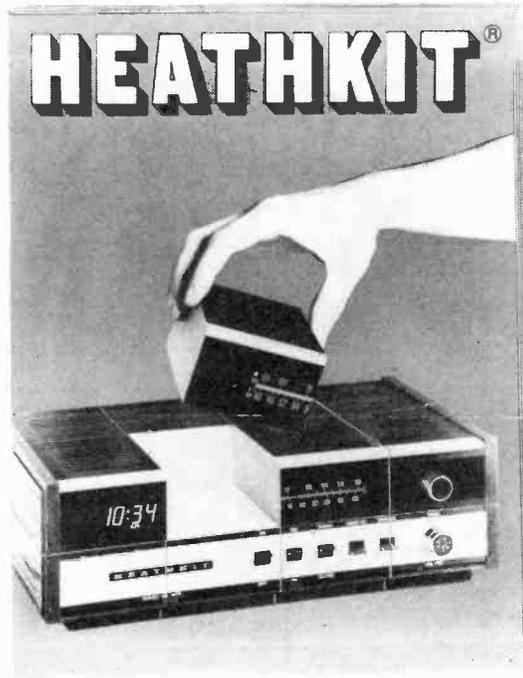
type
TM12 **£80**

LEVELL ELECTRONICS LTD.

Moxon Street, High Barnet, Herts. EN5 5SD
Tel: 01-449 5028/440 8686

Prices include batteries and U.K. delivery. V.A.T. extra.
Optional extras are leather cases and mains power units.
Send for data covering our range of portable instruments.

Complete the coupon and we'll send you our new catalogue. Completely free.



The new Heathkit catalogue is now out. Full as ever with exciting, new models. To make building a Heathkit even more interesting and satisfying.

And, naturally, being Heathkit, every kit is absolutely complete. Right down to the last nut and bolt. So you won't find yourself embarrassingly short of a vital component on a Saturday evening—when the shops are shut.

You'll also get a very easy to understand instruction manual that takes you step by step through the assembly.

Clip the coupon now and we'll send you your free copy to browse through.

With the world's largest range of electronic kits to choose from, there really is something for everyone.

Including our full range of test equipment, amateur radio gear, hi-fi equipment and many general interest kits.

So, when you receive your

catalogue you should have hours of pleasant reading.

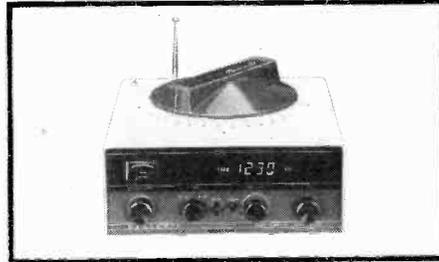
And, if you happen to be in London or Gloucester, call in and see us. The London Heathkit Centre is at 233 Tottenham Court Road. The Gloucester showroom is next to our factory in Bristol Road.

At either one you'll be able to see for yourself the one thing the catalogue can't show you.

Namely, how well a completed Heathkit performs.

Heath (Gloucester) Limited, Dept. WW-45, Bristol Road, Gloucester, GL2 6EE. Tel: Gloucester (0452) 29451.

A new oscilloscope from the Heathkit range. Marine direction finder with digital read-out. Solid-state grid dip meter.



The new Heathkit catalogue. Out now. FREE.

To: Heath (Gloucester) Limited, Dept. WW-45 Gloucester, GL2 6EE. Please send me my free Heathkit catalogue.

Name _____ Address _____

Postcode _____

Remember easy terms are available with the Heathkit Monthly Budget Plan.

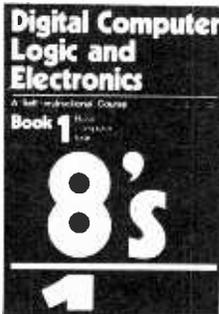


New Course in Digital Design

Understand the latest developments in calculators, computers, watches, telephones, television, automotive instrumentation

Each of the 6 volumes of this self-instruction course measures 11¼" x 8¼" and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.

After completing this course you will have broadened your career prospects and considerably increased your fundamental understanding of the changing technological world around you.



Digital Computer Logic and Electronics
A Self-Instructional Course
Book 1
8's

Also available — a more elementary course assuming no prior knowledge except simple arithmetic.

In 4 volumes:

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flip flops and Registers

£3.95 inc p&p

Offer Order this together with Design of Digital Systems for the bargain price of £9.25.

Design of Digital Systems contains over twice as much information in each volume as the simpler course, Digital Computer Logic and Electronics. All the information in the simpler course is covered as part of the first volumes of Design of Digital Systems which, as you can see from its contents, also covers many more advanced topics.

**Designer
Manager
Enthusiast
Scientist
Engineer
Student**

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self-instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

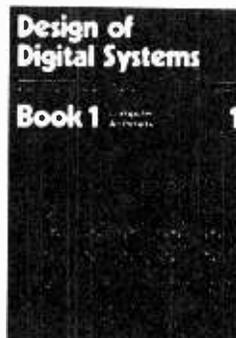
Guarantee—no risk to you

If you are not entirely satisfied with Design of Digital Systems or Digital Computer Logic and Electronics, you may return them to us and your money will be refunded in full, no questions asked.

Design of Digital Systems

A Self-Instruction Course in 6 Volumes

- 1 Computer Arithmetic**
- 2 Boolean Logic**
- 3 Arithmetic Circuits**
- 4 Memories & Counters**
- 5 Calculator Design**
- 6 Computer Architecture**



£5.95

including packing and surface post anywhere in the world (VAT zero rated). Payments may be made in foreign currencies. Quantity discounts are available on request. Total packaged weight does not exceed 4lb —please allow enough extra for air mail.

To: Cambridge Learning Enterprises,
FREEPOST, St. Ives, Huntingdon, Cambs PE17 4BR.

*Please send me....set(s) of Design of Digital Systems at £5.95 each,
*or....set(s) of Digital Computer Logic and Electronics at £3.95 each,
*or....combined set(s) at £9.25 each.

Name.....

Address.....

.....

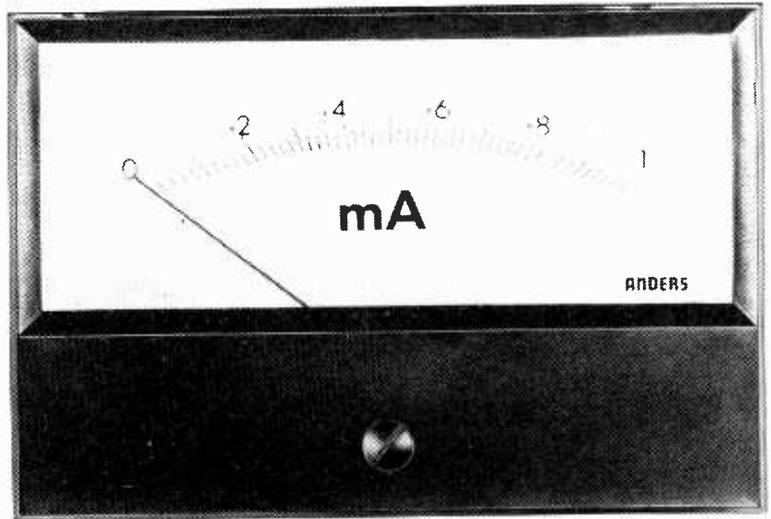
.....

*delete as applicable.
No need to use a stamp—just print FREEPOST on the envelope.

ANDERS MEANS METERS...

REGAL RANGE

- New 100° arc high quality meters at low prices.
- Rugged taut band construction — pivot and jewel available to order
- Sensitivities to 10 μ A
- Very competitively priced for OEM quantities
- Modern styled meters in matt black plastic cases with flattened arc giving long scale.

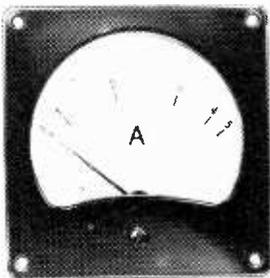


TWO MODELS

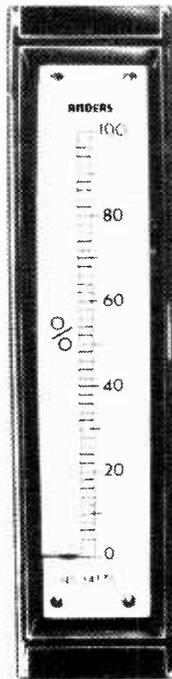
- R55 2.5in (63.5mm) Scale length
- R65 3.2in (81.3mm) Scale length

Anders provide what is probably the largest range of meters available from a single source in Europe: MC/MI, dynamometer, vibrating reed, electrostatic, etc. in over 100 case styles and sizes, a few of which are shown below.

Popular models and ranges are stocked in depth while a specially equipped instrument department enables swift production of non-standard ranges and scales, to suit individual customer requirements, in large or small quantities.



Vulcan Moving Iron. 4 models, 1.5", 1.8", 2.7", 3.7" scales. Voltmeters, ammeters and motor starting meters.



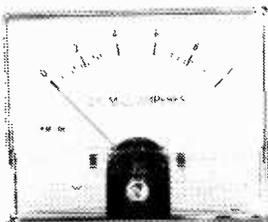
Profile 350 edgewise 4.3" scale. DC moving coil and AC moving coil rectified. Horizontal or vertical mounting.



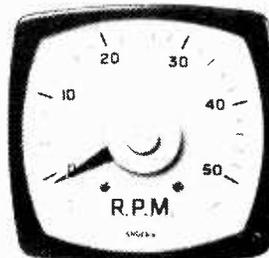
Recorders 60 or 120 mm. charts. Non-ink marking. DC moving coil and AC rectified.



Models KE1 and KE2 Miniature Edgewise Meters. Nominal scale lengths 1.2" and 2". Available in sensitivities from 50 microamps Moving Coil.



Kestrel Clear Front. 7 models, 1.3"—5.25" scales. DC moving coil, AC moving coil rectified, AC moving iron.



Stafford Long Scale 240° 6 models, 3.5"—11.5" scales. DC moving coil, AC moving coil rectified, AC moving iron. Also 98° scale.



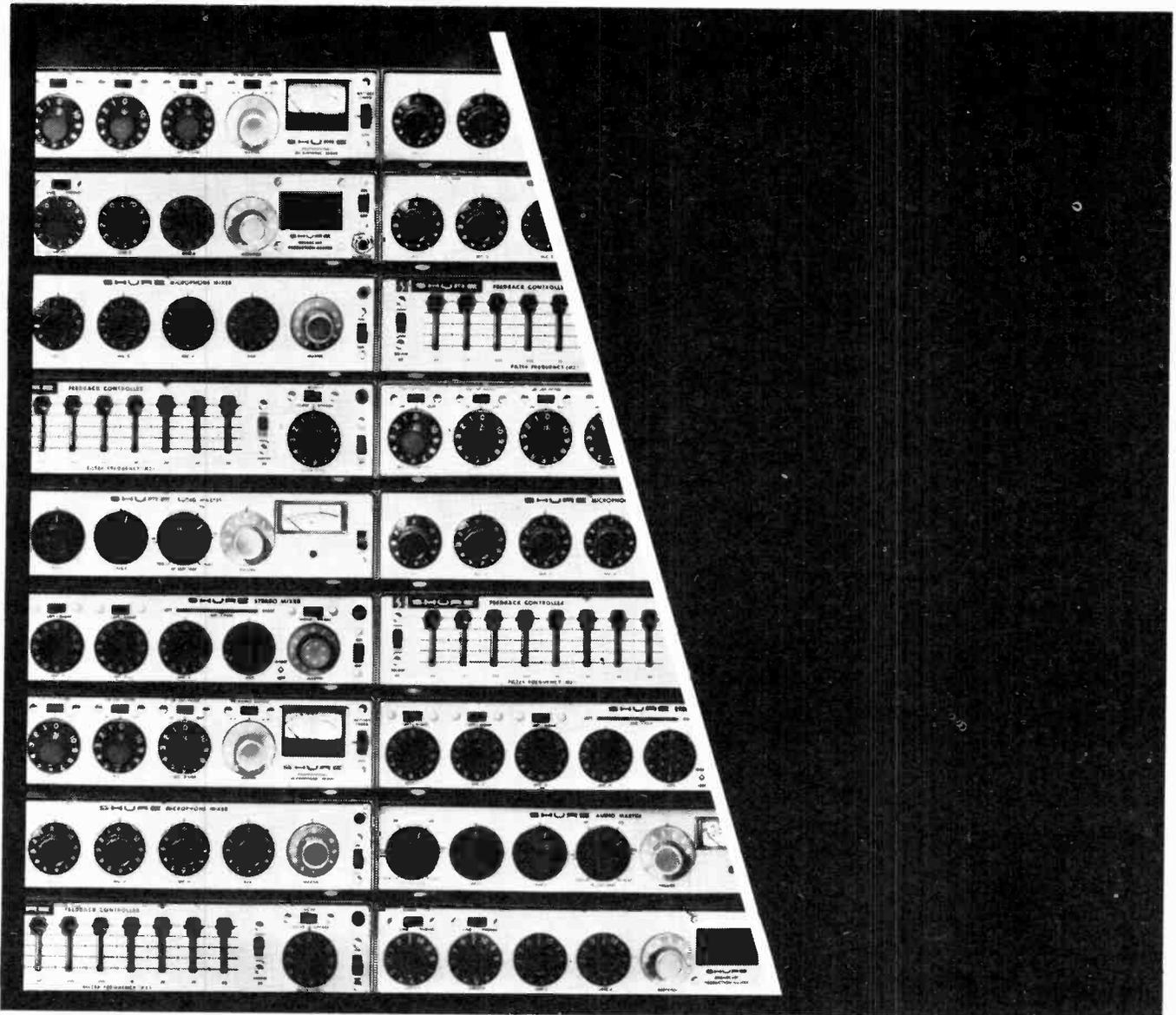
Lancaster Long Scale 240 . 2 models, 4", 5.5" scales. DC moving coil and AC moving coil rectified.

Send for fully illustrated catalogue.

ANDERS ELECTRONICS LIMITED 48/56 Bayham Place, Bayham Street, London, N.W.1. Telephone 01-387 9092.

Manufacturers and distributors of Electrical Measuring Instruments. Sole U.K. distributors of FRAHM Resonant Reed Frequency Meters and Tachometers. Manufacturers of purpose built electrical and electronic equipment to customers requirements.

WW-006 FOR FURTHER DETAILS



It's a mod. mod. modular world.

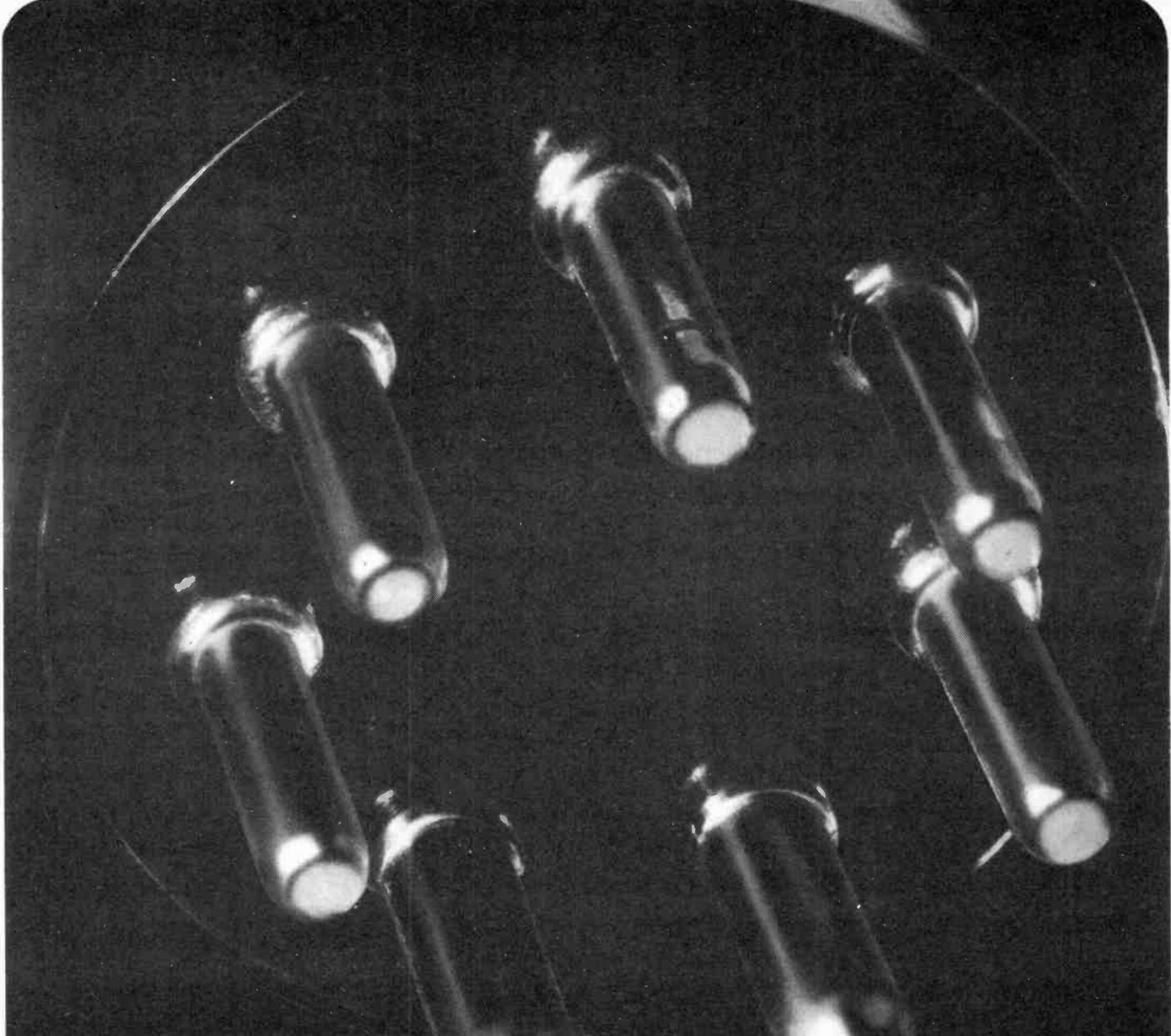


The fact is that all too few music lovers realise that while certain high fidelity components can be less than best, there is one component that cannot endure a sacrifice in quality: the cartridge. Because the hi-fi cartridge functions as the *source of sound* (the point at which the recording is linked with the balance of the hi-fi system), its role is absolutely critical. Just as the camera can be no better than its lens, the finest hi-fi system in the world cannot compensate for an inferior cartridge. Suggestion: For a startling insight into the role of the cartridge in the overall hi-fi system, and a breathtaking re-creation of your favourite recording, see your nearby Shure cartridge dealer. He'll introduce you to the Shure cartridge that is correct for your system and your exchequer. Or, next best, send for our brochure:

Shure Electronics Limited
Eccleston Road, Maidstone ME15 6AU
Telephone: Maidstone (0622) 59881



WW—095 FOR FURTHER DETAILS



Make contact with Teonex

for electronic valves (a really comprehensive range), semi-conductors (a wide variety), integrated circuits. Prices on request.

Teonex offers more than 3,000 devices. They are competitively priced and they are superlative in performance, because the company imposes strict quality control. Teonex concentrates entirely on export and now operates in more than sixty countries, on Government or private contract. All popular types in

the Teonex range are nearly always available for immediate delivery.

Write now for technical specifications and prices to Teonex Limited, 2a Westbourne Grove Mews, London W11 2RY, England.

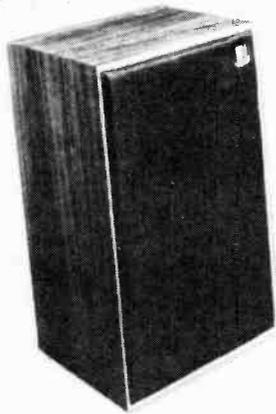
Cables: Tosupply London W11. Telex: 262256

Electronic valves, semi-conductors and integrated circuits available only for export.



sounds international

WW—126 FOR FURTHER DETAILS



You know
KEF Chorale...
natural sound from
a modestly-priced
shelf speaker



With new Kefkit 1 it costs even less!

When KEF Chorale arrived, even the most ardent hi-fi purists had to start taking shelf speakers seriously. The Chorale shattered the myth that natural, uncoloured sound only came from big and costly speakers.

Now, KEF meet insistent demand by offering this standard-setting performance in kit form, as Kefkit 1. In its modest 20 litre enclosure, Kefkit 1 economises on space . . . and cash! Each kit provides two superb KEF drive units connected via a sophisticated printed circuit dividing network . . . ready mounted on a new rigid polyurethane foam baffle. KEF can then test each kit in its correct enclosure, as a complete system. Your Kefkits come with this assurance of full specified performance, backed with a 5 year guarantee. They also come with completed grille assembly, pre-formed acoustic damping foam and full step-by-step instructions. The simple, sure way to enjoy the true KEF sound, at lowest cost.

Please send me details of the new Kefkit 1. Also details of the larger Kefkit 3, for floor-standing enclosures of 60 to 150 litres volume.

Name

Address

WW 4/75



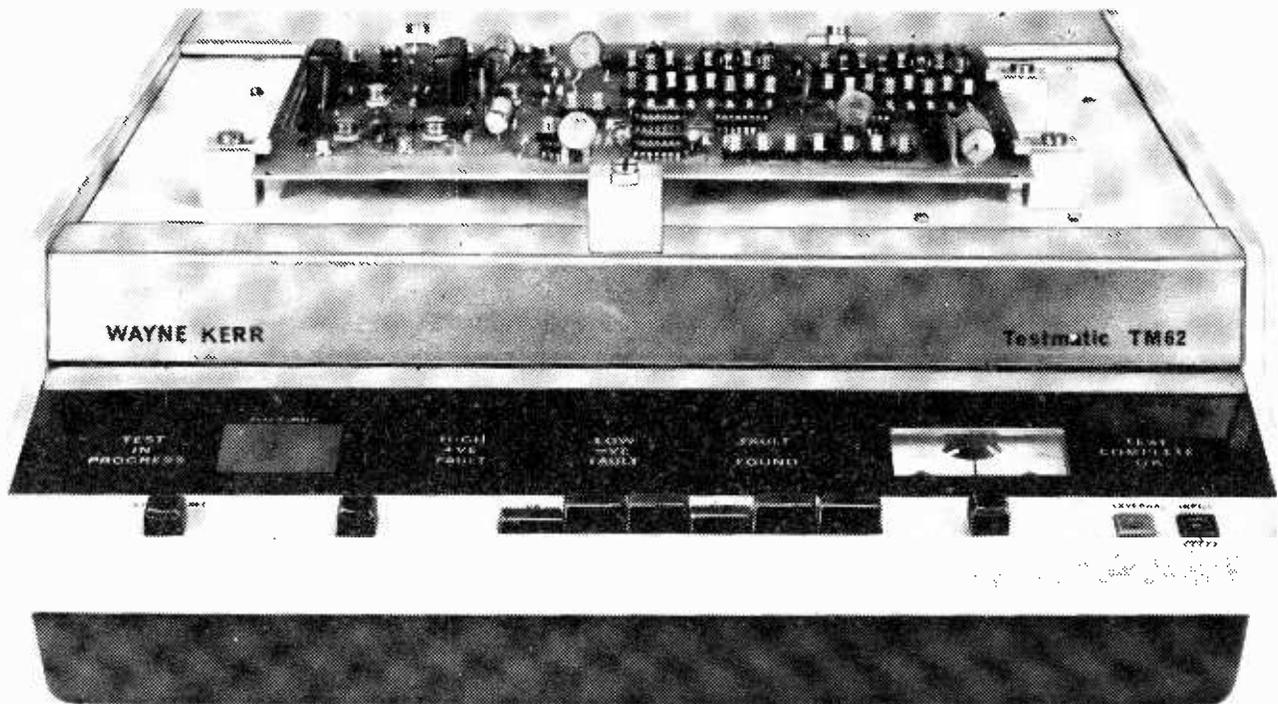
Kef Electronics Limited
Tovil Maidstone ME15 6QP Kent.
Telephone 0622 57258 Teléx 96140



if you're serious
about sound.

New Automatic P.C.B. Tester

Has 60-point electronic scan



Testmatic TM62, designed as a self-contained on-line test station, is a new addition to the Wayne Kerr range of low-cost automatic test equipment. Plug-in test panels can be changed-over in 5 seconds to suit different production lines. Operation is simple: assembly staff can check circuit boards as soon as each one is completed.

The TM62 increases productivity and saves valuable fault-finding time.

All this adds up to reduced costs through early fault detection.

For all the technical data, and further information on the TM62, please fill in the coupon, or phone Bognor Regis (02433) 25811. It could well be the first step in saving your company money.

WAYNE KERR

A member of the Wilmot Breeden group.

Please send me details of the TM62.

For the attention of Mr _____

Company name and address _____

Post to Wayne Kerr, Durban Road, Bognor Regis, Sussex PO 22 9RL

WW/APR

WW-179 FOR FURTHER DETAILS

We expect you'll notice a few changes since you saw us last!

New products have been introduced. New developments have taken place. New ideas have emerged. New faces have appeared.

On top of that the world has changed since the London Electronic Component Show in 1973! We've all had to come to grips with paying higher prices for basic raw materials. And meeting increased labour costs.

See the changes and how they relate to you – at the London Electronic Component Show 1975.

You'll find electronic components, assemblies, semi-conductors, circuit modules, special valves, professional electronic equipment and instruments, production equipment and tools, services and publications well represented. All of vital interest to the professional, industrial, military and consumer electronics industries.

The London Electronic Component Show 1975 keeps you up to date on the international electronics industry!

Special travel arrangements. Pay less – and get more out of your visit – with the

Golden London Package. Exhibition, hotel, travel, entertainment, sightseeing it's all part of the Golden London Package which has been arranged for you by the exhibition travel organisers.

Organised by Industrial and Trade Fairs Limited, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG
Telephone: 021-705 6707. Telex: 337073, Cables: Indatfa Sol.

Sponsored by the Radio & Electronic Component Manufacturers Federation. (RECMF).

24th international London Electronic Component Show Olympia · London 13-16 May 1975 Daily 09 30-17 30



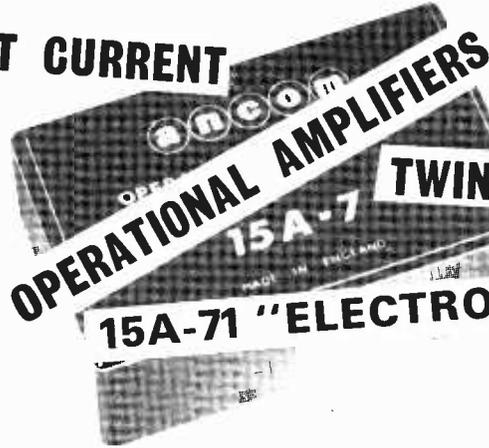
Please send me further information about the London Electronic Component Show and complimentary admission tickets. Details of the special travel arrangements

Complete and return to: London Electronic Component Show, Industrial and Trade Fairs Limited, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG.

Name
Company
Address

ww

ULTRA LOW OFFSET CURRENT



OPERATIONAL AMPLIFIERS
TWIN FLOATING INPUT
15A-71 "ELECTROMETER" VERSION

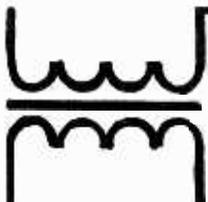
Designed for applications requiring extremely low current measurements and very high input impedances. 15A-71 is a MOSFET input device with a low current measurement capability surpassing that of most valve type electrometer instruments.

	15A-7	15A-71	units
Input offset current	1 (max)	.001	pA
Input offset current vs temp.	0.03	.0001	pA/°C
D.C. Open loop gain each input	500,000	250,000	
Input capacitance each input	8	8	pF
Input impedance non inverting	10 ¹⁴	10 ¹⁵	ohms
Output	±10v @ 3mA		
Common mode voltage	±100v		
Encapsulated module	1.5" (38mm)	0.75" (19mm)	2.375" (60mm)

operational amplifiers

ancom limited devonshire street cheltenham 53861

WW-177 FOR FURTHER DETAILS



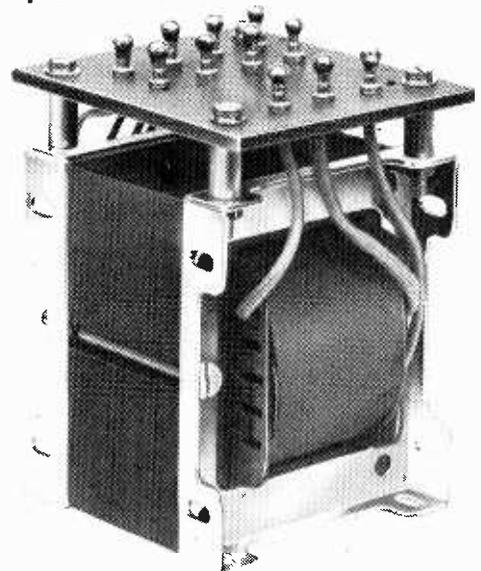
transformers

mains, audio, microphone, ferrite core and other wound components

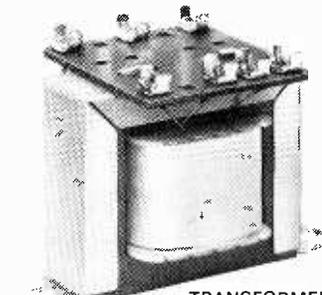
A wide range of transformers manufactured in production quantities to customers individual requirements

Prompt Prototype Service available

TRANSFORMER WITH UNIVERSAL END FRAMES AND TURRET LUG CONNECTIONS



MICROPHONE TRANSFORMER IN MUMETAL CAN



TRANSFORMER WITH TWO HOLE CLAMP AND SOLDER TAG CONNECTIONS

Drake Transformers Limited

Telephone:
Billericay 51155

Kennel Lane,
Billericay, Essex.

WW-047 FOR FURTHER DETAILS

The Greenwood guide to professional soldering.

Greenwood Electronics offer a range of highly advanced products specifically for professional soldering applications.

For more detailed information about the comprehensive Greenwood range, contact the address below.

1. The Iso-Tip. A safe, high-power iron which works anywhere without a mains lead. The breakthrough? Nickel Cadmium cells that are re-chargeable. (A charging stand is included for 240v or 115v A.C.) Each charge gives at least 60 soldering joints. Weight? Only 6 oz.

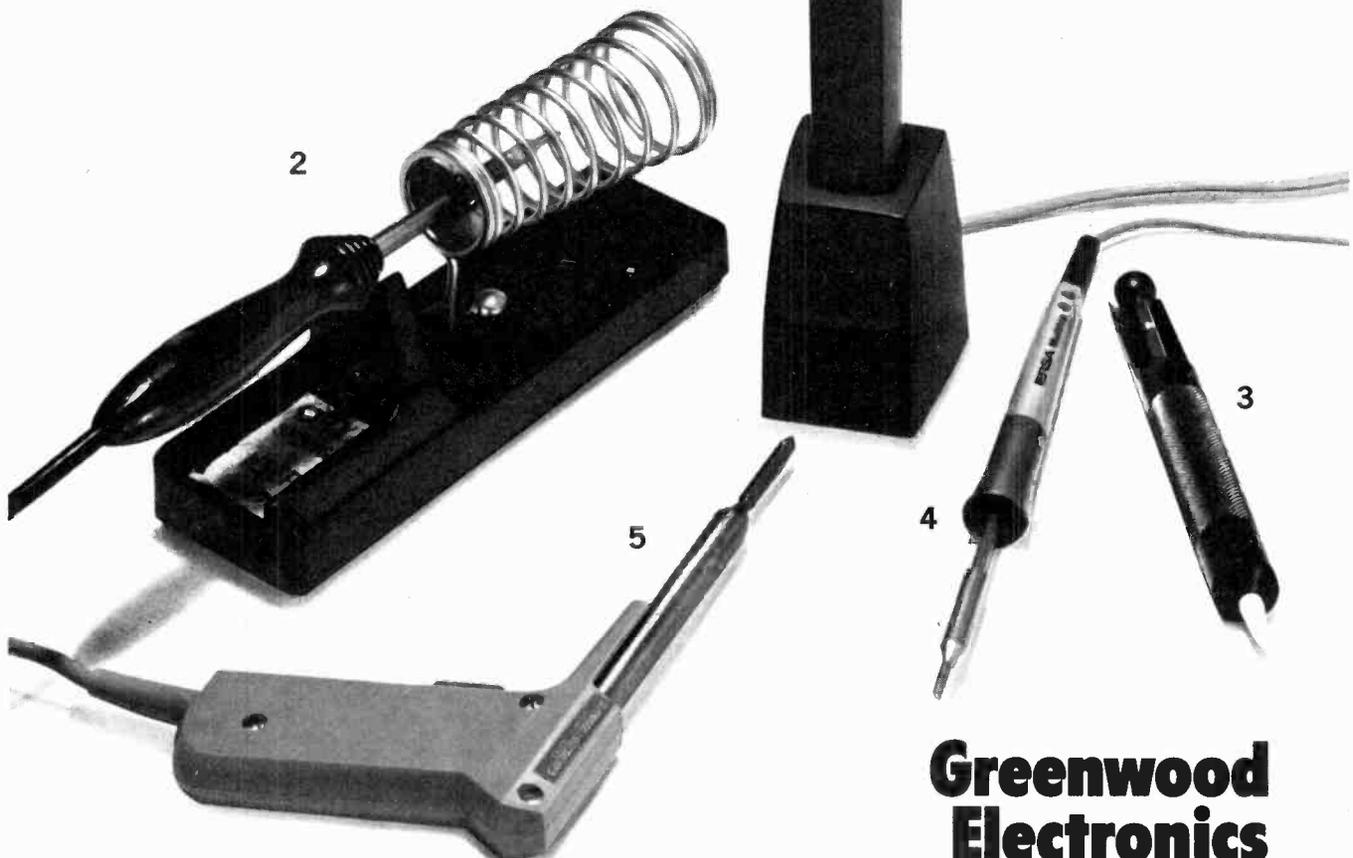
2. The Oryx 50. A temperature controlled mains soldering iron. (Temperature control within $\pm 2\%$). Adjustment (200° - 400°C) can be made whilst iron is operating, using the same tip. Light, compact, and easy to handle. A large 50W element loading gives rapid heating and high performance with constant tip temperature.

Also available: Oryx safety stand.

3. Oryx SR3A desoldering tool. Ideal where components are tightly grouped. Instantly removes unwanted solder from printed circuits etc. Accurate, reliable, speedy, and safe.

4. The Ersa Multitip. A top-quality iron that's ultra-light offering reliability so necessary to achieve constant production flow. A range of different shaped tips simply push onto the stem of the iron. It has the unique advantage that you can change the element in seconds.

5. The Ersa Sprint. Unique - it heats up to maximum temperature in only 10 seconds, and is the lightest gun on the UK market. Ideal for the service-man. With its light weight (only 7 oz.) and compact construction, it can be manoeuvred in even the most awkward areas.



Greenwood Electronics

Portman Road, Reading RG3 1NE. Tel: Reading (0734) 595844. Telex: 848659.

Anti-reflection coatings for high-power laser systems

Check your requirement from this list:

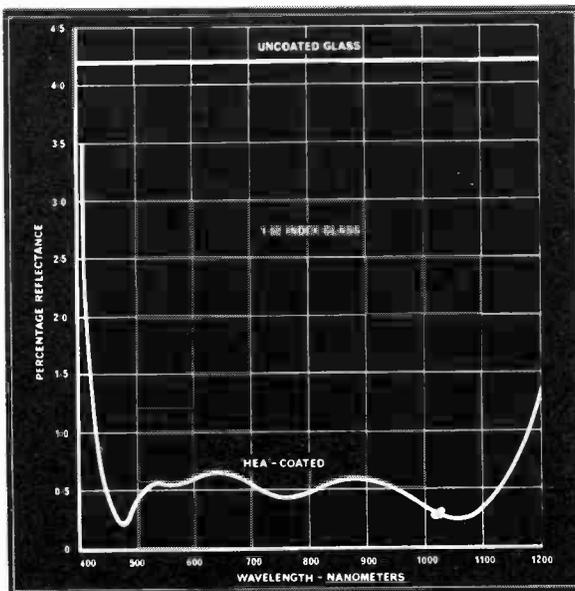
VERY LOW REFLECTIVE COATINGS
 Reflectance equal to less than 0.05% at specified wavelength.

HIGH-EFFICIENCY REFLECTIVE COATINGS
 Details on request.

ANTI-REFLECTION WIDE BAND COATINGS
 Visible to Near Infrared.

POLARISING COATINGS AND BEAMSPLITTERS
 Details on request.

NARROW BAND FILTERS
 0.9 microns and above.



Comparison between OCLI Wide Band 'HEA'-coated and uncoated 1.52 index glass (measured performance)

For more information, send this advertisement to:

OCLI OCLI Optical Coatings Ltd.,
 Hillend Industrial Estate,
 Dunfermline, Fife, Scotland KY11 5JE.
 Tel. Inverkeithing 3631 (038-34 3631).
 Telex. 72307.

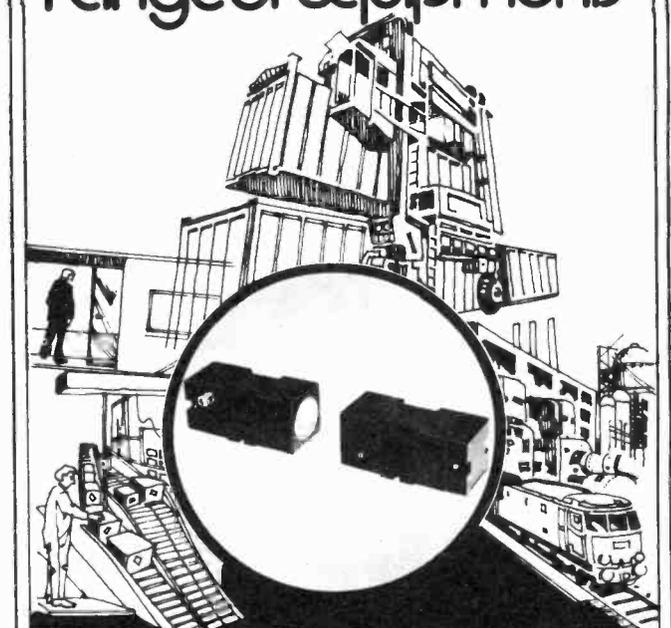
OC-52C

SPANNING EUROPE

WW-175 FOR FURTHER DETAILS

Industrial Action with the JAMES SCOTT INDUSTRIAL

microwave range of equipments



The James Scott range of Microwave equipment now offers industrial users a greater choice of alternative systems in robust, industrial, cast aluminium housings, for a wide variety of applications.

The range is made up of standard sub-assemblies which can be permuted to suit individual application requirements.

Some Suggested Applications for these Units
 Level controllers; Proximity alarms; Small object counters; Process control systems; Positioning systems; Door opening systems; Safety barriers; Presence/detectors; Train control systems; Vibration sensing systems; Intruder alarms; Road vehicle systems.

If any of the above are your problems or if you have a particular problem for which we could adapt a system please write or telephone for further information and technical literature to.

JAMES SCOTT
(Electronic Engineering) Ltd
 CARNYNE INDUSTRIAL ESTATE
 GLASGOW G32 6AB
 Tel: 041-778 4206

WW-065 FOR FURTHER DETAILS

TRANSISTOR DATA ?

THE SEMICON INTERNATIONAL TRANSISTOR DATA MANUAL

lists over 20,000 transistors of international origin alpha-numerically. Single line entries with major characteristics over 14 columns makes quick and easy reference. 400 pages. Free updating service.

EXTENSIVE SUBSTITUTION GUIDE
CV NUMBERED DEVICES
OUTLINE DRAWINGS

ALTERNATIVE MANUFACTURERS
AND AGENTS ADDRESSES

NEEDS SEEING TO BE APPRECIATED

ORDER NOW £8.80 includes postage
(TO COUNTRIES OUTSIDE UK ADD 60p POSTAGE)
FULL REFUND IF NOT COMPLETELY SATISFIED
PUBLISHED BY

SEMICON INDEXES LTD.,
2 DENMARK ST, WOKINGHAM, Berks. RG11 2BB
Tel: WOKINGHAM (STD 0734) 786161



Now suitable for U.K., European and American voltages...

Minimod, the versatile British made range of encapsulated power supplies first introduced in 1973, has now been extended to cover European and North American mains voltages (and is interchangeable with most American types). Normally available ex-stock, all units are fully stabilised with fold back current limiting – the 5V models have over voltage crowbar too!

STANDARD MODELS

Type Number	Output Voltage	Output Current Amps	Short Circuit Current mA (Typical)	% Regulation Line and Load (Typical)
PU01	5 ± 0.1	0.5	370	0.3
PU02	5 ± 0.1	1.0	770	0.5
PU03	15-0-15 ± 0.2	0.10	37	0.1
PU04	15-0-15 ± 0.2	0.20	84	0.1
PU05	12-0-12 ± 0.2	0.12	45	0.1
PU06	12-0-12 ± 0.2	0.24	120	0.2

Input voltage ranges 103 - 126V, 200 - 240V. 210 - 250V. Frequency 50 - 400 Hz all types.

Comprehensive specification given in brochure GT 29b which is available on request.

★ SPECIAL DESIGN SERVICE

Custom built units for applications requiring different specifications are produced as part of our standard service. Try us first.



Specialists in Electronic Transformers & Power Supplies.

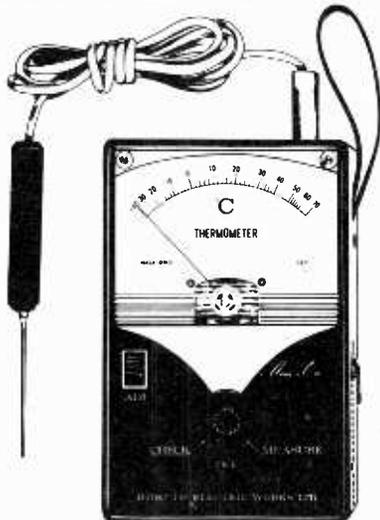
GARDNERS

TRANSFORMERS LIMITED

Gardners Transformers Limited, Christchurch, Dorset, BH23 3PN
Tel. Christchurch 2284 (STD 0201 5 2284) Telex. 41276 GARDNERS XCH

WW—056 FOR FURTHER DETAILS

ELECTRONIC INDUSTRIAL THERMOMETER



THE MODERN WAY TO MEASURE TEMPERATURE

A Thermometer designed to operate as an Electronic Test Meter. Will measure temperature of Air, Metals, Liquids, Machinery, etc., etc. Just plug-in the Probe, and read the temperature on the large open scale meter. Supplied in zippered vinyl case with transparent front and carrying loop, Probe, and internal 1½ volt standard size battery. Model "Mini-On 1" measures from - 40°C to + 70°C, price £17.50 Model "Mini-On Hi" measures from + 100°C to + 500°C, price £20.00 (V.A.T. EXTRA)

Write for further details to

HARRIS ELECTRONICS (LONDON),
138 GRAY'S INN ROAD, LONDON WC1X 8AX
(Phone 01-837 7937)

WW—094 FOR FURTHER DETAILS



AUDIO MEASURING INSTRUMENTS



LOW DISTORTION OSCILLATOR SERIES 3

A continuously variable frequency laboratory oscillator with a range 10Hz–100kHz, having virtually zero distortion over the audio frequency band with a fast settling time.

Specification:
 Frequency range: 10Hz–100kHz (4 bands)
 Output voltage: 10 volts r.m.s. max.
 Output source resistance: 150 ohms unbalanced (optional 150 ohms unbalanced, plus 150/600 ohms balanced/floating)
 Output attenuation: 0–100dB (eight, 10dB steps plus 0–20dB variable)
 Output attenuation accuracy: 1%
 Sine wave distortion: Less than 0.002% 10Hz–10kHz (typically below noise of measuring instrument)
 Square wave rise and fall time: 40/60 n.secs.
 Monitor output meter: Scaled 0–3, 0–10, and dBV.
 Mains input: 110V/130V, 220V/240V
 Size: 17" (43cm) x 7" (18cm) high x 8 3/4" (22cm) deep
 Price: 150 ohms unbalanced output: £250
 150/600 unbalanced/balanced floating output: £300

DISTORTION MEASURING SET, SERIES 3

(illustrated above)

A sensitive instrument with high input impedance for the measurement of total harmonic distortion. Designed for speedy and accurate use. Capable of measuring distortion products down to 0.001%. Direct reading from calibrated meter scale.

Specification:
 Frequency range: 5Hz–50kHz (4 bands)
 Distortion range (f.s.d.): 0.01%–100% (9 ranges)
 Input voltage measurement range: 50mv–60V (3 ranges)
 Input resistance: 47K ohms on all ranges
 High pass filter: 12dB/octave below 500Hz
 Power requirement: 2 x PP9, included.
 Size: 17" (43cm) x 7" (18cm) high x 8 3/4" (22cm) deep
 Price: £200

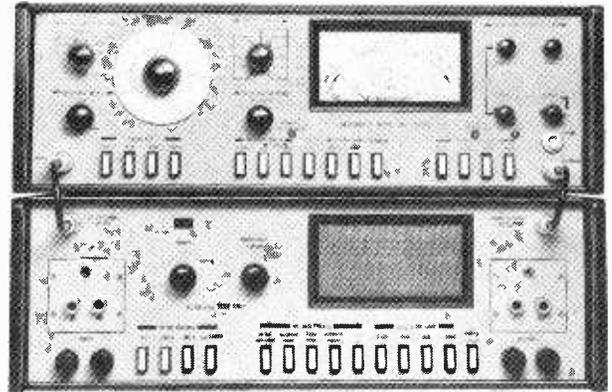
Now available in reasonable delivery time

RADFORD LABORATORY INSTRUMENTS LIMITED

**Bristol BS3 2HZ
 Telephone 0272 662301**

WW—049 FOR FURTHER DETAILS

Audio Test Set



for amplifiers, mixers tape recorders

Checks . . . frequency response
 signal/noise ratio
 distortion
 cross-talk
 wow & flutter
 drift
 erasure
 sensitivity
 output power
 gain
 . . . in one compact unit.

Auxiliary Unit provides extra facilities for Studio testing.

Send for leaflet RTS2

Ferrograph Company Limited Auriema House 442 Bath Road
 Cippenham Slough Buckinghamshire SL1 6BB
 Telephone: Burnham(062 86)62511 Telex: 847297

FERROGRAPH

A member of the Wilmot Breedon group

WW—087 FOR FURTHER DETAILS

ITT

instrument services

ITT Instrument Services is a new concept in the supply of electronic instruments and power supplies based on the same business strategy as the already successful component

distributor ITT Electronic Services. The service is aimed at providing a very broad based line of test equipment from various suppliers both in the U.K. and abroad with deliveries from stock.

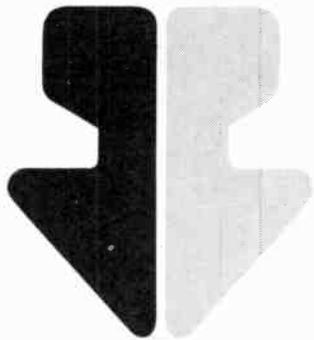
Products from:

- | | |
|-----------------------|-------------------|
| DUMONT, SCOPEX, | LYONS, RACAL, |
| HAMEG, GREENPAR, | JERMYN, MARCONI, |
| FLUKE, DATRON, ITT, | EDGCUMBE PEEBLES, |
| GOERZ, AVO, GEC, | ADVANCE, GRESHAM, |
| LINSTEAD, ANALOGIC, | ZIRKON, WEIR, |
| EXEL, SIFAM, WAVETEK, | KINGSHILL, BERCO. |

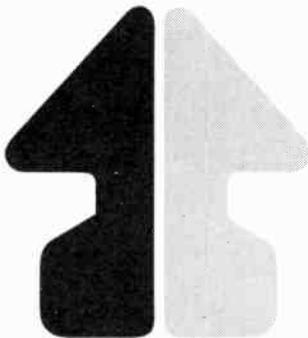
Have you got our new comprehensive catalogue

Broad range of products
5 experienced sales engineers

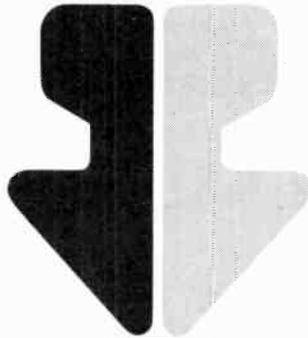
Manufacturers guarantees maintained
No price differential (all at manufacturers prices)
Immediate information and service
Items available ex-stock
New name and telephone number



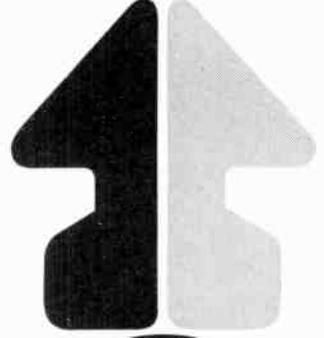
POWER SUPPLIES



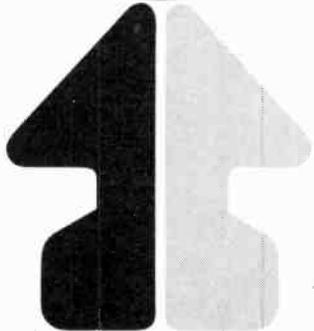
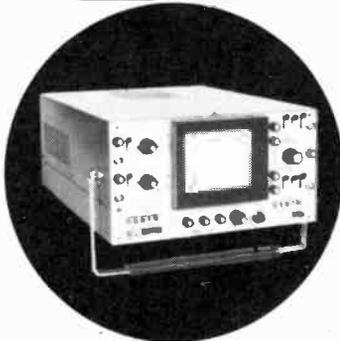
DIGITAL MULTIMETERS



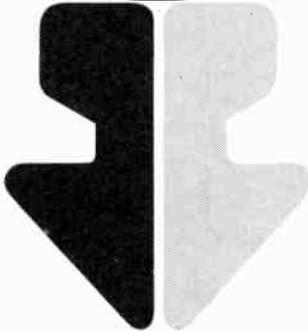
SIGNAL SOURCES



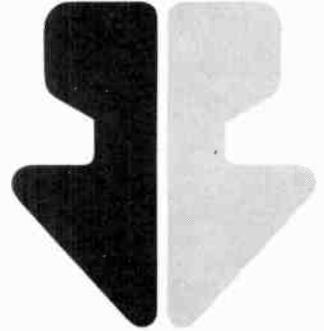
ANALOGUE MULTIMETERS



OSCILLOSCOPES



TESTERS



Edinburgh Way, Harlow, Essex.
Telex: 81146 (Sentercel Harlow)
Telephone: Harlow 29522



instrument services

WW-197 FOR FURTHER DETAILS

Purpose-built servo and actuator systems using standard components

McLennan Engineering Ltd. have considerable experience in the solution of actuator and servo problems using synchronous, stepping and DC motor techniques, an important facet of our skill lying in purpose-designing around standard components for speed and economy.

The illustrations show a selection of modules from the standard range and include the new EM/ 100/100A servo drive system. All items are available individually or can be supplied engineered to custom-built systems.

1. EM 100/100A SERVO AMPLIFIER. A new addition to the range. A complete servo drive system including power supply which is eminently suitable for driving printed circuit motors and other servo motors up to 1/6 h.p. EM 100 - output $\pm 24V$, 4 amps continuous, 45 amps peak. EM 100A - output $\pm 24V$, 7 amps continuous, 75 amps peak.
2. DC SERVO AM 1006S. With integral potentiometer. Max continuous output Torque 14.6 kgcm at 7 r.p.m.
3. LOW INERTIA DC SERVO MOTOR. Output 5W
4. CONTROL AMPLIFIER EM 40 Output $\pm 15V$ 0.5 amp
5. TYPICAL PRECISION GEARS 120 to 32 DP



McLennan

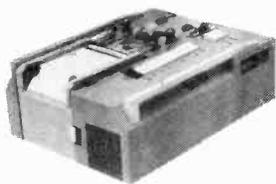
McLennan Engineering Ltd
Kings Road, Crowthorne, Berkshire.
Tel: Crowthorne 5757/8.

WW-106 FOR FURTHER DETAILS

STRIP CHART RECORDERS

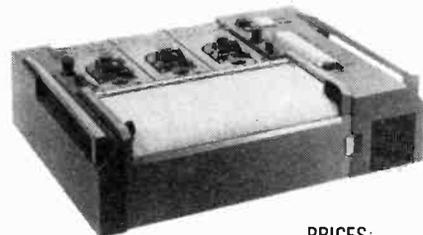
Made in USSR

Series H3020 Recorders



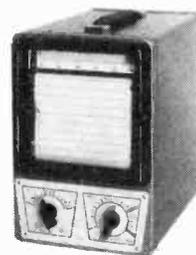
Sensitivity: 8mA F.S.D.
Speed of response: 5Hz
Chart width: 80mm per channel
Chart drive: 230-250V AC mains
Chart speeds: 0.1-0.2-0.5-1-2.5-
12.5-25 mm/sec

Time and event marker pens fitted.



PRICES:
Single pen model H3020-1 £80.00
Three pen model H3020-3 £130.00

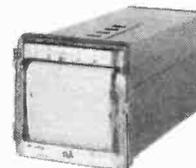
MULTI-RANGE UNIVERSAL PORTABLE AC/DC RECORDING VOLTAMMETER H390



Measurements ranges, AC/DC: 5-15-150-250-500mA, 1.5-5 Amps
5-15-150-250-500V
Accuracy: 1.5%DC, 2.5%AC
Chart width: 100mm
Chart drive: 220-250V AC mains
Chart speed: 20-60-180-600-1800-5400 mm/hour

PRICE: £78.00

SWITCHBOARD PATTERN MINIATURE RECORDING MILLIAMMETER H3100



Full scale deflection: 1mA DC
Accuracy: 2.5%
DC resistance of the coil: 18,100Ω
Chart width: 80mm
Chart drive: 220/250V AC mains
Chart speeds: 20-60-180-600-1800-5400 mm/hour

PRICE: £44.00

ALL THE ABOVE PRICES ARE EXCLUSIVE OF CARRIAGE AND VAT,
PLEASE WRITE FOR FULL DETAILS TO:

Z & I AERO SERVICES LTD,

44A WESTBOURNE GROVE, LONDON W2 5SF

Tel: 01-727 5641

Telex: 261306

WW-155 FOR FURTHER DETAILS

MEASURE FREQUENCY ANYWHERE WITH MULTIMETER SIZE INSTRUMENT POWERED BY FOUR PENCCELLS

Latest technology miniature device uses four 0.3" LED digits to display frequency. 5 ranges with coupled decimal point give resolution of 0.1Hz to 1kHz in decade steps.

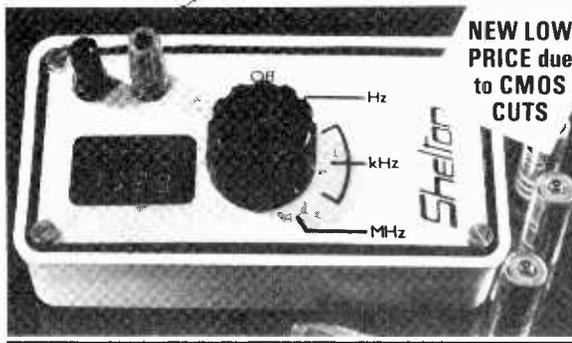
TAKES UP ALMOST NO BENCH SPACE.

NEW LOW PRICE. £67.50 inc p&p ex vat.

Mains PSU available which fits inside ready drilled case.

Shelton

INSTRUMENTS LTD., 24 Copenhagen Street, LONDON N1 Tel: 01-278 6273



NEW LOW PRICE due to CMOS CUTS

MINIATURE BATTERY FREQUENCY METER FM-1

FOUR-DIGIT MEMORY DISPLAY

FIVE RANGES

4 ppm CRYSTAL

SIZE 6 1/4 x 3 1/2 x 2 1/4 in —including knob and terminals

* Also: FX-1 FREQUENCY MULTIPLIER (X 60.X 100) *
—see December W.W. £29.50

WW—114 FOR FURTHER DETAILS

THE TUNER YOU CAN TRUST

ONE YEAR AGO

this month, the design for this tuner was published in this magazine. At that time we offered kits of parts for the circuit boards and a guarantee that they would work as well for you as for us.

Today, our many satisfied customers confirm our confidence. The design remains unchanged.



NOW we can offer this superb tuner directly to you **READY BUILT†**
The same high standard of performance plus first class construction and a **5 YEAR GUARANTEE**
Try it at home for 10 days, full refund if not satisfied. **£110 INC. VAT.**

THE ONLY TUNER WITH THESE FEATURES:

- * Foolproof tuning
- * Single lamp station indicator
- * Push button and manual tuning
- * Anti-birdy filter
- * Powerful limited range A.F.C.
- * Full muting of unwanted noises

† U.K. only at present

Full kits still available ex-stock at original prices, send S.A.E. today for full details to:

Icon Design

33 RESTROP VIEW, PURTON, WILTS SN5 9DG

WW—183 FOR FURTHER DETAILS



SPEEDSERVICE

A new service from one of the largest United Kingdom exporters of tubes and semiconductors

AEL · GATWICK HOUSE · HORLEY · SURREY · RH6 9SU
Telex 87116 · Cables Aerocon Telex Horley · Telephone Horley 5353

WW—107 FOR FURTHER DETAILS



MODEL U-50DX

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

MODEL P28	£9.76	MODEL F80TRD	£25.28
MODEL JP5D	£11.58	MODEL A145	£21.52
MODEL BX 505	£28.12	MODEL 380CE	£28.12
MODEL 380YTR	£15.28	MODEL N101	£31.81
MODEL U50DX	£15.60	MODEL 480ED	£35.89
MODEL A303TRD	£17.45	MODEL EM800	£81.06
MODEL K30 THD	£24.01	MODEL R1000CB	£75.27

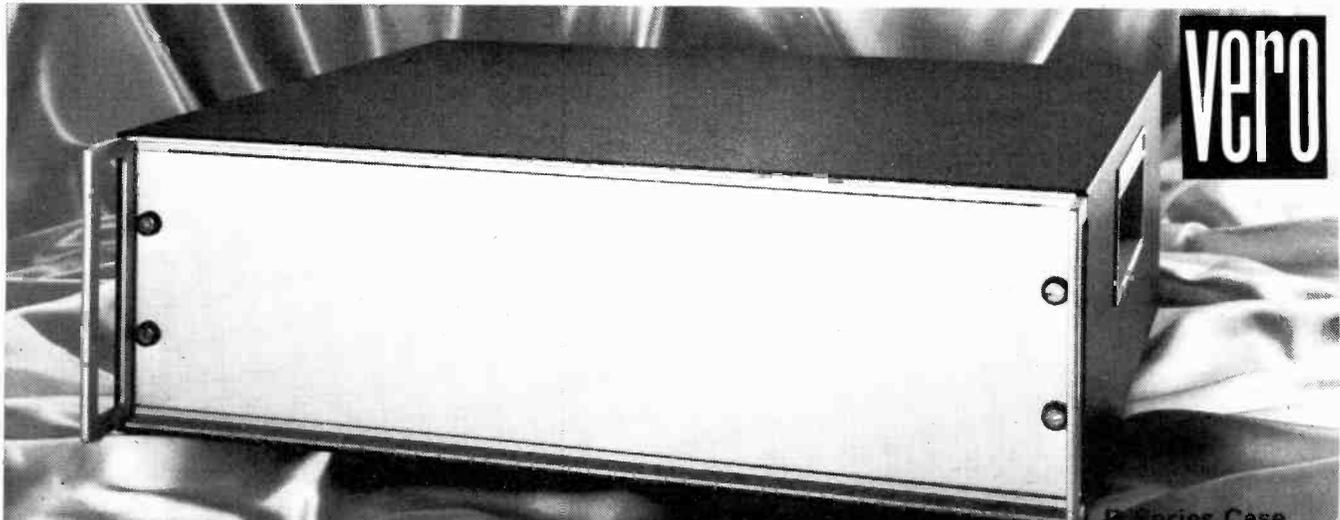
Excellent Repair Service

THESE PRICES ARE SUBJECT TO AN ADDITIONAL CHARGE OF 8% FOR V.A.T. Cases extra, available for most meters, but not sold separately.

Please write for illustrated leaflet of these and other specialised Sanwa meters

SOLE IMPORTERS IN U.K.
QUALITY ELECTRONICS LTD.
47-49 HIGH STREET, KINGSTON-UPON-THAMES, SURREY. KT1 1LP
Tel: 01-546 4585

WW—013 FOR FURTHER DETAILS



vero

A Large Range of Cases for all Applications

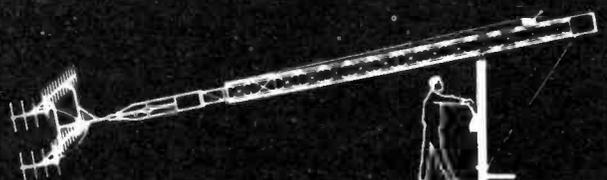
Series Case
Ex-Stock Availability

- Slim line.
- Integral front rim, with or without handles.
- Retractable tilt feet.
- Removeable bottom and rear panels incorporating ventilation slots.
- 8½", 12½" or 17½" deep, 10½" and 19" wide.
- 1u to 6u heights.
- Side handles - standard on 17½" deep version, extra on other sizes.
- Chassis runners and front panels also available.

Vero Electronics Limited Industrial Estate, Chandler's Ford, Eastleigh, Hants. SO5 3ZR
Tel: Chandler's Ford 2952 Telex: 47551 World Leaders in Packaging Technology

WW-182 FOR FURTHER DETAILS

INSIST ON VERSATOWER



Acclaimed as the World's leading telescopic tiltover tower in the field of radio communication
 Models from 25' to 120'

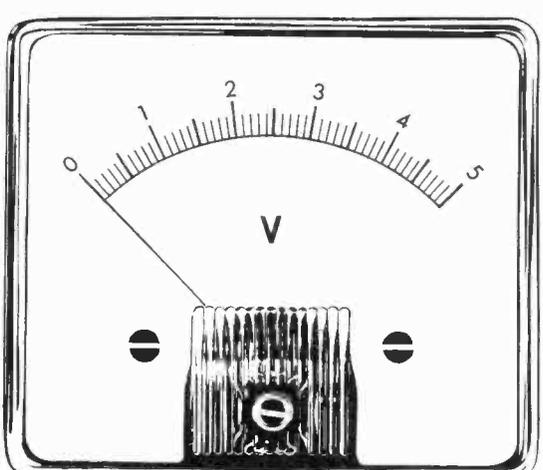


Look for the name
STRUMECH

Strumech Engineering Co Ltd
 Coppice Side, Brownhills, Walsall, Staffs.

WW-027 FOR FURTHER DETAILS

METER PROBLEMS?



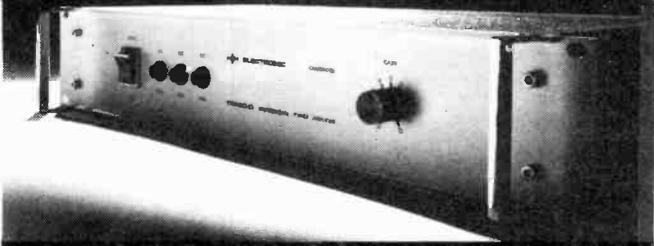
A very wide range of modern design instruments is available for 10/14 days' delivery.

Full information from:
HARRIS ELECTRONICS (London)
 138 GRAYS INN ROAD, W.C.1 Phone: 01/837/7937

WW-051 FOR FURTHER DETAILS

TPA SERIES - D

integrated circuit power amplifier



TPA 50 - D Specification

Power Output 100 watts rms into 4 ohms
 65 watts rms into 15 ohms

Freq Response ± 0.1 dB 20Hz to 20KHz into
 15 ohms. -1dB at 150KHz

Total harmonic distortion Less than 0.04% at all levels up to
 50 watts rms into 15 ohms

Input sensitivity 0dBm

Noise -100dB

Rise time 2 μ seconds

Price £70 plus V.A.T.

100V Line (C.T.) and balanced inputs available.

For full technical information contact:

H/E ELECTRONIC

CAMBRIDGE ROAD, MILTON, CAMBS
 TELEPHONE CAMBRIDGE 65945/6/7

WW—180 FOR FURTHER DETAILS

Switching problems? Rely on Zettler.

Producing 30 basic types of relay and 15,000 variants with regard to contact stacks, terminals, energizing current and contact material, Zettler is among the largest manufacturers of electro-mechanical components.

Our product range comprises:
 Low profile (platform) · Timing · Miniature · Low contact capacity · Hermetically sealed · Stepping · Mains switching · Latching Contact stacks · Solenoids



Platform Relay AZ 535

for reliable insulation between signal and heavy duty circuits. 1 changeover.
 Contact material: Silver cadmium oxide, or fine silver.
 Printed circuit mounting (32.5 x 20 x 11 mm).
 Coil voltages: 6 to 110 V DC.
 Contact rating: 240 V max., 3 A max., 500 VA.

We resolve your switching problems rapidly and expertly. Please contact us for further details.

 **ZETTLER** Zettler UK Division
 Equitable House, Lyon Road
 Harrow, Middx. HA1 2DU, Tel. (01) 863 6329
 A member of the worldwide ZETTLER electrical engineering group, est. 1877

WW—173 FOR FURTHER DETAILS

A revolution in the recording industry



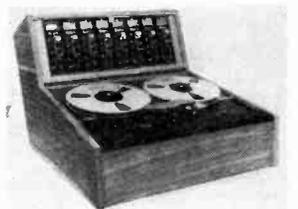
The Itam 805 8-track master recorder. £1790

Comprehensive facilities include sync on all channels, servo controlled capstan, modular electronics, variable speed (optional), relay solenoid operation.



Fully modular electronics using plug-in PCBs throughout. Separate sync and replay amps give identical levels. Switchable VUs with slow decay. Individual oscillator for each channel. Dolby A switching facility.

Compact console presentation for easy portability. £1,790 + VAT. Full console optional extra.



itam

Industrial Tape Applications, 5 Pratt Street, London NW1 0AE.
 Tel: 01-485 6162/7833. Telex: 21879.

WW—190 FOR FURTHER DETAILS

Whiteley

Acoustic Hoods

These strongly made hoods for both outdoor and indoor use are designed to specifications which meet Post Office approval. Suitable for desk, shelf or wall mounting, they are available with or without internal light fittings and doors if required.



WHITELEY ELECTRICAL RADIO CO. LTD., Mansfield, Notts, England. Tel. Mansfield 24762. London Office: 109 Kingsway, W. C.2. Tel. 01-405 3074
WW—116 FOR FURTHER DETAILS

PRODUCTION TESTING
DEVELOPMENT
SERVICING
EDUCATION

POWER UNITS

NOW AVAILABLE WITH 3 VARIABLE OUTPUTS

Type VRU/30/25—£175.00 + 8% VAT

Input 200–250V, 50Hz
or 100–120V, 60Hz to order
Output 1: 0–30V, 25A, D.C.
Output 2: 0–70V, 10A, A.C.
Output 3: 0–250V, 4A, A.C.

Other units are also available with outputs of:
0–60V 12A.
0–120V 6A.
0–240V 3A.

ALL CONTINUOUSLY VARIABLE

SEND FOR FURTHER DETAILS OF THESE VERSATILE UNITS TO

Valradio LIMITED, BROWELLS LANE,
FELTHAM, TW13 7EN, MIDDLESEX.
TELEPHONE 01-890 4242

WW—110 FOR FURTHER DETAILS

J E S AUDIO INSTRUMENTATION

Illustrated the Si 451 Millivoltmeter — pk-pk or RMS calibration with variable control for relative measurements. 40 calibrated ranges **£42.50**

Si 452	£35.00	Si 453	£50.00
Distortion Measuring Unit.		Low distortion Oscillator.	
15 Hz — 20 KHz — .01%		Sine — Square — RIAA	

J. E. SUGDEN & CO., LTD. Tel. Cleckheaton (09762) 2501
CARR STREET, CLECKHEATON, W. YORKS BD19 5LA

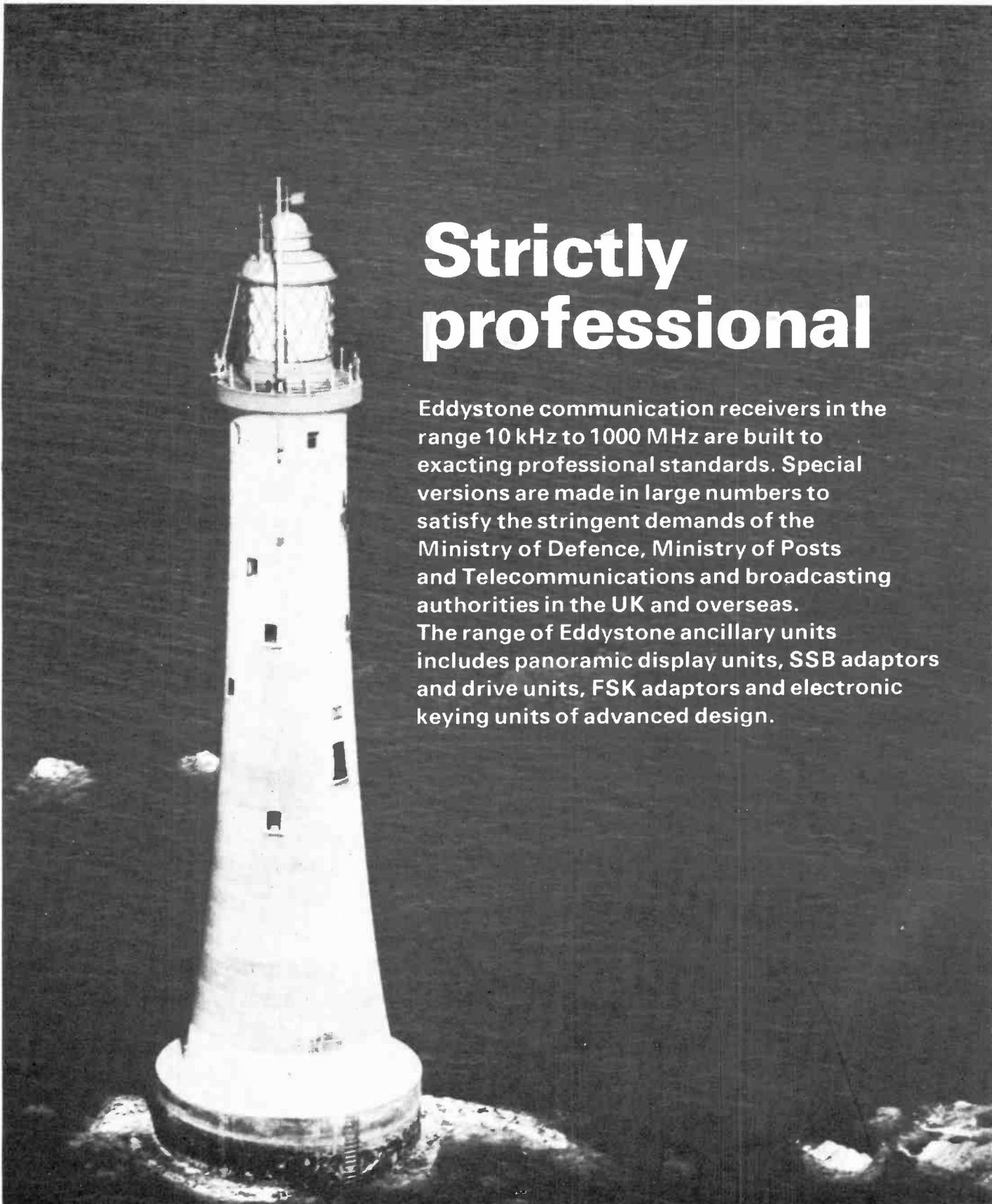
WW—042 FOR FURTHER DETAILS

QUARTZ CRYSTALS — FAST!

AEL

AEL GATWICK HOUSE, HORLEY, SURREY, ENGLAND
Tel: Horley (02934) 5353
Telex: 87116 (Aerocon Horley) · Cables: Aerocon Telex Horley

WW—026 FOR FURTHER DETAILS



Strictly professional

Eddystone communication receivers in the range 10 kHz to 1000 MHz are built to exacting professional standards. Special versions are made in large numbers to satisfy the stringent demands of the Ministry of Defence, Ministry of Posts and Telecommunications and broadcasting authorities in the UK and overseas. The range of Eddystone ancillary units includes panoramic display units, SSB adaptors and drive units, FSK adaptors and electronic keying units of advanced design.

Photo by Aerofilms Ltd.

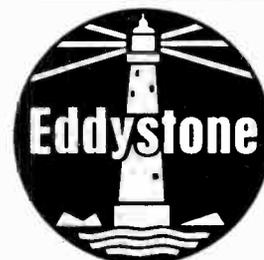
Eddystone Radio Limited

Member of Marconi Communication Systems Limited

Alvechurch Road, Birmingham B31 3PP, England.

Telephone: 021-475 2231 Telex: 337081

A GEC - Marconi Electronics Company



WW-191 FOR FURTHER DETAILS

ELEKTOR

You told us you enjoyed
Elektor 1

Don't miss Elektor 2, out now

Elektor is a fund of well
thought-out and thoroughly
tested projects, new ideas using
modern electronic compo-
nents, objective comment
on new developments.

Try it



ELEKTOR 2

mos tap
minidrum
dil logic probe
numeric displays
electronic
loudspeaker

Use the Elektor
printed circuit
board service
for immediate
delivery of high
quality epoxy
glass boards
for all major
projects.

In Elektor 2

- | | |
|----------------------------|----------------------------------|
| † Electronic drum kit | † Modulation systems – AM to CPM |
| † Touch sensitive switches | † 7-segment displays |
| † DIL Logic probe | † High-quality T.V. sound |

Write to us enclosing 35p P.O. or cheque for Elektor 2. If you would like a subscription for the next seven issues (£3.60 till end 1975), send no money, write or phone for subscription card.

Elektor Publishers Ltd.
6, Stour Street, Canterbury CT1 2XZ. Tel Canterbury (0227) 54439

Nagra tape recorders

overseas and home enquiries invited

Nagra III
Series Machines Fully
Overhauled
by Factory Trained
Personnel.
Guaranteed
for six months.

Please apply to the exclusive UK agents :

NAGRA KUDELSKI

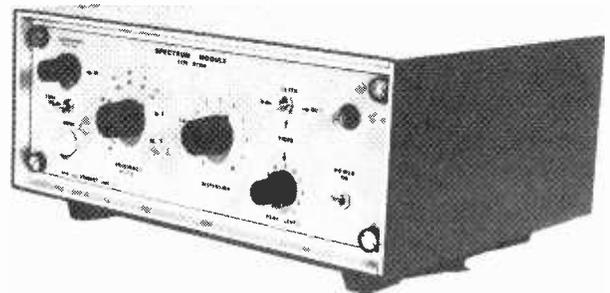
HAYDEN

Hayden Laboratories Ltd.
Hayden House, 17 Chesham Road,
Amersham, Bucks. HP 5 AG. Telephone: (02403) 5511

Y&R HMA7

STARWET

Spectrum Analyser Module ST858



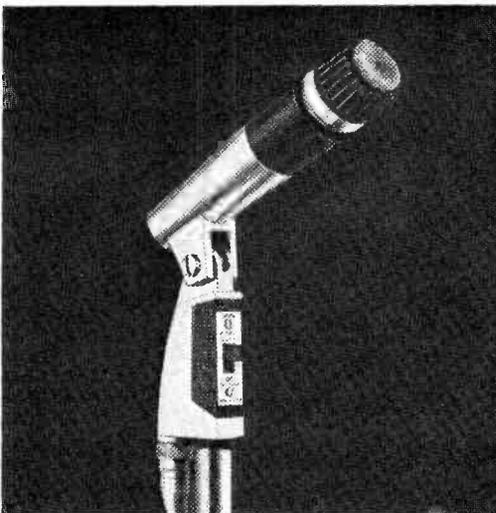
SPECIFICATION: Frequency range 10 MHz to 850 MHz in two calibrated ranges **Sensitivity** Better than 50 mv for 0.5V per cm **Resolution** Better than 25 KHz. **Dispersion** From less than 1 MHz to 400 MHz variable **Input** Via 50 ohm BNC connector on front panel **Output 1** Coax cable for connection to Y input on scope **Output 2** Coax cable for connection to sync. input on scope **Power requirements** 240 volts AC 50 Hz 10 watts. (Other voltages and frequencies available as required) **Size** Width 11in (28cm.) Height 4.375in. (11.2cm.) Depth 8.5in. (21.6cm.) **Nett weight** 7.5lbs (3.4 Kg) **Gross weight** 10lbs (4.5 Kg.)

For further details contact the sole distributors of
STARWET equipment:

CHILTMEAD LTD
7-9 ARTHUR ROAD, READING, BERKS
(rear Tech College) Tel. Reading 582605



Microphones matter most.



Never have so few words said so much about sound system installations. The truth is that a carefully chosen, top-quality microphone makes a measurable difference in sound system quality—regardless of the other components in the system. It is false economy at its worst to be a microphone miser. Install *Shure Unidyne* or *Unisphere* microphones—for installations with a marked superiority in voice intelligibility (and fewer service calls due to microphone problems). For the name of your local sound specialist, write:

Shure Electronics Limited
Eccleston Road, Maidstone ME15 6AU
Telephone: Maidstone (0622) 59881



WW—180 FOR FURTHER DETAILS

SIEMENS

MKM stacked foil polycarbonate dielectric capacitors.



Giving them their full title, as above, tends to waste your time and ours. Instead, we would prefer that you concentrate your attention on the wide range of features offered by their revolutionary design.

Overall dimensions start at only 13mm x 3.5mm x 7.5mm. And apart from the standard

10mm size, there's a choice of 7.5mm and 15mm lead spacings, 100v or 250v types and capacitance values from 0.001 μ F to 0.22 μ F.

All sealed in a heat-shrunk plastic skin offering complete protection against levels of humidity specified for class F environment. With a resin base which gives a defined bearing section between the capacitors and mounting plate and

good thermal insulation during soldering.

Add to these features an operational temperature range of -40°C to $+100^{\circ}\text{C}$, highly competitive prices, ex-stock availability and an even larger unprotected range – then waste no more time. Send for our leaflet now.

A new protected range. From Siemens.



To Siemens Ltd., Great West House, Great West Road, Brentford, Middx., TW8 9DG
Please send me your leaflet and sample on.

- The new protected MKM range of capacitors
- The popular MKM range.

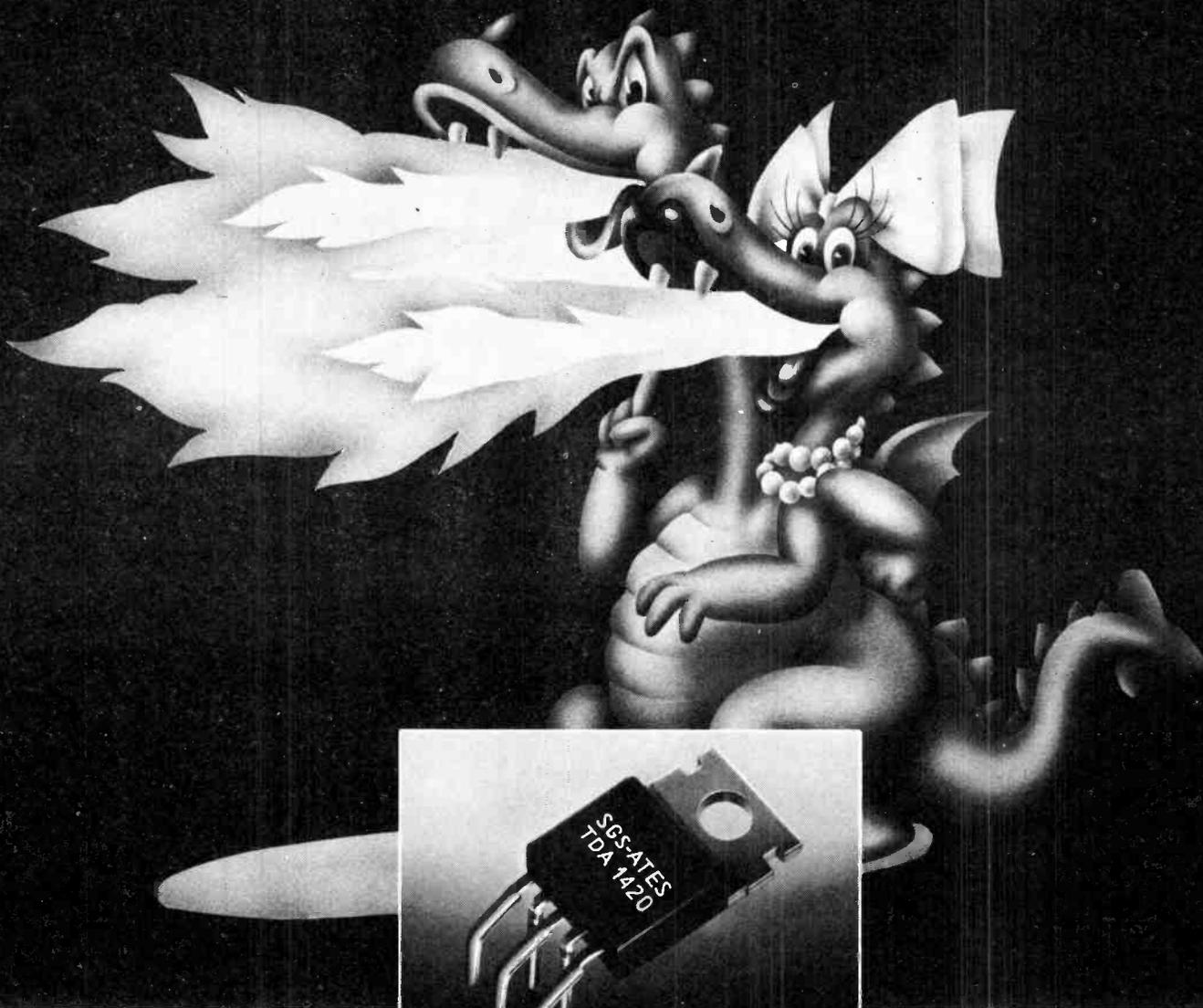
Name.....
 Position.....
 Company.....
 Address.....

ww1

RIGHT ON TARGET AGAIN

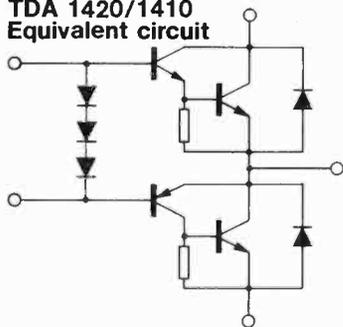


A perfect match when things get hot



1st monolithic complementary darlington pair

TDA 1420/1410
Equivalent circuit



The TDA 1420 integrates a quasi-complementary (NPN/PNP) darlington pair and biasing diodes for perfect electrothermal matching. Applications for this versatile power IC include DC or stepping motor drivers, op amp power boosters, audio output stages, etc.

All this in Pentawatt®, the rugged 5-pin plastic pack.

For lower voltages try the TDA 1410.

Key parameters	TDA 1420	TDA 1410
V_{CEO}	44 V	36 V
V_{CES}	60 V	50 V
I_C	3 A	3 A
$P_{tot} @ T_c \leq 60^\circ C$	30 W	30 W

PHILIPS



The plus factor* in test equipment



**PAL TV
Pattern
Generator
PM 5509**

- Full coverage I-F; Bands I, III, IV and V
- Electronic tuning with 5 preset channels
- 10 test patterns (colour and B & W)
- Adjustable chroma/burst and HF-amplitude
- Special sync, video and VCR outputs
- External video and sound modulation possibility
- NTSC version available: PM 5512



HF Generator PM 5324

- Frequency range 100 kHz-110 MHz
- X-tal calibration
- Special band spread ranges
- High frequency stability
- Electronically stabilised output max. 50mV rms in 75 ohms
- Calibrated output attenuator
- Facilities for: internal and external AM and FM
- Wobulating with sweep width control
- Simultaneous AM and FM.

TV Sweep Generator PM 5334

- 8 frequency ranges, 3 MHz-860 MHz
- Sweep width continuously adjustable over selected range
- Sweep frequency adjustable, 8-50 Hz
- One variable and three fixed markers
- Signal frequency is highly accurate and thermally stable
- Stabilised output into 75 ohms load
- Built-in floating bias source.

***The 'Philips Plus'**
The 'Philips Plus' is a working proposition for anyone who buys, specifies or uses test and measuring equipment. It is the quality of design, specification and appearance—particularly in human engineering terms—of every instrument. A total test and measurement capability. The ability to supply all the user's needs from a single source.

Plus a complete range of compact Oscilloscopes

Suitable for radio and television service requirements. Models include PM3200X 15 MHz/2mV single beam Oscilloscope, PM3110 10 MHz/50mV dual trace Oscilloscope with large screen.



Pye Unicam Ltd

Philips Electronic Instruments Dept.,
York Street Cambridge England CB1 2PX
Tel. Cambridge (0223) 58866 Telex: 8173731

WW—184 FOR FURTHER DETAILS



**Phoenix
Electronics
(Portsmouth) Ltd**

139-141 Havant Road,
Drayton, Portsmouth, Hants PO6 2AA

Full member of AFDEC—the industry's association of franchised electronic component distributors.

Our prices include VAT at the current rate—and carriage on all goods is free.

Send for our catalogue and price list—we'll mail that to you free, too.



THIS MONTH'S BARGAIN OFFER—
Special transistor kit. 4 each JFETs and PUJTs, 4 each plastic power NPN and PNP transistors, plus 4 x 1A/400V bridges—catalogue value £6.88.
BARGAIN PACK PEP6—£4.90

Please send your catalogue—free!

Name

Address

..... WW4



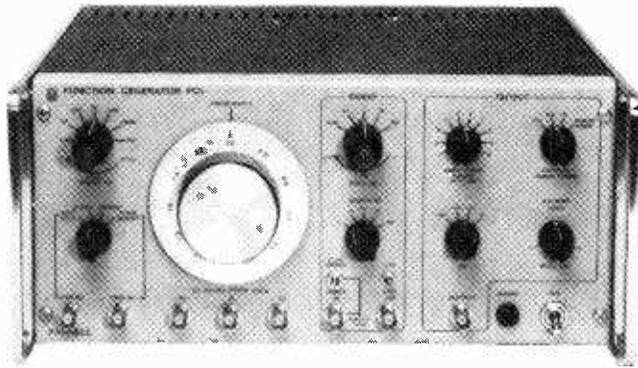
naim audio
MANUFACTURERS OF AUDIO EQUIPMENT

- NAP160 POWER AMPLIFIER
- NAC12 PRE-AMPLIFIER
- NAM402 LOUDSPEAKER

With effect from Jan. 1, 1975, we are handling all export enquiries and orders ourselves. Please write direct to naim audio Ltd.

You can now find our factory and showroom at...
11 Salt Lane, Salisbury, Wilts, SP11DT
The telephone number remains the same...
SALISBURY 3746

WW—040 FOR FURTHER DETAILS



THE FG1 FUNCTION GENERATOR

WAVEFORMS AVAILABLE

Sine, square, triangles and ramps. Continuous swept, triggered, gated bursts, frequency modulated, externally sync'd.

AMPLITUDE

Max. 20V pk-pk into open circuit (10V into 50Ω) on selected waveform at main output. Adjustable from 1mV. Four basic waveforms available simultaneously from 600Ω at fixed level of 2.5V pk-pk.

ATTENUATOR

4 positions, 60dB in 20dB steps. For best possible resolution and signal to noise ratio at low signal levels.

FREQUENCY

0.02 Hz to 2MHz in seven decade ranges - sine, square and triangle. 1000:1 continuous coarse and fine adjustment on each range. 0.01 Hz to 1kHz in five decade ranges - ramp. Dial accuracy ± 3% of range max. 0.02Hz to 200kHz.

OFFSET

±5V d.c. bias will offset waveform above or below zero. Push-pull adjustable control.

EXT. VCO

0 to +10V gives 1000:1 frequency upshift from min. dial setting. 0 to -10V gives 1000:1 frequency down shift from max. dial setting, within any selected range. Voltage may be a.c. or d.c. Frequency modulation of the output about a centre frequency is possible.

SWEEP

Range: 1000 to 1. Mode: Lin or log. Times 1mS to 1000S. Width: 5 position switch gives stepped reductions as a percentage of max.

SYNC

Sync. pulse output may be used to trigger an oscilloscope. X-Y plotter etc. Or the output frequency of the FG1 may be locked to a periodic reference signal for tests requiring coherent signals.

Real value for money at **£245 U.K.** (excluding V.A.T.)



INSTRUMENTS DIVISION

FARNELL INSTRUMENTS LIMITED, SANDBECK WAY, WETHERBY, YORKSHIRE LS22 4OH TEL: 0937 3541 TELEX 557294 LONDON OFFICE TEL: 01-802 5359

WW-185 FOR FURTHER DETAILS

Measure airflow accurately for only £67.00

The AVM500 gives accurate and immediate metering of airflow. The standard scale is between 0 and 30 metres/second (70mph). Other calibrations can be supplied at cost.

Airflow is measured by a constant temperature bridge, supported on a lightweight probe, which is connected by cable to the meter. Operation is by battery. The AVM500 is therefore extremely quick and easy to move and instal. A recording instrument is available.

Please send details of your AVM500. I am interested in wind measurement for

Name Position

Company

Address

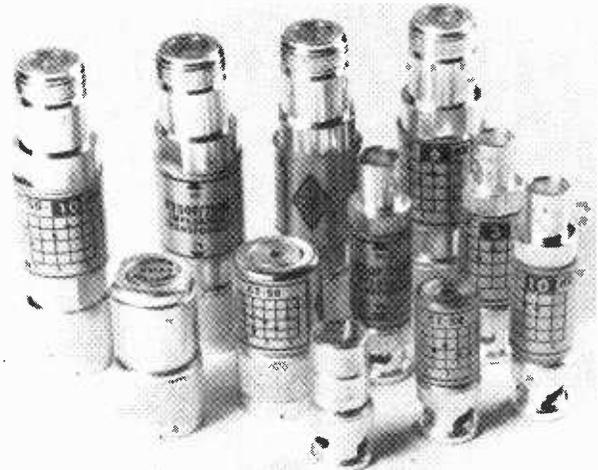


WW2

Prosser Scientific Instruments Ltd
Lady Lane Estate Hadleigh Suffolk
Tel Hadleigh (047-338) 3005

1/2 watt ATTENUATORS TERMINATIONS IMPEDANCE TRANSFORMERS

MANUFACTURED BY ELCOM SYSTEMS INC.



LOW COST

FAST DELIVERIES

FROM

aspen electronics limited

18a HIGH ST NORTHWOOD MIDDX HA6 1BN
TELEPHONE NORTHWOOD 27688

GET IT WHILE IT'S GOING

This is the first ever Wireless World Annual. It's got 128 pages including features covering all aspects of electronics and communications — new and established techniques, some practical, some theoretical — all written to the high standard you'd expect from Wireless World. Contents include: A General Purpose Audio Oscillator by L. Nelson Jones (a constructional project specially commissioned for the annual); Constructional Design for a Small Boat Echo Sounder by John French; Scientific Calculations with an Arithmetic Calculator by R. E. Schemel. There is also a reference section packed with useful information.

£1 from newsagents or £1.35 inclusive by post from the publishers.

Wireless World Annual 1975

To: General Sales Department, Room 11, Dorset House, Stamford Street, London SE1 9LU.
Please send me.....copy/copies of Wireless World Annual 1975 at £1.35 each inclusive. I enclose remittance value £..... (cheques payable to IPC Business Press Ltd).

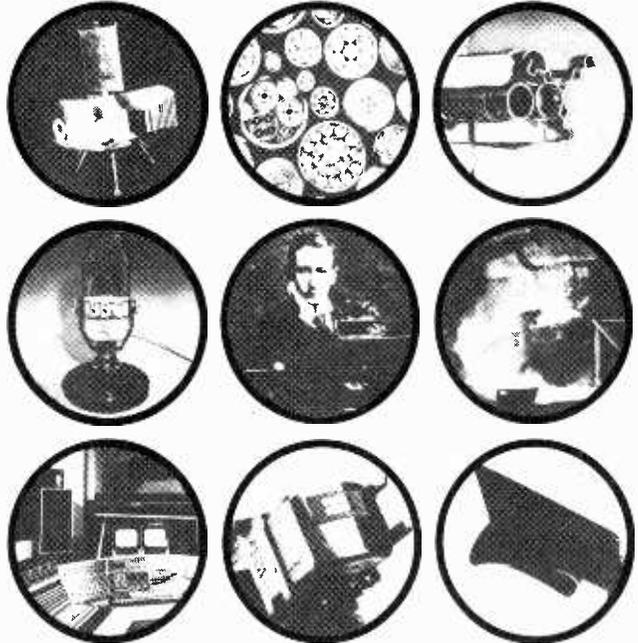
Name (please print)
Address

Company registered in England No. 677128
Regd. office: Dorset House, Stamford Street, London SE1 9LU

wireless world annual 1975

£1.00

COMMUNICATIONS • ELECTRONICS



NOW IT'S THE AMCRON M600

M600 POWER AMPLIFIER

1350 watts DC-Coupled



Coupling two M600s together through a socket provided at the back of each amplifier produces a 140 Volt balanced output. This configuration is called an M2000, and produces 2 kilowatts into an 8 ohm load. A peak catching meter, and threshold lights provide convenient front panel output monitoring.

The M600 amplifier is a new high-power amplifier capable of providing 1,350 watts RMS over a bandwidth of DC to 20 kHz. 70 volts RMS at the output terminals, very low noise, and distortion. AC/DC selector switch, plug-in front panel circuit board, built-in fan for cooling, and the ability to connect two M600s together to double the power, and output voltage, are just some of the features which place the Amcron M600 in the forefront when considering power amplifiers.

Driving shakers, and vibrators, motors, and difficult speaker systems, providing power for material or components testing, or used as a large distribution amplifier, the M600 is equally at home.

Brief specifications:

RMS power out	750 watts into 8 ohms 1,350 watts into 4 ohms
DC output	20 amps (supply fuse limited)
Power bandwidth	DC to 20 kHz + 1 db. - 0 db. 600 W into 8Ω
Phase response	+ 0 db. - 15 db DC—20 kHz
Slew rate	16 V/μsecond
Damping factor (8Ω)	greater than 400 DC—1 kHz
Hum & noise	120 db below 600 Watts
THD	less than 0.05% DC—20 kHz. 600 W into 8Ω
Dimensions	19" std. rack, 8 3/4" H. 16 1/2" deep, Wt. 92 lb.



MACINNES LABORATORIES LTD

MACINNES HOUSE, CARLTON PARK INDUSTRIAL ESTATE,
SAXMUNDHAM, SUFFOLK IP17 2NL
TEL: (0728) 2262 2615

WW-194 FOR FURTHER DETAILS

Get it!

Your easy new guide to the all-star ARROW miniature ranges

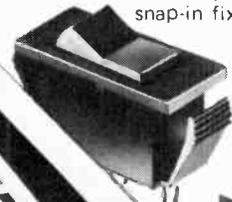
80 Series
Compact 2A 250V AC/DC switches with 1 pole 2 position lever or push button action



79 Series
4A 250 V AC/DC switches with 1 pole 2 position push-button or lever action.



1600 Series
16A 250 VAC switches with 1 pole 2 and 3 position rocker lever action. Popular snap-in fixing

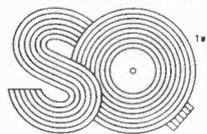




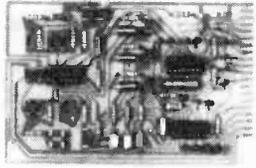
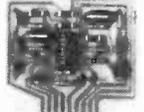
Send today for your copy of this new Arrow miniature switch brochure.

Arrow Hart

Arrow-Hart (Europe) Limited,
Plymbridge Road, Estover,
Plymouth, PL6 7PN
Tel: Plymouth (0752) 701155



SQ IS A TRADEMARK OF CBS INC.

SQ QUADRAPHONIC DECODERS

SQ the leading quadrasonic system, designed by CBS engineers, offers not only 4 channel ambiphony from the fast expanding range of SQ encoded discs but also immensely increased depth and fullness of sound from standard stereo recordings too.

Feed 2 channels (200-1000mV as obtainable from most pre-amplifiers) into your choice of any of our 3 decoders and take 4 channels out with no overall signal level reduction. On the logic enhanced decoders Volume, Front-Back, LF-RF, LB-RB and Dimension controls can all be implemented by simple single gang potentiometers—no need for exotic 4-gang units!

These state-of-the-art circuits, used under licence from CBS, are offered in kit form comprising first grade components only—fibre glass circuit boards of professional quality designed for edge connector insertion, all resistors 2% metal oxide, all polystyrene and polycarbonate capacitors 5% or better and in decoder L2 ultra low noise (MPS A18-0.5dB typ.) transistors used in each amplifying stage.

M1 Basic matrix decoder with fixed "10-40" blend. 10 Resistors, 14 Capacitors, 1 Integrated Circuit, Printed Circuit Board. **£19.00.**

L1 Full logic controlled decoder with "wave matching" and "front-back logic" for enhanced channel separation using three specially designed Integrated Circuits. 24 Resistors, 42 Capacitors, 3 Integrated Circuits, Printed Circuit Board. **£29.20.**

L2 More advanced full logic decoder with "variable blend", extended frequency response, increased front-back separation. 43 Resistors, 44 Capacitors, 3 Integrated Circuits, 9 Transistors, 6 Diodes, Printed Circuit Board. **£29.20.**

All kits include IC sockets and construction notes. Prices include CBS licence fee.

Please write for further details in FREE LIST.

United Kingdom: Post Free. Please add 8% VAT. Overseas: No VAT. Please add (per kit) £1.50 p & p AIR MAIL or 80p p & p SURFACE MAIL.

AMBIENTACOUSTICS

PO BOX 3000
ANDOVER, HANTS SP10 3EQ

WW—079 FOR FURTHER DETAILS

TELEVISION CAMERA KITS

Complete kits are available for both "Mullard" and "P.E." design. Each kit includes a comprehensive construction manual, and a completely FREE technical back-up service to ensure your success. VHF and UHF Modulator Kits also available to allow standard domestic T.V. to be used as monitor.

All parts available separately, including a wide range of lenses, vidicon tubes, special mains transformers and focus/scan coils. Also available P.W. tele-tennis game.

Send 5" x 7" S.A.E. for full details or come along for a demonstration and a chat with our technical staff.

CROFTON ELECTRONICS

124 Colne Road, Twickenham, Middlesex TW2 6QS.
Tel. 01-898 1569. Telex 934642 Cadanac LDN.

WW—105 FOR FURTHER DETAILS

Principles and Calculations for Radio Mechanics Part 1

R. A. Bravery and A. P. Gilbert

Part of the Radio, Television and Electronics Servicing Series, this volume deals with the subject matter for Part 1 of the City and Guilds Radio Mechanics Course 222.

1974 152pp., illustrated 0 408 00119 4 £1.50

Obtainable through any bookseller or from
NEWNES-BUTTERWORTH
Borough Green, Sevenoaks,
Kent TN15 8PH. Tel. Borough Green 2247.



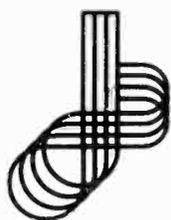


**“SOUNDS CLEAR”
WITH JACKSON**

As the AM/FM wavebands grow more crowded all radio receivers will require finer tuning. Our new P503 variable capacitor incorporates integral gearing with a 3:1 reduction, three FM sections, all separately shielded from each other, plus two AM sections which can be fitted with trimmers if required. Yet it's no larger than the successful two gang P22. Our skilled personnel can produce custom made components to suit your individual needs. And with 45 years of experience your guarantee is our reliability.



TYPE P503 AM/FM CAPACITOR CATALOGUE NO. 4229.



Write for further information to:—
**JACKSON BROTHERS
(LONDON) LIMITED**

Kingsway, Waddon, Croydon CR9 4DG.
Tel: 01-681 2754/7 Telex: 946849
U.S. Office: M. Swedgal, 258 Broadway,
New York, N.Y. 10007.

BS 9000 Approved.

WW—178 FOR FURTHER DETAILS

**Eliminate
TV receiver
distortion with
Celestion *TELEFI***



TELEFI

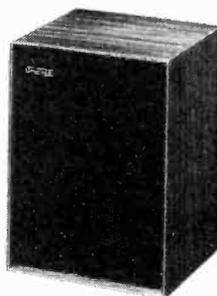
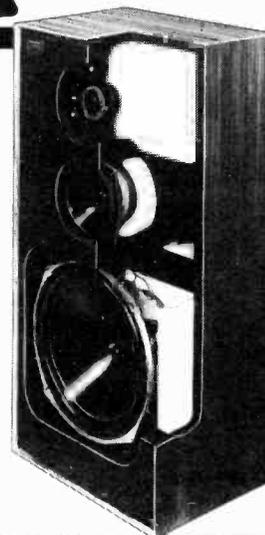
At last you can enjoy TV entertainment with the added pleasure of true Hi-Fi sound. Telefi is a unique electronic invention which picks up VHF from the TV and relays this through your own Hi-Fi equipment. Telefi ensures crisp, full-range, distortion-free reproduction of music and speech providing an improvement over ordinary TV sound which will amaze you. Telefi is safe and requires no permanent connection to the TV set. Telefi is indispensable to the TV viewer who requires Hi-Fi TV sound.

"As selected for The Design Centre, London"

LOUDSPEAKERS

Celestion Loudspeakers are engineered to the highest standard and provide superlative sound reproduction. The cut-away illustration shows the high, mid and bass speakers used in the Ditton 44 Monitor, one of the most popular loudspeakers available to the discerning listener.

A range of models is available to suit your personal requirements, Celestion Hi-Fi Loudspeakers carry a five-year guarantee.



The Hadleigh loudspeaker, was specially created to meet a public demand for a high quality speaker of compact proportions. Not a difficult task for Celestion who produce the most popular bookshelf speaker ever (Ditton 15) – but we set out not only to produce an immaculate loudspeaker with a sparkling performance, but to do so at a budget price. For the enthusiast seeking a really excellent Hi-Fi system at reasonable outlay we recommend without hesitation the Hadleigh.

Celestion



**Loudspeakers for the Perfectionist
DITTON WORKS, FOXHALL ROAD, IPSWICH, SUFFOLK IP3 8JP.**

WW—059 FOR FURTHER DETAILS

wireless world

Electronics, Television, Radio, Audio

APRIL 1975 Vol 81 No 1472

Contents

- 151 Outlook for cable television
- 152 Using ferrite pot-cores by *D. E. O'N. Waddington*
- 155 Sixty years ago
- 155 April meetings
- 156 Artificial vision progresses by *T. E. Ivall*
- 158 Announcements
- 159 News of the month
 - TV standards converter
 - IEE on engineering profession
 - First production c.c.d.
- 161 75 years of magnetic recording—2 by *Basil Lane*
- 165 Letters to the editor
- 169 Noise—confusion in more ways than one—2 by *K. L. Smith*
- 173 HF predictions
- 173 Wireless World noise reducer announcement
- 174 Space news
- 175 Circuit ideas
 - Deflection amplifier for 'scopes
 - Low battery voltage indicator
 - Sinewave oscillator uses c.d.a.
- 177 An aerial rotator servo by *D. J. Telfer*
- 182 Loudspeaker developments
- 183 Circards 21: voltage to frequency converters by *J. Carruthers, J. H. Evans, J. Kinsler and P. Williams*
- 185 Vision cassette recorders
- 190 Literature received
- 191 Transistor-aided ignition by *G. F. Nudd*
- 192 Project: National Electronics Council Link scheme
- 193 World of amateur radio
- 194 New products
- 198 Real and imaginary by "*Vector*"
- a80 APPOINTMENTS VACANT
- a104 INDEX TO ADVERTISERS

Price 30p (Back numbers 50p)

Editorial & Advertising offices: Dorset House, Stamford Street, London SE1 9LU.

Telephones: Editorial 01-261 8620; Advertising 01-261 8339.

Telegrams/Telex, Wiworld Bisnespres 25137 London. Cables, "Ethaworld, London SE1."

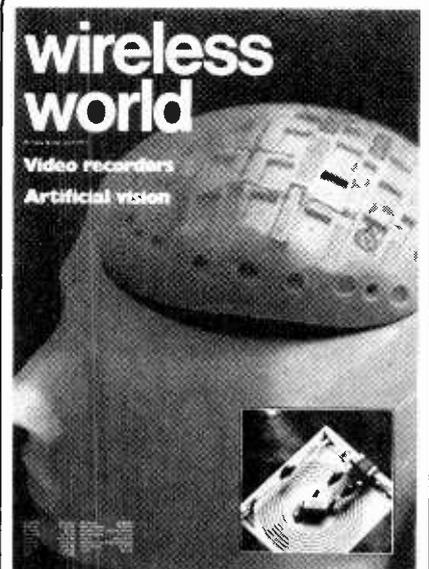
Subscription rates: 1 year, £6 UK and overseas (\$15.60 USA and Canada); 3 years, £15.30 UK and overseas (\$39.80 USA and Canada). Student rates: 1 year, £3 UK and overseas (\$7.80 USA and Canada); 3 years, £7.70 UK and overseas (\$20.00 USA and Canada).

Distribution: 40 Bowling Green Lane, London EC1R 0NE. Telephone 01-837 3636.

Subscriptions: Oakfield House, Perymount Rd, Haywards Heath, Sussex RH16 3DH. Telephone 0444 53281.

Subscribers are requested to notify a change of address four weeks in advance and to return envelope bearing previous address.

© I.P.C. Business Press Ltd, 1975



This month's cover picture, showing part of an uncompleted implant for the human head and a thick film implant receiver, made by Eric Sayer, introduces the article on artificial vision on p.156 of this issue. (Photographer Paul Brierley)

IN OUR NEXT ISSUE

Wireless World noise reducer

Constructional project based on the Dolby principle for which we are supplying a kit of parts (see page 173)

Build an oscilloscope

Professional standard design for home construction with 50MHz Y-amplifier bandwidth and extensive facilities

Display devices survey

Review of techniques used in alpha-numeric display devices and characteristics of types now on the market

SIXTY-FIFTH YEAR
OF PUBLICATION

ibpa
International Business
Press Associates

Telequipment's new dual trace 10 MHz battery operated oscilloscope

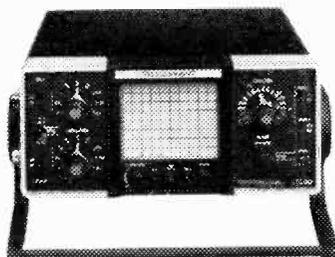


...and that's about the size of it

4 x 9 x 11 inches! Weight, less than 10lb!
Price, only £275*.

Small in all but specification, Telequipment pack into the tiny frame of the D32 features normally associated with instruments twice its size.

Easily carried on any assignment the D32 is probably the smallest and least expensive scope of its kind in the world.



*Exclusive of VAT

Priced at £275* (including re-chargeable batteries) this dual trace scope offers 10MHz bandwidth at 10mV/div sensitivity; automatic selection of chopped or alternate modes; automatic selection of TV line or frame displays; and the choice of battery or mains operation.

Size up the D32 for yourself and write or phone for a demonstration of this truly remarkable instrument now.

Telequipment gives you more scope for your budget

TELEQUIPMENT



**Tektronix U.K. Ltd.,
Beaverton House, P.O. Box 69, Harpenden, Herts.
Telephone: Harpenden 63141 Telex: 25559**

TQ4

WW—188 FOR FURTHER DETAILS

wireless world

Outlook for cable television

Editor:

TOM IVALL, M.I.E.R.E.

Deputy Editor:

PHILIP DARRINGTON
Phone 01-261 8429

Technical Editor:

GEOFFREY SHORTER, B.Sc.
Phone 01-261 8443

Assistant Editors:

BILL ANDERTON, B.Sc.
Phone 01-261 8620

BASIL LANE
Phone 01-261 8043

MIKE SAGIN
Phone 01-261 8429

Drawing Office:

LEONARD H. DARRAH

Production:

D. R. BRAY

Advertisements:

G. BENTON ROWELL (*Manager*)

A. PETERS (*Classified Advertisements*)
Phone 01-261 8508 or 01-928 4597

JOHN GIBBON (*Make-up and copy*)
Phone 01-261 8353

I.P.C. Electrical-Electronic Press Ltd

Managing Director: George Fowkes

Administration Director: George H. Mansell

Publisher: Gordon Henderson

It's a pity that the cable television companies' experiments with local origination of programmes, at Bristol, Greenwich, Sheffield, Swindon and Wellingborough, have not proved very successful. Greenwich is virtually closed down (except for three hours at weekends when the station is run by outside volunteers), other stations are facing criticism about uninteresting programmes and some are doubtful whether they will be able to carry on after 1976. This may prove that the companies are not very good at producing programmes, that the type of material they are providing is not wanted or that they have insufficient finance from their private sources to produce the programmes they would like. It would be a pity, though, if this experience threw doubt on the whole principle of originating programmes locally and distributing them on cable, for this is what the cable television companies are well fitted technically to do, especially if in the future a large number of programmes and/or interactive information services is required.

Whereas in broadcasting the number of programmes that can be transmitted is limited by the amount of electromagnetic spectrum available, there is theoretically no limit, from an engineering point of view, to the number of programmes/information services that can be distributed by cable. In practice, judging from recent developments such as the "dial-a-programme" system and experimental work on using bundles of optical fibres for local distribution, it should be possible to bring 30-40 interactive channels into a household. The fact that programme material is originated locally does not mean that it has to be about local affairs, in the manner of a local newspaper. By analogy with the education service it can be material of general or national interest but with a "mix" adjusted to local circumstances and demand.

But now into this scene steps the Post Office with a claim that it should take over the whole of cable television. In its evidence to the Annan Committee on the future of broadcasting it says "The transmission of information is Post Office business . . ." and "If and when there is an increase in television broadcasting, leading to a wide-scale requirement for cable-TV networks, the Post Office is, we believe, the organization to provide such networks on a national basis to meet the demands both for enhanced television and for the broadening range of telecommunication services—voice, vision and data—that we foresee".

Of course the Post Office is the right organization to handle the large-scale transmission of information—probably by integrated digital systems in the future—on trunk routes between cities. And this rightly includes the long distance transmission of television signals. But this doesn't mean that the Post Office is necessarily the best organization to handle local distribution. It certainly has extensive plans but lacks the experience of the cable television companies (at present it provides networks in six new towns) and as a public corporation it does not have the spur of competition that gives a keen assessment of the market and often leads to valuable technical developments.

The cable companies have made a considerable investment in their networks. This is not to say they should necessarily be guaranteed a good return—after all it was a risk they took. But this is also a national investment and as such should be taken into account in any plans for the future.

Using ferrite pot-cores

Basic inductor design for the development engineer

by D. E. O'N. Waddington, M.I.E.R.E.

When, as a schoolboy, I became interested in radio, I blamed all my failures to persuade crystal sets to work on the coils. As I lived about 50 miles from the nearest transmitter which radiated a meagre 2kW, I now feel that this was a bit unjust to the coils. Nevertheless, coil design remained a bogey for many years. One of the main reasons was that so many variables are involved that the design is always complicated. To design a single layer coil with a specified inductance value, one has to assume diameter, winding length, wire diameter and winding pitch before starting on the calculation of the number of turns. The odds are that the first try will produce a ridiculous answer and it will probably be necessary to try several times before a practical result is achieved. Even at the end of all this, there will be a nagging doubt as to whether the result is correct or not! Multi-layer coils are even worse, if possible, as the dimensions predicted by theory are seldom realizable in practice. In fact the only method appears to be to take an "educated" guess at the coil design and to check by calculation. Thus it was with a great sense of relief that I learned to use ferrite pot cores. At last here was an inductor which could be designed.(most of the time!).

I will start with a short description of the core material and manufacture. It is well known that placing a magnetic core inside a coil increases its self-inductance. However, the alternating magnetic field causes eddy currents to flow within the core absorbing energy from it and reducing the effective Q of the coil. This loss occurs mainly because of the low resistivity of the core material. It also increases with frequency. In transformers it is usual to reduce this loss by laminating the core material and insulating each lamination from its neighbour. The thinner the laminations, the lower the eddy current loss, and the higher the frequency to which the core may be operated. However, a practical limit is reached very quickly so that this technique, while giving a substantial improvement, does not provide the answer for radio-frequency coils.

One method of overcoming the limitations of laminations is to use a powdered iron dust core in which finely divided

particles of iron, or other ferro-magnetic material, are suspended in an insulating medium and moulded into a core. This effectively insulates the particles from each other and reduces eddy current flow but, at the same time it reduces the effective permeability of the core to ten or less. Nevertheless, these iron dust cores are very useful at radio frequencies as not only do they increase the effective inductance of coils, but, when used in cup form, they tend to confine the magnetic fields within the coil, providing a measure of screening. For high frequency work iron dust cores are superior to ferrites both in performance and cost. The design methods which I will be describing can also be applied to iron dust cores.

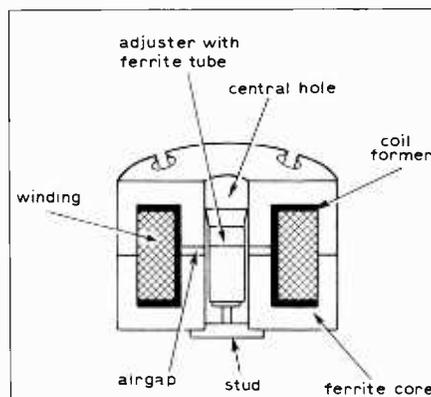


Fig. 1. Cross section of a typical pot core.

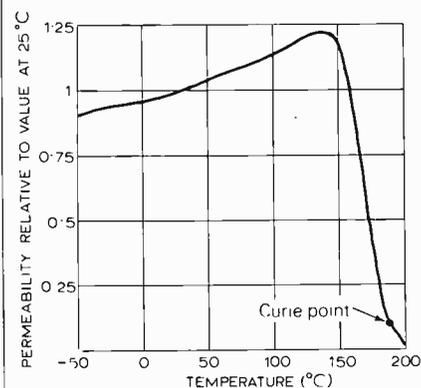


Fig. 2. Variation of permeability with temperature for a low-frequency ferrite material.

Unlike iron dust cores, ferrite cores are primarily made of non-conducting materials, which belong to the family of ferrites. The ferrites are non-metallic refractory materials composed of the oxides of iron and other metals, usually cobalt, copper, manganese, magnesium, nickel or zinc. The most important ferrites for pot cores are manganese zinc and nickel zinc-ferrite¹. In manufacture the correct proportions of the relevant oxides are milled together so that they are thoroughly mixed. They are then moulded into the desired shape in a press and fired at a temperature in the range from 1000°C to 1300°C. During this process chemical reactions occur and when the resultant cores are cooled to room temperature, they are hard and brittle. This firing or sintering process is a very critical one as the properties of the finished core depend largely upon the precise firing temperature and the time for which it is "cooked". The cores shrink appreciably (between 20 and 25%) during the firing process and, as the ferrite is very hard to machine, it is also essential that the density of the moulded core must be correct before firing as subsequent adjustment would be very costly. The cores used for inductors are said to be "soft". In this context soft means that the core does not remain magnetized to any appreciable extent after a magnetizing field has been applied. This is analogous to "soft" iron cores recommended in text books for electric bells, etcetera.

For use in inductors, the cores are usually made in the form of cups as shown in Fig. 1. The mating surfaces are ground smooth and polished so that the air gap is reduced to a minimum. The effective permeability of the basic core material will be of the order of 2000 for low frequency ferrites, reducing to 100 for high frequencies. This basic permeability is very sensitive to temperature variations, the degree of sensitivity depending upon the composition of the ferrite. Normally the permeability increases fairly steadily with temperature until it suddenly falls off very rapidly to the Curie point (see Fig. 2). Curie point is generally defined as the temperature at which the permeability has fallen to 10% of its maximum value and lies in the range from 150 to 200°C for

most ferrites although some ferrites have Curie points as high as 500°C. For inductors, the cores are usually modified by grinding the centre spigot so that there is an air gap in the magnetic path. The working permeability of the finished core depends upon the length of this gap which also confers two very desirable properties. Firstly, the temperature coefficient is greatly reduced and now depends to a greater degree upon the physical dimensions of the core. Thus it is possible to specify the temperature coefficients of various cores with fair accuracy. Secondly, by adjusting the position of a ferrite slug so that it "bridges" the air gap, it is possible to adjust the working permeability of the core and hence the inductance of a coil wound on it. As would be expected, cores with small gaps (high permeability) have less adjustment range than those with large gaps although neither has a very large range (5% to 25%). In early cores, the adjuster was not a built-in feature and it was necessary for the user to grind the core himself to adjust the inductance. This was done by rubbing the core on fine emery paper taking great care to keep the surfaces flat. I mention this method as it still has its uses when an inductor is just out of the adjuster range. However I would not recommend its use as cores are easily cracked by the overheating which can be produced by too vigorous rubbing. For repeatable and stable performance, it is essential that the two halves of the core are adequately clamped together. Most manufacturers supply excellent clamping systems although gluing, with Araldite for example, is a very effective assembly method. Cores are usually made in matched pairs so it is best to keep them in pairs. Sorting is both tedious and frustrating.

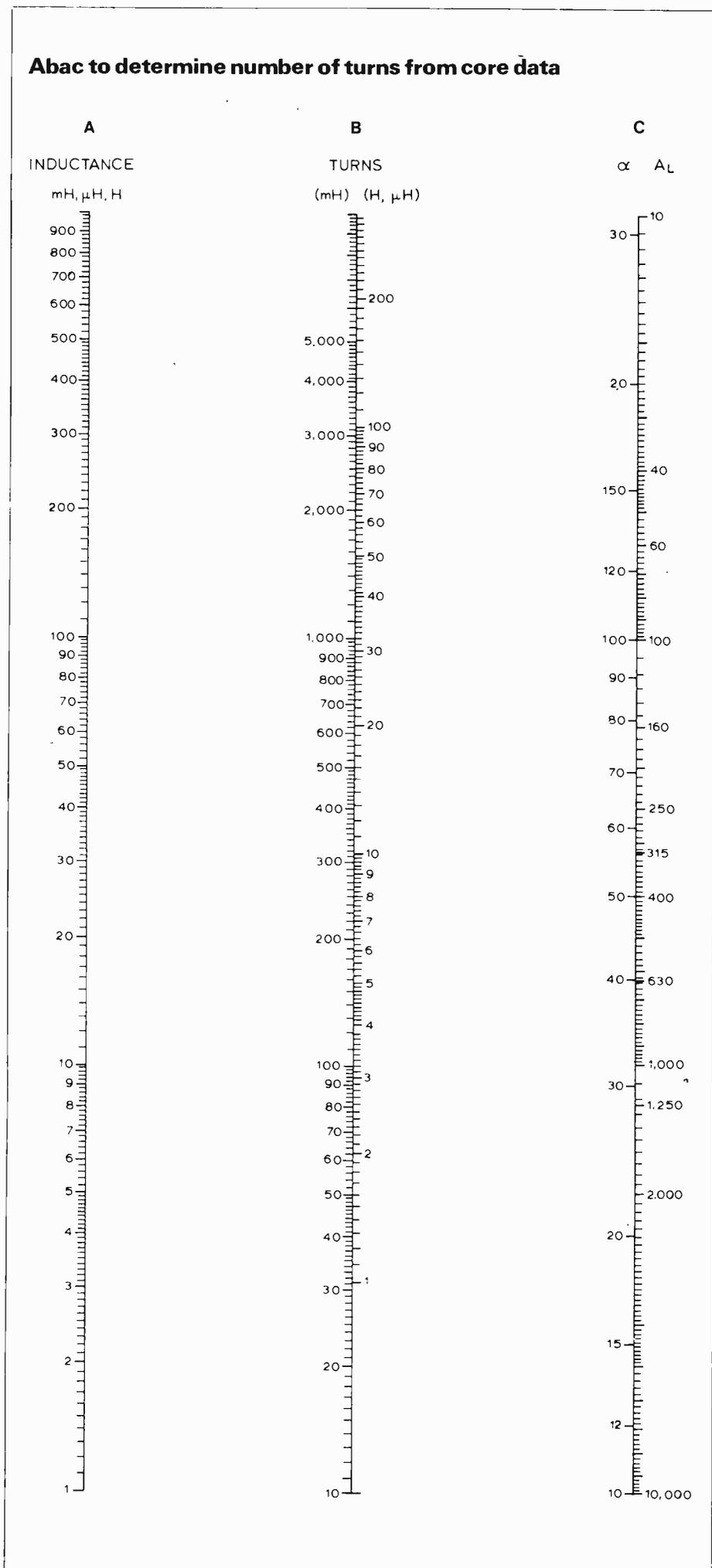
Core losses

The losses which occur in ferrite cores are of three main types; hysteresis, eddy-current and residual.

Hysteresis loss. This is usually very small compared with the other losses and, at low drive levels, it may be ignored. At high signal levels, however, it can contribute an undesirable effect in the form of non-linear distortion, mainly third order. The degree of distortion depends upon the flux density and can be predicted by calculation¹. Normally this effect is of little significance but, in some audio applications, it may become important. The cure is

Fig. 3. To work out the number of turns required to give a specified inductance value, lay a ruler across the abac connecting the required inductance (on scale A) with the A_L or α (on scale C) of the core used. The number of turns is read from scale B.

Note. For micro-henries use the right-hand calibration of scales A and B. For millihenries use the left-hand calibration of scales A and B. For henries use the same scales as for micro-henries but multiply the number of turns by 1000.



either to run the core at a lower level or to use a larger core (which amounts to the same thing!).

Eddy-current loss. This depends mainly on the resistivity of the core material. Thus, in most ferrites this loss is small so that it is normally lumped in with the residual losses. There are exceptions where the eddy-current losses "resonate" with the dimensions of the core at high frequencies². The discussion of them, however, is beyond the scope of this article.

Residual losses. These depend upon the composition of the ferrite and will vary with the different grades. These losses are frequency dependent, usually increasing relatively slowly up to a "critical" frequency after which they increase drastically. Thus the grade of ferrite determines the high frequency operating limit.

Coil losses

These are far more severe than in air-cored coils because, in addition to skin effect, there are eddy-current losses in the conductors caused by proximity effects. This means that the *Q* of the inductor will also depend upon the type of wire used as well as the core losses. In general, solid conductors give a maximum *Q* at a very much lower frequency than that for maximum *Q* with stranded wire and the *Q* will also be lower. One manufacturer quotes the following:—

- Solid wire $Q_{max} = 200$ at 20kHz (10–100mH)
- Stranded .06mm $Q_{max} = 600$ at 150kHz (.2–1mH)
- Stranded .04mm $Q_{max} = 700$ at 200kHz (.2–1mH)

This information is usually included in the manufacturers' data books in the form of typical ISO-*Q* curves although it is sometimes in tabular form. The word "typical" seems to have the meaning ascribed to it by a cynical engineer; namely "It has actually been achieved once!" In all fairness, however, the quoted *Q* can be attained under ideal conditions with all details fully under control. However, even if the final *Q* is less than that predicted, it should be far higher than could have been obtained using an air-cored coil and, of course, the dimensions of the coil will be considerably smaller.

Inductor design

The calculation of the number of turns necessary to achieve a particular inductance value is very easy as manufacturers quote either *A_L* (induction factor) or *α* (turns factor). These can be defined as follows:—

A_L (induction factor)—The self-inductance, in nano-henries, that a coil wound on the core should have if it consisted of a single turn.

$$A_L = \frac{L}{N^2} \text{ or } N = \sqrt{\frac{L}{A_L}}$$

L is in nano-henries
N is the number of turns.

The term *α* (sometimes *C* or *K*) is the turns factor or the number of turns required for a coil wound on the core to give an inductance of 1 milli-henry.

$$\alpha = \frac{N}{\sqrt{L}} \text{ or } N = \alpha \sqrt{L}$$

L is in milli-henries
N is the number of turns

e.g., required—a 9mH inductor. The core selected has an *A_L* of 400 or *α* of 50. $N = \sqrt{9 \times 10^6 / 400} = 3 \times 10^3 / 20 = 150$ turns or $N = 50 \times \sqrt{9} = 50 \times 3 = 150$ turns. The abac shown in Fig. 3 provides a simple alternative method of determining the number of turns. Lay a ruler across the abac connecting the *A_L* or *α* on the right-hand scale with the required inductance value on the left-hand scale and read the number of turns from the centre scale.

Normally the winding factors given in the manufacturer's data will refer to a coil wound so that it fills a predetermined percentage of the winding space and it may be necessary to adjust the number of turns slightly depending upon whether the bobbin is fuller or emptier. Fig. 3 shows the sort of variations which can be expected with a typical core. In general it will be seen that, with high permeability (i.e., "small gap"), the degree of "fullness" of the bobbin has very little effect upon the turns factor. On the other hand, lower permeability cores (i.e., "large gap"), are more affected by the "fullness". This effect is caused by fringing of the magnetic field in the gap. It is good practice however to choose a wire gauge which fills the winding space as completely as possible. This gives the lowest d.c. resistance together with the highest *Q* value. Most core manufacturers give tables or charts showing the numbers of turns which will fill the various bobbins. Now that there has been a degree of standardization of core sizes (British Standard B.S.4061 range 2 and International I.E.C. Pub.133) it has been possible to prepare some winding charts which have fairly universal application. Fig. 5(a) shows winding data for the round cores and Fig.5(b) gives data for r.m. (rectangular module) cores. The numbers of turns which should fit the cores are nominal so that it is generally safer to use a slightly thinner gauge than suggested by the chart.

I feel that a word of warning is necessary here. As George Orwell says, "All animals are equal but some are more equal than others." This comment could well be applied to ferrite pot cores. So far the standardization only goes as far as specifying the dimensions of the cores and formers and *A_L*. Nothing is said of clamping systems, termination methods or adjusters so far as I know. At least, if it is specified, it is frequently ignored. In general British manufacturers produce reasonably compatible systems but the same cannot be said for all the imported products. This means that it is necessary to study alternative core types very carefully before accepting them as equivalents.

Earlier in this article I referred to the temperature coefficient of the permeability. Obviously this will affect the stability of the finished inductor. In practice there are one or two more points to be watched if the best stability is to be obtained. Movement of the coil in the core will change the

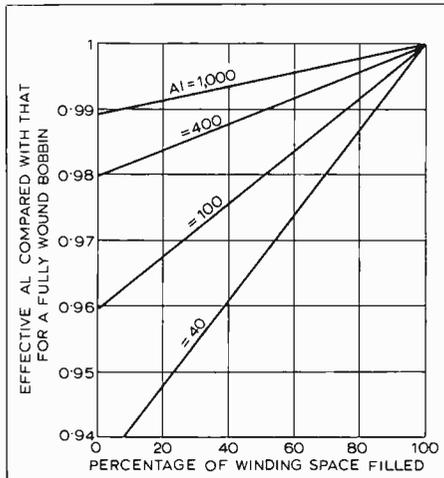


Fig. 4. This family of curves shows how the induction factor varies with the "fullness" of the available winding space for an 18mm pot core. Other core sizes will exhibit similar variations.

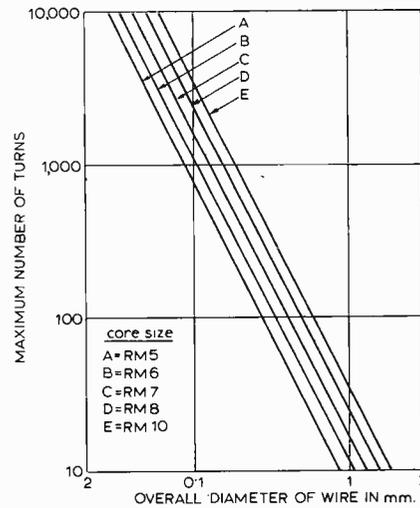


Fig. 5(a). These curves apply to round cores conforming to B.S.4061 range 2 or I.E.C. Pub.133.

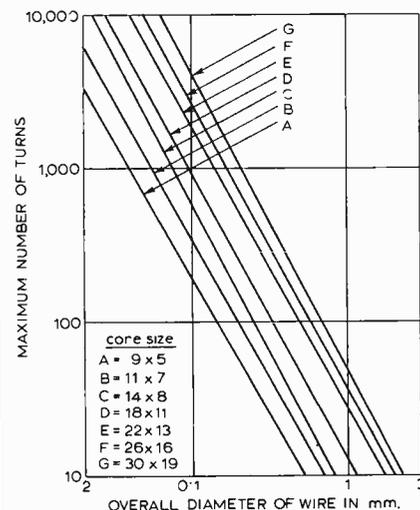


Fig. 5(b). These curves apply to R.M. (rectangular module) cores.

inductance slightly so the coil should be locked in position. Similarly movement of the individual turns of the coil can also introduce instability. This makes it desirable to impregnate the coil. Actually, if moisture penetrates the coil it can degrade the Q so there is a second reason for impregnation.

If the impregnation is carried out with the coil fitted to the core care must be taken that the adjuster system is kept clear. While moisture does not affect the permeability of the basic core to any measurable extent, it can affect the adjuster system so that it is wise to check this point. Personally I have found that the adjusters which consist of a ferrite tube fitted on a plastic sleeve with a hole up their centres to screw onto a brass screw are the best. A further point to watch is a phenomenon known as "disaccommodation". This is a temporary change in permeability which occurs if the core is subjected to a thermal or mechanical shock. However, provided that final adjustment of the inductance is not carried out until 24 hours after the shock, this effect should not prove troublesome.

In conclusion I would like to thank Mullard Ltd for permission to reproduce illustrations of their cores and graphs.

References

1. Snelling, E. C. "Soft ferrites, properties and applications". Butterworths, London 1969.
2. Mullard Ferroxcube. Mullard Components Division, May 1955.

Sixty Years Ago

In 1915, spy scares were getting well into their stride and the still-new invention of "wireless" was fuel to the fire. Suitcase transmitters were still in the future, however, and it seems that people's imaginations tended to become a little over-heated. A note in our April 1915 issue commented: "Mr Charles R. Gibson has been contributing long articles recently to the *Glasgow Herald* on the present use of wireless by the belligerents, and in the course of one of them tells an amusing story which, according to the writer, was repeated to him with portentous seriousness as an incident of the greatest gravity which had recently come under the narrator's personal observation:

"Two German workmen had been arrested as spies, and there had been discovered, hidden beneath the hearthstone of the kitchen in their two-roomed tenement house, a complete wireless installation capable of transmitting messages to Berlin."

Mr Gibson comments that it is possible to send wireless messages as far as from here to Berlin, but not with apparatus that can be stowed away beneath a kitchen hearthstone, or even contained in a large room."

Meetings

LONDON

7th. IEE—"Mechanical shock protection in the design of electrical equipment" by L. A. Ward at 17.30 at Savoy Pl., WC2.

8th. IEE—Discussion on "Microprocessors versus programmable logic arrays" at 17.30 at Savoy Pl., WC2.

9th. IERE—Colloquium on "Radar and associated systems for vehicle guidance" at 14.00 at 9 Bedford Sq., WC1.

9th. IEE—Discussion on "Is there a future for pointer instruments?" opened by G. D. H. Keen, Dr R. B. D. Knight and A. H. Silcocks at 17.30 at Savoy Pl., WC2.

10th. IERE/IEE—Colloquium on "Computers in transport" at 10.00 at 9 Bedford Sq., WC1.

10th. IEE—"The work of the House of Commons Select Committee on Science and Technology" by Airey Neave followed by discussion at 17.30 at Savoy Pl., WC2.

10th. RST—The Fleming Memorial lecture "Television: parliament and the people" at 19.00 at the Royal Institution, Albemarle St., W1.

11th. IEE—Colloquium on "Spectrum allocation management and engineering in radio communication" at 10.00 at Savoy Pl., WC2.

11th. IEE—Colloquium on "Innovatory ideas in energy generation and conversion" at 10.30 at Savoy Pl., WC2.

14th. IEE—Colloquium on "Electronic counter measures—components and systems" at 10.30 at Savoy Pl., WC2.

15th. IEE—"Replaceable control systems" by B. Welch at 17.30 at Savoy Pl., WC2.

15th. AES—"Speech perception and speech synthesis" by D. B. Fry at 19.15 at the IEE, Savoy Pl., WC2.

16th. IEE—Colloquium on "Hardware and software aspects of parallel processors" at 11.00 at Savoy Pl., WC2.

16th. BKSTS—"Portable power systems for cinematography" by V. F. Saunders, R. W. Scarr and F. R. Cloke at 19.30 at Thames Television Theatre, 308-316 Euston Rd., NW1.

17th. IEE—Colloquium on "Techniques for designing for reliability" at 10.30 at Savoy Pl., WC2.

17th. IEE—"Engineering management and the professional unions" by A. Grosschalk at 17.30 at Savoy Pl., WC2.

18th. IEE—Colloquium on "Alpha numeric display devices" at 14.30 at Savoy Pl., WC2.

23rd. IERE—Colloquium on "Recent developments in turntable design" at 10.00 at 9 Bedford Sq., WC1.

23rd. BKSTS—"The factors affecting the image quality of 16mm film for television" by Arthur Branson at 19.30 at Thames Television Theatre, 308-316 Euston Rd., NW1.

24th. RTS—A.G.M. followed by "Television special effects using electronics and photography" by A. B. Palmer at 18.30 at London Weekend Television South Bank TV Centre, Upper Ground, SE1.

25th. IEE—Colloquium on "Digital microwave relay systems above 10GHz" at 14.30 at Savoy Pl., WC2.

28th. IEE—Colloquium on "Message switching" at 10.30 at Savoy Pl., WC2.

30th. IERE—Colloquium on "Trends in testing telecommunications materials" at 10.00 at 9 Bedford Sq., WC1.

30th. IEE—"Artificial vision" by P. E. K. Donaldson at 17.30 at Savoy Pl., WC2.

BIRMINGHAM

9th. IEETE—EASCON 75 on "The Partnership? training—education" at 10.30 at the City of Birmingham Polytechnic.

EDINBURGH

28th. IEETE—"Electronics versus the criminal" by J. S. T. Charters at 19.00 at Carlton Hotel, North Bridge.

GLASGOW

29th. IEETE—"Electronics versus the criminal" at 19.00 at Royal Stuart Hotel, Jamaica St.

GRAVESEND

3rd. IERE—A.G.M. followed by "The application of digital computers to radar and navigation at sea" by Bruce Williams at 19.00 at the Tollgate Motel, Watling Street.

LIVERPOOL

8th. IEETE—"Automatic flying controls" by D. I. Jackson at 19.30 at MANWEB Social Club, Thingwall Road.

MANCHESTER

10th. IEETE—"Intruder alarms" by E. Tanham at 19.30 at UMIST, Reynold Building, Sackville St.

READING

8th. IERE—"Project management" by Dr. I. Maddock at 19.45 at the J. J. Thomson Physical Laboratory, University of Reading, Whiteknights Park.

SWINDON

29th. IEETE—"Technician engineers and technicians—their role, status and qualifications" (speaker from IEETE secretariat) at 19.30 at The College, Regent Circus.

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

Literature Received

ACTIVE DEVICES

We have received a 24-page catalogue giving specification of the Siemens range of charge storage varactors, varactor diodes for frequency conversion, tuning varactor, PIN, Schottky, tunnel, backward, IMPATT diodes and Gunn elements. Siemens Ltd, Great West House, Great West Road, Brentford, Middx TW8 9DG WW401

Also available from Siemens is an applications booklet on the subject of surge voltage protection WW402

A price list and complete set of data sheets describing the Monolithic Memories Inc. range of semiconductor memories is available from Memory Devices Ltd, Central Avenue, East Molesey, Surrey KT8 0SN WW403

Books on c.m.o.s. logic devices and applications by Motorola are available from Jermyn. The CMOS Handbook (applications) is available free with each order for the CMOS Data Book, which is priced at £2.50. CMOS is the Motorola name for c.m.o.s. Jermyn Distribution, Sevenoaks, Kent.

The seven-volume set of RCA Data Books for 1975 is now available. The complete range of RCA semiconductors is described, including diodes, transistors, integrated circuits of all kinds, thyristors and microwave devices. Each volume costs £1.80, the price for the complete set being £8. RCA Ltd, Solid-State-Europe, Sunbury-on-Thames, Middx.

We have received from OVUM a bibliography of charge-coupled devices, containing abstracts on general information, theory, technology, bucket brigades and several other subjects. The book is well-indexed and is entitled "International abstracts on charge-coupled devices 1970-74". It is available from Ovum Ltd, 22 Grays Inn Road, London WC1 at £30.

Many applications of a variety of semiconductor devices are described in a new book by Siemens. Both discrete semiconductors and integrated circuits, both digital and analogue, are dealt with in applications from industrial control to audio. The book is available free of charge from Marketing Services Department, Siemens Ltd, Great West House, Great West Road, Brentford, Middx. WW404

Artificial vision progresses

Improved design of microelectronic implant giving more stimulation points on the brain and greater reliability

by T. E. Ivall

Editor, *Wireless World*

Work by the Medical Research Council's Neurological Prostheses Unit in providing some degree of vision for blind people by means of microelectronic implants in the head was described in our May, 1971 issue*. Two implants have been made and fitted, one in a female patient in 1968 and one in a male patient in 1972, and both have given encouraging results. Since 1972 research and development led by P. E. K. Donaldson has been continued with the object of improving the design of the implant, notably to increase the number of electrical stimulation points on the visual cortex of the brain and to make the implanted electronic devices neater and more reliable.

The principle of the MRC's visual prosthesis is directly to stimulate a large number of points on the visual cortex of the brain of a person who has become blind, for example, through damage to the optic nerve^{1, 2, 3}. As a result the patient "sees" spots of light, called phosphenes, which are fixed in the visual field. By suitably organizing the electrical stimula-

tion these phosphenes can be arranged into meaningful patterns for the patient, such as letters of the alphabet or Braille characters. The stimulation is applied by 500 μ s pulses of current fed to electrodes mounted in two flexible silicone rubber cups which fit round the two occipital lobes of the brain. The stimulating pulses come from microelectronic inductive-loop receivers and logic units which are implanted, as packages in a silicone rubber "cap", between the skull and the scalp (Fig. 1). No implanted battery is needed as all the required power comes from the external bank of inductive-loop transmitters (mounted in a hat-shaped shell similar to a hair-drying hood) which activate the implanted receivers.

The d.c. outputs of the implanted receivers are electrically arranged to form a matrix of rows and columns, so that when a particular "row receiver" and a particular "column receiver" are energized simultaneously by their transmitters their d.c. outputs activate a particular AND gate (at the "intersection" of that row and that column). The d.c. output of the AND gate then provides the stimulating pulse for a particular electrode on the visual cortex.

Thus if there are x row receivers and y column receivers in the implant it is possible to identify xy unique pairs of receivers and therefore to have xy stimulating electrodes. The external transmitters are arranged in a corresponding matrix of rows and columns. Row-transmitters generate 500 μ s pulses of r.f. at 10MHz while alternate column-transmitters give 500 μ s pulses at 8MHz and 6MHz (this arrangement of different frequencies for adjacent column-transmitters being a means of avoiding cross-talk).

In the implant described in our May, 1971 issue there were nine row receivers and 20 column receivers, giving 180 stimulation points. It was designed for a 64-year-old male patient who had been blind for 30 years with retinitis pigmentosa. When a dummy of the device was handed over to the neurosurgeon who was to perform the implantation operation he said it was too big and he would have difficulty in closing the scalp over it. Would the engineers please think again? It was therefore decided to reduce the number of row receivers from nine to five and the number of column receivers from 20 to 15. In addition it was decided to eliminate the 1.0 μ F tantalum capacitors in series with all but three of the AND gate outputs (see May, 1971 issue, p.216). Capacitance is needed in these outputs to keep the mean stimulating current zero and so avoid electrolysis at the electrodes and consequent tissue damage, but it is possible to rely on the capacitance-like properties of the electrode-tissue interface. (More about this later.)

A dummy 5 \times 15 device was accepted as satisfactory by the surgeon in July, 1971 and the actual 5 \times 15 implant, giving 75 stimulation points instead of the 180 originally intended, was implanted into the patient on February 4, 1972. As a result of testing⁴ it was found that the

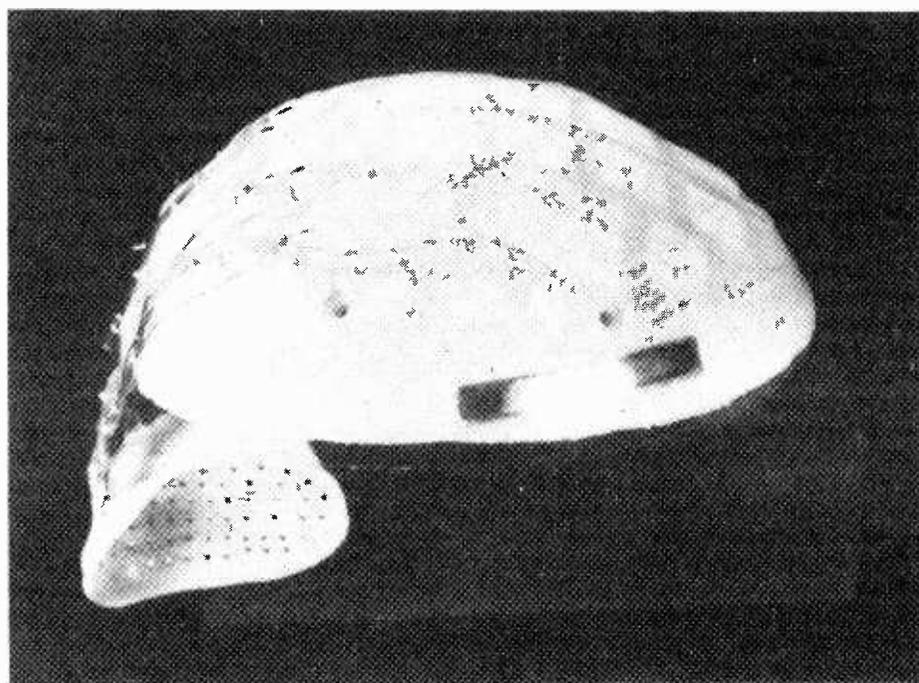


Fig. 1. Completed second implant, showing the stimulating electrode assembly at the end of its cable (bottom left), before surgical implantation in the head of a 64-year-old male patient. See also front cover.

*Artificial vision, *Wireless World*, May, 1971, pp. 214-217

patient could in fact "see" 55 phosphenes of the theoretically possible 75. These, however, were disappointing for pattern organization purposes because the phosphenes were larger than those experienced by the first patient and when pairs were elicited simultaneously they tended to fuse together into a single, bigger phosphene. Finally six good phosphenes—bright and clearly defined—were chosen lying in two vertical columns of three, the format for Braille characters, and the subsequent tests on this patient were mainly confined to the reading of Braille text fed to the transmitters character by character by a punched tape apparatus.

Experience gained from this second implant clearly showed that it was desirable to provide many more stimulation points on the visual cortex to make possible more detailed patterns of phosphenes and to allow for possible failures of stimulation points after implantation. Moreover it was believed that the patient had himself inadvertently put some electrodes out of action simply by scratching and bumping his head, and this suggested some mechanical fragility in the wiring between the microelectronic packages. It was therefore decided to produce a third design of implant which would overcome these problems.

To provide more stimulation points it is of course necessary to put more receivers and AND gates into the implant, but in order to keep the implant size down to that required by the neurosurgeon the packages obviously have to be made smaller. The most bulky packages in the second implant were the hermetically sealed logic units containing transistor and diode AND gates. These logic units are also the most environmentally sensitive of the packages—the environment being a warm saline "mist" produced by the body fluid—hence the need for particular care in sealing them. It was decided, however, to do away with the hermetic sealing, which required rigid ceramic packages measuring 29mm × 20mm with projecting connection tags. Instead, after experiments with various materials, straightforward encapsulation with silicone rubber adhesive was chosen. At first sight this seems a very unsuitable process, for silicone rubber has a high permeability and a low water absorption, and it must therefore transmit water vapour rapidly. But in fact hybrid electronic components are not very susceptible to water vapour. Thick film resistors, chip capacitors, cross-over glazes, conductors and passivated semiconductor devices can be operated successfully in the presence of such vapour. On the other hand, water as

liquid affects the operation of the circuit in two ways: it can provide spurious conduction paths which cause malfunction; and it may allow electrolysis to occur, filling up the package with electrolytic debris, which causes further shorts, and allowing the generation of gas under enormous pressure. Water as liquid will condense from water vapour in any voids which may be present in the encapsulating material, and it is the voids at the interface between the encapsulant and the electronics which cause the trouble.

The requirements of the encapsulant in the implant packages are therefore not only the usual one, that it shall penetrate the surface convolutions of the microelectronic circuitry everywhere so that no voids are left when the device is first made, but also that it shall discourage the formation of new voids subsequently. This means that the adhesion of the encapsulant must be good, and that the encapsulant

should be a rubber and not a resin, so that small strains set up at the encapsulant-electronics interface (as a result of, say, slight swelling of the encapsulant because of its water load) do not nevertheless set up large stresses which break the adhesive bonds. Fortunately silicon rubber adhesives are both rubbers and very adhesive in the presence of water, and this is why they work. The conclusions of the MRC workers are, therefore, that moisture-protecting encapsulants work not because they are in any sense a wall, but because they displace water as liquid from the surface of the microelectronics.

Using this encapsulation technique, logic packages containing 19 AND gates have been produced measuring only 26mm (long) by 7mm (wide) by 3mm (deep) as shown in Fig. 2. Unlike the previous hermetically sealed packages they have flying leads. The hybrid microelectronics forming the circuit (Fig. 3) are laid on a

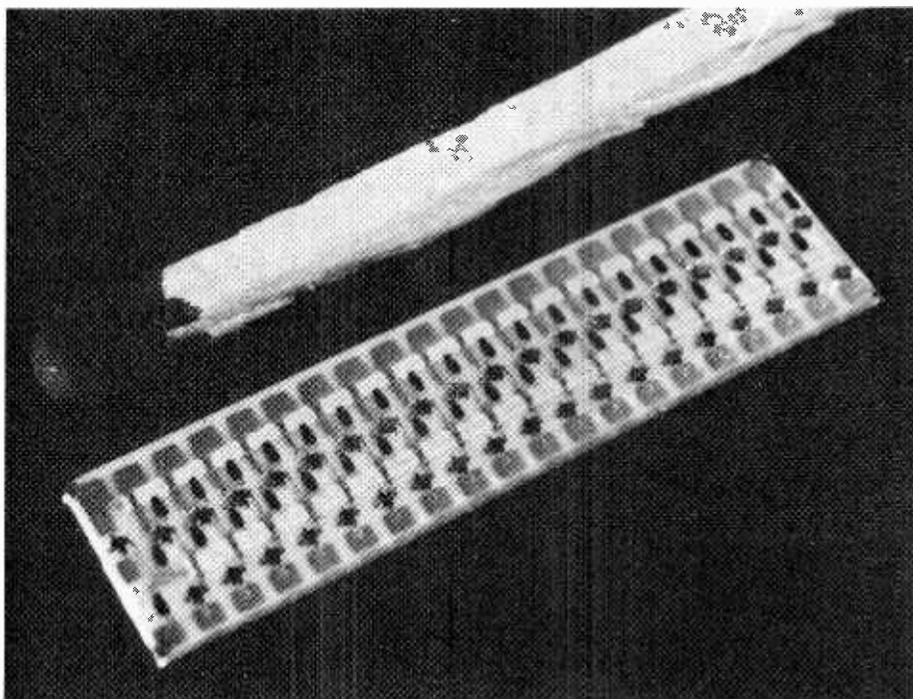
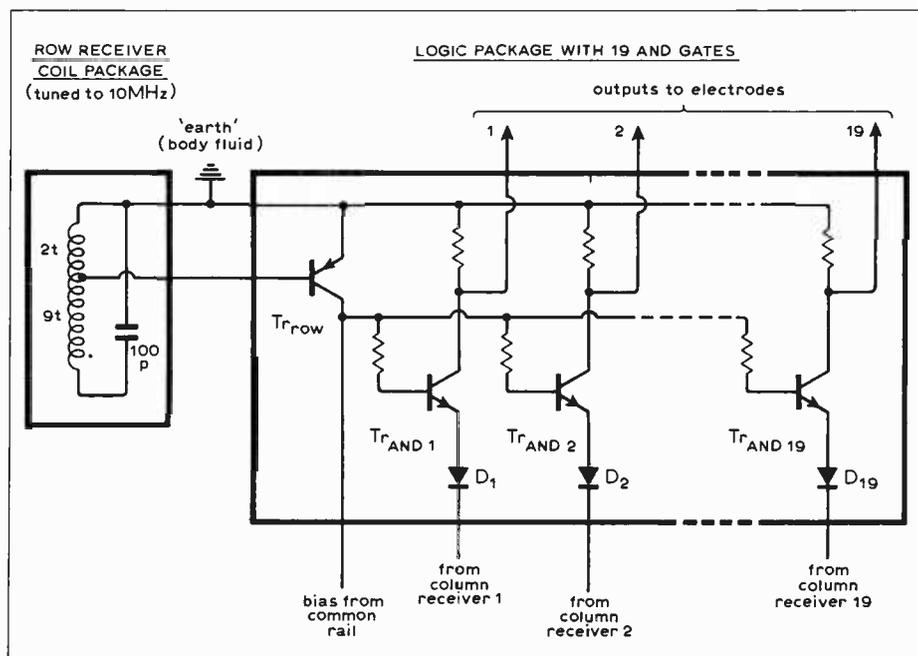


Fig. 2. Thick-film microelectronic circuit of the logic package, carrying, on a 26mm × 6mm substrate, transistors, diodes and resistors for 19 AND gates (see Fig. 3).

Fig. 3. One of the 16 logic packages fed by (left) one of the 16 row-receiver coils. Outputs from the 19 column-receivers are fed into the diodes. All resistors are 10kΩ.



25mm × 6mm ceramic substrate and the thick film parts of the circuit are successive layers of resistor material, palladium silver conducting pads and cross-overs, glass for insulation, and gold for transistor connecting pads and the two bus-bars shown in Fig. 3. The transistors and diodes attached to this thick film circuit are beam lead devices, and have a silicon nitride impermeable skin put over them.

Although there are fewer AND gates in this new logic package (19 as against the previous 20) the smaller size of the package allows more logic units to be used and in fact the third implant will contain 16 of these units (instead of nine). These will be fed with d.c. pulses from 16 row receivers (one is shown in Fig. 3) and 19 column receivers, giving 16 × 19 unique pairs of receivers on the matrix and therefore allowing 304 stimulating electrodes. Thus, relative to the second implant with its 75 outputs, the number of stimulation points will be quadrupled in this new implant.

The row and column receivers will be encapsulated in the same silicone rubber adhesive as is used for the logic packages. Samples of units made in this way have been tested by operating them under normal electrical conditions while immersed in a warm saline bath (1% sodium chloride solution at 50°C)—a more literal meaning for “soak testing”—and in many months of continuous testing no insulation failures have been detected.

The thick film receiver circuits themselves have been modified to make them smaller and safer. Most notably the inductive pick-up coils are now made in thick-film form (see illustration on front cover) instead of being coils of copper wire. The coiled conductor deposited on the ceramic substrate is of platinum, gold plated to bring the coil resistance to below 2 ohms. This has the advantage of allowing a thinner receiver package and avoiding the use of copper, which could be chemically harmful to the patient. Moreover it allows more stringent cleaning methods to be used on the circuit. The tuning capacitors are chip devices while

the detector rectifiers are passivated diodes.

The final space-saving expedient is to do away with, as mentioned above, the 1.0μF wet tantalum electrolytic capacitors connected between the outputs of the AND gates and the stimulating electrodes. In the project described in our May, 1971 issue these were housed in packages each containing 15 capacitors. The alternative, as explained, is to combine the capacitor and stimulating electrode into one by coating the electrodes with a suitable dielectric layer. Thus the metal electrode forms one plate of the capacitor while the surrounding biological tissue forms the other plate. Experiments at the MRC Unit have in fact shown that tantalum electrodes coated with tantalum pentoxide can perform stably as capacitor anodes when implanted into biological tissue⁵. Capacitances and leakages (typically 1μA at 5V in a 1μF device) do not differ much from those obtained in the electrolytes of conventional tantalum capacitors. It therefore seems likely that this technique will be successful when such capacitor-electrodes are used in future implants.

Resistance to mechanical shear forces on the implant, with consequent breaking of inter-package wiring, will be sought by virtually wiring the implant with springs.

References

1. Brindley, G. S., and Lewin, W. S. “The sensations produced by the electrical stimulation of the visual cortex”, *J. Physiol.*, 1968, vol. 196, pp. 479–493.
2. Brindley, G. S. “Sensations produced by electrical stimulation of the occipital poles of the cerebral hemispheres, and their use in constructing visual prostheses”, *Ann. Roy. Coll. Surgeons*, 1970, vol. 47, no. 2, pp. 106–108.
3. Donaldson, P. E. K., and Davies, J. G. “Microelectronic devices for surgical implantation”, *The Radio and Electronic Engineer*, vol. 43, no. 1/2, Jan./Feb. 1973, pp. 125–132
4. Donaldson, P. E. K. “Experimental visual prostheses”, *Proc IEE*, vol. 120, Feb. 1973, pp. 281–298.
5. Donaldson, P. E. K. Technical note: “The stability of tantalum-pentoxide films *in vivo*”, *Medical and Biological Engineering*, Jan. 1974, pp. 131–135.

Announcements

The basic methods and techniques used in **Industrial Digital Control Systems** and their applications in both computer and non-computer systems, is the subject to be studied at a vacation school on Industrial Digital Control Systems. It is being organized by the Control and Automation Division of the Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, in association with the Institute of Measurement and Control, to take place at the University of Oxford between April 7 and 11th.

An agreement has been signed between Keighley Instruments, 1 Boulton Road, Reading, Berks RG2 0NL and Neff Instruments of Duarte, California, USA for marketing Neff's range of **data amplifiers** for laboratories in the UK and Ireland.

The fourth Salon International Audiovisual et Communication (**International Audiovisual and Communication Show**) will be held in Paris, Porte de Versailles, from April 2–8th. On April 3rd, the presentation-discussion will be concerned with “Cable Television in France Today”.

Arrow-Hart (Europe) Ltd have announced the appointment of Radio Resistor Co Ltd, 9–11 Palmerston Road, Wealdstone, Harrow, HA4 7RS, to their network of stockists and distributors for Arrow switches including the subminiature ranges.

GDS Sales Ltd, Michaelmas House, Salt Hill, Bath Road, Slough, Bucks. has announced that its franchise for Hewlett Packard **optoelectronic components** has been extended. Under the new agreement GDS will be stocking HP Schottky and PIN v.h.f./u.h.f. diodes.

A new business **ITT Instrument Services** is being established by the Distribution Division of ITT Components Group, Edinburgh Way, Harlow, Essex, with effect from the beginning of February. ITT Instrument Services takes over from the Instrument Product Group of ITT Electronic Services. It is a much larger and independent marketing operation with its own field force, catalogue and internal sales engineers, but utilizes the computer system and stores operation of ITT's Distribution Division. The catalogue covers the following product areas: oscilloscopes, digital multimeters and voltmeters, analogue multimeters, analogue and digital panel meters, signal sources, counter timers, testers, modular power supplies, bench power supplies and variable transformers.

This year's AGM of the National Association of **Hospital Broadcasting Organisations** is to be held on April 12 and 13th. The host station will be Radio Whittington, Whittington Hospital, North London.

Calvert Engineers Ltd has moved to new premises at 44a Elmsdale Road, Walthamstow, London E17 6PW. CEL has been involved in the manufacture and installation of telecommunication equipment and with this new move production capacity is being increased to include **cable television** equipment.

Celdis Ltd, 37/39 Loverock Road, Reading, Berks RG3 1ED have announced that they are the UK agents for the range of small **electric motors** manufactured by Papst Motoren KG in Germany.

The **Electronic Component Show (RECMF)** will this year be held at Olympia, London from May 13th to 16th, 09.30–17.30 daily. Organizers of the show are Industrial and Trade Fairs Holdings Ltd, Radcliffe House, Lennon Court, Lode Lane, Solihull, W Midlands.

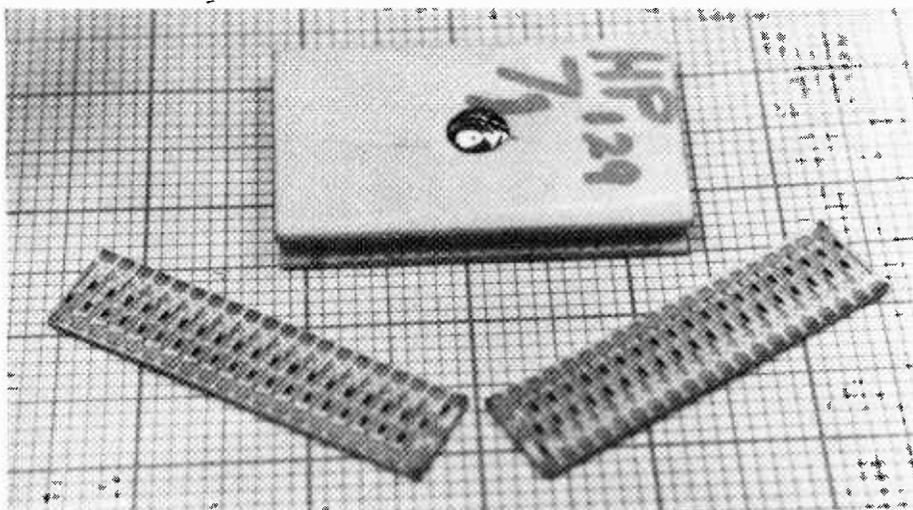


Fig. 4. Two of the new thick-film logic circuits compared in size with the hermetically sealed logic package (above) used in the second implant.

News of the Month

DICE throws a double

Latest version of DICE, the Digital Intercontinental Conversion Equipment designed by engineers of the Independent Broadcasting Authority, can convert 525-line NTSC colour pictures as used in the USA and Japan into 625-line PAL or SECAM pictures used in most other parts of the world, and will now also operate in the reverse direction, taking advantage of the availability of higher-speed integrated circuits. Improvements are mainly in the field of vertical resolution, particularly relevant to pictures coming in to the UK. This two-way DICE was first demonstrated outside the IBA Engineering Laboratories in December 1974 and an agreement has recently been signed giving Marconi Communication Systems exclusive world-wide manufacturing and marketing rights.

The standards conversion is essential not only for "live" relays via satellite, but also where programme material or videotape is exchanged between countries working to different television picture standards. A number of different types of standards converters have been developed over the years, but IBA engineers were the first to develop the unit based on digital techniques to eliminate the need for careful alignment and adjustment and to provide conversion without perceptible picture impairment.

The latest DICE occupies no more floor space than the original unit and uses about 8,000 integrated circuits, while the main storage devices alone represent the equivalent of more than 15 million transistors. Five-line interpolation is now used rather than the three-line integration of the experimental digital converter and the spatial filters have been improved. The converter is available for operational use within 30s of switching on from cold.

IEE recommends reconstruction of engineering profession

The following is a summary of the conclusions reached by a council of the Institution of Electrical Engineers concerned with the future organization of the engineering profession.*

The council agreed that the structure of the engineering profession was in need of change and endorsed the President's proposal that any change, whether in the form of an adjustment of the Council of Engineering Institutions or the setting up of a new central body to replace it, should be based on these principles:

- Authority and responsibility for learned-society and professional matters affecting special branches of engineering must remain in the hands of the individual specialized institutions.
- The central professional body should progressively become the single effective authority and instrument for qualifying chartered engineers, assisted wherever appropriate by experts nominated by the specialized institutions.
- The central body should not include technician engineers.
- The central body should not be federal in structure but should comprise individual engineers of all disciplines, the members of its council being elected in a suitable manner by the chartered engineers.
- Provision should be made to enable well-qualified members of certain non-chartered societies to become chartered engineers, provided that their education, training and experience were judged by the central body to be of sufficiently high standard.
- A person should not be eligible for registration as a chartered engineer unless he was a member of a specialized institution recognized for the purpose.

*"The importance of status", *Wireless World*, Oct, 1974, p.363.

First production c.c.d. memory

The first c.c.d. memory to be put into large-scale production has been introduced. The new device is a 1-kilobyte serial storage element claimed to represent a significant advance in the density of solid-state memory storage. It is aimed at memory applications in terminal buffers, video display refresh; microprocessor-control data stores and electronic switching in data communication networks. The memory utilizes a buried channel, ion-implanted barrier structure in the storage registers combined with n-channel silicon-gate m.o.s. structures for timing, charge detection and level conversion circuitry. The nine two-way data lines are t.t.l. compatible and have three-state output buffers for wired-OR application.

The device is organized as 1,024 words by nine bits each. It contains nine 1,024-bit low power c.c.d. registers which are shifted in parallel to provide storage and retrieval of nine-bit words in a byte-serial mode. Each register is accessed by its own two-way data line and all nine registers are serviced by common two-phase data transfer clocks and read/write control functions. The device operates in four modes: read, write, read/modify/write and recirculate. Power dissipation in the read and write modes is said to be 250mW maximum and only 30mW in standby recirculate mode. Average random byte access time is 200µs. The device uses simple two-phase clocking and is packaged in a standard 18-pin ceramic

Engineer uses EMI's portable Privateer telephone scrambler device to transmit confidential information back to head office.



d.i.l. Data rate is 50kHz to 3MHz. Evaluation quantities of the CCD450, manufactured by Fairchild are available on four-week delivery, while production quantities will be available in the fourth quarter of 1975.

High-speed waveform recorder

Since 1969 the National Research and Development Corporation has been supporting a work programme at the University of Manchester aimed at developing a novel type of storage cathode-ray tube to be used for signal averaging. A 16-channel laboratory prototype has been built and NRDC would now like to hear from companies who would be interested in completing the development and assessment of the instrument and in its subsequent commercial exploitation.

The basic principle of the waveform recorder is as follows. The electron beam in a c.r.t. is focused so as to form a beam whose cross-section at the face of the tube is narrow (approximately 0.5mm) in the *x*-direction but broad in the *y*-direction (approximately 1cm). This rectangular beam falls upon a faceplate consisting of a series of parallel, electrically isolated strips of aluminium that are also narrow in the *x*-direction but broad in the *y*-direction. The electron beam can be scanned across the strips in the *x*-direction. The signal being investigated is fed to the c.r.t. electrodes controlling the *y*-deflection of the beam and the strips are located within the tube so that the amplitude of the signal determines how much of the beam's area falls upon any particular aluminium strip. With zero signal there is no overlap and when the signal is

maximum the entire beam falls on an aluminium strip. Each strip is connected to a storage capacitor which is charged by the impinging beam, the quantity of charge being determined by the degree of beam overlap. As the beam scans repeatedly in the *x*-direction, charge is accumulated and, by monitoring the potential of each capacitor, the average signal can be extracted.

Study on teleconferencing

The Stanford Research Institute in California has recently undertaken a nine-month study of "teleconference" systems that enable people to communicate to a mass audience across the span of a continent. Audio and visual systems that are substitutes for bringing together conference participants offer an attractive means of saving costs, but only if people use them. An engineer-economist of the institute states, "We know a lot about the technology of such systems, but we need to know a lot more about their psychological and sociological aspects". The findings will document effectiveness of the systems, usage patterns over a period of time and how the cost, quality and types of capabilities offered by a system affect its usage. In the UK the Post Office runs a service of this type called Confravision.

TV deliveries still down

Deliveries to UK distributors of UK made and imported colour television receivers reached 165,000 in December, a 23% decrease compared with December 1973, according to the latest statistics compiled

by the British Radio Equipment Manufacturers' Association. This brought the total for the year to 2,209,000, a fall of 20% compared with 1973.

Total monochrome television deliveries for December of 51,000 brought the total for the year to 821,000, a fall of 42% compared with January to December 1973. BREMA members delivered 59,000 audio stereo systems in the month, a fall of 27% compared with December 1973, bringing the year's total to 831,000, a fall of 17% compared with 1973. Deliveries of radio receivers reached 259,000 for the month, a 44% drop on December 1973, bringing the 1974 total to 4,798,000 compared with 6,681,000 in 1973, a fall of 28%.

These figures are for deliveries of UK made and imported deliveries to home distributors including those to rental and relay companies.

Bell Laboratories celebrate fifty years

The research and development unit of the Bell System marked its 50th anniversary in January. In its first 50 years Bell Labs scientists and engineers have been awarded more than 17,000 US patents, two Nobel physics prizes (in 1956 for the invention of the transistor), three National Medals of Science and hundreds of other prizes.

One of the largest industrial laboratories in the world, Bell Labs is now an organization of about 16,000 employees, with 18 locations in nine states of the USA. It was established in New York City in 1925 with the reassignment of 3,600 staff members of Western Electric Co's engineering department and some additional supporting personnel from the American Telephone & Telegraph Co.

Briefly

Radio City on v.h.f. The Independent Broadcasting Authority's new v.h.f. f.m. stereo transmitters at Allerton Park, Liverpool are now in operation on 96.7MHz, carrying the programmes of Radio City, previously available only on 194 metres medium wave. The IBA's local 95.9MHz relay station in Rotherham is also now in service, carrying the programmes of Radio Hallam.

Merseyside slant polarized. Since the start of programmes on January 24, the v.h.f. service of BBC Radio Merseyside (95.8MHz) has used slant polarization. This will provide improved reception for portable receivers and v.h.f. car radios, particularly towards the limit of the service area. Listeners using outdoor horizontal aerials should find reception unchanged.

New SERT president. The Council of the Society of Electronic and Radio Technicians has elected as its third President, Sir Cyril English, who took the chair on the occasion of SERT's 10th anniversary on January 30.



Charge coupled image sensor, the "eye" of RCA's new tubeless TV camera held below. The image sensor and camera will be available in Europe early in 1976.

75 years of magnetic recording

2—The dark years

by Basil Lane

Assistant Editor, Wireless World

Up to about 1915 the use of valves had been extremely limited and rarely applied to the telegraphone type of recorder. However, from that date on until the mid-1950s it was to play a massive part in turning a declining technology into a brilliant new era. The dark years of World War II were also approaching to produce a remarkable dichotomy in recording media. In this article the story advances to 1945.

The combination of World War I and mismanagement of the technical development of the Telegraphone, brought about the demise of the Poulsen companies by about 1918. From then on there are only passing references to magnetic recording in the literature, mostly connected with Poulsen models or slight variants of them. As mentioned in Part I of this series, it was Kurt Stille who revived interest in magnetic recording and this through the medium of the Dailygraph, later developed into the Textophone⁶, and a steel tape machine originally conceived for synchronized film sound track.

In Britain, Stille's ideas were exploited by Ludwig Blattner, who, according to a contemporary account,²⁷ was a small, lively man with a keen showman's mind. He, with his engineers, developed a machine called the Blattnerphone, an early model of which was used to provide synchronized sound for demonstration films. These films were used as part of a sort of "circus show" where a public audience would come to see the "talkies" and in the intervals Ludwig Blattner, also a keen dancer, would pull ladies from the audience to dance with him on stage to recorded music from the Blattnerphone!

More seriously, the BBC took an interest in these machines and by 1931 at least one had been bought and installed at Savoy Hill (Fig. 1). This was a machine that used steel tape 6mm wide running at a speed of 1.5 metres per second with a playing time of 20 minutes. Since the drive was by d.c. motor, it suffered from wow and speed drift, which had to be corrected by operating a rheostat and observing a stroboscope attached to the capstan.

Pressure was increasing within the BBC to provide an Empire Service and since the government of the day had taken so long to produce a decision to allocate

funds for the capital investment, the BBC took an independent decision to finance the initial stage and open service just after Christmas 1931. Since the long-distance transmissions had to be timed to obtain reasonable hours of reception—usually early evening local time—broadcasts were beamed by using directional aerials, with the transmitters switched to

each aerial at two hour intervals. Thus, to enable a programme broadcast to Australia to be heard in Canada the material had to be available for repeat. Disc recording had not been used in the BBC up to that time, and in any case the playing time was rather limited. The Blattnerphone seemed to provide just the right answer.

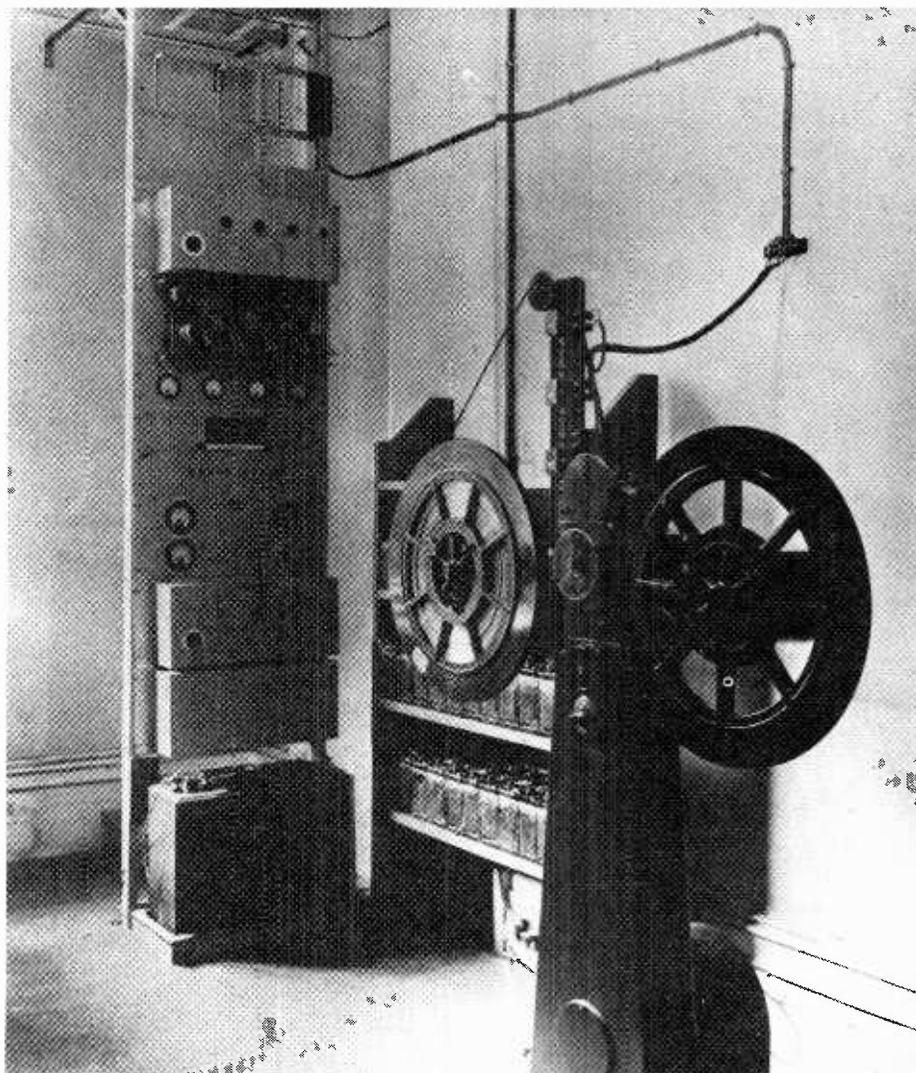


Fig. 1. An early 6mm Blattnerphone machine installed in Savoy Hill in 1931. (Courtesy BBC).

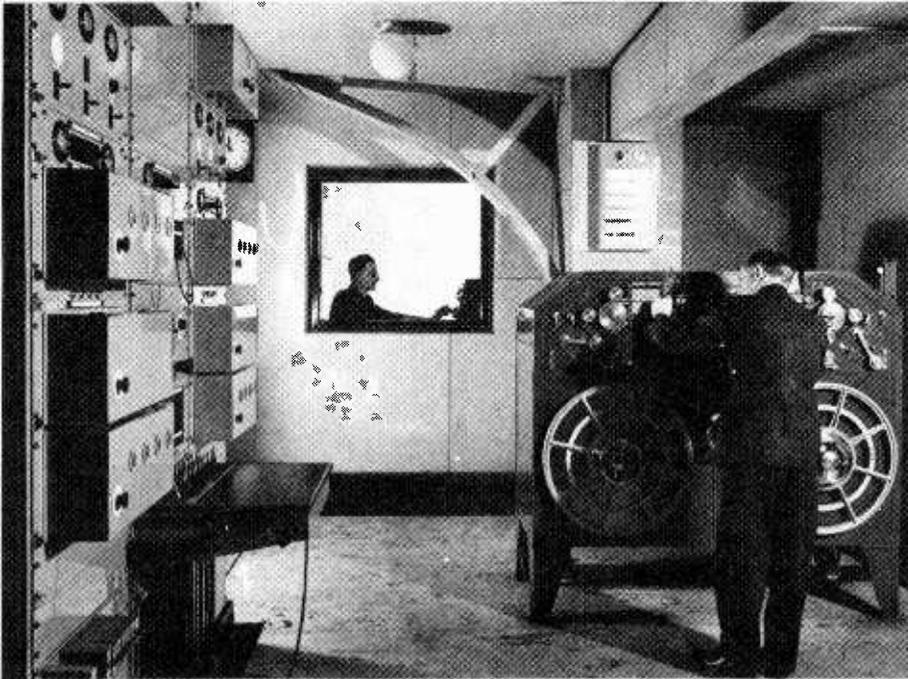


Fig. 2. A Marconi-Stille recorder installed in BBC Maida Vale studios from 1934.

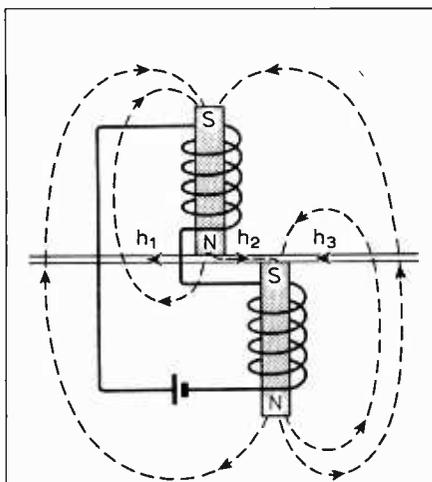


Fig. 3. The Stille erase head assembly showing the saturating flux fields.

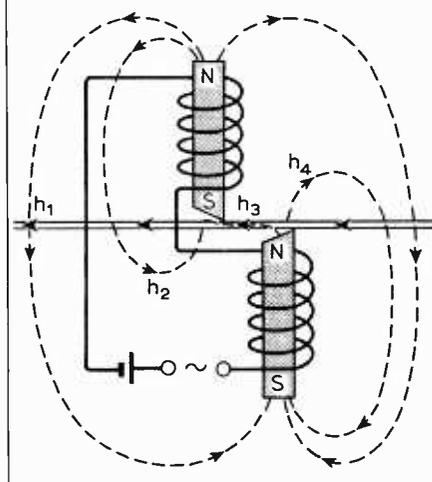


Fig. 4. The record head flux field of a Marconi-Stille machine.

Having pointed out the deficiencies in the 6mm Blattnerphone, the BBC then encouraged an engineer, von Heising of the British Blattnerphone Company, to develop a machine meeting the BBC requirements²⁸. After only three months, two prototypes were produced and installed, first at Savoy Hill and then at Broadcasting House. Further technical details on these and later machines follow, but for the moment, suffice it to say that the speed stability was improved and tape width reduced to 3mm. Apart from the somewhat dangerous operating conditions, the steel tapes were also difficult to edit.

Nevertheless, it was obvious that this represented somewhat of a challenge to the engineers of the day, since several magazine programmes were broadcast during late 1932 and in 1933. One of these included a composite programme of the 1932 Economic Conference in Ottawa which was compiled from seven miles of recorded steel tape²⁹. However, the fact that steel tape was a new recording medium coupled with the prospect of being able to erase the tapes made it unreliable, in the minds of the BBC, as a source of archival recordings. What confirmed this thought was that part of the first Christmas Day, 1932 feature programme was accidentally erased. Godfrey²⁹ goes on to say that subsequently arrangements were made, with the British Homophone Company, to record highlights onto disc from Blattnerphone tapes, the signal being fed from Maida Vale to Kilburn by telephone lines. He also remarks that this must have been the first time discs were produced from magnetic recordings.

Shortly after 1932, the Marconi Company bought rights in the Blattnerphone machine and produced a slightly lighter version which was mounted on a wooden table. By 1934 this, however, was

superseded by what surely must have been one of the largest audio magnetic recorders ever — the Marconi-Stille machine. This was mechanically very sophisticated and six were ordered and installed in Maida Vale from 1934 (Fig 2). Two more were added during the war and these machines were in constant use during this period and after, the last one being taken out sometime around 1950.

A fascinating tale is told of one of the early Blattnerphones. This machine was one of the original two 3mm recorders installed at Savoy Hill and as part of the move to Broadcasting House they had to be shifted overnight. It had just been connected, though not tested, when a telephone call came through to the tape room to get a machine going, whatever it took. The switches were thrown without further ado and with, it would seem, a good deal of finger crossing, to record an historic interview with Amelia Earhart. The date was May 21, 1932, the very day she landed after an epic flight across the Atlantic.

History was to repeat itself since during 1939 it was resurrected from the embryo BBC museum to be the first tape machine installed at the dispersed BBC wartime location in Worcestershire. Once again, the same engineer, with other colleagues, had hardly completed the installation when they were told to get the machine going, this time to record the Prime Minister. The date was September 3, 1939 and the Prime Minister was Chamberlain broadcasting the declaration of a state of war between Britain and Germany³⁰.

This self-same machine was again resurrected to record some items for the 50th Anniversary of the BBC and now rests in a well earned retirement at Bristol City Museum, awaiting location in a new gallery.

Technical specification

The second generation Blattnerphones were driven with an a.c. synchronous motor which improved speed stability. Since this was an era before the adoption of a.c. bias, the tape was erased and biased with d.c. set from preset controls on the amplifier rack. The replay amplifier was a standard BBC type A amplifier³¹, modified to permit an equalization circuit to be connected to the grid of one of the valves. A power output stage, capable of giving up to 10W, provided the loudspeaker monitoring facility. The microphone and head-driving amplifier were specially designed for the job. The Blattner machines were only fitted with three head block assemblies, the later Marconi types having five, the reason for which was not at first obvious to the author. Contact was therefore made with the engineer mentioned in the previous anecdotes, R. C. Patrick, for an explanation. It would seem that the idea originated with Patrick, who at that time was working in BBC Research. Marconi had just taken over the licence to produce the machines and had asked the BBC, as largest users of Blattnerphones, what improvements could

be made.

Editing of steel tapes was then quite common but unfortunately the actual edits, which consisted of a soldered joint, destroyed the knife-edge pole pieces of the record and replay heads. Patrick suggested that two standby heads, one record and one replay, were fitted which during operation of the machine were left out of contact with the tape. After the passage of an edit, the spare heads would then be quickly brought into contact and the damaged heads opened to permit replacement of the spring-loaded pole pieces and wait for another edit!

Of the three basic types of head assembly used, one was erase, one record and one replay. The design consisted of two simple pole pieces, solenoid wound, one on either side of the tape. The erase-head pole pieces had a flat contact surface with the tape and were made of Stalloy, also used for the record head. The assembly could be hinged open to facilitate threading.

Erase was by saturation magnetization of the tape³¹, illustrated in Fig. 3. Briefly, a direct current of about 20mA was passed through the coils connected in series. When the tape approached from the left, the field h_1 applied, the strength being above tape saturation as it passed under the first pole piece. There then followed a reversal of flux under the influence of field h_2 and finally another reversal caused by h_3 . The tape was left in a saturated state in the direction of this field.

The record head was of similar construction, though the interchangeable pole pieces were this time shaped to a knife edge to improve short wavelength performance. Of the alternative arrangements possible, single pole piece or double narrow stagger, double wide stagger or double pole piece with one being idle, the BBC adopted the double pole narrow stagger arrangement (Fig. 4).

Again, the coils were connected in series and a 4mA direct current bias applied with the signal. Here the tape saturation field h_1 was reduced by field h_2 , restored to saturation by h_3 and finally subjected to the demagnetizing influence of h_4 . Since h_4 was also modulated by the signal the remanent flux in the tape followed the current fluctuations in the head.

Finally, the replay head used by the BBC, had only one pole piece, made of Permalloy, since the setting of two pole pieces, which produced better high-frequency performance, was too critical for practical purposes.

The actual tape deck of the Marconi-Stillie machine represented a considerable advance on early models with the tape drive being achieved through three motors. Tape was drawn off the feed spool by drive No. 2 and fed into a box reservoir

where a loop would build up. When the earthed loop contacted a metal surface at the bottom of the box the bias was removed from the grid of a thyatron and a relay in the anode operated, to switch a resistance into the motor circuit, slowing the motor down.

The tape was drawn from this reservoir by a capstan drive, which in turn fed a loop of tape into a second, larger reservoir. Again, when the loop of tape contacted the bottom of a reservoir a thyatron operated relay would remove resistance from the winding motor circuit speeding the motor up.

Despite sterling service and a surprisingly good performance for its day, disc recording gained the ascendancy during the World War II and after 1947, the impact of plastic based tape was to sound the death knell for this remarkable machine.

Recording in Germany

Going back to the late 1920s the seeds were being sown, in Germany, of a new-

old idea which, in later years, was to revolutionize the art of magnetic recording. This was the revival of the idea of coating a flexible insulated base with a finely divided magnetizable substance. An independent engineer from Dresden, Fritz Pfeumer, was struggling to develop both a recording tape which had a flexible insulated base with a magnetizable surface and also a suitable machine. Presumably his funds and resources were too limited, since although he had secured a patent³² for such a tape (filed in February 1929), by 1930 he soon after sought the help of a German electrical company Allgemeine Elektrizitäts Gesellschaft of Berlin (A.E.G.).

It is not too clear just how good a chemist Pfeumer was, since his early patent sounds rather more like a recipe for a pudding than a tape coating! In the introduction, he acknowledges that there prior inventions regarding the use of magnetizable substances on a flexible base but then goes on to describe the methods for his type of tape. I quote, "... a powder of soft iron is mixed with an organic binding medium such as

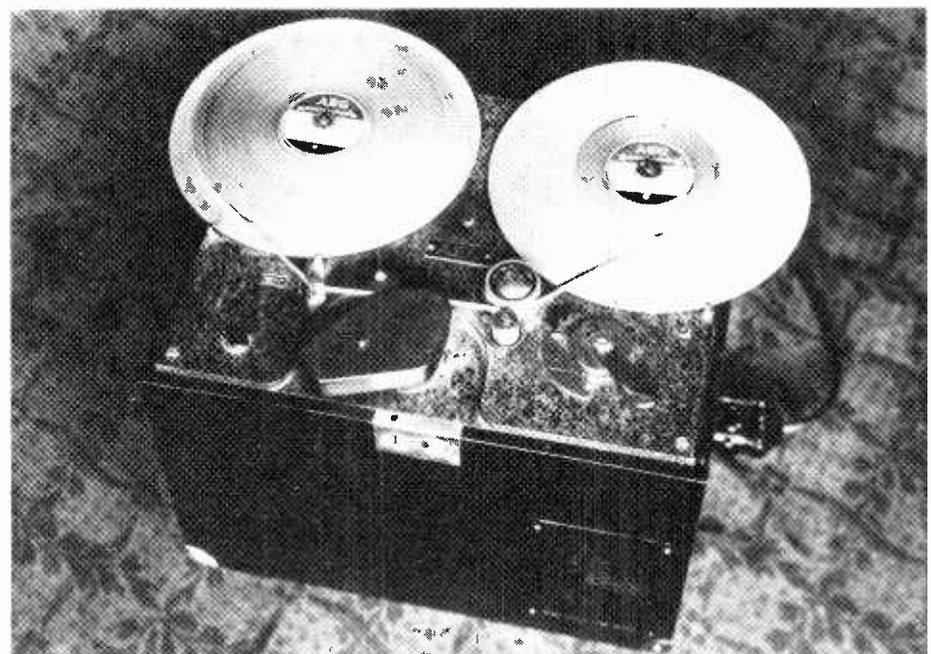
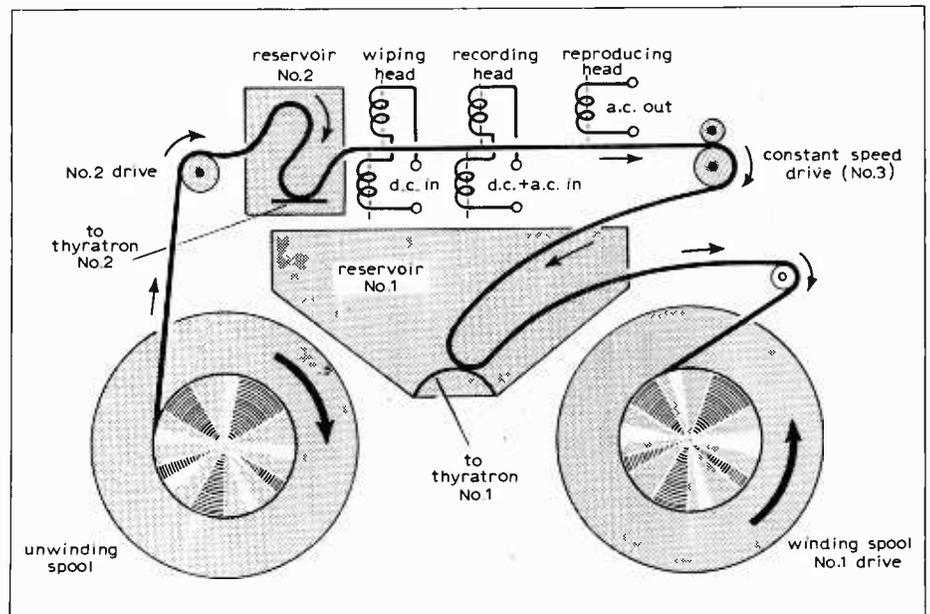


Fig. 5. Tape drive system for the Marconi-Stillie machine.

Fig. 6. The first model Magnetophone shown at the Berlin Radio Exhibition, August 1935.

dissolved sugar, molasses or the like, which is then dried and finally caramelized or carbonized, that is, the carbon chemically combined in the iron by heating. The steel powder so produced is then, while in a heated state quenched in water or other liquid, dried and again powdered. The use of such a material has for its object that phonograms are thereby obtained which last many years without loss of strength of sound."

He went on to suggest that this powder could be then mixed with a water-insoluble binder and coated onto paper or cellulose type films. Also in the patent he suggests the coating of sound stripes on moving picture film. Several alternative magnetic materials were included in the specification, such as nickel-iron alloys, ferrosilicon or iron-hydrogen compounds. At least one reference³³ indicates that Pfeumer did succeed in making paper tape, and also one coated on a cellulose hydrate film.

Fortunately for Pfeumer, A.E.G. were very interested in the proposition, but very soon realized that specialists would have to be used to manufacture a suitable tape. They chose I. G. Farbenindustrie Aktiengesellschaft of Ludwigshaven. This company specialized in the production of a wide variety of chemicals including fast opaque pigment dispersions and carbonyl iron used in the manufacture of loading (Pupin) coils for the telephone system.

Hermann Bücher of A.E.G. was soon in contact with a brilliant physical chemist at I. G. Farben, Wilhelm Gaus, who readily responded to the proposals and set to work on a suitable tape. The pace thus far seemed to have been a little slow from Pfeumer's first ideas, but now it increased—though not without quite a few problems, both technical and in company politics.

Some eighteen months after the initial approach Gaus reported back to Bücher that progress was good having received favourable reports on the quality of the first tapes delivered to A.E.G. In return, A.E.G. suggested that their machine was nearing completion and should be ready for launch in 1934 at the autumn Radio Exhibition in Berlin. With this air of optimism circulating, the two companies prepared for a grand launch. Designers at Ludwigshaven produced an exhibit which ran riot with ideas of the potential at domestic and broadcast level.

In July 1934, a decision to produce the first 10,000 metres of tape was taken, and by August this was in the hands of A.E.G. A further 40,000 metres was to be produced in time for the exhibition which was to be held from 17th to 27th August. With time getting short, internal politics started to show, since press releases and a prior announcement to a meeting of the Technisch-Literarische Gesellschaft du Berlin showed considerably greater restraint than the designers of the Ludwigshaven exhibit. Here an emphasis was laid on the speech recording aspect of the invention, rather than on music. Someone had suggested that any flaws in the performance would damage the prospects of the invention if exaggerated claims had been made initially. So, the plan was to underplay the potential, but as

events were to show, this sudden pessimism was the precursor to real problems. A joint meeting of management from both companies, was held one week before the exhibition and demonstration given. The result was that the recorder was withdrawn, delivery of tapes stopped and the press information suppressed as far as possible.

The trouble was two-fold, first that the prototype machine made in breadboard form, suffered from amplifier instability when condensed into a practical cabinet. Second, the performance did not come up to that of the competition. Remember, the Marconi-Stille and its predecessors had been in practical service in broadcasting for at least two years and similarly, in Germany C. Lorenz had introduced the Stahlton-Band Maschine^{34,35}. This was a steel tape machine using Stille's principles, but considerably smaller than the British versions having a frequency response up to 5kHz. The best achieved by the prototype A.E.G. machine was 3kHz at a tape speed of 1m/s. In addition the noise performance was hardly up to broadcast standards, so it was natural that there should be much soul-searching before taking any further commercial decisions.

Eight weeks later, the A.E.G. engineers announced that they had overcome the problems and a second demonstration was arranged. The resulting decision was favourable and so development went ahead to finally produce, in the summer of 1935, a completely redesigned model meeting all requirements and available for the 1935 Radio Show in Berlin.

With a potential success on their hands, I. G. Farben suddenly ran into internal political problems with two of their factories—Ludwigshaven, who had developed and produced the first tape, and Wolfen entrenched in film coating, squabbling over who should mass-produce the tape. Wolfen, by the way, was later to be split, by an Occupying Forces Commission, away from I. G. Farben to become the Agfa tape and film concern—but that is a separate story to be told later. The final decision was delayed until 1938, due to vacillation by the Reichs-Rundfunk-Gesellschaft, (German Radio) on which recording system to adopt. By 1938, Ludwigshaven was so firmly in full production that no decision needed to be taken.

However, this takes us beyond August 1935 and the Radio Exhibition where the first eight A.E.G. machines, now called the Magnetophone, were shown and demonstrated with success, indeed with so much success, they were all immediately sold. The first Magnetophone tape was cellulose acetate, coated with carbonyl iron powder. Since at the time, the steel tape, wire, and direct-cut disc were firmly entrenched in broadcasting it was to be some years of hard selling before A.E.G. was successful in getting the Magnetophone accepted by the German broadcasting stations and during that time several stages of evolution were to occur. The first model (Fig. 6) was to be superseded by the FT2 an elegant console model, and the K3, a portable machine in three parts—deck, amplifier and loudspeaker. These appeared in 1937³⁶

to be followed later by the K4, a broadcast machine made in portable or rack-mounted form. One interesting incident occurred in 1936 during the period of promotion; Sir Thomas Beecham was invited, with the London Philharmonic Orchestra, to go to Ludwigshaven to record the first public concert on magnetic tape. Beecham, being quite interested in recording, accepted and on November 19, 1936 made a tape recording parts of which survive to this day.

However, even he could not have been too impressed with the Magnetophone, since during that season he purchased two German optical sound recorders and had them installed in Covent Garden, where he later made private recordings of his seasons in 1937 and 1938!

Iron powder produced by the carbonyl process was not ideal as a magnetic material for tape since it had low coercivity and the individual particles were still too large to permit high-frequency recording. In addition the particles were spherical, a disadvantage not realized until much later when a study of small particle magnetics was to reveal the advantages of shape anisotropy.

However, there were other promising materials and one of these was magnetite (Fe₃O₄) suggested in 1934 by Erwin Leher. Some tape was eventually produced using this oxide, but it had rather too high a coercivity which made erasure a problem, and so brown gamma-ferric oxide, still with spherical particles, was eventually adopted.

It was in January 1938 that seal of success was to be set upon the Magnetophone when the technical manager of Reichs-Rundfunk Gesellschaft, Dr. Hans-Joachim von Braunmühl gave an announcement at a lecture that the Magnetophone had been adopted by R.R.G. for broadcast service.

References

26. Aldous, D. W. Recording on steel tape. *Wireless World* June 29, 1939 pp. 611, 612.
27. Aldous, D. W. Private communication with the author.
28. Rust, N. M. The Marconi-Stille Recording and Reproducing Equipment. *The Marconi Review*. No 46, Jan-Feb 1934, pp 1-11.
29. Godfrey, James W. The history of BBC Sound recording. *Sound Recording and Reproduction* (B.S.R.A.) Vol 6 No 1, May 1959, p9.
30. Patrick, R. C. Private communication with the author.
31. Godfrey, James W. and S. W. Amos. Sound recording and reproduction. (BBC Engineering Training Manual) Pub. Iliffe & Sons Ltd. 1952.
32. Pfeumer, Fritz. Brit. Pat. 333, 154. Aug 5, 1930.
33. Zimmermann, Paul A. Magnetic tapes, magnetic powders, electrodes. Vol 4 of series published by the Archives of Badische Anilin- & Soda-Fabrik AG 1969.
34. G.W.O.H. The magnetic recording of sound. *The Wireless Engineer* Vol 13. No 151, April 1936, pp. 175-178.
35. "Die neue Stahlton-Bandmaschine" *Lorenz Berichte* Jan 1936 p49.
37. "Magnetophon. Universalgerät für Fononfahme und Wiedergabe" an A.E.G. catalogue issued Nov. 1937.
38. Hickman, C. N. Sound Recording on Magnetic Tape. *Bell Laboratories Record* Vol 16, April 1937, pp 165-177.
39. "BBC Mobile Recording equipment" *Wireless World* Vol 50, No 5. May 1944 pp 133-135.
40. Pulling, M. J. L. B.I.O.S. Final Report No 951.
41. Menard, James Z. FIAT Final Report No 705.

Letters to the Editor

AMPLIFIER CLAIMS

I was much amused by the letters from Mr Paravicini and Mr Radford in the January issue.

If one accepts that the best equipment from the two companies can look each other in the eye without too much neck stretching, then one must give Mr Radford the laurels for reaching this rarefied level with a much lower component count, and hence a better cost/price ratio.

Unfortunately, this does not guarantee success.

The lesson that British manufacturers, whether of amplifiers or motorcycles, have signally failed to learn is that the buying public is notoriously indifferent to specifications.

Lux will win the battle in the shops because, sadly, the most important parameter of all is the shiny knob area.

R. A. J. Glowacki,
London, N.W.3.

RIBBON MICROPHONES

John Dwyer's statements with regard to ribbon microphones in your "Microphone survey" in the October 1974 issue would seem to be drawn from references which relate to microphones produced in the 1930s and not of present day manufacture.

Beyer Dynamic have, for the last twelve years, been producing a hand held ribbon microphone. In fact within the range they have three different microphones serving the entertainment industry. All of these are supplied to broadcasting authorities and corporations throughout the world. They are also much in demand within the club circuits where microphones are not always treated very well and the Beyer microphones withstand the rough treatment in this area.

We would like to draw your attention to an extract from a letter we have received from the Revox Corporation of New York.

"I had thought that the English reviewers were somewhat more *au fait* with current ribbon microphone tech-

nology than their American counterparts, as here in America, I am constantly battling to overcome odious remarks and comparisons made against the ribbon transducer technique.

"It therefore came as some shock to note Mr Dwyer's same old hackneyed statements: to wit: 'The ribbon corrugations provide some control of the tension as well as increasing the mass of the ribbon and making it more rigid: it is still delicate, though, and susceptible to rumble and wind. The ribbon exhibits the worst susceptibility to handling noise.'

"... Ribbon microphones tended to be bulky in the past and their delicacy has tended to encourage them being abandoned in favour of the capacitor or moving coil types. They can be used for pressure operation by providing a cavity at the back of the ribbon to provide an acoustical resistance.'

"These damaging remarks, of course, cannot be applied to the Beyer ribbon. However, all ribbons seem to be 'tarred with the same brush' no matter whether they are described on your side of the Atlantic, or mine."

This we feel expresses the views of Beyer and, of course, of the Revox Corporation.

Douglas Ireland,
Eyeline Communications Ltd,
London WC2.

Mr Dwyer replies:

Naturally the ribbon microphone can be constructed in such a way as to make it as good as other types.

The article was intended as a guide to the basic principles of operation of the various types of transducer now in wide use for good quality sound reproduction. All of the various types of transducer have disadvantages of one kind or another if only the basic construction is used. It is obviously true that a well designed unit of any type can overcome its inherent limitations. Nevertheless it is equally true that the cost of doing so may become an added limitation, as may the complexity of the unit so produced, and I think, if I may suggest so, that the simpler a unit is the more reliable it is. This may explain why, on the numerous occasions on which I have visited recording studios, the type of microphones predominantly in use were those either of the capacitor or the moving coil type. Every studio has at least one ribbon, but the occasions on which it is used tend to be rather specialised. I can only rely on the use to which the microphones are put as a guide to their value, though it may be that British recording engineers, like those elsewhere, have been subjected to a propaganda campaign of massive proportions conducted by the makers of capacitor and moving coil types in concert. If that is the case I can only say that I am sorry I have become an unwitting instrument of such propaganda. In addition, I am sure that Beyer microphones mentioned in the letter are every bit as good as Mr Ireland says Beyer say they are. My remarks were not intended to suggest that no ribbon microphone

could be as robust or as rumble-free as any other type, and it would be misleading to suggest that that was what I was saying.

dB CONVERSION ON A SLIDE-RULE

The article by Mr Nelson-Jones "Electronic engineers' slide rule" in the February issue prompts me to mention a technique for dB conversion using the LL2 and LL3 scales on a standard slide rule. If "6" on the C scale is set opposite "1000" on the LL3 (corresponding to 60dB=1000), other ratios may be converted to dB by reading from the LL3 scale to the C scale; 6 on the C scale is also opposite 2 on LL2 (corresponding to 6dB=2) so lower ratios may be read from the LL2 scale to the C scale.

Certainly the new rule should be a great deal more convenient, but the above technique may be of use to someone.

R. A. Scott,
Bury St. Edmunds,
Suffolk.

Mr Nelson-Jones replies:

I have tried the method suggested by Mr Scott and it is certainly ingenious, but I find it hard to remember which scale is which, and in addition the accuracy is not good. I am sure I would soon get used to the method, but I find it much easier to use the new scale with the A and B scales, and the accuracy is much higher. I had in fact heard of the method before, but had never tried it out until Mr Scott's letter arrived.

EMERGENCY POWER GENERATOR

Congratulations to Mr J. M. Caunter for tackling the power disruption problem (February issue), but I feel that the car dynamo could have been more effectively converted by making use of the principles embodied in the most recent alternators fitted to cars. In these designs it is the rotating armature which is excited by the battery and the fixed stator windings which are used to generate the a.c. This has several advantages: the currents flowing into the armature via the brushes are smaller, and steady, and the armature heat dissipation is lower. The stator, by contrast, being heavily heat-sunked can develop quite large amounts of power, and, since plenty of winding space is available, can be more readily wound for 240V. In modern car alternators, the regulating equipment is carried within the frame of the alternator, and consists of a power transistor controlling (on/off system) the armature current. The armature current is reduced whenever the output voltage causes a zener diode to conduct, so that the armature current is rapidly pulsed. This method of control, though suitable for battery charging, would not be suitable for a mains-output

alternator, and a voltage-controlled current regulator with a non-pulsed output would be needed.

I. R. Sinclair,
Braintree,
Essex.

Mr Caunter replies:

While I agree with Mr Sinclair that most alternators work on the principles he describes, and there are several obvious advantages to be gained from using this method of construction, his suggestion is not applicable to the conversion of a dynamo for two important reasons.

Firstly, the dynamo has a solid steel yoke and cast-iron pole pieces and is therefore not designed for rotating field operation. If this were attempted, a large amount of power would be lost in circulating eddy currents within the solid stator. The armature, on the other hand is laminated to reduce this loss to a minimum when rotated within the stationary field supplied by the existing field winding. Secondly, since the stator is not of true annular form, the variation in reluctance of the magnetic circuit seen by the rotor as it rotated would produce serious distortion to the output waveform.

The best way to improve the performance of the alternator is to get as much copper as possible into the armature slots. This necessitates using a finer gauge wire to improve the filling factor, and either winding for 240V in a single winding taking great care over the insulation, or by winding several parallel windings together and operating at a lower output voltage as in the present design. It is quite possible that the output could be increased to over 300W in this way.

Incidentally, if anyone has been put off the idea of building this generator because of the machining needed to construct the slip rings, and has no scruples about passing a current through the dynamo bearings, the following suggestion passed to me by a colleague may be worth trying. Connect one end of the armature winding to the shaft and the other to all the commutator segments shorted together. With the earth brush removed, the output can now be taken from the alternator casing and the live (insulated) brush output.

A NOVEL CLASS B OUTPUT?

As far as I know all class B output configurations are based on the same principle: two emitter followers are tied together and the circuit is improved, in a more or less elaborate way, by replacing a single emitter follower by a two- or three-transistor circuit in an attempt to approach an "ideal" emitter follower.

An example of this is the Quad. 303 which has two triplets in the output stage. Although a very fine amplifier, it exhibits clearly the shortcomings of this type of output circuit, which are: (a) the quiescent current has to be adjusted; (b)

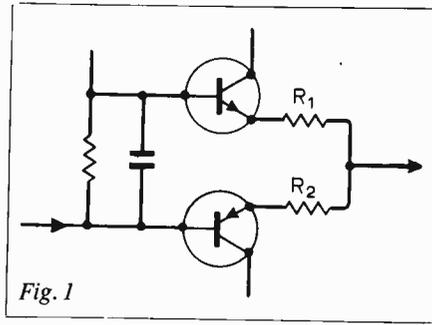


Fig. 1

the quiescent current is dependent on the temperature; and (c) too much quiescent current results in a kind of "take over distortion". This kind of distortion is due to a signal current flowing through the resistors R_1 or R_2 (Fig. 1), cutting off the quiescent current of the other stage, which results in a voltage shift at the input necessary to keep the output following the signal.

It is obvious that crossover distortion decreases with increasing bias current. From the facts mentioned before it is also obvious that an increasing bias current causes an increasing "take over distortion". So, with this type of output there is an optional value for the quiescent current.

It is possible to overcome all these shortcomings by using the circuit shown in Fig. 2. This circuit has none of the limitations mentioned in (a), (b) and (c). The quiescent current is set at 15mA by Tr_7 . (Later on 5mA proved to be sufficient.) For d.c. this transistor forms a constant current source as long as diode D is not forward biased. For small signals Tr_1 and Tr_4 can be regarded as a long-tailed pair without a tail, for positive signal the upper half (Tr_1, Tr_2, Tr_3 and Tr_4) is active behaving as a super emitter follower. The same for negative signals,

but this time with Tr_1, Tr_4, Tr_5 and Tr_6 .

Since Tr_1 and Tr_4 are used in both modes of operation and the output resistors are missing, no "take over distortion" is possible.

One advantage is a lower output impedance due to the missing output resistors.

Nico M. Visch,
Rotterdam,
Netherlands.

DIGITAL SPEEDOMETER

I read the articles on the digital speedometer by Bishop and Woodruff in the September and October issues with great interest, but I feel that "average speed" is not really the parameter of interest. What one really wants to know is the difference between the elapsed time and the time which should have been taken to travel that distance at a particular speed.

The above comment arises from the fact that one usually knows the distance to be travelled and a reasonable average speed which one can hope to maintain during the whole journey. What is required is an indication of how much time you have in hand or how far you are behind the clock at any time during the journey. This is the information provided mechanically by the Halda Speed Pilot used by many trials drivers.

I would thus be interested in a modification to the design of the average speed part of the project to substitute an electronic equivalent of the Speed Pilot. This only requires multiplying the actual distance travelled by the inverse of an

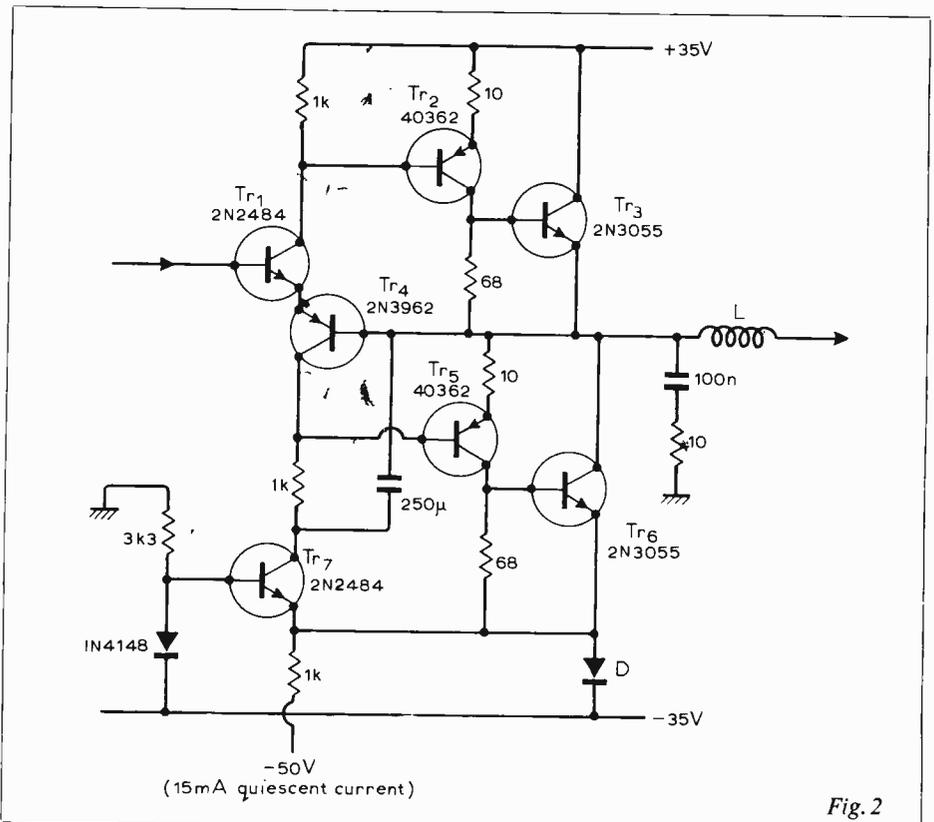


Fig. 2

average speed set in by hand and subtracting this from the actual time elapsed, to arrive at a plus or minus indication of the time in hand.

G. B. Weston,
Wooburn Moor,
Bucks.

SOUND BROADCASTING DYNAMIC RANGE

There has recently been comment in the press^{1,2} on the undesirability of a large (but relatively natural) orchestral dynamic range, as broadcast by the BBC. The opinion expressed is that a lightly compressed programme is unsuitable for domestic loudspeaker reproduction. Thus a reduction in transmitted dynamic range is demanded. Such a step would be regressive and could not be easily compensated for by those who have the facilities to appreciate a natural dynamic range.

My suggestion is that domestic amplifiers should incorporate a switchable dynamic range compressor. Thus the transmitted dynamic range could remain high, and those people (including myself, at times) who require music at reduced dynamic range could then adjust the compression as necessary, while retaining the option to appreciate the full dynamic range.

It is well known that simple compressors are unsatisfactory on high-quality equipment—manufacturers would be expected to fit circuits and controls appropriate to the quality of the rest of the equipment. It is my belief that most people who demand an increase in compression would not notice the transient distortion which automatic control introduces. This innovation would also encourage the record companies to decrease their compression.

J. M. Hughes,
The University,
Nottingham.

References

1. Angus McKenzie, *Hi Fi News and Record Review*, January 1975, p.107.
2. Tim Souster, "The Mike Oldfield concert", *The Listener*, January 23, 1975.

TWIN VOLTAGE STABILIZED POWER SUPPLY

Mr Linsley Hood is to be congratulated on an excellent piece of writing and a very nicely conceived design ("Twin voltage stabilized power supply", January issue). Nevertheless there are one or two points about which I am not entirely happy, and on which he may care to comment:

1. An output smoothing capacitor has been used, of 32 μ F. This is far too big since it will make nonsense of the current-limiting under conditions of initial connection (i.e., the current-limit won't work

until the capacitor has discharged its surplus coulombs into the luckless load). In theory there is no need for an output smoothing capacitor at all: in practice one will probably be found necessary to maintain stability, but it should not need to be greater than 1 μ F or so.

2. I am not at all happy about the 12-volt reference supplies. As Mr Linsley Hood rightly points out, the overall performance of the whole circuit depends basically on the stability of the reference voltage; and the simple series-fed zener which he uses is not really good enough. A further defect is that he has chosen a 12-volt zener, and this will have quite a large voltage/temperature coefficient. Three possible solutions to these defects present themselves: (a) change the zener voltage to 5.6, which is a zener with practically zero temperature coefficient; (b) use two zeners in series (8.2V + 3.9V, say) so that their temperature coefficients, which of course will be of opposite sign, cancel to near zero; (c) replace the zener with a suitable proprietary potted regulator.

Solutions (a) and (b) have, apart from the stated advantage regarding temperature-coefficient, no other virtues. In fact they also have a number of fairly obvious drawbacks. Solution (c), on the other hand, is ideal—potted regulators are cheap (Signetics, for instance, do a very high quality one for 67p); their stability, both long and short term, is excellent; and the external circuitry with them is not only simple but allows for a precise adjustment of regulated voltage. In short, a suitable choice of potted regulator provides such an obviously ideal reference source for Mr Linsley Hood's excellent design that I cannot for the life of me see why he has failed to use it!

J. F. K. Nosworthy,
Cranleigh School,
Surrey.

Mr Linsley Hood replies:

I am grateful to Mr Nosworthy for his kind letter and his helpful comments. To take his second point first, the suggestion of replacing the zener stabilization of the regulators appears to be an excellent one. I only wish I had thought of that idea myself! However, the intention of the design in its published form was not to provide a very high degree of precision and the simple arrangement shown was adequate in practice.

On Mr Nosworthy's first point, concerning the size of the output capacitor, and the magnitude of the energy stored in this, the answer is not so simple. In practice, all engineering design is a matter of compromise between conflicting requirements; between performance and economy of means; between versatility and simplicity. Depending on the design specification or the order in which the designer places his priorities, so the nature of the design which will be evolved.

Because, in this instance, I was prepared to accept the use of a 32 μ F output capacitor, it became practicable to use a relatively simple loop stabilization con-

figuration, having a straightforward 20dB/decade roll-off in open-loop gain and a good gain and phase margin with a wide range of output load reactances coupled with a very high d.c. stabilization factor. The use of a smaller output capacitor would have demanded a lower open-loop gain and a flatter open-loop frequency response, and a different balance between the conflicting requirements of source and load ripple rejection.

LOW-COST PRACTICE ELECTRONIC ORGAN

Electronic organs have continued to improve and prices are still competitive. In fact the "pop" enthusiast who is happy with a one-octave pedalboard is well catered for. However the "straight" organist who wishes to practise at home and needs two manuals and a 32-note radiating and concave pedalboard to RCO dimensions has much less choice and faces a much higher outlay. A low-cost practice instrument is therefore proposed, on which one manual and the pedalboard are monophonic, i.e. capable of playing only one note each at a time. If the other manual is polyphonic (i.e. chords can be played on it) much of the classical repertory can then be practised on it, including Bach's trio sonatas. Much "pop" music can also be played on it.

Monophonic manuals already exist and the u.j.t. gives single-resistor tuning though not an ideal waveform; other circuits are available¹ and tunable i.c. tone generators are now on sale. No monophonic pedalboard with 30 or 32 notes has yet been marketed, though a separate one-octave pedalboard is on sale. It would appear desirable to market a 32-note monophonic pedalboard which could be used in conjunction with instruments lacking a pedalboard, and/or incorporated in the low-cost practice instrument proposed. In either event the pedalboard might be arranged to tip on end when not in use. 32-note pedalboards are priced at £40 or more without circuits, and it might prove cheaper to mould the pedals etc. in plastic. A more drastic price reduction might perhaps be achieved by moulding the whole pedalboard in flexible plastic. The further alternative of moulding the whole pedalboard in rigid plastic and relying on proximity detectors to actuate the note played seems unlikely to find favour.

It is possible that a further reduction in cost might be achieved by limiting the polyphonic manual to a maximum of four notes at a time, as described by J. Asbery²; other methods might be developed for selecting from four tunable oscillators, e.g. by the interruption of light beams, but the devices used have of course to be shown to be cheaper than a conventional full range of oscillators. The practice organ might well have a headphone socket (with safe isolation), so that practice can be made inaudible to other people.

Opinions are invited from users as to

whether a low-cost practice instrument is worth developing, and if so what features should be included.

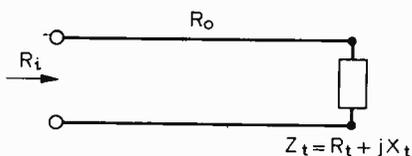
K. J. Young,
61 Madeley Street,
Derby DE3 8EZ.

References

1. Oscillators and networks with single-potentiometer frequency control, Young, K. J. *Electron. Compon.*, Vol. 12, No. 19, Oct. 1971.
2. Multiphonic organ, Asbery, J. *Wireless World*, June 1973.

IMPEDANCE OF A TRANSMISSION LINE

I read with interest the articles on transmission lines: "Graphical analysis of pulses on lines", in the September 1972 issue and "Transmission lines for the birdwatcher" by P. I. Day in the September 1974 issue. They have been very useful to me, as I could take some hints from them and they led me to a successful method of analytical and graphical resolution of transmission line problems which is different from that of the Smith Chart. I have been able to achieve a thorough knowledge of the Smith Chart, and it seems to me that it cannot help to solve the problem of matching a transistor to a line without a stub, as suggested in the second article. The problem in fact is to find the impedance of the matching line, and its length, and it is impossible to properly enter into the Smith Chart if the impedance of the line is unknown.



I am sending the resolution of the first part of that problem which may also help in the use of the Smith Chart to solve many other problems.

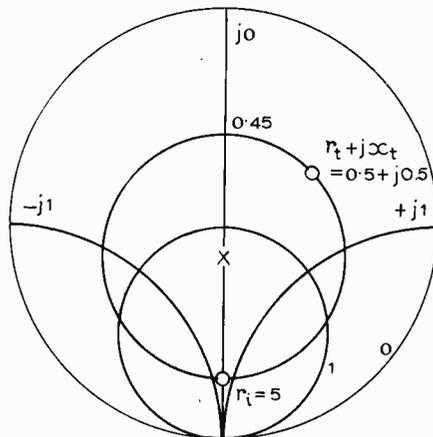
$$R_o = \sqrt{\frac{R_i R_t - R_t X_t^2}{R_i - R_t}}$$

In the transistor-matching circuit of the example in the article ($R_t = 50$; $R_i = 5 + j5$) the impedance is 14.9 and the length 0.193λ . I think the formula is original, and hope it will be useful.

Romolo Aratari,
Gioia Dei Marsi,
Italy.

Mr Day replies:

Sr. Aratari has obtained a result which certainly enables one to enter directly the Smith Chart, but he is incorrect in assuming that the Smith Chart cannot be used to determine the line impedance. There is a very simple construction by which we can find the impedance of a line needed to transform from one complex impedance to another. Obviously the situation he describes when we are transforming to a resistance is a special case of the general construction.



Basically we rely on the fact that a circle centred on the Smith Chart real axis can be transformed by a change of normalizing impedance to a circle anywhere on the chart axis. So to match $5 + j5$ to 50 ohms, as in the example, a possible procedure is as follows.

Choose any normalizing impedance, say 10 ohms, then the normalized impedances are $r_t + jx_t = 0.5 + j0.5$ and $r_t = 5$

Enter both points on the Smith Chart and construct a circle passing through both with its centre on the axis. The circle intercepts the axis at 5 and 0.45 so the required line impedance is

$$10 \sqrt{5 \times 0.45} = 15 \text{ ohms}$$

To find the line length the simplest method is to re-enter the Smith Chart using 15 ohms as the normalizing impedance. The original choice of normalizing impedance is completely arbitrary, but greater accuracy is obtained the nearer the circle is to being central.

The constructed circle must not intersect the chart boundary. If it does then the simple matching is insufficient; this condition is identical to the requirement that R_o be real, so R_t must lie outside the range $R_t \rightarrow R_t + X_t^2/R_t$.

Unfortunately I am not aware of any references covering the use of the Smith Chart in this off-centred mode, but undoubtedly they must exist somewhere in the technical literature.

ELECTROLYTIC CAPACITORS

I was most interested to read the survey on capacitors by Mr R. A. Fairs (December issue) and feel that the presentation was extremely useful. There is, however, one criticism which I would offer on his article, where he refers to the practice of etching aluminium foil in electrolytic capacitors (see p.512). The point is that etching does not increase the permittivity of aluminium oxide, which is generally between 7 and 10 . Etching is applied to the base aluminium foil and this can increase the surface area by up to three times that of a plain foil. The oxide layer is then formed over the etched foil, resulting in the subminiature capacitors which we see today.

The etch factor and permittivity "con-

stants" can be better recognized when the formula for a capacitor is examined.

$$\text{i.e. } C_{pf} = \frac{\Sigma \times A}{4\pi t \times 9 \times 10^{11}}$$

which becomes $C_{pf} = \frac{0.0885 \Sigma A}{t}$

where Σ =permittivity, i.e. $7-10$ for aluminium oxide, A =the area of each plate in sq.cm, and t =distance between plates in cm; (in the case of electrolytic capacitors this is the thickness of the oxide layer).

The question of etched foil capacitors being unable to withstand high currents is not entirely correct as multi-tab internal connections ensure that the high peak and/or ripple currents can be applied. Certain limitations to ripple currents do exist with regard to low CV products, due to the dissipation of heat (generated by the I^2R loss inherent in the electrolyte and connections) from the surface area of the can, but, in the main, etching of the foil only marginally degrades the tangent of loss angle ($\tan\delta$).

P. D. Habermel,
Mullard Ltd,
London W.C.1.

Mr Fairs replies:

The statement concerning the increase in permittivity of etched aluminium foils was not entirely correct. The point here is that, although etching increases the effective area of the foil, it does not alter the thickness of aluminium oxide coating applied after etching has taken place.

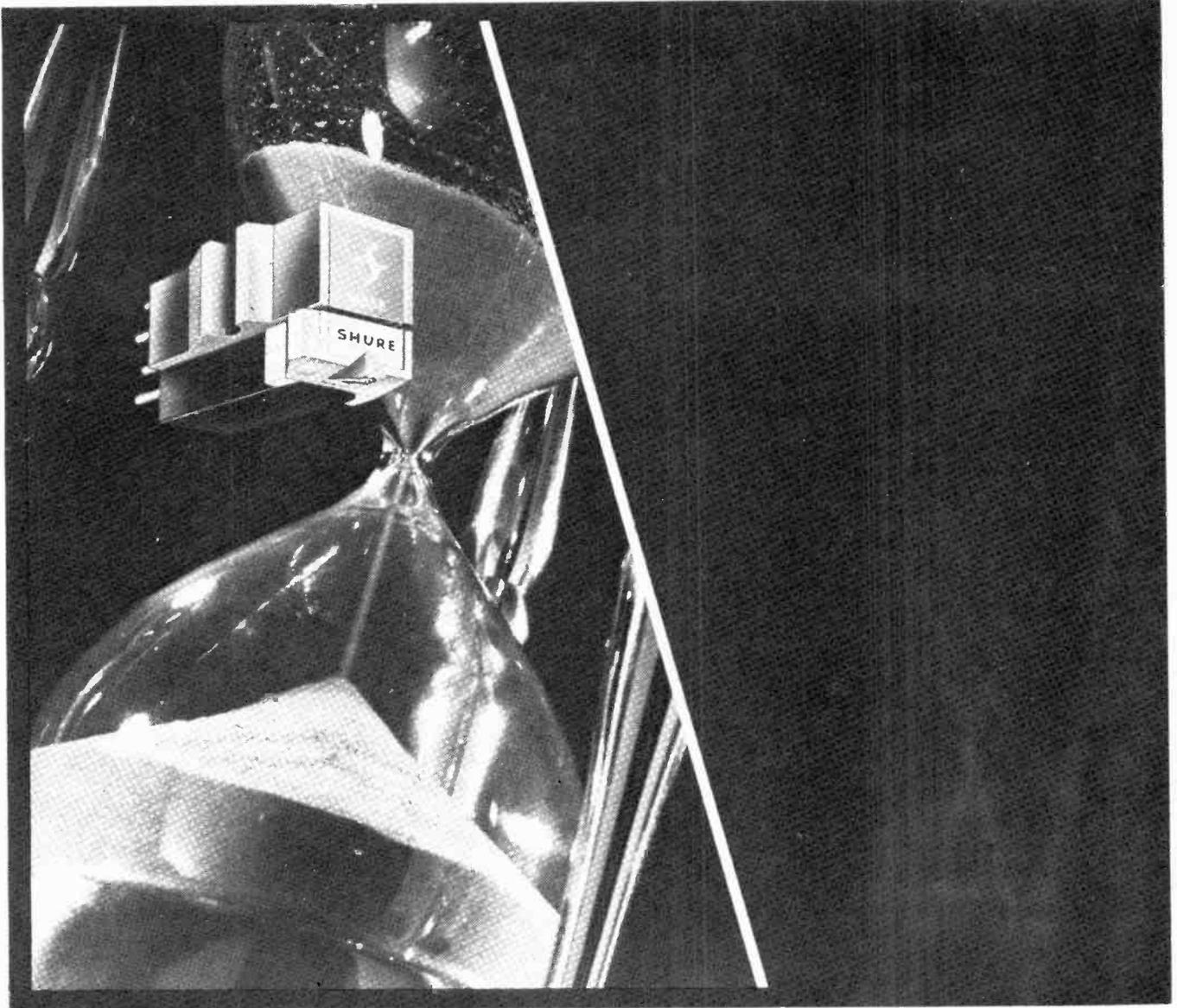
In the early days of manufacture of etched aluminium electrolytic capacitors, the aluminium oxide coating may have been inconsistent due to imperfections in the etch; this explanation would support my statement on this matter, the material for this part of the article being drawn from several research papers on this topic.

I do take Mr Habermel's point on this "increase" in permittivity and support the arguments he gives showing that etching does not cause an increase in permittivity of the aluminium oxide in present-day manufacture of electrolytics.

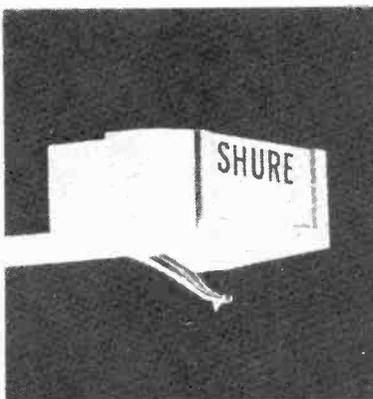
As Mr Habermel points out, the current rating of etched foil electrolytic capacitors is only slightly different from plain foil types. My statements on this matter were not intended to deter any would-be purchasers of etched film capacitors (which are usually adequate for almost every application) but merely to point out the design limitation that exists between the two types. It was unfortunate that space in the article did not permit a more fuller discussion on the differences between the two types of capacitor.

There is not much I can add to Mr Habermel's informative letter except that one can argue a slightly greater dissipation factor in etched film electrolytics due to tortuous paths in the etched film followed by the oxide layer; this argument can be considered trivial in present-day technology.

I thank Mr Habermel for his kind comments and his interest in the article.



If you bought a Shure M55E cartridge in, say, 1970...



It's almost certainly time you bought a new stylus if you have not already done so.

Although the stylus tip is a finely polished diamond, wear cannot be eliminated entirely and a gradual, perhaps imperceptible, deterioration in performance has taken place since your system was installed.

Fit an N55E stylus to restore the performance to the original standard or consider replacing the cartridge to upgrade the performance of your system. Why not ask Shure Electronics Limited for their recommendation?

Shure Electronics Limited
 Eccleston Road, Maidstone ME15 6AU
 Telephone: Maidstone (0622) 59881

I am at present using

Arm or Unit

Cartridge

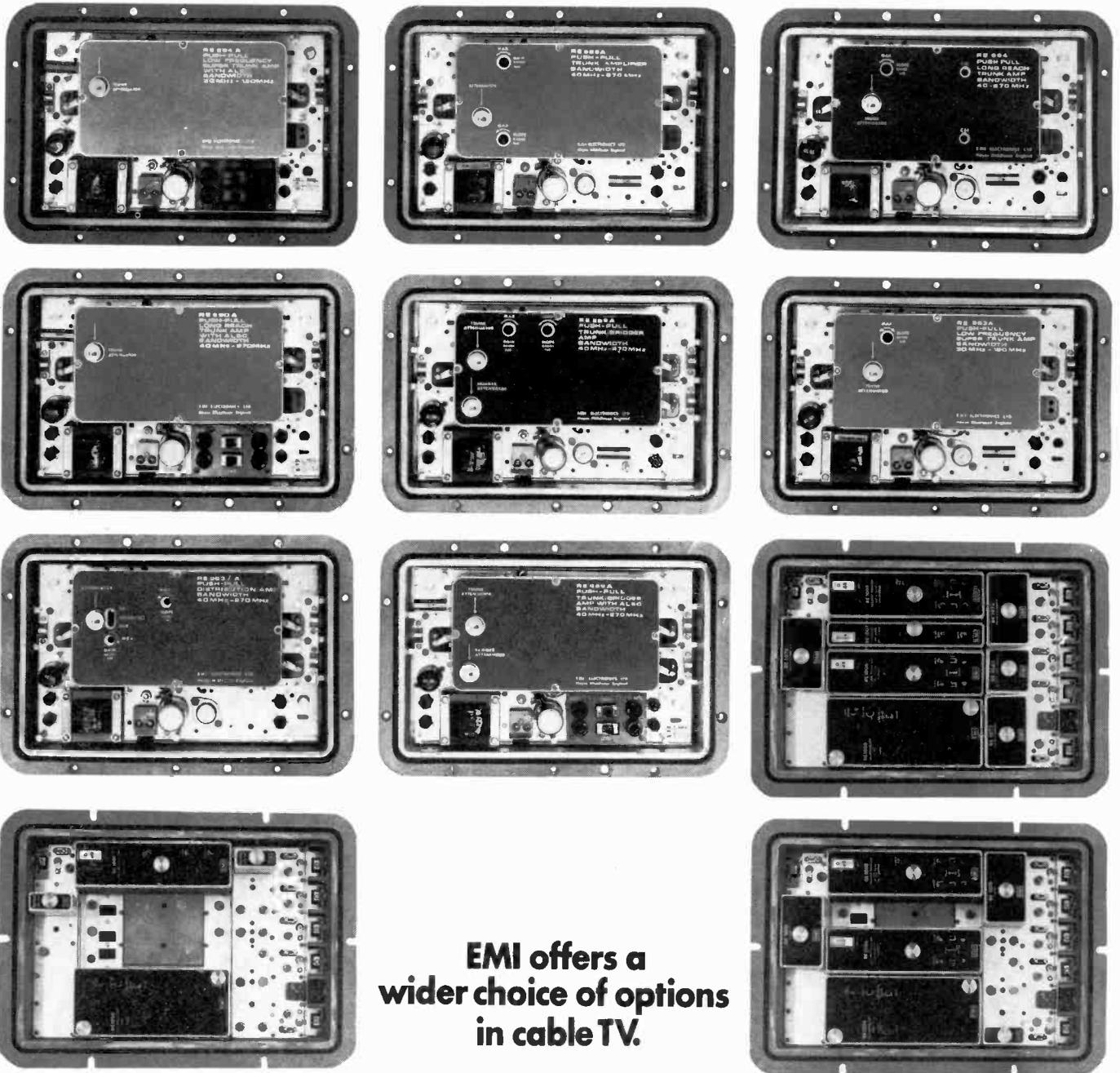
Amplifier

Name

Address

Please recommend the best Shure cartridge to upgrade my system.





EMI offers a wider choice of options in cable TV.

The quality of EMI Colorline cable television equipment is proved daily in systems bringing high quality television to hundreds of thousands of people—particularly in Europe.

Now EMI introduces a new range of modular VHF network amplifiers offering full two-way facilities.

The new range—the Colorline RE1000 series—has a basic forward bandwidth of 40-300 MHz with optional reverse band-widths of 5-30 MHz or 5-100 MHz. At the same time EMI also introduces a unique multi-channel VHF/UHF Distribution Converter. It enables up to seven channels to be converted from a VHF trunk network into the UHF bands for local distribution.

This new equipment, complemented by our Colorline RE900 series of VHF push-pull equipment and by the ME 690 modular series of VHF/UHF

MATV equipment provides the systems designer with an even greater variety of options to meet virtually every requirement of VHF and UHF cable distribution.

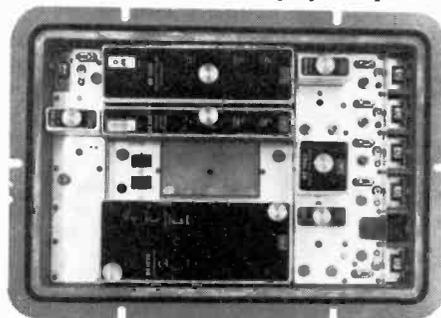
As pioneers in the development of high definition television, EMI has accumulated nearly forty years experience in every aspect of television broadcasting—embracing hardware, software and practical operating 'know-how'. This unique breadth of experience makes us highly competent to help you. Contact us at the planning stage.

That's what we're in business for.



EMI Telecommunications

A member of the EMI Group of Companies. International leaders in music, electronics and leisure. EMI Telecommunications Division, EMI Limited 252, Blyth Road, Hayes, Middx., England. Tel: 01-573 3888. Telex: 25145. Cables: EMISOUND London.



WW-210 FOR FURTHER DETAILS

Noise—confusion in more ways than one

2—Noise temperature and noise generators

by K. L. Smith

University of Kent at Canterbury

In part 1, temperature was shown to play a large part in discussions about noise. In this part the noise temperature concept is discussed more fully, together with methods of measurement at low frequencies using a noise generator.

If a resistor at room temperature is connected across the input terminals of an amplifier of bandwidth B (Hz), the available noise power kT_0B is amplified by the gain G_A . This means that the output power from the amplifier is $G_A kT_0B$. The noise power added by the amplifier must also be taken into account. If this amplifier contribution is P_{Na} at the output, it can be added to the above expression directly, because noise powers from different sources can simply be summed if they are unrelated. The total available output noise power P_{NO} becomes $G_A kT_0B + P_{Na}$ as shown in Fig. 5(a).

This is the point at which we think up our first bit of convenient fiction. We imagine that the amplifier is completely noiseless and account for P_{Na} by a (now fictitious) extra noise power available at the input terminals. So we write $P_{Na} = G_A kT_e B$. By this dodge we can replace a noisy amplifier by a noiseless equivalent, Fig. 5(b), whose output is

$$P_{NO} = G_A kT_0B + G_A kT_e B$$

or
$$P_{NO} = G_A kB(T_0 + T_e).$$

The whole thing is equivalent to an input source resistor at a temperature of $T_0 + T_e$ connected to a noise-free amplifier, where T_0 is the room temperature of the actual

resistor at the input terminals ($=290K$) and T_e is the effective input noise temperature of the amplifier. Like available gain, T_e varies with input matching conditions, so there is not a unique T_e for every system. It will depend on how the system is used. An amplifier with a low T_e is better noisewise than one with higher temperatures, other things being equal. The idea of T_e is a little abstract because it is not a physical temperature (the input of an amplifier with $T_e = 4000K$ would not be glowing white hot!).

One or two points arise at this stage. The first is that we are not limited to a source temperature of T_0 in every case. Thus the noise power output for a receiver whose effective input temperature is T_e and connected to an aerial whose aerial temperature is T_a is

$$P_{NO} = G_A kB(T_a + T_e).$$

Another point arising is to do with the bandwidth B —I have been assuming that we know all about it. B is not the normal 3-dB bandwidth used by radio engineers, but is the noise power equivalent bandwidth and involves notions about the available gain-bandwidth product ($G_A B$). I have relegated these ideas to a brief discussion in Appendix B.

There is another very easily overlooked complication and that is the possibility of more than one channel allowing signals and/or noise to pass through the system. An obvious example is the superhetrodyne receiver with a response at the image frequency. I often wonder how many experimenters measure the noise perform-

ance of their v.h.f. converters, oblivious of the fact that they have a wide open channel at the image frequency. Incidentally, this "improves" the (erroneously) measured single-channel noise performance figures, so one should beware of excellent-looking figures on some manufacturers equipment specifications.

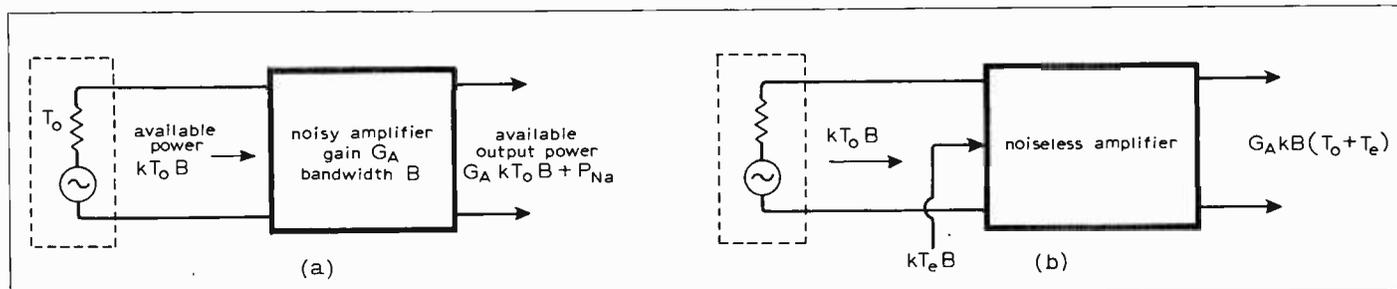
A useful concept in connection with the above arguments is that of the operational noise temperature, T_{op} . This is a measure of the overall system performance. A knowledge of T_{op} enables the all important output signal to noise ratio to be calculated. As an example of how this idea arises, consider a superhet with a gain G_s at the signal frequency and G_i at the image frequency, as outlined in Fig. 6. The noise bandwidth is usually B_{IF} for all channels, because it is set by the i.f. amplifier. The signal may occupy a bandwidth B_s ($B_s < B_{IF}$ because if the i.f. is narrow it will limit B_s to B_{IF}). The total available output noise power from this receiver will be

$$P_{NO} = k(T_s + T_e)B_{IF}G_s + k(T_i + T_e)B_{IF}G_i \quad (3)$$

where T_s is the temperature of the aerial, signal generator etc., at the frequency of the signal channel, and T_i is the same quantity but at the image frequency. If the temperature is constant over the two channels, then $T_s = T_i$.

The question arises, how do we handle P_{NO} for signals to noise ratio purposes? The answer is that if the available output signal power is P_{so} , the signal-to-noise ratio is given directly by P_{so}/P_{NO} , a little thought shows this to be the important

Fig. 5. It is more convenient to replace a noisy real amplifier (a) with a noiseless one (b), and account for the noise by inventing a fictitious noise temperature T_e at the input.



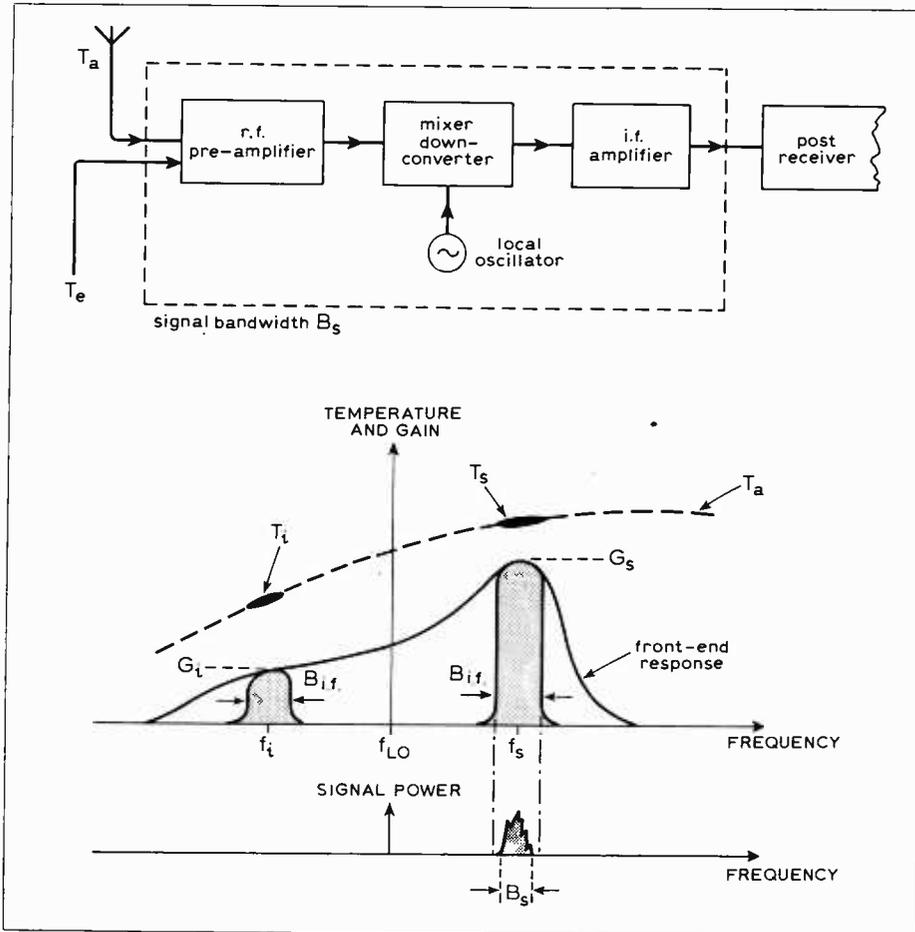


Fig. 6. In a superhet receiver there are usually at least two channels through which noise can pass to the output. Unless signal information is also coming in via the image frequency f_i , it is always advantageous to reduce G_i to the smallest possible value. The "shape factor" of the i.f. bandpass, B_{IF} also has a significant effect on the noise performance.

final parameter in any data link or communications system. The effect of the noise power is as though all of it is concentrated into the signal bandwidth B_s . Therefore we define another temperature, the operating noise temperature, T_{op} as $P_{NO}/kB_s G_s$.

Notice the particular gain bandwidth product used. You will be pleased to know this is about the limit of abstract thinking we need, so we will soon be back to more concrete things!) Substituting for P_{NO} , by using equation (3), and assuming for simplicity that $T_s = T_i$ and relabelling them T_a , the aerial temperature, operating noise temperature becomes

$$T_{op} = \frac{(T_a + T_e) B_{IF} (G_s + G_i)}{B_s G_s}$$

$$= \frac{B_{IF}}{B_s} (T_a + T_e) \left(1 + \frac{G_i}{G_s}\right)$$

Fig. 7. Overall noise temperature of a cascade of amplifier stages can be deduced as shown here.

This equation offers considerable meat to get one's teeth into. First, it illustrates the rationale of using temperatures in noise discussions. Awkward Boltzmann's constants cancel out and one is left with the various temperatures and parameters of the amplifier only. Clearly, the output signal to noise ratio degrades as T_{op} becomes larger. The lowest T_e should be the aim when designing the equipment and is achieved by noise matching and low noise components in the front end.

Care should be taken to understand the significance of T_a . For instance, the signal from a satellite is not enhanced when it is originating from the direction of the sun! (T_a shoots up.) Significantly, simple but all too easily-forgotten pieces of work need to be attended to, such as making sure B_{IF} is not greater than B_s . If the receiver bandwidth is twice as wide, say as that required to pass the signal, then T_{op} is doubled. The noise coming in via the image channel increases T_{op} . If $G_i = G_s$ (as in microwave receivers) T_{op}

is again doubled. The receiver designer should reduce the bandwidth to the minimum (B_s) and filter out the image, (make $G_i = 0$) to obtain the minimum operating noise temperature. Then $T_{op} = T_a + T_e$.

There are certain wideband signals which are received with a sensitivity advantage if both channels are wide open. Radio astronomical signals are themselves wideband noise powers. This means that useful signal powers are received in both sidebands. In fact the wider the bandwidth of the radio astronomy receiver the more signal power will be received. There is a worsening of signal-to-noise ratio by a factor of two if a double-channel receiver is used to receive a single-channel signal.

If the gain of the first stage of an amplifier or receiver is high, intuition might suggest that noise power contributions by later stages are not significant. Although intuition is not very trustworthy sometimes, in this example it is all right, as the following argument shows.

If we consider the three stages with gains and effective temperatures as shown in Fig. 7 then the output noise power is

$$P_{NO} = G_1 G_2 G_3 k B (T_i + T_e) \quad (4)$$

The noise output of the first stage is the noise power from the resistor times G_1 plus the contribution represented by T_{e1} .

Therefore the available noise output from stage one is $G_1 k B (T_i + T_{e1})$. The output from the second stage is its own noise, represented by T_{e2} , plus the input from stage one multiplied by G_2 . The output from stage two is

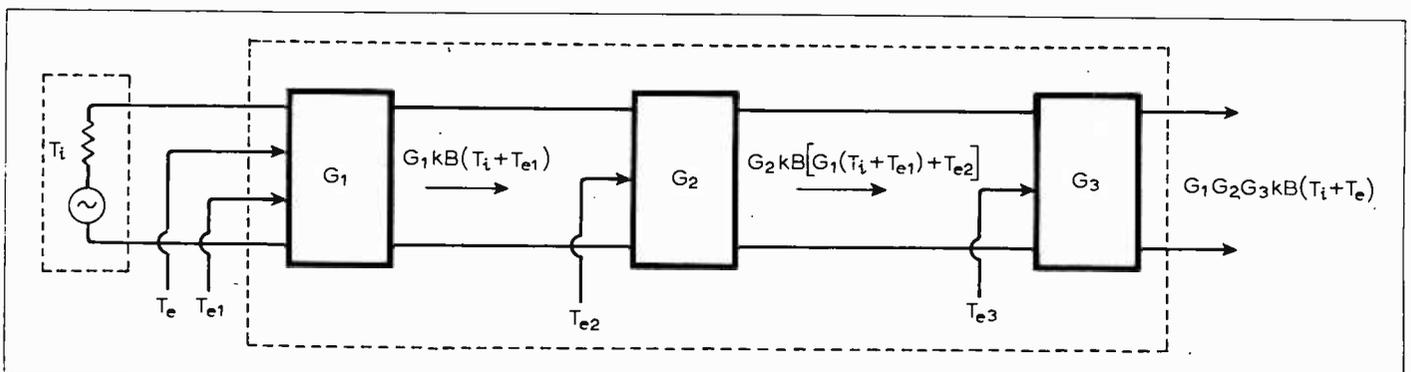
$$G_2 k B \{G_1 (T_i + T_{e1}) + T_{e2}\}.$$

Similarly the output from stage three, which is the final output noise power, is

$$G_3 k B \{G_2 [G_1 (T_i + T_{e1}) + T_{e2}] + T_{e3}\} \quad (5)$$

Equations (4) and (5) are both expressions for P_{NO} , therefore,

$$G_1 G_2 G_3 k B (T_i + T_e) = G_3 k B \{G_2 [G_1 (T_i + T_{e1}) + T_{e2}] + T_{e3}\}$$



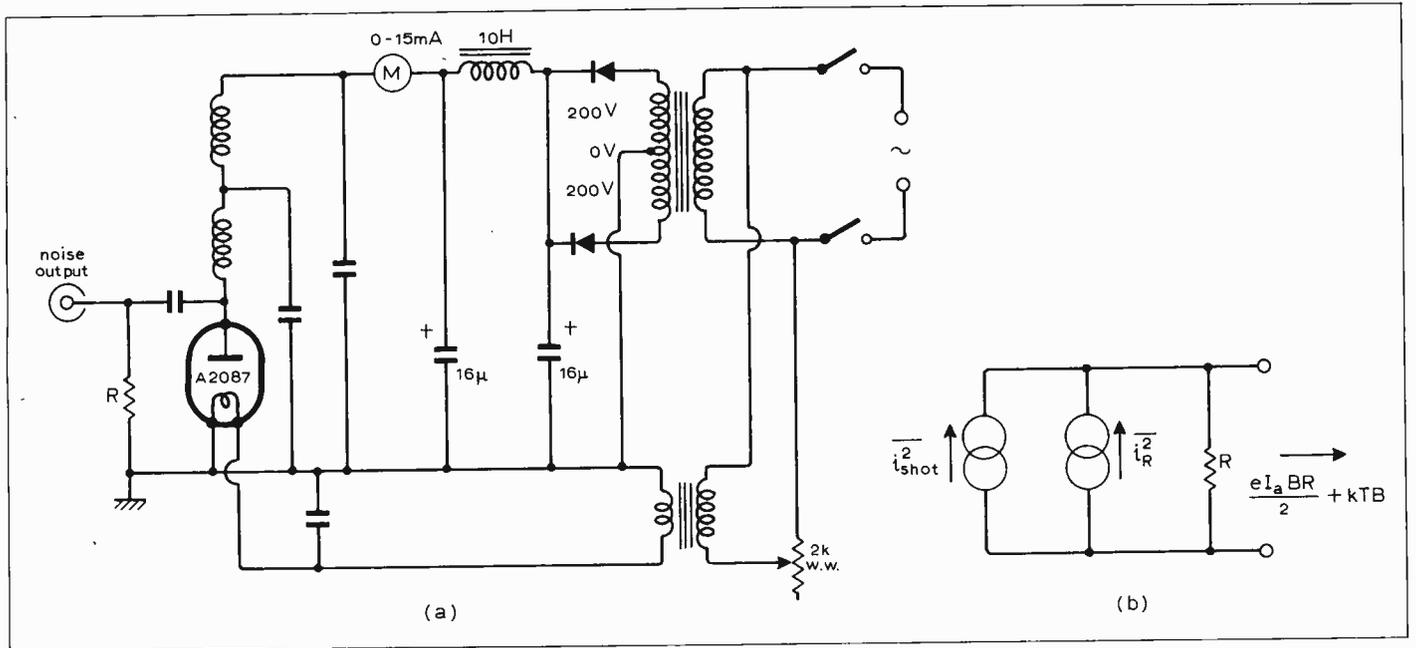


Fig. 8. Still an extremely useful noise source for measurement purposes, the saturated thermionic diode is an absolute noise generator. (a) shows a typical circuit using an A20B7, (b) is the equivalent circuit for calculation purposes.

This cancels down to the final simple equation:

$$T_e = T_{e1} + \frac{T_{e2}}{G_1} + \frac{T_{e3}}{G_1 G_2}$$

Notice that the term containing T_i conveniently subtracts from both sides. This equation shows that if the first stage gain is, for example, 100 times and the effective noise temperature of the second stage is 300K, then the contribution to the overall T_e by stage two is only 3K. Usually the third term can be neglected, unless G_2 is very small. The gain of stage three (G_3) has not entered into the picture. The argument can be extended to any number of stages. The equation is conveniently termed the cascading formula and in effect describes how the various noise temperatures throughout a chain of stages can all be referred to the front-end terminals as a single T_e , the system of stages is regarded from then on as noiseless.

Measuring T_e

The way in which I have discussed the role of the absolute temperature in noise problems, shows the convenience of dividing the output noise power from a signal handling system into two parts. One part is the noise that comes in with the signal represented by T_a and the other is that introduced by the local equipment, which accounts for the T_e term. This means that all the various noise powers produced in the local equipment are lumped together under the title T_e —whether they originate as thermal noise in the resistors, shot effect in the transistors or valves, flicker noise and so on.

If you have just built a receiver or a

customer has ordered a system to be designed with a stated maximum T_{op} , it is essential to be able to make fairly accurate measurements of T_e , so that you know what you are talking about. The basis for any noise measurements involves generating accurately known noise powers. The standard noise generators are based on physical mechanisms including the saturated thermionic diode, the gas discharge tube and the noise generated in a reverse biased semiconductor diode. Sine-wave signal generators can be used as standard power sources, but because they produce narrow band signals, their use in noise measurements involves difficulties interpreting what bandwidths mean and errors are very likely.

Before going on to the construction of noise sources, I will discuss a technique for measuring T_e . The following way for determining T_e might be termed the ratio method. A noise source with an effective temperature T_{hot} when it is fired, is coupled into the amplifier or receiver and the output $P_{NO(hot)}$ is noted on a power meter. The noise source is now switched off but still connected to the system. The temperature when the noise source is not fired can be labelled T_{cold} , with a corresponding output power from the system, $P_{NO(cold)}$. It is not necessary to know accurately the actual values of the output powers, only their ratio, A .

As an example, consider the superhet receiver for which equation (3) applies. Putting in the appropriate values for the "hot" and "cold" conditions, gives

$$P_{NO(hot)} = kB_{IF}(T_{hot} + T_e)(G_s + G_i)$$

$$\text{and } P_{NO(cold)} = kB_{IF}(T_{cold} + T_e)(G_s + G_i)$$

Dividing them gives A

$$A = \frac{P_{NO(hot)}}{P_{NO(cold)}} = \frac{T_{hot} + T_e}{T_{cold} + T_e}$$

From which we get

$$T = \frac{T_{hot} - A T_{cold}}{A - 1} \tag{6}$$

All we require to know is T_{hot} , T_{cold} and A . The bandwidths, gains and k have cancelled. This straightforward result applies for any system whether there are more channels than two or any other complexities. For best results, the value of A is often chosen to be two (the minimum error occurs near this value).

As usual, the assumptions made should be considered to avoid, or at least understand, errors that might creep in. T_{cold} is usually taken to be T_0 , but the temperature of the lab or workshop in which the measurements are made could very well differ by a few degrees from 290K, and there will be a corresponding error introduced. T_{hot} must be known accurately for the particular noise source. The matching conditions of the noise source to the receiver or amplifier should duplicate the conditions that will apply in the operational system. It is not certain that the source impedance of the noise generator when it is fired will be the same as when it is cold. Any difference that does exist will introduce an error in T_e , but it is difficult to establish any such impedance shift.

The output meter should be a true square-law device with voltage or current. In other words it should be accurately linear as a function of power. Any overloading or non-linearity in the amplifier will introduce errors. For instance, the common f.m. receiver is non-linear for amplitude changes, and cannot be investigated by the above method. (The front end could be checked separately, but we are discussing a.m. noise, which would normally be eliminated in this kind of receiver anyway. In f.m. systems the more difficult f.m. noise has to be considered). Errors also arise at the higher frequencies, mainly because of the usual effects of the stray reactances.

Sources of wideband noise, diode noise generators

One of the most useful noise generators for frequencies up to a few hundred megahertz is based on the temperature limited

diode. The full shot-noise generated by a thermionic diode operated under these conditions can be calculated exactly, but involves fairly complex statistical ideas such as Campbell's theorem. A treatment can be found in reference 9 (see part 1). Pierce derived the shot noise equation very simply but his method lacks the rigour demanded by purists. It is an interesting derivation and I have included an outline of it in Appendix C. The full shot noise produced on a direct current I_a in a bandwidth B , is

$$\overline{i^2}_{shot} = 2eI_a B$$

where e is the charge on an electron.

Because the diode is saturated, the effective source resistance of the shot noise generator is very high indeed. Fig. 8 shows a typical circuit for a diode noise generator with a source resistance, R . The equivalent circuit is also shown. The total available noise power from the generator is the sum of the noise power from the shot source and that from R , which is at the ambient temperature T . The two sources of noise power are not correlated, so that their outputs add directly as we have seen earlier. From Fig. 8(b) the available power from the two current generators is

$$P_N = \frac{\overline{i^2}_{tot}}{4G} = \frac{\overline{i^2}_{shot} + \overline{i^2}_R}{4G}$$

where the conductance G is equal to $1/R$.

$$\therefore P_N = \frac{eI_a BR}{2} + kTB.$$

Excess noise temperature, T_D , for a saturated diode is obtained by equating the first term on the right hand side of this last equation to $kT_D B$, so that $T_D = eI_a R/2k$. The numerical values of the physical constants, e and k give the value 11,600 for the quotient e/k . Therefore $T_D = 5800I_a R$. The total noise temperature of the fired source is T_D plus the contribution from R

$$T_{hot} = 5800I_a R + T \quad (7).$$

The cold temperature is simply T , because with the diode off, $I_a = 0$ and no contribution is forthcoming from the shot noise term. From these considerations we know the values of T_{hot} and T_{cold} to use in equation (6). Putting in the quantities gives

$$T_e = \frac{5800I_a R + T - AT}{A - 1}$$

which conveniently simplifies to

$$T_e = \frac{5800I_a R}{A - 1} - T.$$

A number of authors have used the ideas of the noise ratio and excess noise ratio. I think we have enough detail from the preceding discussions to illustrate at this point, how these ideas are used. You may recall the definition involves the ratio of the temperature to 290K or the ratio of the excess temperature to 290K respectively. The ratios obtained are really

noise power ratios, in which the bandwidth and Boltzmann's constant cancel. Being a power ratio, the results are often expressed in decibels. By dividing the equation above by 290K we obtain the noise ratio t_e

$$t_e = \frac{T_e}{290} = \frac{20I_a R}{A - 1} \frac{T}{290}$$

Often T is taken equal to 290K (but see my earlier cautionary note); in that instance this equation becomes

$$t_e = \frac{T_e}{290} = \frac{20I_a R}{A - 1} - 1.$$

The excess noise ratio for a diode generator can be obtained from equation (7) by subtracting 290K from both sides, then dividing by 290K

$$\frac{T_{hot}}{290} - 1 = 20I_a R + \frac{T}{290} - 1$$

and again if $T = 290K$

$$\frac{T_{hot}}{290} - 1 = 20 I_a R.$$

The diode noise source is very convenient because the temperature and noise ratios are directly proportional to I_a , and by just winding up the filament temperature, I_a can be set to any convenient values on an accurate anode current meter. (With due care not to burn out the filament of course!)

Ordinary lumped-component circuitry begins to fail as the frequency of operation rises toward the GHz region. The diode noise generator is no exception and errors begin to affect the result when measuring at the frequencies in question. Another effect becomes important at the same time: transit time of the electrons across the cathode to anode space is significant in the hundreds of megahertz range and the shot noise equation begins to break down.

To be continued

Appendix B Noise equivalent bandwidth

Perhaps you have noticed in the discussion so far, I have blandly assumed that G_A is "the power gain", without any real attempt to discuss how this quantity varies with frequency. Most amplifiers, whether intended or not, are severely

limited in their frequency response. This means that G_A is a maximum somewhere near the centre of the band and drops off towards zero at both ends of the response, except for d.c. amplifiers. If you think of a constant distribution of energy over the frequency spectrum (white noise) then the bandpass function "weights" the contribution in each very small band at points across the response. The total output power is a sum of all these weighted contributions. This is the kind of reasoning we do when finding averages. Fig. B shows an example to make the point clear.

We can imagine G_A to stay at its maximum value for a bandwidth B , then drop off sharply to zero at each side. If the width B of this fictitious rectangular bandpass curve is such that the output power is the same as from the actual response, then B is defined as the "equivalent noise power bandwidth". What we have really said is that the area of the rectangular curve is made the same as the area of the actual curve. This gives us a clue about the mathematical approach to writing down the definition. If the available noise power is constant over the band then the available noise power in any small band df , is Kdf . K is the constant level. Therefore the available output power is $G_A(f)Kdf$ and the total output power is

$$P_{No} = K \int_{bandpass} G_A(f) df.$$

By definition, the total output power is also

$$P_{No} = KBG_{A(max)} \quad (B1)$$

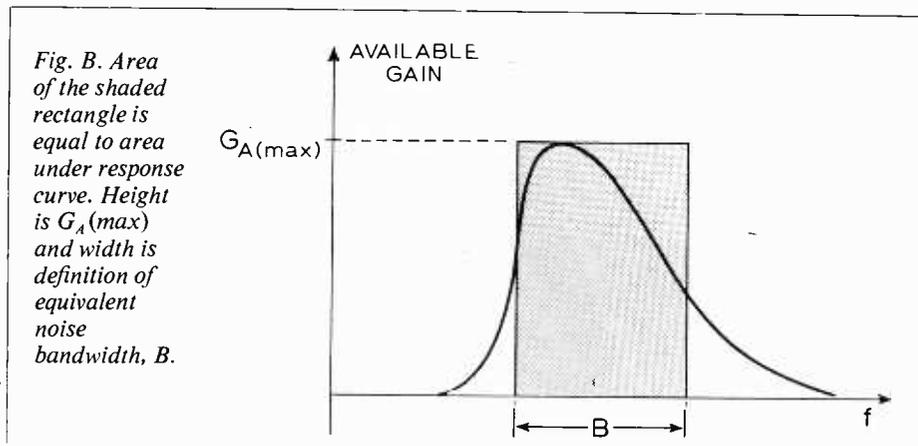
Equating these gives

$$B = \frac{\int_{bandpass} G_A(f) df}{G_{A(max)}} \quad (B2)$$

This is alright if you can do the integration or look it up in tables, but if, as usual, no simple function exists for $G_A(f)$, then the integral would have to be solved numerically. Equation (B1) shows that the amount of noise power emanating from the output of a system is proportional to the gain-bandwidth product $BG_{A(max)}$.

Note that B is not the ordinary "half-power" bandwidth; a simple example shows this to be true by relating the two bandwidths.

Consider the bandwidth to be limited by a series tuned circuit. The reactance at any frequency will be $X = \omega L - (1/\omega C)$. Using the equation for G_A (p.110) available gain is



$$G_A = \frac{K'R_{in}^2 R_g n^2}{(n^2 R_g + R_{in})^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

which can be written

$$G_A = \frac{\text{constant}}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

where R has been written for $n^2 R_g + R_{in}$. From this, $G_{A(max)}$ is $\text{constant}/R^2$. At the 3-dB points $|X| = \pm R$ because G_A is then equal to $\frac{1}{2}G_{A(max)}$. This condition enables us to write down the frequencies of the 3-dB down points. From $R = \omega C - (1/\omega L)$ and $-R = \omega C - (1/\omega L)$ we get two quadratic equations whose solutions are

$$\omega_1 = \frac{R}{2C} \pm \left(\frac{R^2}{4C^2} + \frac{1}{LC}\right)^{\frac{1}{2}}$$

and
$$\omega_2 = -\frac{R}{2C} \pm \left(\frac{R^2}{4C^2} + \frac{1}{LC}\right)^{\frac{1}{2}}$$

Subtracting gives the frequency difference

$$B_{3dB} = f_1 - f_2 = \frac{\omega_1 - \omega_2}{2\pi} = \frac{R}{2\pi C}$$

Using equation (B2)

$$B = \frac{1}{2\pi} \int_0^\infty \frac{1}{1 + \left(\frac{\omega C}{R} - \frac{1}{\omega L R}\right)^2} d\omega$$

The integral is a "do-able" one, and involves \tan^{-1} type solutions. Carrying out this solution, B is $R/4C$, which means that the relationship between B and B_{3dB} for a single tuned circuit is $B = \pi B_{3dB}/2$. Thus B is somewhat wider than B_{3dB} . The Table shows a few relationships for other band-limiting filters.

Circuit	Relationship
Two cascaded tuned circuits	$B = 1.22B_{3dB}$
Three cascaded tuned circuits	$B = 1.16B_{3dB}$
A staggered pair	$B = 1.11B_{3dB}$
A 4-pole Butterworth filter	$B = 1.11B_{3dB}$
A 6-pole Butterworth filter	$B = 1.05B_{3dB}$

The noise bandwidth approaches the 3dB bandwidth more and more closely as the "shape factor" improves. For ordinary i.f. amplifiers with a number of tuned stages, there is very little error if you assume $B = B_{3dB}$.

**Appendix C
Shot noise equation**

A simple but not very rigorous derivation of the shot noise current equation was ingeniously put forward in J. R. Pierce's paper, "Noise in Resistances and Electron Streams" published in the *Bell System Technical Journal*, volume 27 (1948). It goes something like this:

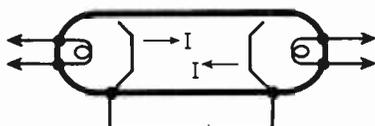


Fig. C. Artificial double cathode "diode" used by J. R. Pierce to derive the shot noise equation.

If a diode consisting of two emitting cathodes (Fig. C) has a potential V between them, a current I will pass equal to $I_V = I_0 \exp(eV/kT)$, where I_0 is the current that passes when $V=0$; that is, by the thermally energetic electrons "bridging the gap". Differentiating gives

$$\frac{dI_V}{dV} = \frac{1}{r_a} = \frac{I_0 e}{kT} e^{eV/kT}$$

As the mean square noise current expected from a resistance r_a is $i^2 = 4kTB/r_a$ and the diode "resistance" at zero volts is $r_a = kT/I_0 e$, it follows that $i^2 = 4eIB$ after substituting for r_a . This is the total noise current produced by the special case of two cathodes exchanging current. Because noise powers add, then the mean square current of one cathode is half the value and therefore $i^2 = 2eIB$, which is the shot noise equation.

(To be continued)

Wireless World noise reducer

Next month's issue will contain the start of an article describing the *Wireless World* noise reducer, an add-on Dolby processor mainly for use with magnetic tape cassette machines. This constructional design, the only one of its kind, has been planned in close collaboration with Dolby Laboratories and will be available from *Wireless World* in kit form.

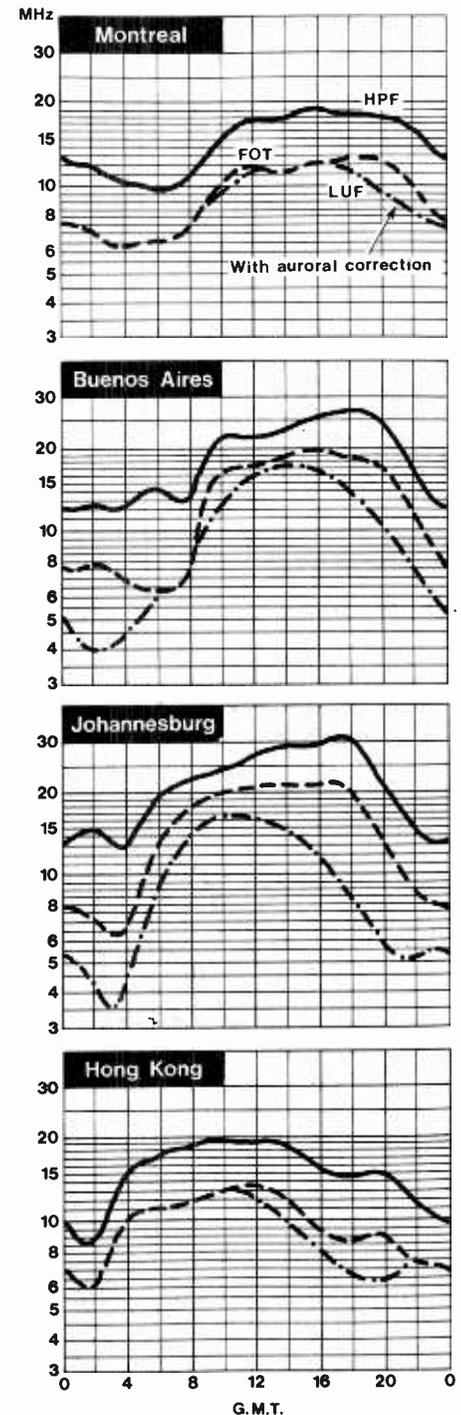
The unit includes a stereo Dolby B processor that is switchable for both encoding and decoding. This means that as well as decoding commercial Dolby B cassettes, encoded tapes can be prepared. For recording stereo broadcasts, a switched 19kHz pilot-tone filter is included. And should B-type encoding be adopted for f.m. transmissions, as in the USA, the unit will also decode those. There is another use of the processor. Because of the improved signal-to-noise ratio obtained with the unit, recordings can be made at a lower level that would otherwise be possible. Consequently some of the noise reduction can be traded for a lower distortion level at peak recorded levels.

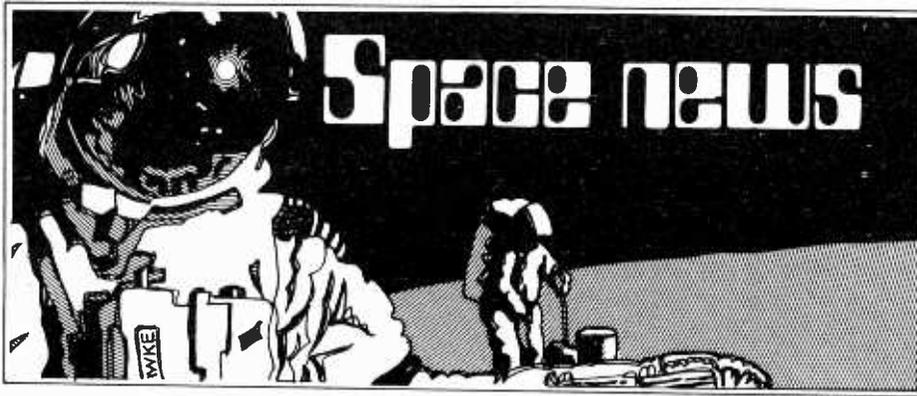
The *Wireless World* Dolby processor can be aligned without using additional instrumentation. The circuit board has been designed to include the required alignment facilities—400Hz and 5kHz oscillators are constructed from components in the *WW* kit, together with a 1-kHz meter calibration oscillator. Full alignment and calibration instructions are included in the article, which starts in the May issue with a description of the Dolby system and its functioning.

HF predictions

Predicted disturbed periods are March 23-28, April 4-10 and 19-25.

Seasonal trend and low solar activity combine to produce FOTs and LUFs which give a restricted choice of time and frequency for reliable day-to-day communication. The charts show that the restriction is severe when both ends of a circuit are in the northern hemisphere.





Seventh Intelsat IV Launch

The seventh in the series of Intelsat IV commercial communications satellites was launched on February 20 after a delay of two weeks from Cape Canaveral.

Final position of the 1400kg satellite is on the equator over the Indian Ocean. When in position there will be three Intelsat IVs over the Atlantic Ocean, two over the Pacific and two over the Indian Ocean, completing the world-wide network originally planned. Each of these satellites is able to carry approximately 3,500 two-way telephone conversations and 12 television channels. Despite the growth already experienced, the pressure of rapidly growing demands for international telephone, television and data transmission has led to the development of even larger communications satellites. The first of a new series designated Intelsat IV-A, with twice the capacity of Intelsat IV is scheduled for launch in the summer of 1975. The satellites are owned by the International Telecommunications Satellite Organization. Frequency re-use by means of a modified communications subsystem using 20 transponders and a novel antenna configuration with separate antenna beams will aid the capacity doubling of the A series. The opening of the frequency spectrum above 10GHz to satellite communications approved by the World Administrative Radio Conference in 1971 will eventually provide communications capacity at least five times higher than that available at the presently used frequencies of 4 and 6GHz.

The delay in launching the most recent Intelsat IV satellite which was scheduled for launch on February 6, was due to the failure of a single electronic component in the spacecraft.

Weather Satellite for Western States

The second in a series of weather satellites, Synchronous Meteorological Satellite-B, was scheduled for launch by NASA from Cape Canaveral aboard a Delta rocket at the end of January.

SMS-B (called SMS-2 in orbit) is to be placed in geosynchronous orbit over the equator at 36,357km altitude at 135

degrees west longitude, which is directly south of Sitka, Alaska, and about 15 degrees southeast of Hawaii. From this position it can view the western half of the United States and Hawaii while its sister spacecraft, SMS-1, can view the eastern US from its perch at 75 degrees west longitude on a line with New York City and just south of Bogota, Columbia.

The two spacecraft will be able to keep a 24-hour watch on the western hemisphere and provide cloud-cover pictures every 30 minutes to weathermen of the National Oceanic and Atmospheric Administration. Each carries a visible and infrared spin-scan radiometer that returns visible light daytime pictures of 0.9km resolution day and night. This continuous coverage is of special importance for short term phenomena such as the severe storm conditions that precede tornadoes. In addition, the west coast of Africa, breeding ground for hurricanes that strike the Caribbean, Florida, Gulf of Mexico and US east coast areas, will be kept under the surveillance of SMS-1. The primary types of data to be obtained consist of meteorological, seismic and

Copy of Indonesia's national communications satellite, scheduled to be in orbit after mid 1976, is pictured at Hughes Aircraft Company in California.



tsunami information. Both SMS spacecraft also carry a space environment monitoring system that monitors solar particle flux, X-ray emission and magnetic field direction and strength.

The US synchronous orbit spacecraft are expected to be joined, beginning in 1977, by similar spacecraft placed in orbit by the European Space Research Organization, Japan and Russia to form a global network of synchronous orbit satellites. The two SMS spacecraft, including all on-board instrumentation cost about \$60m, the Delta launch vehicles about \$4.5m each.

Self-repairing Memories

A technique for the self-checking of a faulty memory on board spacecraft* is under development by Intertechnique, a firm best known for its nuclear instruments and minicomputers. The concept was reported at the Large Scale Integrated Circuits Conference in Paris early in December. The self-check of a memory removes the data stored in it so the feature would be of little value in missiles after they have been fired but could be valuable for satellites. The check can be made after the memory is dumped and its contents transmitted to a ground station, but before it starts to store information again. Intertechnique's concept, which has been patented, is for the memory to check itself at two levels. The lower level is in the basic memory elements, made up of one or several shift registers. These basic elements are grouped together on a printed circuit board along with complementary-m.o.s. test and control logic integrated on a custom chip. Each element has a set of control logic and when a test sequence reveals a faulty one, the associated logic, in effect, shunts it out of the shift-register chain. These so-called elementary cards in turn work under control of a "system card" which contains circuits that interface the memory with the rest of the telemetry system plus c.m.o.s. logic to start tests of the elementary cards. If the test logic on one of them is faulty, meaning that reorganization at the lower level can no longer be made, the system logic shunts around the card and reconfigures the memory accordingly. The European Space Research Organization has so far funded the work.

**Electronics International*, December 1974, pp.14E, 16E, 18E.

Briefly

The Mariner-Jupiter mission scheduled by NASA for launch in 1977 will be the first deep-space probe to use X-band for telemetry and video transmission.

Skynet II, Europe's first communications satellite has recently been accepted as an operational system by the RAF acting on behalf of the Ministry of Defence.

Deflection amplifier for oscilloscopes

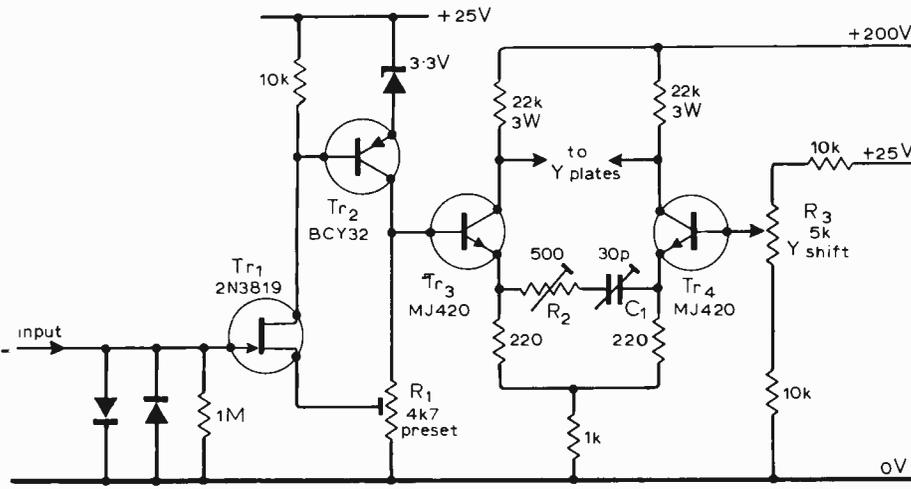
The circuit combines the advantages of a differential output stage and a high-impedance j.f.e.t. input stage. The silicon input diodes form a crude overload protection for the input of the f.e.t. amplifier. Transistors Tr_1 and Tr_2 act together as both an amplifier and a level shifter, the quiescent output voltage of Tr_2 being set by R_1 to approximately 15V. This also sets the gain of the amplifier unfortunately. A multi-turn preset was used for this purpose as the setting can be quite critical.

Transistors Tr_3 and Tr_4 form a differential output stage enabling an output swing of about 400V pk-pk. Feedback

is introduced through the 220 ohm emitter resistors and high-frequency compensation is brought about by R_2 and C_1 . Resistor R_3 forms the Y-shift control.

To set up for operation, set R_2 and C_1 to their maximum values. Set +15V at the collector of Tr_2 using R_1 . Inject a 10kHz square wave into the amplifier and increase C_1 to give the sharpest possible corner to the display without overshoot. Then increase R_2 as far as possible without losing too much of the squareness of the display.

G. A. Johnston,
Stechford,
Birmingham.



Oscillator uses passive voltage-gain network

It is frequently necessary to make a simple oscillator when a limited range of components are available. Most phase sensitive networks used to define the frequency of oscillation have attenuation at zero phase shift. A Wien bridge attenuates three times, a three-stage RC iterative filter 29 times. It is therefore necessary to use an amplifier, but the bandwidth of the convenient 741 is limited and it is a significant item of expense in this context.

Consider the circuit of Fig. 1. When $a = 2 + 2\sqrt{2}$,

$$\frac{V_o}{V_i} = \frac{2}{2\sqrt{2}-1} = 1.094$$

for zero phase shift and $\omega CR = 1$.

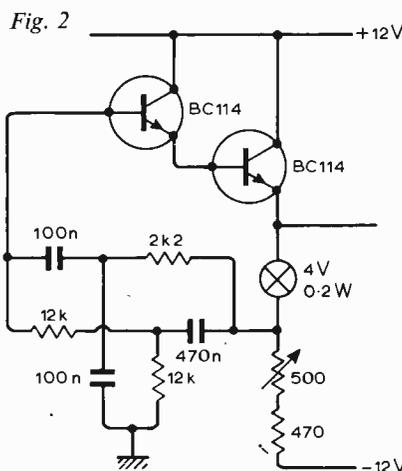
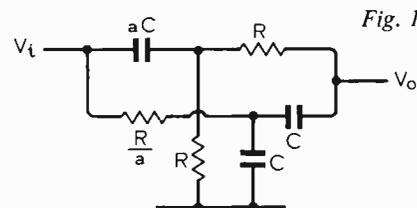
It is easy to obtain an output from an emitter follower greater than 1/1.094.

The circuit of Fig. 2 was tried using a super-alpha pair.

An output of 20V pk-pk was obtained. Factor a was fixed at $4.7 \approx 2 + 2\sqrt{2}$ as a preferred value.

A 4-V, 0.2W capless pilot bulb was used to stabilize the loop gain to unity, rather than the rarer R53 thermistor.

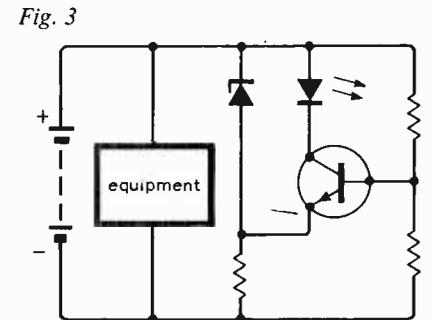
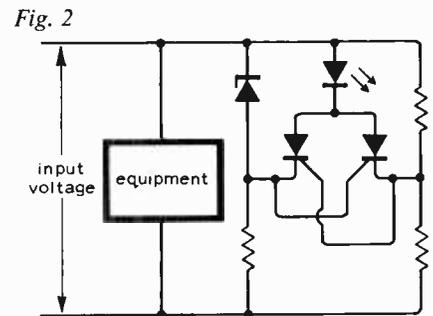
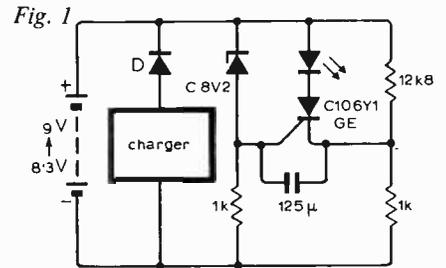
W. R. Jackson,
University of Bristol.



Low battery voltage indication

May I add something more to the interesting idea of P. C. J. Parsonage (*Circuit Ideas*, January 1973).

The low battery voltage indicator circuit can be modified to work as a high battery voltage indicator, or simply a high voltage indicator, just by interchanging gate and cathode connections of the thyristor. In particular, say a battery voltage is 8.3V and needs to be charged to 9V, then the circuit of Fig. 1 can be used. The l.e.d. lights when battery charges to 9V.



The l.e.d. in the circuit of Fig. 2 lights up when the input voltage is $>$ or $<$ $(V + \Delta V)$, where V is the normal voltage at which circuit is designed and ΔV is the change in input voltage at which l.e.d. lights up.

The cost of the equipment can be cut slightly by replacing the thyristor with a less costly silicon switching transistor, Fig. 3. This circuit can return to its original state (l.e.d. off) when the voltage returns to its design value.

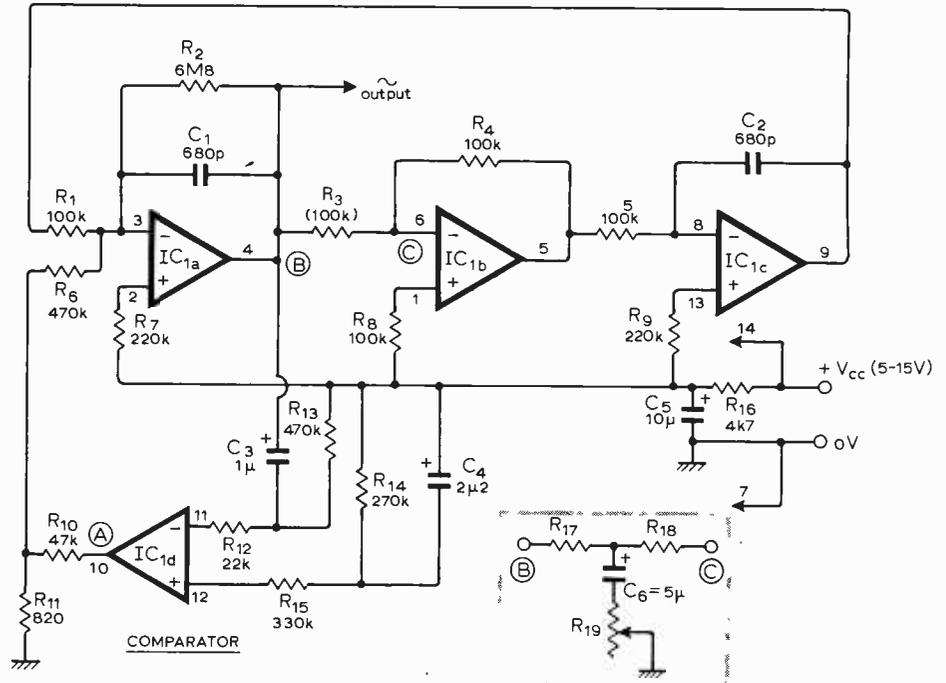
P. R. K. Chetty,
ISRO,
Bangalore.

Circuit Ideas

Sine oscillator uses c.d.a.

The circuit, new in realization but not in principle, produces moderately low-distortion sinewaves (typically 0.5% t.h.d.) which have negligible amplitude bounce on changing frequency. Further advantages are the ability to alter frequency with a single component and the low cost of the quad differential amplifier (LM3900N).

When the supply is switched on the comparator output initially goes to +V_{cc}; after about a second C₄ has charged and the output rapidly slews to 0V. This shocks the bandpass filter, formed by the two integrators IC_{1a}, IC_{1c}, and the inverting amplifier IC_{1b}, and causes it to ring. The resultant sinewave causes the comparator to produce a square wave which



is fed back into the loop to sustain oscillation. Sinewave amplitude is stabilized by virtue of the constant square wave input and is typically 0.25V_{cc} pk-pk, its purity being proportional to filter Q.

Frequency of oscillation (2.34kHz) and Q(62) are:

$$2\pi f = \frac{1}{\sqrt{C_1 R_1 C_2 R_5 R_3}} \quad Q = \omega C_1 R_2$$

Note that owing to the internal compensation of the amplifiers significant Q-

enhancement occurs at frequencies greater than a few kHz and this may lead to oscillation of the filter itself.

To vary the frequency the inset network can be used in place of R₃, the effective impedance being

$$R_{13} = R_{17} + R_{18} + \frac{R_{17} R_{18}}{R_{19}}$$

T. J. M. Rossiter,
Corpus Christi College,
Cambridge.

Pulse height modulator

This circuit reduces the spike feedthrough in series f.e.t. gates by always limiting the gate voltage swing to between the source voltage and the pinch-off voltage. Referring to Fig. 1, if the input voltage (V_i) is

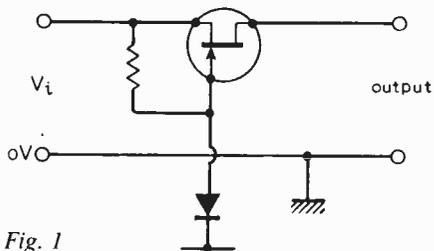


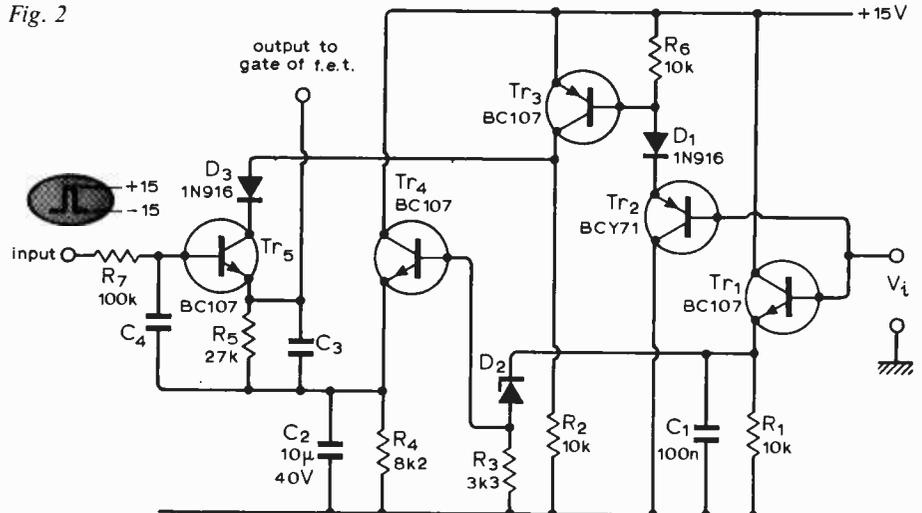
Fig. 1

varied between 0 and 13V, say from an op-amp, then the f.e.t. gate would have to be swung from +13V to -V_p volts (V_p is pinch-off voltage). Fig. 2 shows one version of a circuit used to limit the voltage swing on the f.e.t. gate to approximately V_i - V_p. Input voltage is monitored by the emitter followers Tr₁ and Tr₂ and Tr₁ emitter is maintained at V_i - V_{be} ≈ V_i - 0.7V. Zener diode D₂ is matched as nearly as possible to the measured V_p of the particular f.e.t. in use. If V_p < 1V a forward-biased diode (e.g. 1N916) may be used. The emitter of Tr₄ is therefore established at V_i - V_p - 1.4V. Tr₂, Tr₃ and D₁ establish the upper limit of the voltage swing to ≈ V_i. The switching waveform, a ±15V squarewave with

fast rise and fall times, drives the base of Tr₅. Clearly from Fig. 2 the output waveform cannot go below V_i - V_p - 1.4V or above V_i.

Capacitors C₃ and C₄ are optional. Capacitor C₄ increases the rise time of the output signal and C₃ increases the fall time. Very slow turn off times can be obtained by suitable adjustment of C₃, thereby giving further spike reduction. Resistor R₇ should be kept high because for low values of V_p and high values of V_i the emitter-base junction of Tr₅ will become reverse biased. Alternatively a diode can be placed between the emitter and R₅.

Fig. 2



The modulator was tried with a number of different types of f.e.t.s and always reduced the spike amplitude when compared to the spike produced by a full ±15V swing on the gate. By using a slow fall time the spike amplitude for this edge could easily be reduced by an order of magnitude. The circuit may need slight modification to suit individual requirements but works well with a slowly changing analogue signal and with switching rise/fall time of the order of 1μs.

M. D. G. Dabbs,
Home Office Central Research
Establishment,
Aldermaston, Berks.

NOW, more than ever,

S **single
source
makes
sense**

TO MINIMISE INVESTMENTS AND SOLVE STOCK PROBLEMS

You can increase your efficiency, too, by ordering large or small quantities of any one part, or making up an order of any number of assorted small quantities through the United-Carr Supplies service. We can deliver with more than usual promptitude because we carry such large and varied stocks of CINCH, DOT and FT electronic and electrical components. Fastenings and assemblies.

So, make United-Carr Supplies your SINGLE SOURCE for



Products, including Barrier terminal strips, Edge Connectors, Subminiature Connectors, Rocker switches, Indicator lights, Press fasteners and Metal & Plastic components.

Send now, stating possible requirements, for free and post free catalogue.

United-Carr Supplies Ltd., 112 Station Road, Ilkeston, Derbyshire DE7 5LF.
Tel: Ilkeston 78711 STD 06072 78711. Telex 377117. C.H.F.A.d.

WW-148 FOR FURTHER DETAILS

New. Sinclair IC20.

20 watts stereo amplifier kit

for only £7.95 (plus VAT)

A build-it-yourself stereo power amplifier with latest integrated circuitry...
10 W RMS per channel output...
full short-circuit and overheat protection.

Latest from Sinclair – the brand new IC20 power amp. It incorporates state-of-the-art integrated circuits – 2 monolithic silicon chips each containing the equivalent of over 20 transistors! These deliver 10 W per channel into 4 Ω speakers. And the IC20 has integral short-circuit protection and thermal cut-out – it's virtually indestructible!

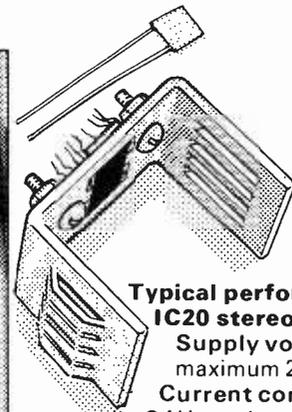
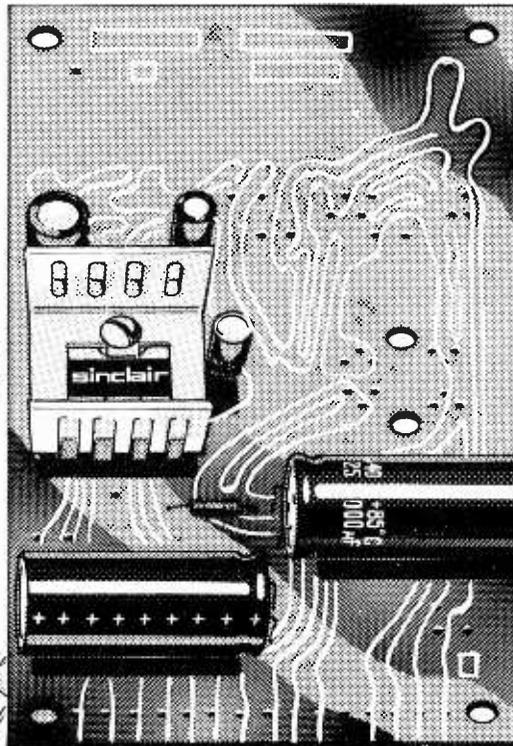
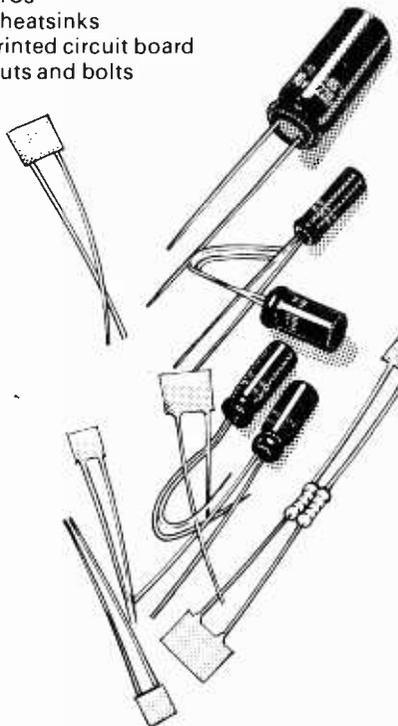
How should I use the IC20?

Use the IC20 for converting your mono record player to stereo... for upgrading your existing stereo... for improving your car radio/tape player. The IC20 runs off a 9-24 V power supply. If you're running the IC20 off the mains, simply add a Sinclair PZ20 power supply (£4.95 plus VAT).

Using the IC20 to improve your car radio/tape player's quality and volume? Run the IC20 off the car battery direct. You don't need a separate power supply, and you're reducing the drain on the player's dry batteries.

A complete kit!

6 resistors
15 capacitors
2 ICs
2 heatsinks
Printed circuit board
Nuts and bolts



Typical performance of the IC20 stereo amplifier

Supply voltage: absolute maximum 24 V, minimum 6 V.

Current consumption: 24 V, no signal – 20 mA each channel.

18 V, 9 W into 4 Ω – 770 mA each channel.

Power output: 14 V supply, 4 Ω load, 10% distortion – 5½ W RMS per channel, 20 V supply, 4 Ω load, 10% distortion – 10 W RMS per channel.

Total harmonic distortion: at 50 mW, 4 Ω load, 20 V supply – less than 0.1%.

Input sensitivity: for 9 W into 4 Ω – 90 mV.

Frequency response: – 3 dB at 40 Hz and 16 KHz.

Load impedance: 4 Ω or 8 Ω, but device is safe with any load.

Improve your audio equipment – today

Both the IC20 and the PZ20 are covered by the Sinclair one-year, no-quibble guarantee – if absolutely any defect arises, Sinclair will replace the whole unit – unconditionally.

You can find both the IC20 and the PZ20 at stores like Laskys and Henry's. But if you have any difficulty, send us a cheque direct and we'll send you an

IC20 and/or a PZ20 at once. 14-day money-back undertaking, naturally.

Sinclair Radionics Ltd,
London Road, St Ives,
Huntingdon, Cambs., PE17 4HJ.
Tel: St Ives (0480) 64646

VAT Registration number: 213 8170 88.

sinclair

An aerial rotator servo

by D. J. Telfer, A.R.I.C.

Lunar and Planetary Unit, University of Lancaster

This article describes a circuit for remotely adjusting angular displacements in a drive shaft, for use with 12–24V d.c. motors at continuous currents of up to 250mA. The system is well suited to a wide range of applications and has been very successfully employed as an automatic aerial rotator. The advantages of proportional control are available while preserving low cost and simplicity of design.

Sometimes there are applications in which the full potential of elaborate control equipment may not be fully exploited. In such instances, a less complex and more economical system could adequately perform the required operations. The control system to be described in this article is simple and yet has been found to be reliable in operation and particularly well suited for use in automatic aerial rotators. Although it was initially designed, while the author was with the Department of Physics, UMIST, for remote positioning of furnace charges, the circuit lends itself to many other possible applications, not least in the teaching laboratory as a technique for demonstrating the use of feedback systems and the principles of proportional control.

Proportional control system

A block schematic diagram is shown in Fig. 1. Use of a Wheatstone bridge to provide positive or negative error signals follows conventional practice. The spindle of one potentiometer RV_1 is mechanically coupled to the final drive (signified by the dotted line) and the other potentiometer RV_2 is the final drive position selector. A difference in the relative positions of the wiper arms of RV_1 and RV_2 produces an error signal which is amplified, firstly by the differential amplifier A_1 , and then by an output stage A_2 connected to the motor, whose direction and speed depend on polarity and magnitude, respectively, of the voltage applied across its terminals. The final-drive shaft keeps turning until the wiper arm position at the motor-driven potentiometer catches up with the selected setting of the control potentiometer. The error signal is thereby continually reduced until the motor stops with the final-drive shaft in the desired position. In the author's design, operational amplifiers are used for A_1 , and A_2 consists of two pairs of complementary emitter followers. An additional feature is the

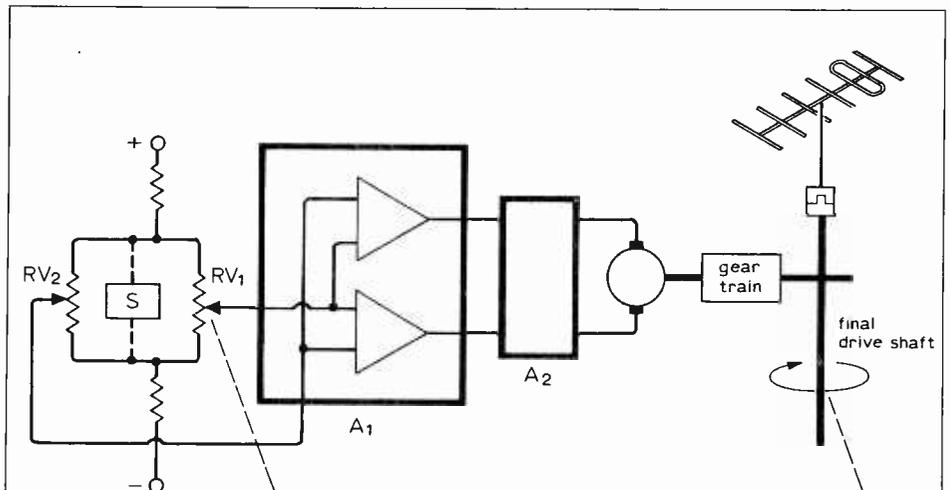


Fig. 1. Block schematic diagram of the proportional control system.

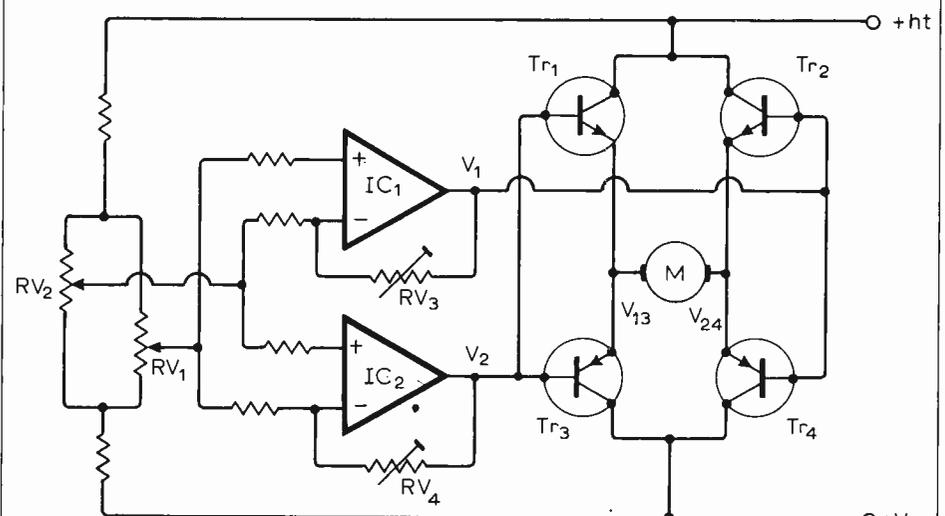


Fig. 2. The final drive shaft of motor M is coupled to the wiper arm of RV_1 .

electronic bridge shunt *S*, which is activated at the final stage of operation to ensure that the motor is switched off.

Amplifier. In Fig. 2 the d.c. error voltage is taken to a pair of differential amplifiers *IC*₁ and *IC*₂, whose gain is adjusted with preset potentiometers *RV*₃ and *RV*₄ respectively. When the wiper arm of *RV*₂ is more positive than that of *RV*₁, the output of *IC*₁ goes negative and that of *IC*₂ goes positive. Under these conditions, *Tr*₂ and *Tr*₃ are turned off, while *Tr*₁ and *Tr*₄ are turned on, affording a low resistance path through which the motor is connected across the supply. If the wiper arm of *RV*₁ is more positive than that of *RV*₂, *Tr*₁ and *Tr*₄ are turned off and conduction is through *Tr*₂ and *Tr*₃, whereupon polarity of the voltage applied to the motor is reversed.

Proportional control. The mode of operation is conveniently described by assigning three states to the system. Fig. 3(a) shows how the output voltage of *IC*₁ (*V*₁) and of *IC*₂ (*V*₂) varies with angular displacement, θ , of the driven potentiometer spindle with respect to the setting chosen for *RV*₁, which is represented by $\theta = 0$ at A.

In region D-C, the input signal is large enough to saturate both amplifiers *IC*₁ and *IC*₂. Motor voltage, which depends upon the difference between *V*₁ and *V*₂, is held at a maximum value. The final-drive shaft rotates at a constant angular velocity, and the spindle of *RV*₂ is driven towards the selected rest position that it will eventually take up at A.

At an angle θ_2 from A, which is predetermined by the setting of *RV*₃, the error voltage falls below that level required to saturate *IC*₁, and *V*₁ steadily decreases. Passage through C represents the onset of proportional control.

In the region B-A, amplifier *IC*₂ is no longer held at saturation. However, the setting of *RV*₄ is such that it has greater gain than *IC*₁. Its proportional control bandwidth, given by $2\theta_1$, is correspondingly narrower than that of *IC*₁. The value of *V*₁ - *V*₂ continues to fall, ideally reaching zero at A. If these conditions are faithfully transmitted to the motor, there is no residual current in the windings and the final-drive shaft comes to rest with the spindle of *RV*₂ exactly in the position determined by *RV*₁. In practice, the motor may stop when an appreciable voltage is still being applied to its terminals. Since at B the value of *V*₁ - *V*₂ is just over half its maximum value at C, this event will be captured within the narrow region BA, provided that mechanical loading is not excessive and that the motor is not severely under-run. Although the author has experienced no difficulty on occasions when 24V motors were run using a 12V supply, it is recommended that the h.t. voltage should be at least 60% of the voltage rating for the motor.

The output voltages of *IC*₁ and *IC*₂ are not transmitted faithfully to the motor because of the emitter-base voltage drop incurred at the power transistors. In Fig.

3(b), the emitter voltages of transistor pairs *Tr*₁, *Tr*₃ (*V*₁₃) and of *Tr*₂, *Tr*₄ (*V*₂₄) converge to plateaux centred at A. The difference between *V*₁₃ and *V*₂₄ is therefore the voltage applied to the motor. However, the range of θ values over which the motor is stationary, SAS', may be compressed by increasing the gain of *IC*₂. This will not affect the overall proportional control bandwidth of the system, which is given by $2\theta_2$, and is dependent on the gain of *IC*₁.

Protection of transistors. Quite low values of residual voltage across the motor can give rise to standing currents high enough to justify an automatic switching arrangement for protection of the conducting pair of output transistors, which will dissipate maximum power just before they become

biased to cut-off, when the emitter-collector voltages approach their highest values. The motor may be made to cut out below a certain applied voltage, within the region BA of Fig. 3(b), by connecting a suitable relay across the motor. For example, a motor rated at 24V maximum was run with 20V on the h.t. rail of the circuit. Satisfactory action was obtained from a reed switch having a solenoid resistance of 800Ω, operating at 7V.

Any such cut-out device must come into operation before the motor has actually stopped, resulting in a dead zone about A in Fig. 3(b) which is greater than SAS'. This state of affairs may be avoided by introducing a time delay so that the motor can stop at its limiting voltage before being switched off.

An alternative switching method, incorporating a delay, is shown in Fig. 4. This solid-state approach, which the author has found to be very effective, uses a complementary pair of transistors shunted across the bridge potentiometers. Conductance of the transistor pair *Tr*₅ and *Tr*₆ is appreciable only when both base voltages are within a limited range centred on half h.t. potential. The state of this circuit may first be considered with the input diodes *D*₃ and *D*₄ disconnected from the output of *IC*₂.

The bases of *Tr*₅ and *Tr*₆ are connected by a resistor through which most of the mutual base current will flow, since *D*₃ and *D*₄ are reverse-biased by the small potential difference reflected across this resistor. Base bias is forward at both transistors, which conduct and act as emitter followers. Their mutual load is the bridge, across which the voltage falls to a value approaching the sum of the voltages across the interbase resistor and the emitter-base junctions. In practice this total amounts to about 2V.

Next the connexion of *D*₃ and *D*₄ to the output of *IC*₂ is restored, via a limiting resistor *R*. No significant change will occur at the bridge shunt until the small reverse bias voltage at either *D*₃ or *D*₄ is cancelled by a voltage swing at *IC*₂, transmitted through *R*. When the output of *IC*₂ goes sufficiently positive, conduction through *Tr*₆ is maintained but *Tr*₅ is cut off. Conversely, *Tr*₅ conducts and *Tr*₆ is turned off during negative excursions. The diodes *D*₁ and *D*₂ protect *Tr*₅ and *Tr*₆ from Zener breakdown of their base-emitter junctions under reverse biasing conditions.

Finally, the onset of shunting action is delayed by introducing a capacitor *C* between the input of the shunt circuit and ground. A suitable choice of time constant for *RC* is about one-fifth of the duration of the proportional control régime.

Practical circuit

The circuit diagram of a practical design for use with 24V d.c. motors appears in Fig. 5. An electronic bridge shunt is employed and the unit may be run from a 15 to 28V supply. Feedback capacitors are included to lower the a.c. gain of the operational amplifiers in order to reduce transient response and provide a safe-

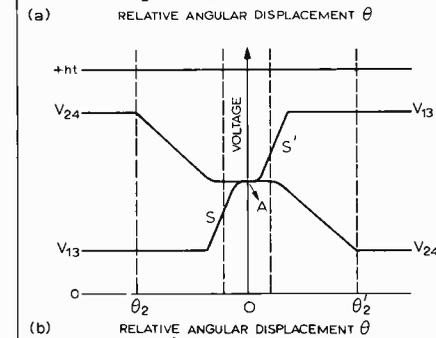
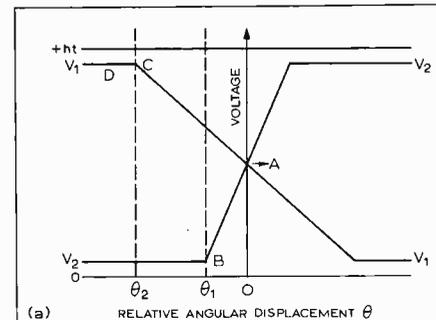


Fig. 3(a). Voltage at IC outputs plotted against θ ; at (b) is shown the voltage at emitters of power transistors plotted against θ . Limiting voltage of the motor is reached at S and S'.

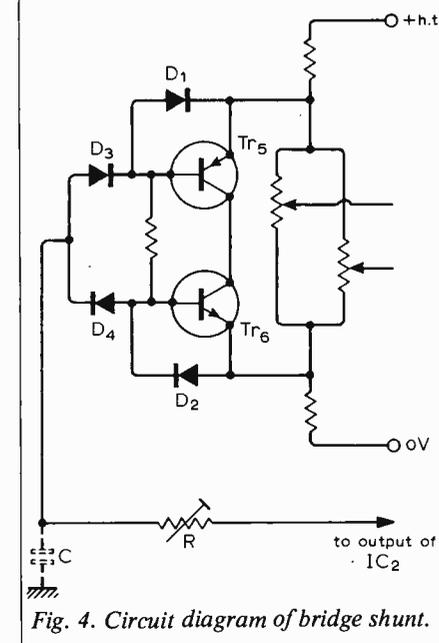


Fig. 4. Circuit diagram of bridge shunt.

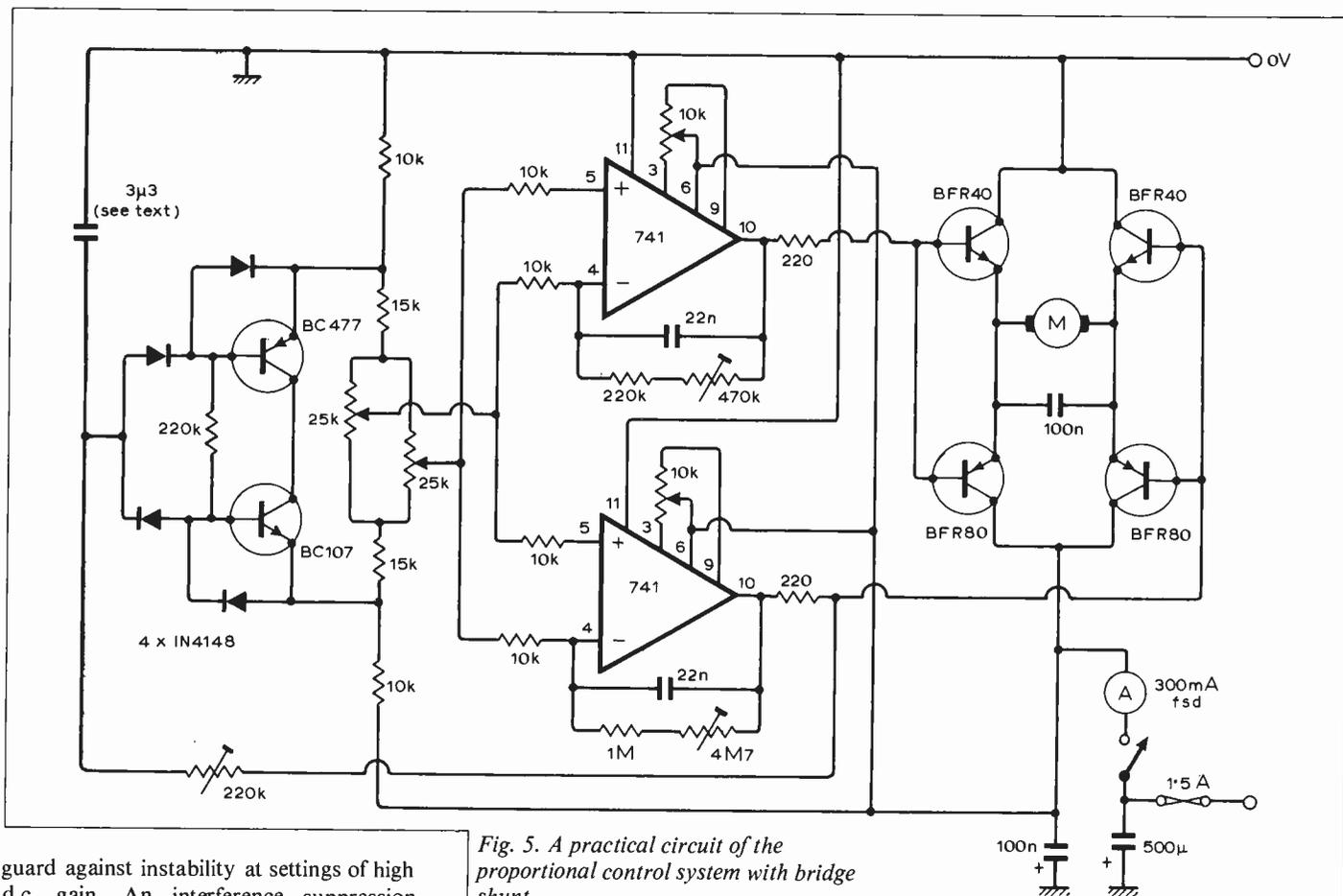


Fig. 5. A practical circuit of the proportional control system with bridge shunt.

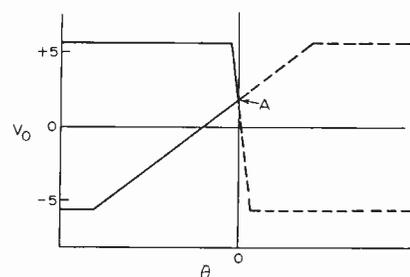
guard against instability at settings of high d.c. gain. An interference suppression capacitor is also connected across the motor terminals. Inclusion of offset null controls (the 10kΩ potentiometers) is recommended. Adjustments are carried out with the wiper arms of the bridge potentiometers brought to the centre of their tracks and then short circuited together. The offset null potentiometers are then set to give an output of exactly half h.t. potential at each operational amplifier.

A panel meter for monitoring the behaviour of the motor is a useful asset. Total current may be measured, as shown in Fig. 5, or, alternatively, motor voltage or current may be displayed, using a centre-zero instrument to follow directional changes.

The power supply should be capable of delivering 1A at the operating voltage and be well smoothed. Otherwise, requirements are not critical.

Performance. Operation with the bridge shunt is not critically dependent upon supply voltage, so long as the input capacitor value fulfils the time constant requirements mentioned above. Fine adjustments may be made with the 220kΩ preset potentiometer, which is normally set near mid-range. Efficacy of the shunt is improved if bridge resistance is high compared to the value of resistance presented by the shunt during its turn-on period. However, the values of bridge circuit resistors shown in Fig. 7 were found to be more than adequate and may be considered to represent an upper practical limit above which the performance of the differential amplifiers becomes adversely affected. This arises

Fig. 6. Illustrating the effect of displaced crossover point A on the symmetry of the proportional control characteristics. Amplifier output voltage V_o has its zero of voltage reference at half h.t. potential. The zero axis of θ represents here the situation when both wiper arms are at the positive end of the bridge.



because of the differences in d.c. input resistance of the inverting and non-inverting inputs, and variation in amplifier gain with wiper arm position at the bridge potentiometers. The operational amplifiers see highest source resistance, and experience concomitant reduction in gain, when the wiper arms are near track centre. In this region, therefore, the proportional control bandwidth becomes relatively expanded.

Measurements of amplifier output voltage were made with the bridge wiper arms positioned at similar track intervals and then shorted together. Experimental conditions and data are summarized in Table

1 for an h.t. of 15V and feedback resistors of 680kΩ (IC_1) and 4.7MΩ (IC_2). The behaviour pattern shown in Fig. 6 represents the situation with the wiper arms at the positive end of the bridge. The crossover point did not deviate markedly from the $\theta=0$ axis, but was displaced in voltage, being more positive than the half-h.t. potential axis, which is taken as the zero of voltage reference. At the negative end of the bridge, an approximately equal negative displacement relative to a centre offset potential of 0.25V was observed. The bridge shunt was removed during these measurements, which confirmed that the effective common mode gain of the amplifiers was near to unity. This tends to produce a degradation in symmetry of the proportional control characteristics, which change progressively from one end of the bridge to the other. Therefore, the ratio of voltage across the bridge to peak swing at the amplifier outputs should not exceed 0.15 if good symmetry is to be preserved.

Voltage reflected across the bridge is directly proportional to the supply voltage whether or not the bridge shunt is used, so that proportional control bandwidth at

	Deviation of output voltage from half-h.t. potential.		
	positive end of track	centre	negative end of track
IC_1	1.9V	0.25V	-1.5V
IC_2	2.0V	0.25V	-1.5V

given gain settings remains practically constant above 20V h.t. At lower h.t. voltages the discrepancy between peak output swing of the operational amplifiers and the supply voltage must be taken into account. During conduction, approximately 1.5mA base current flows at the power transistors. This loads the amplifiers sufficiently to produce a total discrepancy of about 1.5V. As the supply voltage is reduced, there is little change in this value, but its effect in decreasing the bandwidth becomes more noticeable.

In addition, the difference between h.t. and peak motor voltage amounts to approximately four volts, and this becomes an important consideration when using the circuit to drive motors at lower peak voltages.

Circuit properties are considered further in the light of other practical experiments. A small 24V d.c. motor (see Fig. 4) was connected to the circuit of Fig. 7, which was operated at 24V h.t. and with fixed

feedback resistors; 330kΩ for IC_1 and 4.7MΩ for IC_2 . Maximum potential across the bridge was 3V, falling to 0.7V at cut-off, when the motor current was reduced to less than one microamp.

An xy plot of motor voltage against amplifier input voltage V_i measured at the bridge wiper arms is presented in Fig. 7. Total proportional control bandwidth CC' was 82 degrees, centred at mid-scale, for a driven potentiometer electrical rotation of 280 degrees. The bandwidth of IC_2 was seven degrees, giving a practical dead zone of ± 2.5 degrees for a limiting motor voltage of 3V.

Potentiometer drive. There are various possible mechanical arrangements at the bridge potentiometers, and only the rotary type is considered. To cover rotation through a complete circle, a 360-degree potentiometer with 1:1 coupling is required at the final-drive shaft and also at the control box. Alternatively, the more usual

pattern with electrical rotation in the region of 280 degrees may be used in conjunction with pulley, chain or gear coupling of the correct ratio. If the absence of a 90-degree sector from the rotation range can be tolerated, direct 1:1 coupling may be retained, as in the rotator.

Aerial rotator

In point-to-point v.h.f. and u.h.f. communication, well-sited portable equipment incorporating a low-power transmitter can be capable of very encouraging results, particularly if a high-gain directional aerial is used, in conjunction with a reliable and accurate means of turning the mast. In aerial rotator applications the servo system may be used in conjunction with a variety of mechanical arrangements, depending on the requirements of the operator.

Basic construction of a portable aerial rotator for mounting on the roof-rack of a stationary vehicle is shown schematically in Fig. 8. The drive unit is readily demountable and an alternative type may be fitted if desired; Fig. 9 shows how the gearbox adapted by the author was installed. This was part of an ex-government switching unit having rubber mounting bushes and a 24V d.c. motor coupled to the final-drive shaft through 625:1 reduction gearing.

Removal of the lower cover plate exposed the switch wafers, which were then discarded to allow a feedback potentiometer to be coupled to the final-drive shaft through the 1:1 gearing as illustrated. Drive was transmitted to the mast through a simple dog clutch. A similar arrangement was employed at the potentiometer spindle, into which a slot was cut to accommodate a blade filed on the end of the coupling shaft. Although the potentiometer could have been mounted in a carefully positioned hole drilled in the lower cover plate, compactness was preserved by fixing the potentiometer case to the inside of the cover plate with soft solder, in the position shown. In order to mount the component in this way, the threaded part of the spindle collar was shortened. The spindle was of nylon to minimize damage in the event of accidental servo overruns at track limits.

Above the deck, short lengths of mild steel slotted angle were bolted together to act as a support for the vaned tube containing the aerial mast socket bush (Fig. 8). Grease was applied liberally to the mast socket bearing before fitting it to the bush. Positioning of the lower retention bolt allowed the mast socket assembly to be lifted just clear of the gearbox dog to permit easy and rapid alteration of the aerial reference direction by 180 degrees. An upper retention bolt was also fitted to secure the mast. Steel J-clamps were used to firmly fasten the rotator to a secure vehicle roof-rack (Fig. 10) and dimensions of the grooved mounting blocks were adjusted to suit the type of rack. Protection from the weather was afforded by fitting an aluminium cover over the gearbox and applying paint to external surfaces.

Upper torsional limits for the above

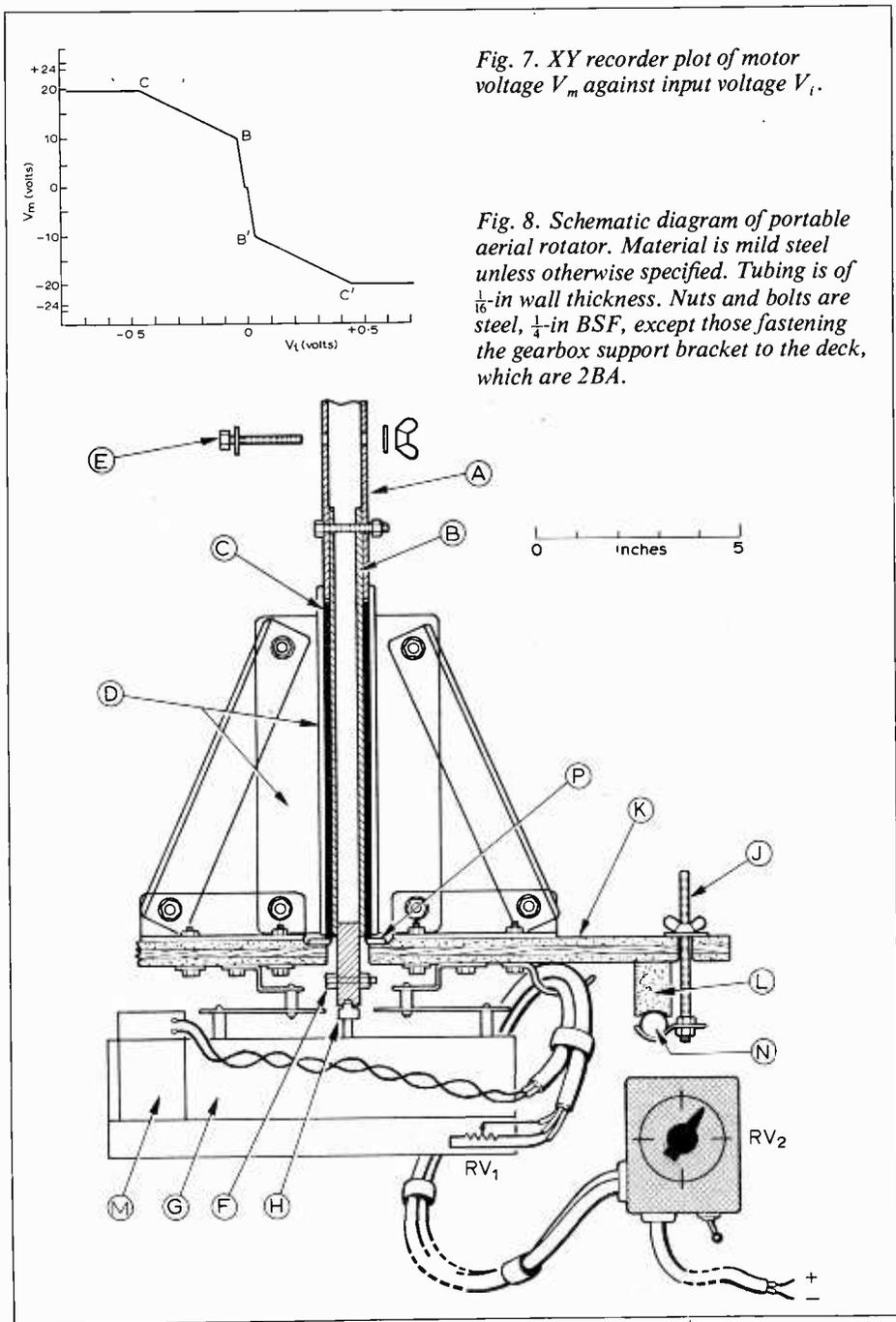


Fig. 9. Underside view of rotator showing adapted gearbox unit with lower cover plate detached to expose the feedback potentiometer (bottom right). Final drive shaft and dog clutch are in the centre, with the motor at left centre.

Fig. 10. Rotator secured to horizontal roof-rack bars.

gearbox were approached in normal weather conditions with an eight-element conventional Yagi array cut for the two-metre amateur band, which was supported at its centre of gravity on a five-foot mast. Aerials of greater physical size were not considered practicable on a free-standing mast fixed to this type of rotator.

Mechanical backlash in the blade and slot feedback potentiometer coupling has the effect of allowing the aerial to overrun its selected heading, but by judicious use of the relative sizes of blade and slot, can be made to correct any slight lag which may otherwise be present.

Feedback and control potentiometers should preferably have a linearity better than 2%, and the system be calibrated before operation.

In practice, the portable rotator has performed with consistent reliability in conjunction with the control unit described. Aerials have also included a 16-element aerial for the 70cm amateur band, using a five-foot mast.

When the portable rotator was used with the above proportional control unit, time taken for complete rotation of a 2m eight-element Yagi array was about 20s at 15V h.t.

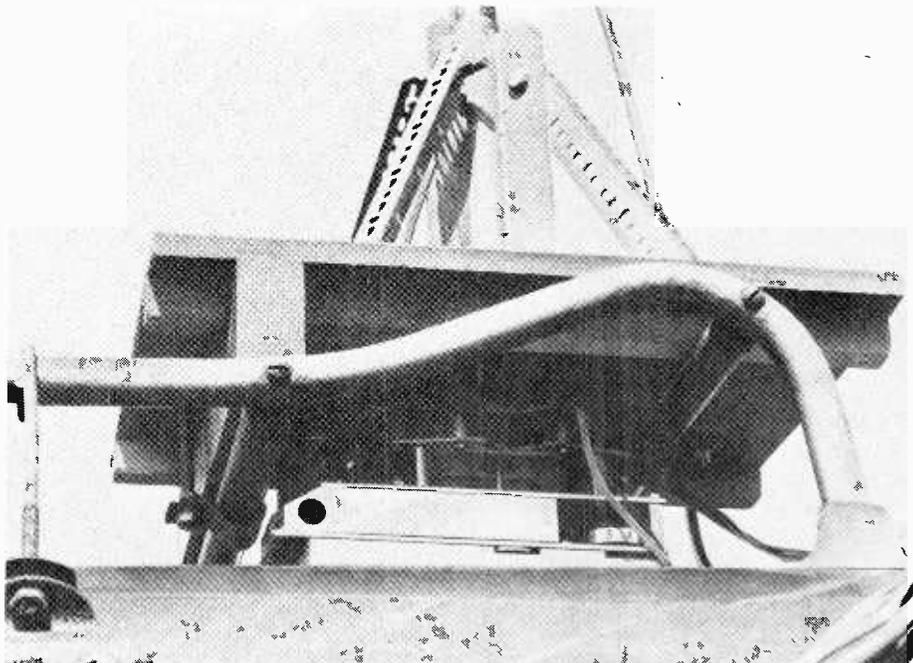
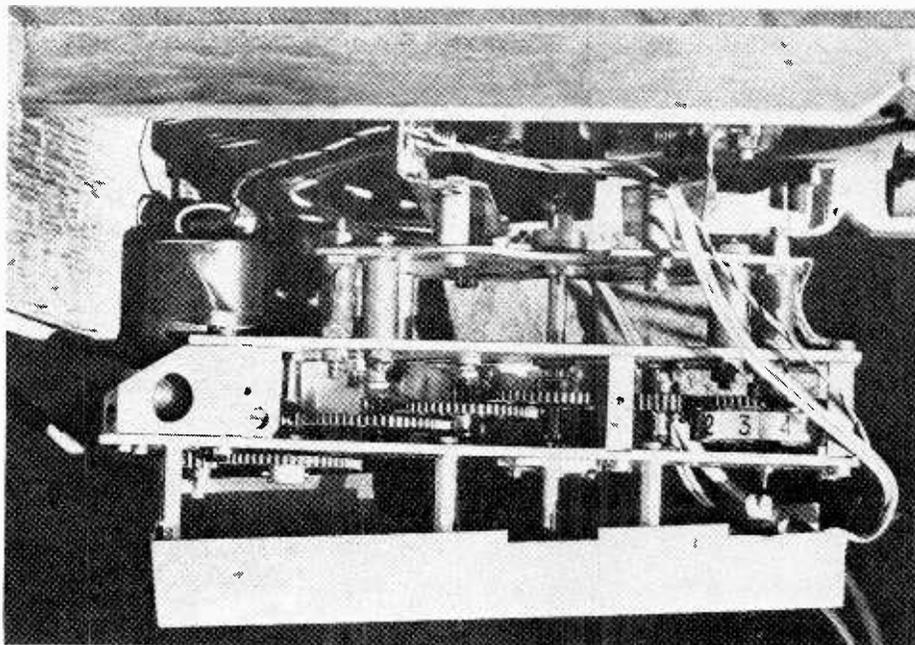
Circuit assembly. Components in the prototype were mounted on a 2½in square piece of 0.1in matrix Veroboard, in a 4½ × 3½ × 2in diecast box, with the control potentiometer and dial on the largest face. A five-cored cable from the motor and driven potentiometer was plugged into a DIN socket on the control box, allowing different motor units to be activated.

If the motor connections are reversed, an aerial rotator will become an automatic beam heading avoider. Care must be taken to connect the control and driven potentiometers in the correct sense, and to prevent mechanical damage to the latter component, operational checking should be carried out with both wiper arms near track centre.

Other applications

In common with other proportional control systems, the above design commends itself to a wide variety of possible functions. Simple modifications may greatly extend its range of capabilities.

By connecting a suitable amplifier (such as another 741) in place of the driven potentiometer, the system may be coupled to external probes or sensors. For instance, the e.m.f. across a thermocouple junction may be used for remote automatic position-



ing of a furnace charge. Position is manually pre-set with the control potentiometer.

If the driven potentiometer is mechanically disengaged from the motor, the unit becomes a manually adjustable reversible motor speed controller.

Law and insurance

It is of the utmost importance to ensure that, as a load attached to a vehicle roof-rack, the rotator and aerial conform to legal requirements.

There must be no danger to people inside or outside the vehicle. On a public highway the aerial and rotator also become illegal if any part extends beyond the front, rear or sides of the vehicle by more than 12in.

Any effect that the presence of the aerial and rotator may have on the vehicle's insurance should be ascertained.

The author has found that the authorities are very willing to help in these matters, and if the operator has any doubts about his position, he should not hesitate

to seek advice from the Traffic Department of the local police.

Suppliers

Transistors and integrated circuits were obtained from Texas Instruments. Minimum size of heat sinks for the power transistors will depend on circuit applications, and manufacturer's literature should be consulted. For the rotator, the TO-92 plastic encapsulation may be bonded to the diecast box with epoxy adhesive.

The surplus gearbox unit, and also separate d.c. motors, were obtained from North West Electrics, 769 Stockport Road, Manchester.

An extensive range of small gearboxes is manufactured and supplied by S. H. Muffet Limited, Mount Ephraim Works, Tunbridge Wells, Kent. For driving the rotator, the author recommends that a unit is chosen with an output ratio of 500-1,000 which is capable of delivering at least 30lb. in. continuous torque at the output shaft.

Recent loudspeaker developments

Consider the performance of a practical loudspeaker system in which the sealed volume of the enclosure, cone area and mass of the moving parts are kept constant. The results of changing the motor strength are plotted in Fig. 1. In the 70 to 500Hz range, if Bl (product of magnet strength B and coil winding length l) is increased output will increase, if it is decreased output will decrease. However, around resonance the reverse happens. Increasing Bl decreases output and decreasing Bl increases output. In other words efficiency or cone velocity for a given input at frequencies above resonance are directly proportional to Bl , while at frequencies around resonance these two factors are inversely proportional to Bl .

It can be seen from Fig. 1 that for a given loudspeaker system, and where a flat amplitude response is desired, the motor must be of the correct strength. If the motor is too small, efficiency is low and there is a bump in the bass. If it is too large, efficiency is high, but the bass response is down. This also shows that purchasing the speaker with the larger magnet could result in the use of a speaker with less than optimum bass response. By juggling motor parameters, there is apparently an inevitable trade-off between bass response and efficiency in the flat band. Restating the requirements, then, we need a large motor for high efficiency above resonance and a smaller motor for similar efficiency at bass frequencies.

Dual motors

The usual practice for adjusting the power output of the motor is to vary the magnet strength, B . To construct a speaker with two different magnetic field densities to drive the same cone would be both expensive and difficult to manufacture. Suppose instead it was possible in effect to make l vary with frequency in such a manner that a lower value of Bl in one frequency range would not affect a higher Bl product in another range and vice versa. Fig. 2 shows a simple method.

A second voice coil is wound over or under the conventional voice coil and is driven via a series LC resonant circuit adjusted to resonate at the same frequency as the fundamental mechanical/acoustical resonant frequency of the woofer. The LC circuit presents almost zero impedance at resonance and a sufficiently high impedance one octave either side of resonance to effectively remove voice coil 2 from the circuit. Thus l of voice coil 2 can be adjusted to eliminate the high value of motional induced back e.m.f. at the fundamental resonance, f_0 . A lower impedance path is provided at f_0 to maintain current

According to a recent article in the American journal *Audio*¹ it is possible to adjust separately the amplitude response of the upper range and bass frequencies of a single loudspeaker drive unit without one affecting the other, thus reducing the necessity for the motor (coil and magnet system) to be of an optimum strength for a system.

flow and the bass response at f_0 can be adjusted at will and independently of mid-range response above f_0 . In effect a second motor is added that generates less back e.m.f. and offers a lower impedance to the amplifier at the tuned frequency.

A voice coil gap of twice the width is not required to accommodate the extra voice coil. The output and inner clearance spaces are the same as usual and since a single layer coil with a notch in the top plate for the return end of the coil has apparently proved satisfactory, the gap width need only be increased by 25%.

Summarizing, the design (it is claimed) "does not involve trade-offs in areas of performance, requires no additional amplifier power or equalizer, has the

advantage of simplicity of construction and offers an improvement readily discernible on listening".

Soft speaker

Further to the item "Flexible speaker cone" (News of the Month, March issue), this system, under development in W. Germany by JWM Systems, has caused somewhat of a stir in the technical press, be it on an academic level of interest only. The flat diaphragm structure of this new loudspeaker is a flexible, highly viscous, elastic material. The diaphragm is driven at its centre by a conventional voice coil and magnet system. The area of radiation is inversely proportional to the radiated frequency.

To ensure that the radiation area is symmetrical around the centre point of the diaphragm, the voice coil is split into two, each section being fed with an offset current of opposite polarity. In similar manner to a differential input, like signals cancel so that the voice coil remains centred in the gap between magnet pole pieces. The system requires equalization to account for a 6dB per octave drop in response above 6kHz.

The new diaphragm² consists of a flexible bearing structure and a filling compound. A mesh of polyamide threads is used as a bearer, which is capable of stretching. In its manufacture, the diaphragm is radially pre-loaded (stretched) to a small degree and the visco-elastic filling compound is applied as a lacteal dispersion which dries like varnish and becomes interlaced in the polyamide.

The diaphragm is held at its circumference by the speaker basket frame and in addition there is a firm star-shaped support in the centre. In operation, amplitude is limited to a maximum of 3mm at the coupling point between voice coil and diaphragm. With the amplitude of vibration decreasing out from the centre, a smaller and smaller part of the diaphragm vibrates as frequency rises so that the large area required for moving a large air volume at bass levels and the low mass favourable for rapid movement at high levels is achieved with the single diaphragm. The prototype drive requires a continuous input of 3.2W for 96dB s.p.l. at 1m at 1kHz.

References

1. Watkins, W. H., "New Loudspeakers With Extended Bass", *Audio* (American journal), December, 1974, pp. 38-46
2. Pfau, E., "Ein neuer dynamischer Lautsprecher mit extrem nachgiebiger Membran", *Funkschau* (reprint), March 15, 1974.

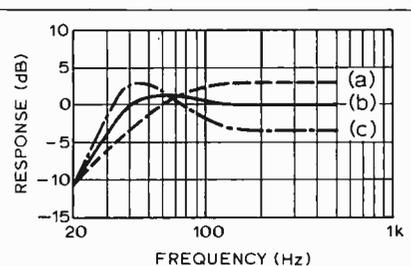


Fig. 1. Loudspeaker amplitude response for different values of motor strength (a) motor too large, (b) motor optimum, (c) motor too small.

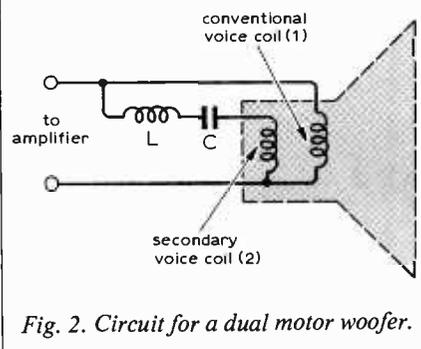


Fig. 2. Circuit for a dual motor woofer.

Voltage-to-frequency converters

This article complements set 21 of Circards

by J. Carruthers, J. H. Evans, J. Kinsler and P. Williams

Paisley College of Technology

Voltage-controlled oscillators—astable multivibrators—waveform generators—frequency modulators: under each of these headings one finds circuits that have an important common property, that the output frequency is a function of some reference or control signal. Such circuits are multi-variable systems in which several parameters of the output waveform are controlled singly or in various combinations by other parameters at the input. Thus the same circuit can appear under different headings depending on which input/output relationship is of priority concern.

As an example, some recent integrated circuits have been designed as waveform generators with square/triangle/sine wave outputs. If the output waveform is of no particular concern, the fact that the frequency of each output is proportional to a direct control voltage assumes a greater importance. The circuit can then be called a voltage-controlled oscillator. Now assume that the control voltage is set to a particular quiescent value with a smaller alternating voltage superimposed. Then the output frequency is modulated by the a.c. input, with the carrier frequency corresponding to the quiescent value of control voltage. The label for this circuit is frequency modulator.

In set 21 of Circards the primary property of interest is the relationship between an input voltage or current and the frequency of the output, with much less importance being attached to the wave shape or amplitude. A particularly desirable property is that the voltage-to-frequency relationship be linear, and in extreme cases departures from linearity of as little as 0.01% may be desired. In the process of achieving this, the output pulse height and width may have to be equally well controlled but these are a means to the end and not an end in themselves. There are other cases where the frequency needs to be varied only over a limited range, demanding only a small linear region to the V/f characteristic. A good example is found in the design of v.c.os for high-frequency phase-locked loops. Restriction of the frequency range and of linearity is a compromise accepted more or less willingly in exchange for a speed capability that matches that of the associated digital circuits.

In nearly all of these examples, the basic timing mechanism is that of charging a capacitor from a control voltage or current. The voltage change across the capacitor is sensed by some level-detecting circuit which activates an electronic switch

to discharge the capacitor and restart the cycle. Two categories of circuit can be clearly distinguished:

- where the discharge time of the capacitor is made short compared with the shortest charging time and need not be under the control of the input voltage, and
- where both charge and discharge times are controlled in common by the input. The first-mentioned circuits produce sawtooth waveforms across the capacitor and short duration output pulses, while the last-mentioned commonly develops a triangular wave across the capacitor, in association with a square wave at a separate output.

These ideas are illustrated in Figs 1 to 4. In Fig. 1, constant current results in a constant rate-of-change of voltage across the capacitor, i.e. the time taken to charge to a given p.d. will be inverse to the charging current. If that level can be sensed and caused to end the cycle or half-cycle, then the repetition frequency (being inverse to the period of the waveform) will be proportional to the current and a linear I/f converter results. The simplest way of causing the cycle to recommence is to place a low-value resistor across the capacitor to discharge it in the shortest possible time. If the discharge current is large compared to the charging current, then it is immaterial whether the charging current is disabled or not and Fig. 3 represents the basic principle of many V/f converters, with the switch periodically closing at the instant when the p.d. across the capacitor reaches a defined value.

An alternative principle is shown in Fig. 4. The current generator is applied to the capacitor in the reverse direction giving an opposing slope to the ramp but of equal magnitude. The resulting waveform is triangular with the repetition frequency linearly related to the current if the points at which switching is initiated are defined. The provision of a purely electronic two-pole change-over switch is difficult, and the reversal of current direction is more often achieved by using a single-pole switch or its equivalent to control the current generator directly.

A second problem that often arises is that the changing p.d. across the capacitor affects the nominally constant current. This is obvious in terms of the non-linearity of the ramp, but may not affect the linearity of the

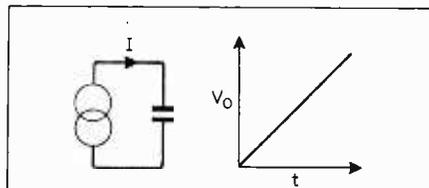


Fig. 1. Constant charging current allows repetition frequency to be made proportional to current.

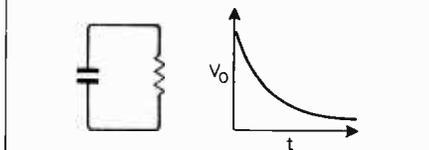


Fig. 2. To cause charging cycle to recommence, a low-value resistor is switched across the capacitor to discharge it quickly.

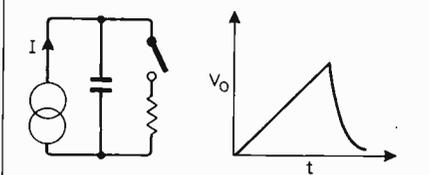


Fig. 3. If discharge time is made small enough the charging current can remain connected. Level of capacitor voltage is used to operate discharge switch.

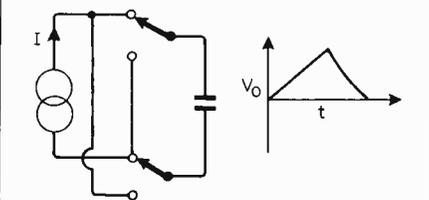


Fig. 4. Triangular waves with repetition frequency proportional to current are produced by reversing capacitor charging current.

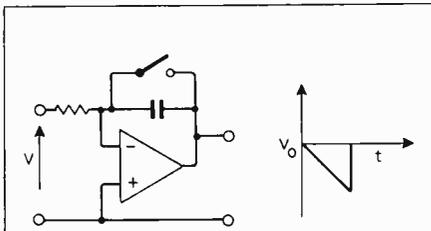


Fig. 5. Using the charging capacitor in an op-amp integrator ensures current is independent of capacitor p.d.

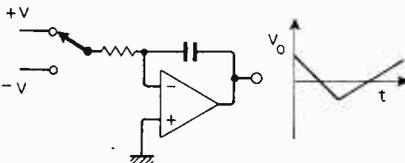


Fig. 6. Simple form of triangular wave generator uses principle of Fig. 5.

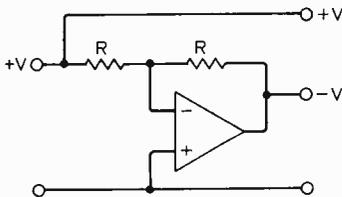


Fig. 7. Circuit provides equal +V and -V inputs for Fig. 6 with an op-amp of -1 gain.

V/f function provided the waveshape is well controlled, e.g. accurate V/f conversion is possible with simple R-C charge and discharge circuits though the wave shape is highly non-linear. Where waveshape is also of importance, the capacitor forms part of an operational amplifier integrator circuit, with the virtual earth action ensuring that the charging current is independent of the p.d. The discharge element now has no point connected to ground which can raise problems in activating it. (Fig. 5.)

This technique leads to a simple form of triangular-wave generator shown in Fig. 6 where both the +V and -V inputs have to vary together if the slopes are to remain of equal magnitude. By using both the input and the output of an amplifier with a voltage gain of -1 this is readily achieved (Fig. 7). Alternative methods include the design of amplifiers whose voltage gain is switched from +1 to -1, and of integrators in which the direction of capacitor current is reversed by a switch while the magnitude is controlled by a single input voltage.

In all of these circuits there remains the problem of the level sensing circuitry that is to determine the instant of switching; both switching speed and accuracy of level are important making the design of a fast, accurate V/f converter a difficult one.

The term charge-dispersing is a big one in the literature on precision V/f converters. A feedback system is set up in which the output pulses from a generator (basically

monostable in form) are arranged to feed back a constant amount of charge for each output pulse. If these units of charge are combined at the input of the system with the control signal, and the overall feedback is negative, then the pulse rate will be proportional to the control signal.

In block-diagram form in Fig. 8, the principle is illustrated by a combination of V/f and an f/V converter. Assuming that the amplifier gain is high, and that the f/V converter is very linear then the feedback overcomes any non-linearities in the V/f converter, i.e. $V_o = V$ to a high accuracy because of the feedback while $V_o \propto f$ ensuring that $f \propto V$ without reference to the linearity of the V/f converter. The f/V converter might be of the diode-pump variety which with suitable design can transfer a fixed charge into a load for each output pulse rate.

A level-sensing monostable gives an output pulse when the input level rises above a critical value. If the input then falls a second pulse is generated on the next excursion through the set level in the same sense. An important restriction is that the capacitor shall have been completely discharged prior to the second pulse—otherwise the time taken for recharging will be shortened and the output pulse-width reduced. The output of such a monostable would ideally be a train of constant-amplitude constant-width pulses, which could be smoothed and fed back to the input amplifier as in Fig. 9.

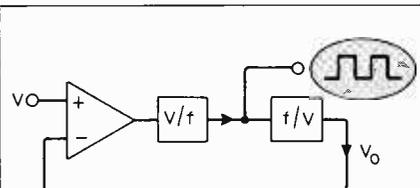


Fig. 8. In this "charge-dispersing" system, a constant amount of charge for each output pulse is fed back so that pulse rate can be proportional to the control signal.

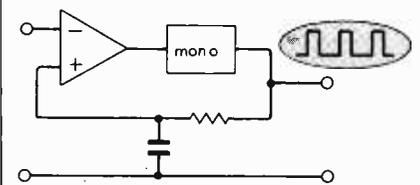


Fig. 9. Monostable circuit produces output pulse when input exceeds a certain level, in either sense.

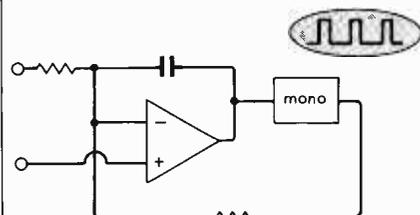


Fig. 10. An alternative arrangement is to dispense charge into a summing integrator. Output pulse rate is a linear function of control voltage or current.

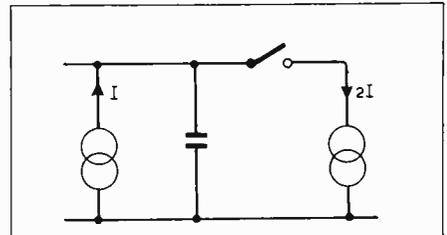


Fig. 11. Technique of using two current sources, but switching only the one having twice the value of the other, is used in some i.cs.

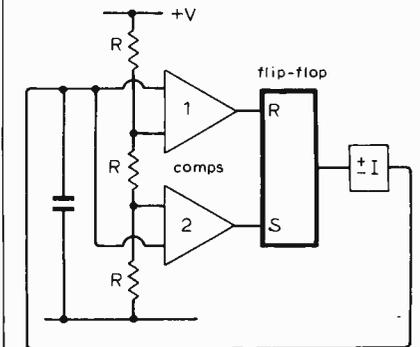


Fig. 12. Triangular wave generator using technique of Fig. 11. Comparator reference inputs are set to 2V/3 and V/3, the capacitor voltage ranging between these limits.

A better arrangement dispenses these units of charge into a summing integrator—Fig. 10. For positive pulses a negative control voltage is required, the integrator output ramping up until a pulse is produced from the monostable. The charge dispensed into the summing junction causes the output of the integrator to fall, again rising slowly under the action of the control current. On average, the net charge inflow has to be zero, the charge dispensed per pulse is constant and hence the pulse-rate is a linear function of the control voltage/current.

Other recent i.cs revert to the separate constant current circuit for timing circuits and waveform generators, and the resulting I/f linearity can be accurate enough for many applications. One technique is to have two current sources one set by the external control voltage, the other of opposite polarity but of twice the magnitude—Fig. 11. Keeping the former permanently on and switching the latter on and off makes the net current in the capacitor change from +I to -I. A circuit configuration to use this technique to produce a triangular-wave generator is shown in Fig. 12.

Two comparators sense the capacitor voltage, their reference inputs being set to +V/3 and +2V/3 by an internal potential divider. Assume the current at I; the capacitor charges until its p.d. reaches +2V/3. Comparator 1 changes its output and resets the flip-flop. This reverses the direction of current flow until the capacitor discharges to +V/3. The comparator 2 operates setting the flip-flop into its original state and restarting the cycle.

The one you can't ignore!

Push-button tuner unit (optional) with built-in timer

Still frame playback for critical analysis or convenient pause (optional: CR 6000E only)

Feather touch control. Solenoid operated transport

Recording of two sound tracks at the same time (or post-dubbing on one track)

Assured compatibility. The cassette you make will play on any 50Hz U-type VCR

Remote control unit (optional)

You will probably make a JVC U-type VCR the heart of your cassette system. But where do you go from there?

You cannot do better than ask Bell & Howell's Video Systems Division. It has six years' experience in supplementing the wide range of equipment it sells with a planning, installation and service organisation able to provide first-class video systems and ensure first-class results.

Bell & Howell engineers work with IVC colour cameras and recorders, Electrohome monitors, Viscount, Thomson-CSF and Tamron products, and the JVC range from video cassette and portable recorders to cassette duplicators. They can design the system best suited to your needs - and your budget.

We'd like to tell you more. Telephone Bell & Howell's Video Systems Division on 01-902 8812 or write to Bell & Howell A-V Ltd., Freepost, Wembley, Middlesex HA0 1BR (no stamp required).



BELL & HOWELL

WW-189 FOR FURTHER DETAILS



**MEET AND MATCH
ALL YOUR VTR
REQUIREMENTS
WITH THE NEW
SHIBADEN SV630**

No matter what your requirements in the application of colour VTR, the new Shibaden SV 630 Cartridge Video Recorder will help you in a wide range of differing applications — in education, industry, and commerce.

The SV 630 is a 1/2" Colour Video Recorder that guarantees exceptional reliability and picture stability and conforms fully with the EIAJ standard. This extends to full tape compatibility with existing reel to reel EIAJ VTRs, in monochrome. Separate Audio and Video connections are provided in addition to the EIAJ standard connector. And the unit is capable of record/playback on PAL/SECAM colour standard.

Manual or Auto

Among the outstanding features of this new VTR is the facility to control input levels, both manually or automatically, on audio and video. AGC circuits are used to facilitate this feature while automatic colour control circuits are used in both record and playback circuits to ensure stable and high quality colour reproduction.

Really Easy Operation

Operating the SV 630 couldn't be easier. Once the cartridge is popped in, the keys operate at the touch of a finger putting you in complete command of play, record, fast forward and stop functions . . . the tape rewinds as soon as the programme has finished . . . and pops out upon the completion of rewinding.

Anyone can control and operate this new unit right from the word 'go', ensuring a professional performance no matter what the circumstances or where the unit is used.

Write now for full technical specifications or telephone the Shibaden Technical Service at: 01-203 4242.

 **Hitachi**
Shibaden (UK) Limited
BROADCAST & CCTV EQUIPMENT MANUFACTURERS
Lodge House · Lodge Road · Hendon · London
NW4 4DQ. Telephone: 01-203 4242/6

WW-174 FOR FURTHER DETAILS



The
new
Rank**

**WOW & FLUTTER Meter
Type**

1742

Fully transistorised
for high reliability

Versatile
Meets in every respect all current specifications for measurement of Wow, Flutter and Drift on Optical and Magnetic sound recording/reproduction equipment using film, tape or disc

High accuracy
with crystal controlled oscillator

Simple to use
accepts wide range of input signals with no manual tuning or adjustment

Two models available:
Type 1742 'A' BS:4847: 1972 DIN 45507
CCIR 409-2 Specifications
Type 1742 'B' BS 1988: 1953 Rank Kalee
Specifications

For further information please address your enquiry to
Mrs B. Nodwell



**RANK FILM
EQUIPMENT**

Rank Film Equipment, PO Box 70
Great West Road, Brentford
Middlesex TW8 9HR
Tel: 01-568 9222 · Telex 24408 · Cables Rankaudio Brentford



TREC
consultants
ltd.

**created by
BROADCAST ENGINEERS &
PRODUCTION STAFF**

**main agents for:-
SONY, PHILIPS, AKAI,
DECCA & KODAK**

**a complete service for
PROGRAMME PRODUCTION
EQUIPMENT SALE, LEASE,
HIRE & REPAIR**

CONTACT ALAN ENGLISH

TREC consultants ltd.
186 Park View Rd. Welling, Kent.
01-303 8406

Vision cassette and cartridge recorders

Facilities and performance of models on the UK market

In attempting to assess the current state of domestic, industrial and educational video activity, one is reminded of the sub-title of a recent article on the computer industry. It read: "Where are we now, and how did we get into this mess?". For it seems that commercial and political considerations dictate that each new development is attended by a flurry of alternative approaches—some only slightly different to each other—and that the eventual emergence of one or two practical solutions to the problem can take many years. It is all very wasteful, expensive and uncivilized, but nonetheless entertaining.

It seems likely that John Logie Baird, having worked out his system of seeing at a distance which, with fine impartiality he named "tele-vision", was the first to record a picture. There was, in 1927, nothing new needed to do this, as he simply used a 10-in, 78 r.p.m. record and called it "Phonovision". Magnetic recording was not well developed and it was not until the 1950s that an acceptable, recorded image was possible. In 1951, Crosby Enterprises were using a longitudinally-recorded tape at 100in/s for black-and-white pictures, in which the spectrum was separated in 10 bands, each being recorded separately, with two more tracks for control and sound. This was followed rapidly by RCA in 1953 with a longitudinal system capable of recording colour at 240in/s on three tracks for RGB and two more for sync and sound. The longitudinal method, wherein the video tracks were recorded along the length of the tape as in audio tape recorders, was wasteful of tape (high speeds of up to 360 in/s for adequate bandwidth) and caused problems of speed control, particularly in colour. Head-to-tape contact was difficult to ensure and even at high speeds, the theoretical maximum bandwidth of the tape recording process (10 octaves) is insufficient for the 20 or so octaves of a vision signal.

Ginsburg and Anderson, together with a man named Dolby, of Ampex, originated the modern approach to vision recording in 1956 with the transverse-track recorder, using frequency-modulated vision signals to avoid the bandwidth problem. In this principle, the tape is slowed to a canter and the tape-to-head speed is maintained by moving several heads across the tape, giving transverse tracks. Four heads were

used by Ampex, and the term "quadruplex" was applied.

From then on, the transverse-scan recording method was to become standard throughout television broadcasting, using tape up to two inches wide and eventually producing a picture indistinguishable from the original. Much programme material is now transmitted from tape. Only the BBC continued the longitudinal method in

"VERA" (1956), but soon acknowledged that this was not the way to do it.

All this time, the idea of the domestic and educational use of television recording was being pursued, albeit rather spasmodically. RCA had a $\frac{1}{4}$ -in tape system for home use in 1956, and throughout the 50s and 60s one saw optimistic announcements from time to time that the ideal had been achieved, but they all sank without trace. Many systems have been tried, but the "electronic" kinds have now narrowed to several types of tape recorder and a few systems using discs, optical and electro-mechanical. Several manufacturers produce tape systems with open-reel tape handling, but our impression is that, for domestic and educational use, the open-reel machine has had its day and that the enclosed tape storage machine will reign supreme within two or three years. Seven thousand are said to be in use in the UK now.

The tape enclosures take three forms. A cassette, familiar in one form as the audio cassette, possesses two spools mounted either side-by-side as in the Sony machines

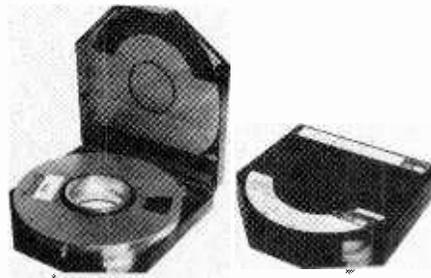
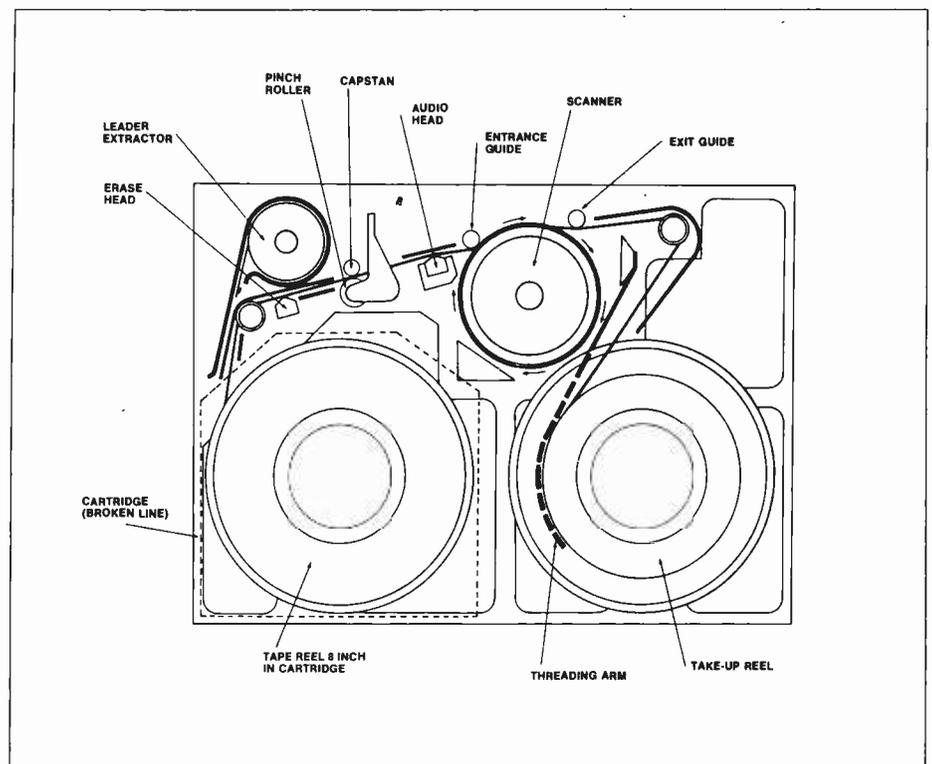


Fig. 1. The IVC cartridge of 1-in tape is shown at (a) and the tape path in the machine is at (b).



or one on top of the other, as in machines made to the Philips pattern. A further type of tape enclosure is the cartridge, which possesses only one spool and is analogous to the 35mm film cassette (we should, perhaps, have mentioned that it is all very confusing!) in which the tape is pulled out of the enclosure, past the heads and on to an external take-up spool contained in the machine. When the tape is used up, it is re-wound into the cartridge and ejected, a process which points to one disadvantage of the cartridge—it cannot, unlike the cassette, be removed until the tape is re-wound.

There is, as yet, very little standardization in the use of enclosed-tape machines. They differ in enclosure type, tape width, signal-processing, tape type and many smaller parameters. Sony and Philips are the leaders in their own fields, and there is standardization in machines using these two different systems as there is in another group, the EIAJ v.c.r. standard used by Matsushita and several others. Both types use helical scanning, which is a half-way stage between longitudinal and transverse scanning. The tape is pulled out of its enclosure and wrapped part of the way round a drum, rising or falling on the way round. The drum is provided with two, three or four heads, which revolve inside the drum about a vertical axis, "looking" at the tape through a circumferential slit in the drum.

As the tape is slightly inclined, moving on a helical path round its part of the drum, and the head axis is precisely vertical, the tracks recorded on the tape are inclined at about 3° to the horizontal. As one head finishes its track, the next one starts the next track and the effect is as though there were one continuous track, recorded at high speed instead of the five or seven inches per second of the actual tape speed. In this way, a low tape speed provides bandwidth of up to 3.5MHz and a horizontal picture resolution of up to 360 lines. Either two audio tracks or one audio and a control track are recorded along the edges of the tape in the normal way.

Signal processing is rather more complicated than in the ordinary audio tape recorder, particularly when a colour signal is being handled. As transmitted, the broadcast colour signal consists of a vestigial-sideband luminance carrier with the upper sideband extending to 5.5MHz, and a chroma signal with a suppressed sub-carrier extending from 3MHz to 5.5MHz. Neither of these signals can be handled directly by the tape machine and must be turned into a recordable form.

The chroma signal is simply transposed to a centre frequency of 562.5kHz (in the Philips system) with a bandwidth of 650kHz and recorded in the normal way as a.m. The reduced bandwidth, and hence

resolution, does not have as serious an effect on colour as it would on the luminance information which determines the sharpness of the picture. Luminance is not recorded directly but is remodulated as f.m. with a deviation of 3–4.4MHz, thereby avoiding the effects of imperfect head-to-tape contact and completely eliminating the need for tape bias, as the waveform is no longer important. Bias for the chroma signal is automatically provided by the luminance f.m. signal, the two being combined in the recording amplifier.

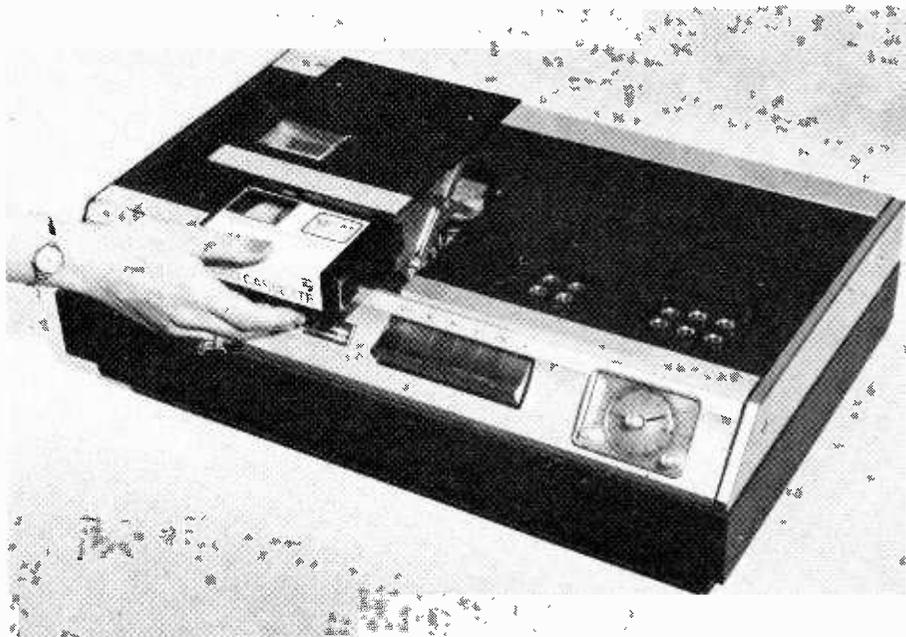
Problems are introduced by the transposition of the chroma signal to a different frequency and also by inevitable phase jitter in the tape transport. This would, of course, be disastrous for the chroma decoder and would also result in an increased amount of sub-carrier patterning on the screen due to the loss of interleaving of chroma sideband energy peaks between those due to time-base repetition rates. Circuitry is therefore needed to overcome this defect, and a description appeared in *Wireless World*, December 1972.

On playback, the luminance information is passed to an f.m. detector and the chroma is reinstated in its proper position at 4.43MHz, prior to being impressed as modulation on a u.h.f. carrier and passed to the aerial socket of the television receiver. Not every recorder possesses an r.f. output and if the output is at video frequencies, modifications to the receiver are needed. Many receivers will need modification for other reasons in order to be compatible with video recorders. For instance, the fly-wheel time-constant will need to be shorter to accommodate the "drop-out" time—the time between one head finishing a track and the next one starting. During the time when no signal is being played back, the flywheel will try to compensate unnecessarily, only to be caught on one leg by the arrival, on time, of the next set of information. The result will be "hooking" or bending of verticals at the top of the picture as the time-base slowly comes back into sync and this effect

Fig. 2. Loading a Philips cassette. Lowering the cassette engages the pins behind the tape and takes it round the drum.

Fig. 3. A Sony cassette is loaded in roughly the same way as the Philips type.

Fig. 4. An IVC cartridge being loaded.



can, without modification, reach half-way down the screen. The time-constant must therefore be shortened so that the hooking occurs invisibly during the blanking time or during a small amount of over-scan. If, however, it is shortened too much, the object of having a flywheel is lost and noise again becomes a problem.

It seems possible that future television receivers will make some provision for the connexion of recorders, preferably in video form, thereby eliminating the cost of a u.h.f. modulator. There will then, of course, be the old question of live chassis, as manufacturers still have not found it necessary to use mains transformers. A. C. Smaal of Philips set out his views on this in *Wireless World* March 1975. On this question of compatibility, it should be pointed out that the different systems are mutually incompatible. The two cassette systems—Sony and Philips—are possibly the closest in conception, but are still incompatible because of the different tape width and cassette type. Compatibility between two machines of the same model is better than it initially was; control circuitry is improved and there does not appear to be an insuperable problem. Dealers have told us that they can choose any machine in stock and play any tape on it with every chance of success.

Some recorders possess their own u.h.f. tuner, which means that the recorder can receive and store information on one channel while the television receiver is displaying another. Others take a video feed from the receiver, necessitating yet another modification.

The feeling expressed fairly freely is that off-air recording is not going to be enough to make a success of these machines. A supply of programme material is essential if they are to enjoy the success of an audio system, but the number of competing formats must be drastically reduced before any programme supplier is likely to commit himself. There is also the question of copyright. It is, after all, an infringement of the Copyright Act of 1956 to record a broadcast programme. The Whitford Committee are unlikely to report for some time and this unenforceable law will continue to be broken daily, but it is an unsatisfactory situation.

The other source of "programmes" is to buy a monochrome television camera (colour is far too expensive a proposition) and to use the camera and recorder as a kind of up-market home movie system, but one would have to be very single-minded about immortalizing Dad and the kids on tape to go to such lengths.

The facility of stop motion or still frame is obtained by stopping the tape feed, while the heads continue to turn. As each track contains one field of information, the same field is scanned continuously. There is a slight problem in that the heads do not now cross the tape at precisely the same angle as when it is moving, so that they may start on one track, cross the guard band between tracks and finish on another. A drop-out then exists and it is necessary to ensure that this drop-out occurs in the blanking interval between frames. Most

machines incorporate a drop-out compensator, the Philips type consisting of a drop-out detector which, when a defect is noted, substitutes for the line of information containing the drop-out a previous line, delayed by 64µs. The difference between the two is usually negligible and preferable to a total loss of information.

Our impression of the two "standard" machines is that the Philips, being smaller, cheaper and possessing a tuner and timer is better suited to the domestic scene than the Sony, but that Sony's performance is a little better and should be more at home with a camera input for education and training.

Other systems

Although this article is intended to cover methods of video recording using tape in "convenience" form, it is well to note that several other contenders exist which use discs—an area of activity on which we intend to report in detail in the near future. Most of these (Thomson-CSF, Zenith, Philips/MCA) use optical methods in either the transmission or reflection modes and have playing times of between 20 and 30 minutes. The records are thin plastic or glass discs and the information is encoded in the form of pits or holes, which tends to render them somewhat vulnerable to dust and grease. The recent Philips/MCA link would appear to give the VLP (video long player) a distinct advantage over others—MCA have a vast library of material and are to manufacture the discs.

The Telefunken-Decca system (TeD) uses what is effectively an up-rated audio record of 8-in diameter playing for ten minutes. Hill-and-dale recording is used. The disc systems were described in detail in *Wireless World*, November 1973.

A recently-announced development from BASF is the LVR (Longitudinal Video Recorder) which again employs a single-spool enclosure. As its name implies, longitudinal recording is used, but the extremely high rate of tape usage common to this method is avoided in the LVR by the 28-track format employed. Quarter-inch tape is used and playing time can be as long as 120 minutes using 6µm thick tape. Little is known of this machine at the time of writing, except that an unusual tape handling system is used. The cartridge opens to reveal the spool of tape, the leader being extracted by a large-diameter capstan, passed through the recording/playback station and again past the capstan onto the take-up spool. Feed spool, capstan and take-up spool are in continuous contact, leaving very little free tape. The extremely thin tape is therefore protected.

A speed of 3m/s is adopted, the reversing at the end of each of 28 passes taking 80ms. Colour recording is offered in conjunction with several audio tracks. Bandwidth is 3MHz. BASF claim that the area of tape used is less than a quarter of that used in the Sony system and even less than in the Philips method. The unit is not expected to make its appearance for at least two years.

A recent announcement is the MDR, developed by Erich Rabe. MDR is Mag-

netic Disc Recording and offers the facility of recording to the user—unlike the optical or stylus-pickup discs. An ordinary record turntable modified to run at 200-r.p.m. carries a disc whose inner section has a helical guidance groove which guides a stylus and, by a link, steers a magnetic head over the outer, magnetic, section of the record. All colour systems can be recorded and played for 15 minutes. Alternatively, the turntable can be slowed to 33r.p.m. and used to record up to 16 hours of audio.

The RCA Selectavision Magtape, not yet available here, uses a new type of tape handling and head format. Four heads are used, a layout which, amongst other benefits, allows all the tape to remain in the two (side-by-side) reel cassette, as only 90° of the drum must be wrapped. The drum protrudes into the cassette to achieve this amount of wrap. Cassette size is 9 × 6¼ × 1½ in.

In the following section, the machines mentioned are the ones we have found to be available in the UK. There are many more, but they are not obtainable here and so have been omitted.

Philips N1500 VCR

Cassette-loading
(vertically-stacked
spools)
Record/playback of colour and monochrome
Tuner for off-air recording
U.h.f. modulator output
PAL standard 625/50
Two heads
½-in tape
Automatic tape threading
Cassette size: 12.7 × 14.6 × 4.1cm
Recording time: 30, 45 or 60min
Bandwidth: 2.7MHz
Tape speed: 14.29cm/s
Dimensions: 56 × 33 × 16cm (with
cassette lid up)
Sound is on two tracks on tape edges
Mains supply: 110–245V ± 10% at 50Hz
± 1%. Any frequency drift must be slow to
remain tolerable
Price: £462.84 (plus v.a.t.) (1500)
cassettes: £11. £14.50 and £17.00
(1500/15M): £537.04 (plus v.a.t.)

This is one of the group leaders in these machines. It provides an acceptably sharp picture but not, perhaps, as finely resolved as in some others. It must be said that most dealers tend to demonstrate Philips machines on large-screen receivers, whereas other systems seem to be shown on small Trinitron sets—a procedure which does emphasize the difference. Controls are provided for tracking, audio record level auto/manual, the usual function controls and a timer for use when recording a programme in one's absence. Cassettes are available for 30, 45 or 60 minute playing times; the cassette holder is raised, the cassette inserted and the whole lowered, thereby engaging pins which pull out a loop of tape and wrap it round the scanning drum. The 1500/15M is similar, but the input and output are at video frequencies for direct connexion of colour or monochrome camera

and monitor. The 1520, at £820, is a semi-professional machine with no timer or tuner, having assemble and insert editing provision, and facility for sound dubbing on two sound channels. It has an extended bandwidth (3.2MHz) for monochrome, and is intended for a video input from a camera. Stop motion is possible, and the output can be either video or u.h.f. Head life on this range of machines is up to 500 hours with chrome tape, and replacement during the first year is free; after this the cost of new heads is £35-£40. The N1500 and 1500/15M are handled by Philips Electrical Ltd, Century House, Shaftesbury Avenue, London WC2H 8AS, and the N1520 by Pye Business Communications Ltd, Cromwell Road, Cambridge CB1 3HE.

Radio Rentals

Model 8200

This is based on the Philips N1500. The performance and appearance are the same essentially, but the programme timer and u.h.f. tuner are not included. The 8200 can be bought or rented (not privately) from Radio Rentals Contracts Ltd, 1/15 Clyde Road, Tottenham, London N15.

Sony

VO-1810UK

Cassette: (Sony U-matic, spools side-by-side)

Record/playback colour and mono-chrome

U.h.f. output modulator/video input

PAL standard on 625/50

Two heads

$\frac{3}{4}$ -in tape

Auto tape threading

Cassette size: 3.3 × 22.1 × 14cm

Recording time: 20, 30 or 60min

Resolution: 300 lines monochrome, 240 lines colour

Tape speed: 9.53cm/s

Dimensions: 67.6 × 23.8 × 46.6cm

Two sound channels

Mains supply: 110-240V ± 5% at 50Hz ± 0.5%

Price: £765 (plus v.a.t.)

Cassettes: £8.20, £9.80 or £14.50

The leader of the U-matic group of recorders, that being a Sony trade mark. The operation of the two types of machine is broadly similar in all external essentials. The VO-1810UK uses chrome tape and possesses a tape winding memory feature, which enables continuous repeat of a full tape or part of a tape, starting and finishing points being pre-set by the operator. Sound dubbing on one channel is provided for. A u.h.f. tuner, type TU1000B is available for off-air recording at £99.

VO-1210

A similar machine to the VO-1810UK but intended solely for play-back of recorded cassettes.

VO-2850 U-matic is a semi-professional machine in the cassette format with assemble and insert editing facilities and sound dubbing. Stop-motion is offered. Price is £2,500.

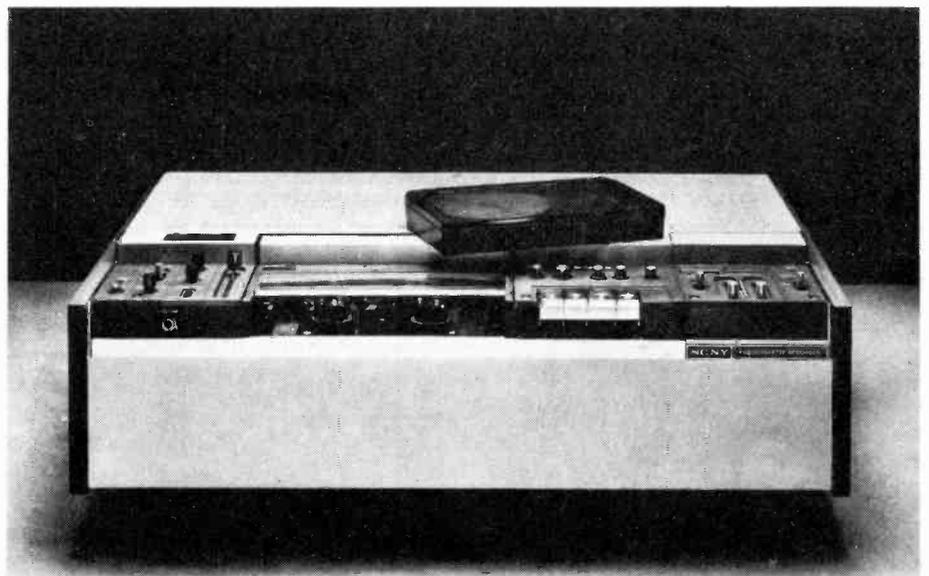
Sony (UK) Ltd, Pyrene House, Sunbury-on-Thames, Middx.



Philips N1500



Radio Rentals 8200



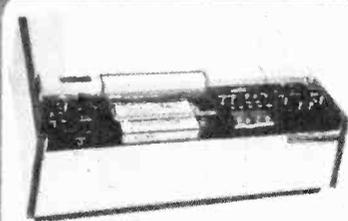
Sony VO-1810UK

TeleTape Video

FOR THE TOTAL VIDEO SERVICE

London's
liveliest video
dealers offer...

SONY

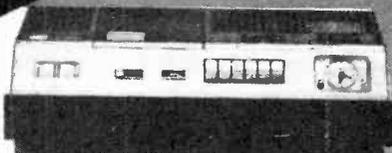


VO1810UK
PAL NTSC UMAC[®] RE-
CORDER PLAYER
Giving high resolution colour,
auto repeat pause, 2 audio
tracks. R/F output.

£765
£645

SONY VP1210UK PAL NTSC PLAYER ONLY

PHILIPS



N1500 VCR

A simple low cost video
cassette recorder. Rec-
ords up to 1 hour. Built-
in tuner for all stations
with time clock. Uses
normal type TV.

£447

N1500/M VIDEO

£537

VIDEO CASSETTES: VC30 mins.
£11. VC45 mins. £14.50. VC60 mins.
£17. PHILIPS/SCOTCH/BASF.

N1520 VIDEO

£850

WITH EDIT

**Free impartial
advice**

AKAI

**COLOUR
CAMERAS**



**VCS 150 Mk II
COLOUR CAMERA**

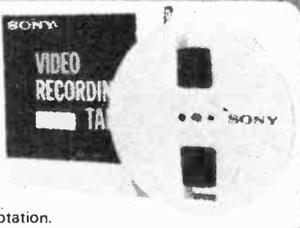
Superb colour reproduc-
tion. Complete with zoom
lens, CCU, etc.

ONLY £1950

**Finest After
Sales Service**

**VIDEO
TAPES**

We offer incredible prices on all types
of 1/2in, 1in, VCR & U-Matic Video
Tapes by Sony, Scotch, Ampex, BASF,
Philips, etc. Our discounts for large
and small quantities are normally
unbeatable. If you want to buy on
the best terms, please telephone or
write to Mr. Ian Crammond stating
your precise requirements for a firm quotation.



LEASING

All of the equipment on this page plus most other top makes are
available on our economic leasing terms. For example £1,000 worth
of the very latest equipment costs £20/30 approx per month to lease.
Please ask us to quote on any item or system.

HIRING

We hire, by the day or week, cameras, VTR's, monitors, large screen
TV projection units with and without operators. We also offer outside
broadcast and studio facilities for production work, editing etc., in
colour or monochrome. Other facilities include tape dubbing, film to
tape transfer and editing. Please contact us for assistance in your
sales conference or presentation. For advice or a quotation without
obligation contact Phil Knight, Production/Hire Manager.

TELETAPE VIDEO, THE LONDON VIDEO CASSETTE CENTRE
76 BREWER STREET, LONDON, W.1. Telephone: 01-734 1319/434 1267

Please send me, without obligation, information on the following makes of video equipment

NAME

ADDRESS

TEL. NO.W

Action Video Rentals



If you can't justify purchasing all the video
equipment you occasionally need why not rent it
from us. We have a vast stock of all types of
video recorders, cameras etc.
(including complete monochrome and colour
portable studio units).

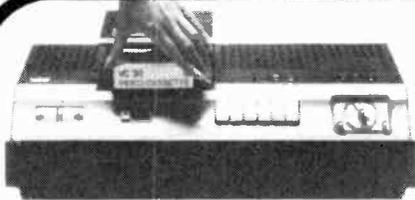


Action Video
45 Great Marlborough St
London W1V 1DB
Phone 01-734 7465/7
Midlands Representatives:
Foxall & Chapman,
51 North Street,
Cheetham, Manchester.
Phone 061-834 5786



You can always get it at REW

At the London Video Cassette Centre at Centrepont



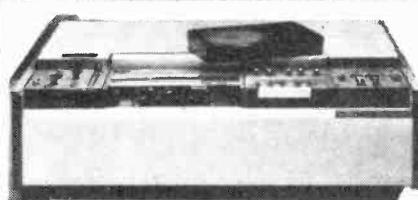
PHILIPS N1500 VCR

Low cost video cassette recorder for up to 1 hour recording time. With built-in tuner and time clock. Available from stock. **SPECIAL OFFER £425 plus VAT**

N1500/M VIDEO INPUT AND OUTPUT VERSION. Available from stock. **£539 plus VAT**

N1520 ELECTRONIC EDIT VCR

Complete with electronic editing facility with insert and assemble modes • 2 audio tracks • extended band width • stop/motion facility. Available from stock. **£850 plus VAT**



SONY V01810 UK

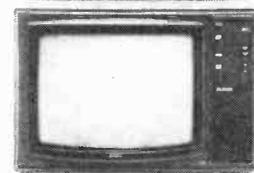
PAL NTSC U-MATIC RECORDER PLAYER

High resolution colour, auto repeat and memory facilities, 2 audio tracks and R/F output. Available from stock. **£765 plus VAT**

SONY VP1210 UK PAL NTSC PLAYER ONLY

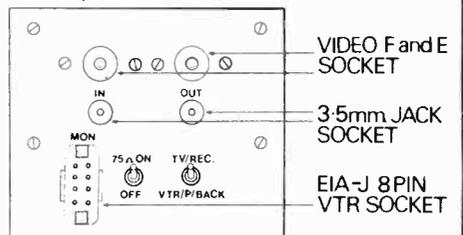
Available from stock. **£645 plus VAT**

DES COLOUR 18" RECEIVER/MONITOR



The DES monitor is based on the SONY KV1810 UB 18" Colour Receiver and provides full video and audio input and output facilities plus an EIA-J VTR connector.

This high quality monitor is compatible with most video tape recorders and video Cassette recorders currently available on the market.



AVAILABLE NOW AT ONLY **£365** plus VAT. Trade Enquiries Welcomed.

LEASING

Because of our unrivalled stock of all the latest equipment we can offer very realistic leasing terms for all your requirements. Why not contact us for quotations without obligation and compare our prices.

HIRING

Our new, enlarged Video Hire Division offers you everything you need by the day, the week or longer for inside or location recording including fully trained operators. Our 25 years experience is also at your disposal to help you with your programmes and presentations.

AKAI

GREAT SAVING!

For one month only we are able to offer the Akai VTS-110 DX complete 1/2" mono kit for an amazing **£525 + V.A.T.** This is a saving of **£150** on the normal price.

Incredibly versatile, the kit comprises portable video tape recorder, video camera, portable monitor and adaptor.

Power source is no problem. You operate from built-in battery, mains, or a car battery. High quality pictures can be relayed from camera, "off air" or other VTR equipment, and can be played back through clip-on monitor, VTR monitor, or any UHF receiver.

With added benefits of still framing and sound dubbing, the Akai VTS-110 DX is excellent value at any time. At our price it's almost a give-away!

Video Tapes

We offer highly competitive prices on all makes of 1/2 in., 1 in., VCR and U-Matic Video Tapes including Sony, Scotch, Ampex, BASF, Philips and Memorex. Next time you are ordering tapes, ring our Sales office at Colliers Wood and let us quote you. You'll be surprised.

REW have been in the Video Industry for over 10 years and their accumulated wealth of experience offers you the finest Video service in the country. All the equipment you need is always available from stock and at their London Video Cassette Centre at Centrepont in London you can view and compare all the latest equipment. REW also offer first class studio and production facilities. Why not contact us when you want to talk video - REW know better than most.

REW are Main Agents for:
 AMPEX, AKAI, NATIONAL-PANASONIC, SONY, HITACHI-SHIBADEN, J.V.C.-NIVICO, MALHAM LIGHTING, ELECTROGRAFT, QUICKSET TRIPODS, ASTON, FUJINON, CANON, DECCA, RANK-IANIRO, LIGHTING
 In our Centrepont showroom we have a permanent demonstration of the full range of Shibaden colour cameras, all available from stock.



The most experienced Video Company in the business

London Showroom - Centrepont, 21 St. Giles High Street, London WC2.

Telephone: 01-836 9183/9025 Ask for Tony Stevenson.

Head Office, Sales, Studios, Production and Servicing -

REW House, 10-12 High Street, Colliers Wood, London SW19 2BE.

Telephone: 01-540 9684 (6 Lines) Ask for Mike Jarvis, Richard Murray or Roy Haines.

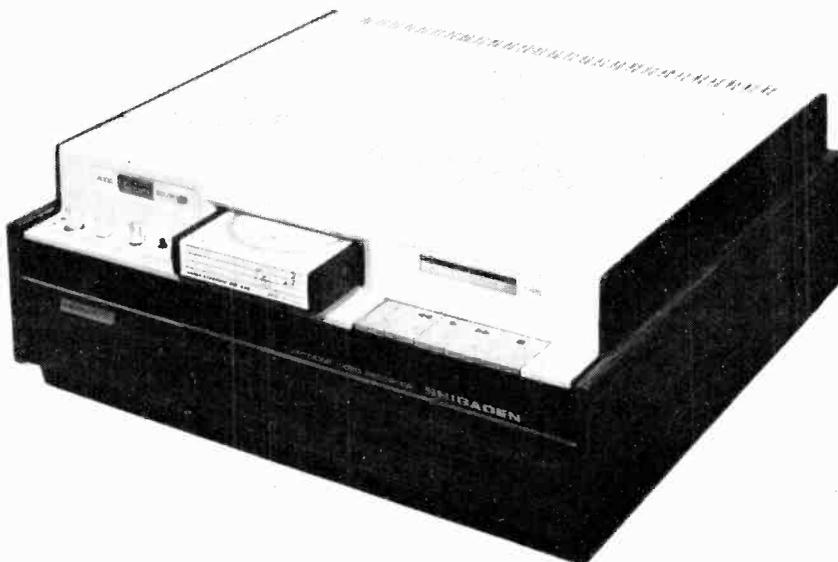
WW-209 FOR FURTHER DETAILS



National NV-5120A-B



JVC CR-6000E



Hitachi Shibaden SV-630E(K)

National (Matsushita)

NV-5120A-B

Cartridge loading (one reel—one in machine)
 Record/playback of colour and monochrome
 U.h.f. output converter as optional extra
 PAL standard 625/50
 Two heads
 $\frac{1}{2}$ -in tape
 Automatic tape threading
 Cartridge size: 12.8 × 13 × 2.9cm
 Recording time: 36min
 Bandwidth: 4MHz (−20dB) monochrome
 resolution 240 lines, 3MHz (−20dB)
 colour (resolution 260 lines)
 Tape speed: 16.322cm/s
 Dimensions: 48.5 × 38.8 × 20.8cm
 Mains supply: 240V 50Hz
 Price: £595 (plus v.a.t.)
 Tape: £8.50 for 36 mins (National tape)

A cartridge recorder which conforms to the only "standard" in existence, if one defines a standard as a specification arrived at by agreement rather than by *force majeure*. The A-matic cartridge uses a single reel, the tape having a stiffened leader which is automatically pulled past the heads onto the tape-up reel. A programmer for repeated playing of selected parts of the tape (search) is provided and there is provision for stop-motion. Controls are solenoid-operated. A timer is obtainable as an extra, as is a remote-control unit. Sound can be dubbed.

A point to note about the EIAJ $\frac{1}{2}$ -inch cartridge is that it can be loaded by the user with $\frac{1}{2}$ -inch tape, so that tape recorded on an open-reel machine can be used in cartridge form.

Collett Dickinson, Pearce & Partners Ltd, Howland House, 18 Howland Street, London W1P 6AT.

JVC

CR-6000 E

Uses the U-matic $\frac{3}{4}$ -inch cassette and is compatible with other U-matic equipment. Records and plays back in colour or monochrome with an r.f. or video input and video output (u.h.f. converter as an extra). It possesses the "search" facility, solenoid-operated controls, audio dubbing and two sound channels. A remote-control unit is an accessory. Playing time is up to 60 minutes. Price £749 plus v.a.t.

Bell and Howell, Alperton House, Bridgewater Road, Wembley, Middlesex.

Hitachi Shibaden

SV-630E(K)

A cartridge machine conforming to the A-matic (EIAJ) $\frac{1}{2}$ -inch standard of the National NV-5120A-B, with a similar specification and range of facilities. A sound-dubbing facility is provided, as is automatic re-wind. The price is £580 plus v.a.t. The price of tape is £12 for 36 minutes (Shibaden tape).

Shibaden (UK) Ltd, Lodge House, Lodge Road, Hendon, London NW4.

Loewe-Opta

Optocord 700

Basically similar to the Philips 1500/15M but with r.f. and video in and out. Auto tracking is provided, as is drop-out compensation and a colour killer which operates on playback only, thereby

avoiding the possibility of recording colour in black and white. A seven-selector r.f. tuner is included, and a timer, and the machine offers stop-motion operation. Price £744.17 plus v.a.t. and the Optocord 700 uses the same type of cassette as the Philips machines. Hokushin Audio Visual Ltd, 2 Ambleside Avenue, London SW16 6AD.

IVC

VCR-101C

Cartridge loading (one spool)
Record/playback in colour
Video input and output
PAL on 625/50
One head (tape completely encircles drum)
1-in tape
Automatic threading
NAB 8-in reel mounted in cartridge
Recording time: 60min
Bandwidth: 3.2MHz luminance, 1.4MHz colour
Tape speed: 17.1cm/s
Dimensions: 18 × 13.5 × 8.5in
Two sound channels
Mains supply
Price £1812 plus v.a.t.
Tape around £21.00 per hour
Yet another cartridge machine, this time using a standard 8-in NAB reel of 1-in tape,



IVC VCR-101C

with obvious compatibility with open-reel machines. Stop-motion is provided and the instruments (this is one of a range) are fitted with audio amplifiers and speakers. The machines are available in monochrome or PAL versions, and are controllable

electrically by t.t.l.-compatible voltage levels. The scanning mechanism is direct-driven, having its own printed-circuit motor. Head life is claimed to be 2000 hours. Bell and Howell, Alpertown House, Bridgewater Road, Wembley, Middlesex.

Literature Received

A booklet entitled "Photocouplers" is now available from Mullard, describing the characteristics, operation and application of these devices. Requests for copies, on headed notepaper, should be sent to Computer Electronics Division, Mullard Ltd, Mullard House, Torrington Place, London WC1E 7HD.

EQUIPMENT

A leaflet describing a deglitched d.a.c. system, the DMC Digisweep, which takes in digital data and drives c.r.t. deflection amplifiers to draw vectors and write alpha-numerics, is available from Amplicon Electronics Ltd, Lion Mews, Hove BN3 5RA WW411

A publication is available illustrating and giving technical data on radiotelephones types M202 (v.h.f.) and M212 (u.h.f.). Pye Telecommunications Ltd, Cambridge CB5 8PD WW412

A basic guide to data communications is the subject of a new brochure relating to computer installations where remote control terminals are connected by telephone lines to a control computer. SE Labs (EMI) Ltd, Spur Road, Feltham, Middlesex WW413

A catalogue from Burns describes a range of equipment intended for the amateur radio market, including a frequency standard, wavemeter, test oscillator and many modules for building into other equipment. Burns Electronics, 43a Chipstead Valley Road, Coulsdon, Surrey CR3 2RB WW414

The Spellman range of high-voltage power supplies is shown in a catalogue 7400 from Hartley. Solid-state, regulated and unregulated, miniature, rack-mounted and modular units are described. Hartley Measurements Ltd, HML House, London Road, Hartley Wintney, Basingstoke, Hants. WW415

We have received a leaflet on the lightweight v.h.f./f.m. marine radiotelephone, Model RF-440, made by Harris. Complete performance details and facilities provided are described, as are several accessories. Harris Corporation, RF Communications Division, 1680 University Avenue, Rochester, New York 14610, U.S.A. WW416

Tally have sent us a leaflet on their latest range of paper tape peripheral equipment, which is designed for use with the PDP11, Nova and Digico 16V minicomputers on a plug-in basis. The leaflet describes a reader and two punches for low and high speeds. Tally Ltd, 7 Cremyll Road, Reading RG1 8NQ WW417

Farnell have produced a leaflet on the PG5000 series of five pulse generators. Types 5111 to 5222 provide between them, dual channel output with delay or positive or negative-going pulses. Repetition frequency is up to 5MHz. Farnell Instruments Ltd, Sandbeck Way, Wetherby, Yorkshire LS22 4DH WW418

We have received a leaflet describing a loudspeaking intercommunication using mains-borne f.m. or a.m. and made by the NOA Corporation. The unit is the Model FN-113S and the leaflet is obtainable from Hadley Sales Services, 112 Gilbert Road, Smethwick, Birmingham WW419

The latest Heathkit catalogue is now available. New equipment this time includes a digital clock/radio, a scientific calculator, a car clock, a 15MHz oscilloscope and a function generator. Heath (Gloucester) Ltd, Gloucester GL2 6EE WW420

A leaflet describing the Digipet electronic weighing machine for top-loading is available from Transducers (CEL). The weighers are by Shinko-Denshi,

provide a digital indication and automatically select ranges of 0-19.99g or 0-199.9g. Transducers (CEL) Ltd, Trafford Road, Reading RG1 8JH WW421

The recent informative advertisements for Wayne Kerr have been reprinted in booklet form entitled "Some Notes on Bridge Measurement". The publication is obtainable free from The Wayne Kerr Company Ltd, Durban Road, South Bersted, Bognor Regis, Sussex PO22 9RL WW422

Peerless loudspeaker kits and drive units are described and pictured in a leaflet from Ross Electronics, 32 Rathbone Place, London W1P 1AD WW423

A description and specification of the Philips time division multiplexer type 3TR 1500 is given in a brochure from Philips' Telecommunicatie Industrie BV, PO Box 32, Hilversum, The Netherlands WW424

MATERIALS

Data sheets describing the applications for and properties of four new silicone resins specially developed for use in the electrical and electronics industries are available. The resins M15 and P22 can be used for binding high-temperature-resistant impregnating varnishes, while PO5 and P15 are additives for use in the manufacture of base cements for electric bulbs. TH Goldschmidt Ltd, York House, Station Road, Harrow, Middlesex .. WW425

A booklet from DuPont describes the company's range of products for the manufacture of microcircuits, optoelectronics, and potentiometers, together with basic information on thick-film compositions. R. G. Paterson, DuPont Information Service, DuPont (UK) Ltd, 18 Bream's Buildings, Fetter Lane, London EC4A 1HT WW426

In a new leaflet, EGM Solders give full details of their ranges of solders, fluxes and chemicals. (EGM is the amalgamation of Enthoven, Grey and Morton and McKechnie.) EGM Solders Ltd, Wolseley Road, Mitcham, Surrey CR4 4JQ WW427

Transistor-aided ignition

A simple solid-state switch for ignition coils

by G. F. Nudd

The contact breaker is, in the author's opinion, the bugbear of a modern car. Many vehicles require the contact breaker to be adjusted, if not replaced, every three months or so. In a recent survey by the Automobile Association one in 15 breakdowns was found to be caused by points failure. Various types of electronic ignition have been designed to overcome the drawbacks of standard systems, notably the capacitor discharge method. However, in the case of mass-produced cars, these systems could be considered overdesigned as they are generally costly, usually requiring a special transformer. Also, in some cases, electronic revolution counters cease to operate correctly.

As a car works perfectly well when the points are in good condition and correctly adjusted all that is needed is an electronic switch to isolate the points from the heavy current and high-voltage backswing of the ignition coil. Until recently transistors capable of the 300V or so needed were not readily available. Now one can obtain the so-called "triple diffused device" that not only offers high-voltage operation but a much better second breakdown region because of its higher switching speed. The author has used the Texas BUY23/23A which, when operated with ten ohms between base and emitter, is capable of withstanding 600V. Some designs have used a high-voltage, high-power zener diode across the transistor for protection. This, however, has been found unnecessary with the author's circuit.

Concerning the driver circuitry, normal amplifying stages have been used in some designs. This, however, gives rise to excessive power dissipations in components when a worst-case circuit is designed for operation between 7 and 15V limits. To overcome this problem, a constant-current driver is used, which results in quite reasonable dissipations, and the design is suitable for all cars using a 12V ignition system. If the car does not have a ballast resistor system, R_2 can be increased from 1.2 ohms to 2.2 ohms, giving less dissipation in the driver transistor. When using the positive-ground version, the ignition coil is connected to ground instead of battery voltage. The capacitor C can be a 600V, electronic type or alternatively a "points" capacitor as normally used in the car, the normal capacitor being left *in situ* to facilitate disconnecting the unit. The capacitor

should be soldered into the i.a. unit because if, for example, it became disconnected through a faulty slide connector, the ensuing high voltage might damage the transistor. Diodes D_4 and D_5 are protection measures for the transistors against voltage transients.

The i.a. unit may be built on a piece of aluminium and attached to the car body under the bonnet for heat dissipation. In the case of glassfibre cars the chassis must be used. Also modern aluminium oxide insulating washers for the power transistors should be used.

The points should be replaced and the engine timed accurately when the unit is fitted. The sparking plugs should be replaced or regapped as normal. It has been remarked that when electronic ignition is fitted there is no need to check the

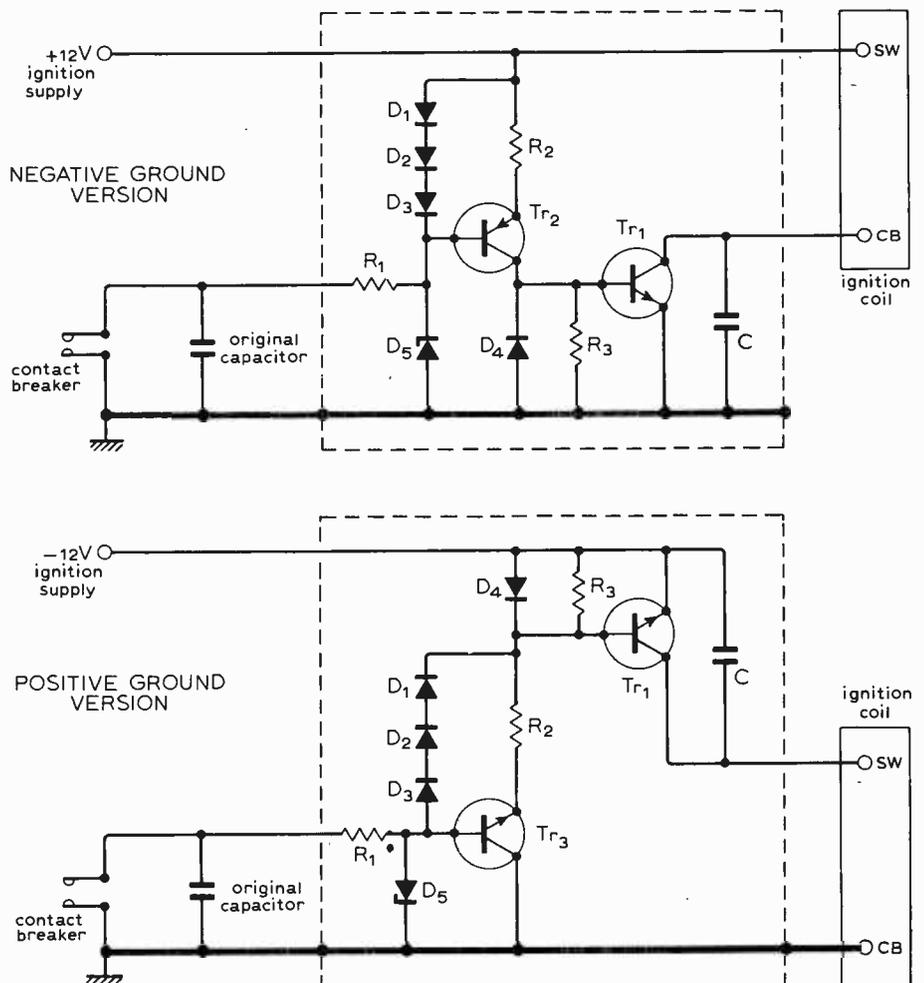
ignition system. This may, in fact, be true with an older type of car but with a more modern one the engine timing must be within a couple of degrees accuracy to obtain optimum power output.

The unit has been functioning in two cars for many months with no troubles. The points themselves wear slowly, both parts receiving slight indentations which causes the unused outer surfaces to gradually be used leaving the engine timing unaltered. The fibre surface of the points which rubs on the cam also wears to the extent of one or two thou at the points-gap in a year.

Components list

- Tr_1 , BUY23A/BUY23
Texas Instruments
- or BDY96/97/98 Mullard
- Tr_2 2N3789/90/91/92
- Tr_3 2N3055
- $D_{1,2,3,4}$ 1N4001
- D_5 18V zener diode 400mW
- R_1 56Ω 2W
- R_2 1.2Ω 2W or 2.2Ω 2W, see text
- R_3 10Ω 0.5W
- C 600V d.c. working, same capacitance as the points capacitor, see text.

Aluminium oxide TO3 thermal insulating washers:
2 off for negative earth A26-2004
1 off for positive earth Jermyn Industries



Complete circuit diagrams for positive- and negative-ground systems.

PROJECT

National Electronics Council Link Scheme

The NEC Link scheme has just entered its second year of successful operation. It is an organization devoted to linking schools wanting to start electronics projects with advisers based in industry and commerce. A good example of a successful link is described in their newsletter and which is reproduced below with their kind permission. Those wishing to contact Link should write to The Organiser, Peter Noakes, Link Scheme, Department of Electrical Engineering Science, University of Essex, Colchester CO4 3SQ.

A link in operation

In October 1973, having received an offer of help from Mr Short, an engineer at Recording Designs (E.M.I.) Limited, Link Scheme put him in touch with Mr Ellerker, a teacher at the Robert Haining School, Surrey. Both were obvious electronics enthusiasts and after the initial introduction we retired to await the outcome. Following initial discussions concerning what each side expected to get from the link, it was decided to develop an introductory electronics course for 12 year olds. After considerable thought, careful design and preparation the course has now been introduced, and I was pleased to receive from the individuals involved in this link the following report. If you are interested in receiving more information, please contact directly any of the individuals mentioned at the end of the report.

Electronics at the Robert Haining School. The lives of most of us today are increasingly influenced by technological development; because of this we have organised a series of courses for our 12 year olds which expose them to a variety of technologies. The basic courses are intended to act as a stimulus, creating interest and enthusiasm.

Introduction to electronic work units. In the case of electronics a set of six work units offers the pupils the opportunity to gain familiarity *with* and confidence *in* handling components, plus intrigue and excitement through seeing and using their completed projects. They very soon show their newly gained knowledge through their ability to select resistors, capacitors, diodes and transistors with confidence.

In designing the units we had to look for efficient ways of producing attractive software which would involve the young

pupils at all stages. A short introduction describing the project and its possible uses is followed by an "items sheet" which involves the selection of components and the placing of them alongside their respective symbols on the sheet. On the next sheet is drawn a 1 cm square grid depicting the component positions as they appear on the actual circuit board and numbered and lettered to correspond with the items sheet. The pupils transfer the components from the items sheet to the grid. It is now a simple matter to transfer the components from the grid to identical positions on the circuit board.

The circuit board is made from white faced hardboard marked with a 1cm square grid and numbered to assist in the transfer of the components. The components are held to the board by tension springs, mounted vertically, which may be stretched upwards to allow the component leads to be slipped between the coils of the spring. This technique is shown in diagrammatic form and is studied before the transfer takes place. A sheet of step-by-step instructions ensures that each component is placed correctly on the circuit board.

When the project is satisfactorily completed the pupils are required to fill in a questionnaire which is designed to test their understanding of the project.

Selection of projects. Selecting suitable projects for the six units of work was not a simple task. The choice was constrained by a number of factors, some dictated by the objectives of the course and others by practical considerations.

The most important objective is that the child should enjoy the work unit and this implies that each project should have a degree of novelty, such that when complete it is fun to use. A further implication of the "fun factor" is that the completed project must be guaranteed to work, provided the components are not faulty and are inserted in the correct positions. Many youngsters have been turned away from electronics as a pastime due to the repeated experience of building projects described in some of the many electronic magazines and finding they cannot make them work. To avoid this pitfall the circuits must be designed to tolerate wide variations in transistor gain, poor tolerance components and a variation in supply voltage consistent with battery operation.

Also, because battery supplies are used, current economy must be considered at the design stage.

A further objective of the course is to demonstrate a range of tasks to which electronics can be applied. However, certain categories of projects were not considered. For example, the obvious applications of electronics in radios and audio amplifiers were deliberately avoided. As 12 year olds do not own cars, electronic gadgets for cars were not included. Also, electronic test instruments were excluded because they have no appeal unless their purpose is understood. In all cases the theory of operation was not considered.

The projects finally selected were as follows:

1. Moisture detector
2. Simple electronic organ
3. Light beam burglar alarm
4. Sound operated switch
5. Two-way intercom
6. Reaction time tester

Future work. In order to provide continuity of work as the present group of 12 year olds moves up through the school, further courses will be developed. At present, consideration is being given to a set of work units based on circuit blocks such as multivibrators, amplifiers, level detectors etc. The object will be to demonstrate how a wide variety of tasks may be tackled by various arrangements of a small number of basic circuit blocks. At some stage it will be necessary to change from the "spring terminal" method of construction to the more conventional technique of soldering. To this end a work unit entitled "An Introduction to Soldering" is being produced, including a video tape presentation demonstrating the technique.

Anyone who would like further details of this work is welcome to contact either:

Ted Ellerker or Brian Burtzell,
Technical Studies Department,
Robert Haining School,
Mytchett Place Road,
Mytchett, Surrey
or
Lawrence Short,
Recording Designs (EMI) Ltd.,
Victoria Avenue,
Camberley, Surrey.

World of Amateur Radio

Proposed changes to American licences

The long-awaited FCC proposals for the major "restructuring" of amateur licence conditions in the United States have now been outlined in a 29-page document, Docket 20282. Among the many changes suggested is a 2000-watt p.e.p. output power limit for those holding an "Advanced Class" permit, thus effectively doubling the already very high powers permitted in the USA. Amateurs with h.f. licences would be restricted to operation below 29.0 MHz until they obtain an "Experimenter" licence. "Novice" licensees would be able to use up to 250 watts d.c. input (for c.w.-only operation) instead of 75 watts, and these licences would be renewable in five-year terms. A new "Communicator" class of licence would not require a Morse code test and would permit use of all amateur frequencies above 144MHz but restricted to frequency-modulation (F3). "Extra" class licences for h.f. and v.h.f. would require a 20 w.p.m. Morse test but no further theoretical examination. Extra facilities on 50 and 144MHz would be given to "Technician" class licensees.

Generally it seems that the FCC wants to make entry into the hobby easier and to give newcomers more facilities, including new Morse-free licences, but would retain the existing "incentive" structure by providing progressively more operating privileges. The FCC has invited comment by June 16, 1975, so it will be some time before these proposals become effective—and of course they may yet be modified.

The r.t.t.y. facilities at ZS3B

Interest in radio-teleprinting continues to grow and many well-equipped stations are using this mode. But surely one of the most elaborate installations must be that of Gerhard Schlorf, ZS3B, in what used to be known as South-west Africa. The following description of his station appeared recently in *Radio ZS*: "The station operates auto start on 14075kHz and offers a number of facilities. In response to a code contained in the incoming 45 baud, 170Hz shift signal a message generator responds: 'ZS3B attended' or unattended, whichever is the case, or

'ZS3B printing'. In response to a different incoming coded signal, a stored message can be activated. Another form of coded input signal records the incoming signal which, if ended appropriately, would by using a memory, switch on the transmitter, switch off the receiver and retransmit the incoming signal to another address.

"Another feature permits an incoming 7MHz signal to be retransmitted at the same time on 14MHz, and vice versa, to allow retransmission to another area.

"The installation includes two teleprinters and the whole station is operative 24 hours of the day with any incoming signal printed, with those signals addressed specifically to ZS3B printed on one teleprinter, so that the operator need not wade through reams of paper to see if anything has come in for him.

"The 14075kHz frequency is crystal controlled and maintained to within ± 30 Hz. The station forms part of a world wide amateur network."

Good winter for "Top Band"

The low sunspot levels of activity which have restricted operation on 14MHz (and above) fairly strictly to the hours of daylight this winter have brought compensating benefits to the considerable number of "Top Band" (1.8MHz) dx enthusiasts, to judge by the latest Bulletin from Stewart Perry, W1BB. He reports that many amateurs have this season completed the by-no-means-easy feat of achieving "worked all continents" on this band (KV4FZ even completed a WAC in a space of eight hours!). Much sought after have been VS6DO in Hong Kong and a growing string of stations in South and Central America. Helena de Kertesz, YV5CKR, after a visit to Europe and the United States returned to Caracas, Venezuela, to become possibly the only "young lady" operator currently active on 1.8MHz dx, and has made many long-distance c.w. contacts. One of the new countries to appear on the band this winter was ST2AY in the Sudan, operated by Roger Crofts, G3UPK. The "first-timers" tests were handicapped by rather poor conditions, but the ARRL 1.8MHz tests in December provided many excellent contacts particularly on the second night. Stew Perry, W1BB, has this season worked 150 dx stations in 46 countries compared with 116 stations in 37 countries in the equivalent season of 1973-74.

50 years of REF

This month, French amateurs are marking the 50th anniversary of the formation of the Réseau des Emetteurs Français in April 1925. This society—long-established as the French national society for radio amateurs—was by no means the first radio society to be formed in France; for example, in 1914 there was the "Groupe Français des amateurs de TSF" and others in the early 1920s included the rather sinisterly named "Club des 8". But in 1925, Jack Lefebvre, F8GL, invited licensed amateurs to join an association that would

be concerned exclusively with amateur radio activities and promised to eschew the intrigues that were plaguing some of the other groups that were attempting to embrace also broadcast listeners. Some 50 amateurs responded and Jack Lefebvre became founder-president.

Although amateur activity has always been on a fairly modest scale in France (currently there are about 5000 French amateurs) at least two of Europe's most successful pioneers of h.f. were located there: Leon Deloy, F8AB of Nice and Pierre Louis, F8BF.

The South African Radio League similarly reaches its 50th anniversary in May.

From all quarters

A suggested "facsimile standard" for British amateurs is put forward in *CQ-TV* by J. J. Wilcox, G8GGU: drum speed 3Hz; drum size 70mm diameter by 70mm long for 1:1 aspect ratio; scan rate 64 or 96 lines/inch; co-operation index 264 or 176; sync/phasing 15 second period, 4% white pulse in black level at start of line; scan direction left to right; modulation a.f.s.k. to A4, F4 or A4J; tones carrier 1700Hz, white 1300Hz, black 2100Hz, stop 1100Hz with picture inversion available.

The Radio Amateurs Old Timers Association (open to amateurs who have held a licence for 25 years) is holding its 1975 annual reunion on Friday, May 16 at the Bonnington Hotel, London WC1 (details Miss M. Gadsden, 79 New River Crescent, London N13 5RQ). Its official "net" is at 1100 hours on the first Thursday of each month on 3740kHz.

Following representations from the RSGB, the Home Office has agreed to a simplification of log-keeping for mobile operation. Logs will now have to show only time of the start and finish of the journey; starting and finishing points of the journey; and frequency bands used during the journey.

The Sunday-morning GB2RS news stations on v.h.f. are now all using the same frequency of 144.5MHz.

In Brief

Letters reaching me from the RSGB are usually franked with the slogan "Radio Society of Great Britain guards the interest of the radio amateur"—but recently the Post Office substituted the rather perverse message: "Collect stamps a great hobby" . . . To counter overcharging of the Oscar 6 battery amateurs can now make use of the morning "descending" orbits on Mondays, Wednesdays and Saturdays . . . Allan Mears, G8SM, has been elected as President of the Thames Valley Amateur Radio Transmitters Society, now in its 42nd year . . . The Amateur Radio Mobile Society's 1975 rally will be on Sunday, May 18 at The Clinical Research Centre, Northwick Park Hospital, Watford Road, Harrow, Middx (near Northwick Park underground station).

PAT HAWKER, G3VA

New Products

Column indicator

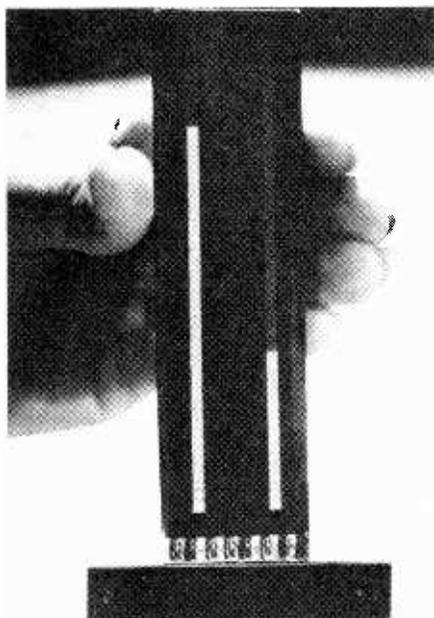
This indicator consists of two columns of light, the lengths of which represent an analogue quantity. Two separate analogue values can be displayed on the columns which are formed by 100 elements, each being illuminated in turn to form a continuous column of light up to 126mm long and 2.54mm wide. The indicator is manufactured by Burroughs and available from Walmore Electronics Ltd, 11-15 Betterton St, London WC2H 9BS.

WW300 for further details

Temperature detector

The "thermafilm" temperature detector is a thick-film unit which matches the BS1904 and DIN43760 specifications and can therefore replace conventional wire-wound platinum resistance detectors. Response time of the device is claimed to be half that of platinum detectors. Thermo-film can be used over a temperature range of -50 to $+600^{\circ}\text{C}$. Matthey Printed Products Ltd, William Clowes Street, Burslem, Stoke-on-Trent, Staffs.

WW303 for further details



WW300

Microwave filters

Models TYG-100 and TYG-400 are continuously-tunable bandpass filters having bandwidths from 1 to 20GHz and 4 to 18GHz respectively. These filters are YIG types offering an error of less than 1% and a resolution on the frequency dial of 10MHz. Maximum average r.f. power from the instrument, which measures $4\frac{1}{2} \times 4\frac{1}{2} \times 3$ in, is 100mW. Telonic Industries UK, 2 Castle Hill Terrace, Maidenhead, Berks.

WW313 for further details

Heat-sinks

A range of black-anodized heat-sinks for TO-5 and TO-100 packages have thermal resistances from 30°C/W and are manufactured from copper-based alloys. Dau UK Ltd, 42A Main Road, Barnham, Sussex PO22 0ES.

WW327 for further details

Vacuum relays

Latest additions to the Kilovac Corporation range of vacuum relays are the KC-3 rated at 8kV, the KC-10 and H-26 both rated at 15kV, and the KC-20 rated at 28kV. The relays offer a dielectric strength of around 1000V/mil when operating, which permits closer contact spacing and low-bounce mechanisms. Walmore Electronics Ltd, 11 Betterton Street, Drury Lane, London WC2H 9BS.

WW320 for further details

Frequency synthesizer

The Rockland model 5100 programmable frequency synthesizer uses digital techniques to provide outputs in 0.001Hz steps from d.c. to 2MHz. Programming is accomplished through t.t.l.-compatible circuits or contact-closures to ground.



WW303



WW313

Either a binary or 8.4.2.1 b.c.d. format can be used, with up to 46 parallel bits or four 12-bit bytes. Output amplitude of the instrument is variable continuously and in 1dB steps to 85dB from a maximum of 10V pk-pk with 50Ω source impedance. Wessex Electronics Ltd, Stover Trading Estate, Yate, Bristol BS17 5QP.

WW315 for further details

Contactless keyboard

Plessey Keyboards have announced a contactless electronic keyboard—the PCK 2000. The unit, which has been produced primarily for the professional computer market, features capacitance coupled keyswitches. These switches operate into encoding logic based on an l.s.i. r.o.m. which provides various design options. The options can be selected on the basis of specification or cost requirements. Plessey Keyboards, Wood Burcote Way, Towcester, Northants NN12 7JN.

WW316 for further details

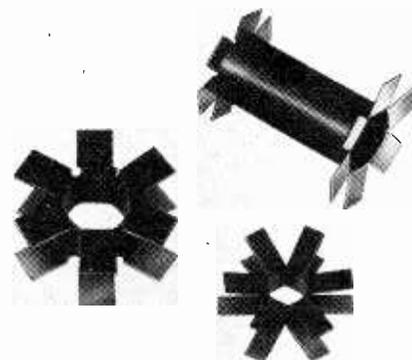
Opto-isolated switches

Two new solid-state switches consist of a low-level voltage switching control, suitable for direct drive from logic pulses, and optical isolation between input and output circuits. The input voltage range is from 3 to 32V d.c., which will switch an alternating current of 10A r.m.s. at a voltage of either 120 or 240V. Hamlin Electronics Ltd, 14 New Road, Southampton.

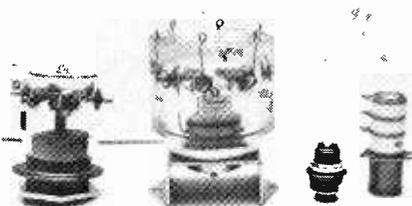
WW317 for further details

Thick-film amplifiers

A 12W class A power amplifier, type TF008, requires an input of 0.5V for full rated output and a claimed distortion figure of 0.05%. The supply voltage range is from ± 12 to $\pm 20\text{V}$, and the frequency response is 10Hz to 30kHz. Type TF009 is a 25W class B design requiring a supply voltage of between ± 17 and $\pm 25\text{V}$ at 2A maximum. Frequency response is



WW327



WW320

20Hz to 60kHz with a typical harmonic distortion figure of 0.2%. Both units require external power transistors, and measure $1.35 \times 1 \times 0.25$ in. Guest Distribution Ltd, Redlands, Coulsdon, Surrey CR3 2HT.

WW318 for further details

Phasor meter

The model STD10,000 phase-sensitive multimeter will give direct readings, of in-phase and quadrature components of voltage or current, on two separate meters. Five voltage/current ranges from 500mV to 500V and 1mA to 10A f.s.d. are provided on the instrument, which operates at 50/60Hz or 12 to 2400Hz with the aid of an adaptor. J. J. Lloyd Instruments Ltd, 1 Brook Lane, Warsash, Southampton, Hants.

WW305 for further details

Digital multimeter

A multimeter offering a voltage range from $1\mu\text{V}$ to 1000V, a resistance range from $1\text{m}\Omega$ to $2000\text{M}\Omega$, and a current range from 10pA to 2A has been introduced by Keithley Instruments. Other features of the model 160B are a 1200V floating capability, a $0.2\mu\text{V}/^\circ\text{C}$ stability, and several options/accessories including a b.c.d. output, a r.f. probe, and a 50A shunt. Keithley Instruments Ltd, 1 Boulton Road, Reading, Berks.

WW325 for further details

Load simulator

The model EL750 is a portable d.c. power tester suitable for checking power supplies. The unit will dissipate up to 750W d.c. and will operate in a constant-resistance or constant-current mode, selected manually in steps by push buttons. Load-current programming can be accomplished by applying an external direct voltage through a connector on the rear panel. Data Technology Corporation, Sherwood House, High Street, Crowthorne, Berks.

WW308 for further details

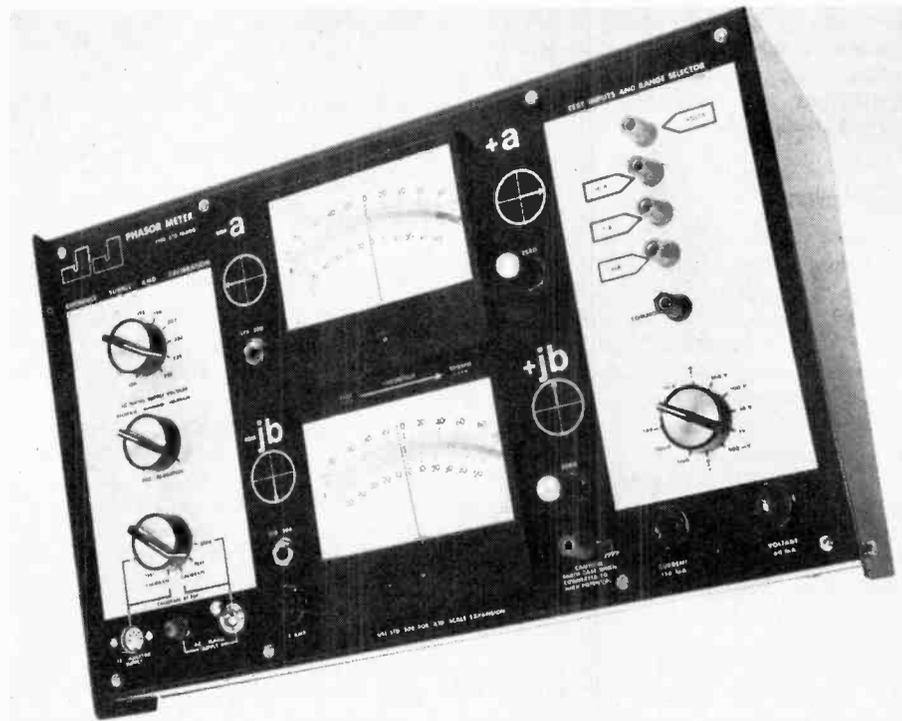
Silk-screen service

Circuitape Ltd have introduced a made-to-order service for silk-screen printed aluminium panels. The panels can be produced in any shape and size with punched holes to specific requirements. Silk-screening can be in any colour with legends in any language. Delivery is normally around five weeks, but a special rapid service is also available. Circuitape Ltd, New Street, Aylesbury, Bucks.

WW306 for further details

Elapse timers

A custom range of elapse timers from Longmore Systems enable time periods between 1ms and 99990s to be measured. Five-decade selection is provided but different ranges may be specified. Control is by voltage-trigger and push-button start-stop with separate reset. Instrument read-



WW305



WW325



WW308

out is on a four-digit display which is accurate to within 10 p.p.m. Longmore Systems Ltd, Environment House, 875 Sidcup Road, London SE9 3PP.
WW307 for further details

YIG counter

The model 331 microwave counter will automatically measure frequencies from 825MHz to 18GHz. The centre frequency of signals with up to 200MHz f.m. deviation can be measured directly and an optional plug-in circuit permits the measurement of signals as low as -25dBm. Remote programming, b.c.d. output and rear input options are also available for systems application, where up to 80 readings a second can be made. Dana Electronics Ltd, Collingdon Street, Luton, Beds.
WW329 for further details

Function generator

The Hewlett-Packard model 3312A function generator contains two independent generators in one case. The main generator has a frequency range from 0.1Hz to 13MHz in eight ranges while the modulator generator delivers signals from 0.01Hz to 10kHz. Both generators provide sine, triangle, square, pulse and positive/negative ramps. By combining the generators, sweep, a.m., f.m. and tone

bursts can be created with an output, from the main generator, of 10V pk-pk into 50Ω. A four-position attenuator with variable control adjusts the output over a 60dB range. Hewlett Packard Ltd, King Street Lane, Winnersh, Wokingham, Berks RG11 5AR.
WW326 for further details

36 position switch

A single-pole, 35-way switch rated at 2A continuous with a breaking figure of 50mA at 300V a.c./d.c. has been added to the N.S.F. range of rotary wafer switches. Both 10° and 20° indexing versions are available from N.S.F. Ltd, Keighley, Yorkshire DD21 5EF.
WW302 for further details

Plastic pots?

Two ranges of conductive plastic potentiometers designated P4100/4200 and P4400, the latter being a low cost version of the former, are now available in the UK. The precision range is rated at 1.8W and offers a resolution of 0.003% with 352° angle of rotation, a linearity within 0.2% and an operating torque of 0.2 cm.g. Both models are manufactured in servo size 13 and can be supplied with up to ten ganged tracks. Variohm Components, The Barn, Wood Burcote, Towcester, Northants NN12 7JR.
WW311 for further details

Active filter

The UAF31 is a two-pole active filter in which, with the addition of three or four external resistors, the Q-factor, resonant frequency and gain can be controlled. Three separate outputs provide low, high and band-pass transfer function—by summing the high and low pass outputs a band-reject transfer function can be obtained. Frequency accuracy is within 1% and the Q range is from 0.5 to 500. Burr-Brown International Ltd, 25A King Street, Watford, Herts WD1 8BT.
WW310 for further details

Pyrometer

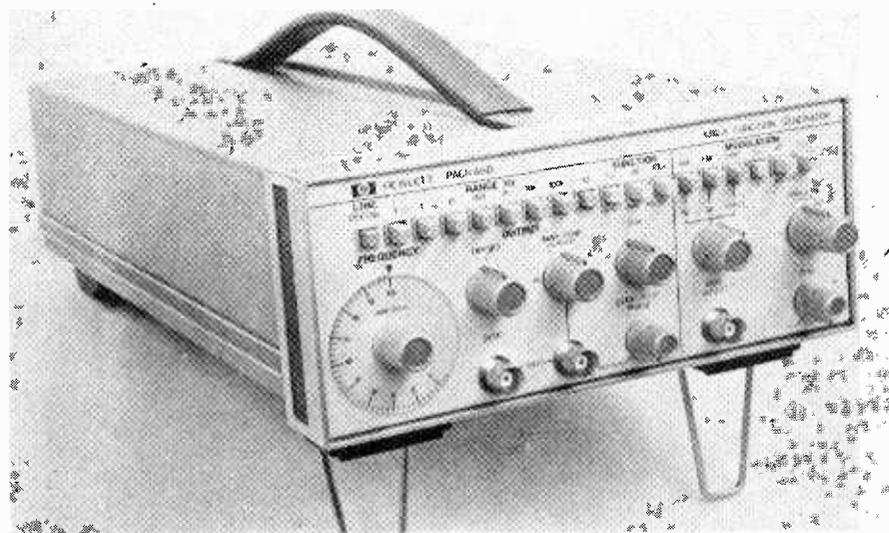
The Litesold pyrometer has been designed for measuring soldering-iron bit temperatures. A fine thermocouple tip, which causes negligible cooling, is placed on the bit and temperature is read off a meter calibrated to 500°C f.s.d. Light Soldering Developments Ltd, 97 Gloucester Road, Croydon, Surrey.
WW332 for further details

Conductive plastics

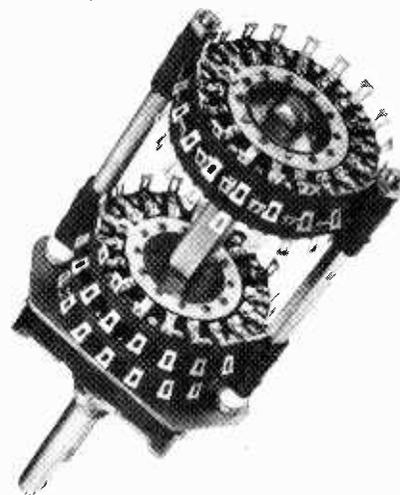
3M have announced a conductive plastic called Velostat. This product is available as a material or as a variety of manufactured items. For the benefit of any organic-chemists that may be reading the material is a carbon-loaded polyolefin



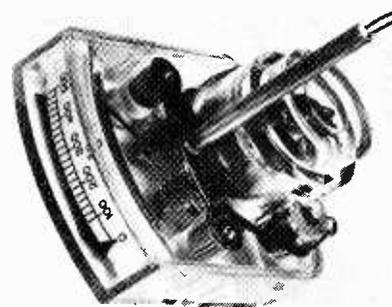
WW329



WW326



WW302



WW332

plastic which is conductive throughout its volume. 3M UK Ltd, 3M House, Wigmore Street, London W1A 1ET.

WW330 for further details

Logic panel meter

This panel meter has a six-digit display and can be used for frequency counting, time, and period measurements. The unit, which occupies 3.3 × 1.4in of panel space, consists of three modules—a six digit decimal counting and display section, a pre-scaler and timing generator module, a clock and offset module which consists of an internal 500kHz crystal oscillator and a programmable divider. Power requirements are ±5V at 800mA. Tony Chapman Electronics Ltd, 80A High Street, Epping, Essex CM16 4AE.

WW331 for further details

Circuit tester

A pocket-sized tester that will check voltage, polarity and continuity is now available in the UK. The instrument has a l.e.d. indicator which glows when either a voltage between 3 and 600V a.c./d.c. is present, continuity in a circuit exists, or the polarity of a circuit/component is correct with respect to the coloured probes. British Central Electrical Co Ltd, Ringwood, Hants.

WW321 for further details

Variable transformers

Cherishaw Ltd have introduced a new range of single- and three-phase variable transformers with current ratings from 2 to 28A. Each model is manufactured in either an open form for panel mounting or enclosed for bench use and all versions are designed for a 240V supply. Cherishaw Ltd, 103 Mount Pleasant, Tunbridge Wells, Kent.

WW322 for further details

Inductors

The 1537 series of moulded r.f. inductors will operate in the temperature range -55° to +125°C and are available in inductances from 0.15 to 240μH. Maximum current ratings range from 115mA, for the 240μH device, to 2.74A for a 0.15μH type. The components measure 0.155in dia × 0.375in and are manufactured by Amphenol Ltd, Thanet Way, Whitstable, Kent CT5 3TF.

WW323 for further details

P.r.o.m. eraser

An ultra-violet power source designed for erasing p.r.o.ms has a built-in timer, variable from 0-30 minutes, and can erase up to six memories in a single run. The unit is manufactured by Stolz A.G. of Switzerland and is available in the UK from Memec Ltd, The Firs, Whitchurch, Aylesbury, Bucks.

WW324 for further details

Sinewave oscillators

A series of low-distortion, amplitude-stable signal sources manufactured by Frequency Devices Inc., provide a single, specified

frequency in the range 100Hz to 10kHz. Features include a stability of 0.02% per °C, amplitude stability of 0.1dB, adjustable output from 1 to 20V p-p. Distortion of the device is 0.1% and the impedance is less than 10Ω. The oscillators are short-circuit protected, measure 1.5 × 2.0 × 0.4in and are available from Lyons Instruments Ltd, Hoddesdon, Herts.

WW304 for further details

Solid State Devices

Names of suppliers of devices in this section are given in abbreviation after each entry and in full at the end of the section.

Photodiodes

The TIXL471 gallium-arsenide l.e.d. and the TIXL451 silicon avalanche photodiode are both high-speed diodes for use in fibre optic application. The devices will connect directly and self-align with Corning T-19H optical waveguide terminations.

WW350 for further details Texas

Regulators

Fixed-voltage regulators for both positive and negative supplies are available with outputs from 5 to 24V and current ratings up to 1.5A. The regulators are supplied in either a plastic package or TO-3 encapsulation.

WW351 for further details GDS

Switching transistor

A triple diffused n-p-n power transistor, type SCA100-120, appears as only a 0.002Ω resistance with a 100A collector current. Saturation voltage at the maximum-rated I_c is 1.7V and the maximum voltage is 120V.

WW352 for further details Impectron

Microprocessor

The Mostek eight-bit parallel microprocessor, type MK5065 is a 40-pin single chip-device. It offers 51 basic instructions or 81 with modifications, and has t.t.l. compatible inputs and outputs.

WW353 for further details Lock

Miniature bridges

A new range of 1.5A silicon full-wave rectifiers comprises seven devices—the MDA100 to 110 designed for voltages between 50 and 1000V. These bridges will operate over a junction-temperature range from -55 to 150°C and will withstand a 45A surge for one cycle of operation.

WW354 for further details Motorola

Alarm i.cs

A range of i.cs designed for alarm application are now available in the U.K. Devices in the range include the 3010 tone alarm which compares an input signal to an adjustable reference voltage if the reference voltage is exceeded a pulsating

or constant tone for driving an external loudspeaker is generated. The 3020 tri-stage alert/alarm has three l.e.d. drivers. Each of the three drivers has two t.t.l. compatible inputs. The 3030 temperature alarm activates both a steady t.t.l. compatible output and a tone output if the temperature of the i.c. package exceeds a preset level.

WW355 for further details

Adrian Electronics

A/d system

A low-cost a/d system can be realized by using the MC14435 d.v.m. i.c. and the MC1505L dual-ramp generator and comparator i.c. One external capacitor and two potentiometers are required to complete the circuit.

WW356 for further details Semicomps

TV-sound i.c.

The TDA1190 is capable of carrying out all the functions of a television sound channel. These functions include an i.f. amplifier/limiter, an active low-pass filter, f.m. detector, a d.c. volume control and a power amplifier.

WW357 for further details SGS-Ates

Zener diodes

A new range of zener diodes are plastic package types with a power dissipation capability of 1.32W and a zener voltage range from 3.3 to 200V.

WW358 for further details Siemens

C.m.o.s. a/d converter

Analog Devices Ltd have announced what is claimed to be the world's first micro-processor-compatible i.c. analogue-to-digital converter to provide up to 10-bit accuracy. The device, designated AD7570, uses c.m.o.s. construction and is designed specifically to interface with microprocessors, and is fully t.t.l./d.t.t.l./c.m.o.s. compatible. The AD7570 features a conversion time of 20μs and a throughput rate of 50kHz.

WW359 for further details

Analog Devices

Texas Instruments Ltd, Manton Lane, Bedford.

GDS Sales Ltd, Michaelmas House, Salt Hill, Bath Road, Slough, Bucks.

Impectron Ltd, 23 King Street, London W3 9LH.

Lock Distribution, Neville Street, Middleton Road, Oldham, Lancs OL9 6LF.

Motorola Ltd, Semiconductor Products Division, York House, Empire Way, Wembley, Middx.

Adrian Electronics Ltd, 28 High Street, Winslow, Buckingham MK18 3HF.

Semicomps Ltd, Northfield Industrial Estate, Beresford Avenue, Wembley, Middx HA0 1SD.

SGS-Ates Componenti Elettronici SpA, Via C. Olivetti 2, 20041 Agrate Br., Milan, Italy.

Siemens Ltd, Great West House, Great West Road, Brentford, Middx.

Analog Devices Ltd, Central Avenue, East Molesey, Surrey.

Real and Imaginary

by "Vector"

The Second Book of Vector

There dwelt in the land of Brit certain high priests who served in the temples of Elektron, which is an invisible god who darteth around in ever-decreasing circles but never into his own nucleus. And the priests of Elektron were devout men, serving no other god but he. And Elektron looked with favour upon them and rewarded them each according to his worth with divers strange gifts. To some he gave power to converse with those from afar off and to others he brought visions of strange happenings in distant lands; yea, even of the United States cavalry in glorious Technicolor.

And to certain other of his high priests Elektron gave powers of levitation, so that they walked with their feet ever-so-slightly off the ground; these dwelt in glass temples called, in the native tongue, Researchlabs or Funnifarms, which were set apart from the common people and to which entrance was denied to all, saving only those having scrips of authority from the chief priest. And these priests were called by the common people Egbonces which meaneth he who knoweth the square root of minus one. And the Egbonces were cunning at fashioning curious devices from boot-latchets and wax so that the populace were astonished and continually cried out, saying, Behold, these are great wonders but of what use be they?

Yet other high priests of Elektron were followers of the prophet Babbage and these were set in authority over divers machines that brought much benefit to the common people; some computed the numbers of the tribes and the taxes that each man should pay; others controlled the *paycheks* of those that laboured, so that each man received less than his hire, while others suggested that the inter-city chariots were tardy in arrival. And Elektron taught the high priests to feed the engines with curious symbols engraven upon tablets that they might print out likenesses of the sex-goddess Bardot devoid of her apparel, which gave satisfaction to many. And these priests likewise withdrew the hems of their garments from the common populace and, by conversing in the alien tongues of Fortran and Algol, preserved their mysteries jealously.

At this time the skies were filled with

heavier-than-air machines of many nations which flew with the noise of emasculated hornets and carried the peoples to and fro, even unto the ends of the earth. These machines were under the auspices of the god Hijak. And certain of the nations had air machines which could drop unpleasantness on the land beneath to discomfort the people; but certain other nations who were poor and backward and, as the saying goeth, not with it, did not possess these amenities. Thus it came to pass that the acquisition of such machines was regarded by all as an outward and visible sign that the possessor nation was emerging from savage practices and an ensample to others.

And certain rich merchants searched diligently and redeemed many heavier-than-air machines; some from the knacker's yard; some which fell from the back of an hangar and yet others which were dislodged privily from the Science Museum. And they purposed to sell these to the heathen for many shekels of gold and at great profit. So it came to pass that the merchants sent envoys to a far country, even to the kingdom of Tsetse-Tsetse.

And the envoys said unto the king of Tsetse-Tsetse, O king live for ever but put not thy money upon it. And the king answered saying, What meanest thou? Then did the envoys reply saying, Surely thou knowest that thy neighbour the king of Beri-Beri hath cast covetous eyes upon thy lands and thy maidens? If only thou hadst an Air Force it would cause thine adversary to wind his neck in. Then did the king beat his breast crying, Woe is me! And the envoys made reply saying Not so, O king, for it so happeneth that we can supply thee with a squadron of Bleriot Mk.Is. And thus it came to pass that the king bought from the envoys for much fine gold and slept peacefully with his wives that night.

Then did the envoys depart and journeyed to the neighbouring land that is called Beri-Beri. And they said to the king of Beri-Beri, O king live for ever but begin not the reading of any long novels. And the king said What meanest thou? Whereupon the envoys replied saying, Knowest thou not that thy neighbour the king of Tsetse-Tsetse hath secretly purchased war-birds and purposeth to ravage thy country? At this the king went as pale as was possible and the end of the matter was that he became Commodore of a squadron of Cabbage White Mk. VIIIs.

And it came to pass that in Brit the god Elektron gave unto his high priests the power to fashion magick bowls which could divine the presence and movements of heavier-than-air machines even at great distances. Yea, and not only this, for, by gazing into the bowl, yessels having their business in great waters could be made to broach each other with greater certainty. And on land its magick powers enabled the Fuzz to put the finger upon all charioteers who, like their forebear Jehu, drove furiously. And the name of this new wonder was radar, which, being translated, meaneth That which worketh by suction and mirrors.

And the rich merchants came unto the high priests of radar and said unto them, Lo, we have heard much of the wonders that thy god Elektron hath taught thee and it seemeth that we can do a deal with profit to all. Make for us great numbers of these magick bowls, we pray thee, that we may sell them to the nations for their greater safety. Do this and we will pay thee many shekels of gold; moreover, we will pull down thy temples which are but potting sheds and in their stead we will raise mighty glass temples to the greater glory of Elektron, wherein thou shalt find all the instruments that thy heart desirest. And we will clothe thee in white raiment and give thee charge over many. What sayest thou?

And the high priests conferred privily and agreed among themselves that they were on to a good thing. So it came to pass that the merchants caused mighty temples to be built wherein the god Elektron might be served, both by day and night; and the high priests, for their part, devised magick bowls with ever greater cunning and these the merchants sold to whoever was in the market place. Thus it came about that both the king of Tsetse-Tsetse and the king of Beri-Beri were persuaded to buy the magick bowls with which to keep vigil each upon the other. Yea, both primary and secondary radar had they in plenty and certain inhabitants of the two countries were trained to interpret the signs and portents which appeared upon these bowls whenever an heavier-than-air machine was drawing nigh.

And behold, it came to pass that upon a certain night there was a watchman in the kingdom of Tsetse-Tsetse who was an exceeding dim lamp; moreover, when interpreting the symbols on the magick bowl, he was, as the saying is, unable to tell Squawk from Clutter. And this watchman, fearful of what he supposed he saw upon the face of the bowl, said unto himself The enemy is upon us, and thereupon smote the Panick Button. Whereupon the Bleriot Mk.Is rose (all excepting one which had broken its elastick band) and brought destruction to the sleeping land of Beri-Beri. But the Cabbage Whites, being forewarned by their magick bowls, were already riding the heavens and bringing affliction upon their neighbours. And, by morning, both countries were bathed in blood.

And in the temples of Elektron there was great commotion, for the hot lines were glowing red and the artificial moons which the high priests had raised were overburdened with coloured images of the slaughter, for the delectation of the common people. And when all was accomplished, overseers from the United Nations came and wagged their heads and voted Tsetse-Tsetse and Beri-Beri into their assemblies in recognition of their emergence.

Sanyo Video Tape Recorder Systems

In a changing world... audio visual innovations and methods are developing with incredible speed. Keeping pace with this development is the range of uses to which this equipment can be applied. Practical applications are virtually limitless and indeed appear to be bounded only by the employers imagination. Sanyo, acknowledged leaders in slow motion and 'stop frame' techniques, whose VTR products have been used world wide for many years in industry, commerce, education and sport have, with the aid of extensive research, produced a range of high quality competitively priced audio visual equipment. Cameras, recorders, monitors - the best of their kind.



VTR 1100SLR
 $\frac{1}{2}$ " 4-head monochrome solid-state VTR offering four different viewing motions: standard, slow, still and frame-by-frame. Features include: rotating 4-head ferrite magnetic helical scanning system for perfect slow motion, independent audio erasure and re-recording for voice-over, video editing, ALC, digital counter for instant location of material, auto shut-off.

VM 4120 (K)
 11 $\frac{3}{4}$ " monitor with R/F. Off-air portable video monitor/receiver with high resolution 12" CRT. Ideal for educational purposes. Can be used as conventional TV.

VTR 2000
 A compact lightweight $\frac{1}{2}$ " Video Tape Recorder with a host of advanced features including an automatic level control system that eliminates video and audio signal adjustment, independent audio erasure for re-recording and inserting commentaries, background music etc. a skew and tracking control system, automatic shut off switch, tape counter and a perfect ferrite crystal head assembly. Weight less than 29lbs.

VC 1150
 General purpose video camera with switchable internal/external sync. and ALC. For use with the VTR 1100 SLR and VTR 2000.

VCA 200 E Video camera kit with built-in viewfinder, microphone, zoom lens and tripod. For use with the VTR 1100SLR and VTR 2000. 3" electronic viewfinder can also be used as a playback monitor.

VM 4155 (K) Robust 16" industrial video monitor with sound channel.

VM 4092 (K) 9" industrial video monitor. Robust metal case. High resolution 10" CRT. For use in stores, hospitals, etc.

VC 1120 Surveillance video camera with R/F. Covers all light conditions from extra-low 20 lux 2ft-candles to outdoor brightness with ALC. Takes all lenses, including wide angle, zoom, close-up and telephoto.

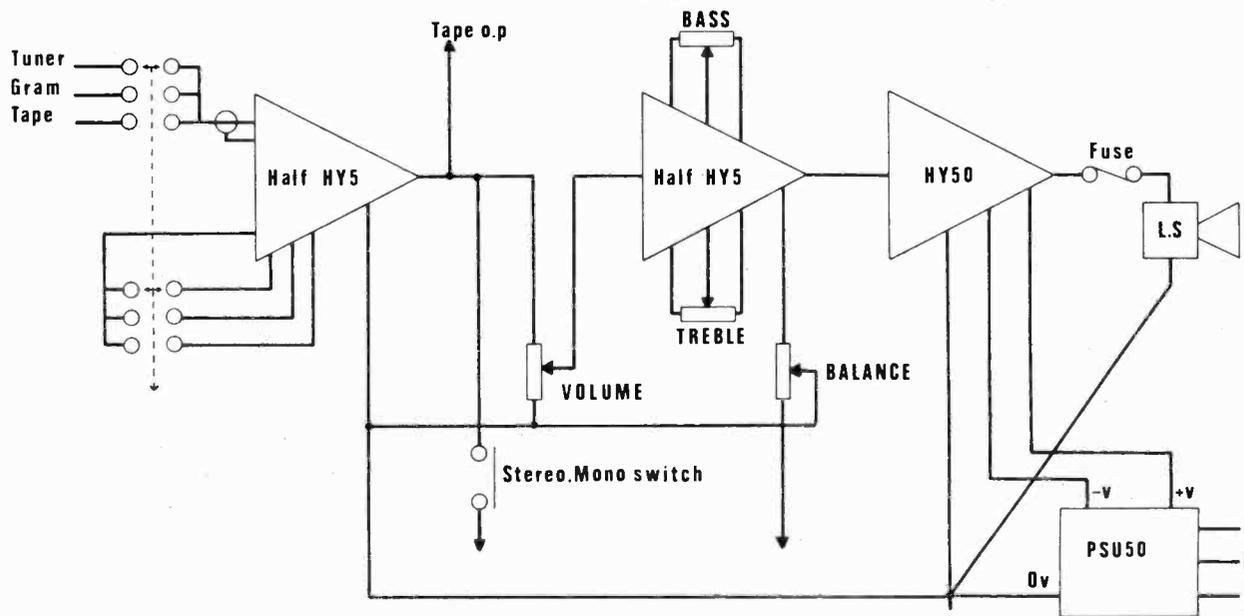
VCS 3000 Low light level video camera. Operates at very low light levels for security purposes. Also for use with infra-red lighting.

SANYO  a world of difference

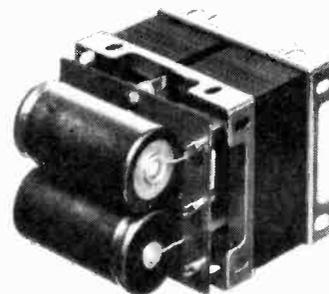
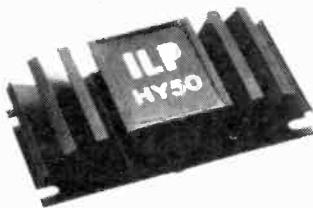
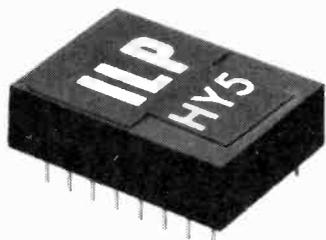
For further information please apply to VTR Manager, Sanyo Marubeni (UK) Limited, Sanyo House, Bushey Mill Lane, Watford, WD2 4UQ. Telephone: Watford 30421.

IP I.L.P. (Electronics) Ltd

SHEER SIMPLICITY!



Mono electrical circuit diagram with interconnections for stereo shown



The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

TECHNICAL SPECIFICATION

Inputs
 Magnetic Pick-up 3mV.RIAA
 Ceramic Pick-up 30mV
 Microphone 10mV
 Tuner 100mV
 Auxillary 3-100mV
 Input impedance 47kΩ at 1kHz

Outputs
 Tape 100mV
 Main output 0db (0.775 volts RMS)

Active Tone Controls
 Treble ±12db at 10kHz
 Bass ±12db at 100Hz

Distortion 0.05% at 1kHz
Signal/Noise Ratio 68db
Overload Capability 40 db on most sensitive input

Supply Voltage ±16-25 volts.
 PRICE £4.50 + 0.36 V.A.T. P & P free.

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided: Input, output, power lines and earth.

TECHNICAL SPECIFICATION

Output Power 25 watts RMS into 8Ω
Load Impedance 4-16Ω
Input Sensitivity 0db (0.775 volts RMS)
Input Impedance 47kΩ
Distortion Less than 0.1% at 25 watts typically 0.05%
Signal/Noise Ratio Better than 75db
Frequency Response 10Hz-50kHz ±3db
Supply Voltage ±25 volts
Size 105 x 50 x 25 mm.
 PRICE £5.98 + 0.48 V.A.T. P & P free.

The PSU50 incorporated a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS

Output voltage 50 volts (25-0-25)
Input voltage 210-240 volts
Size L.70. D.90. H.60 mm.
 PRICE £6.00 + 0.48 V.A.T. P & P free.

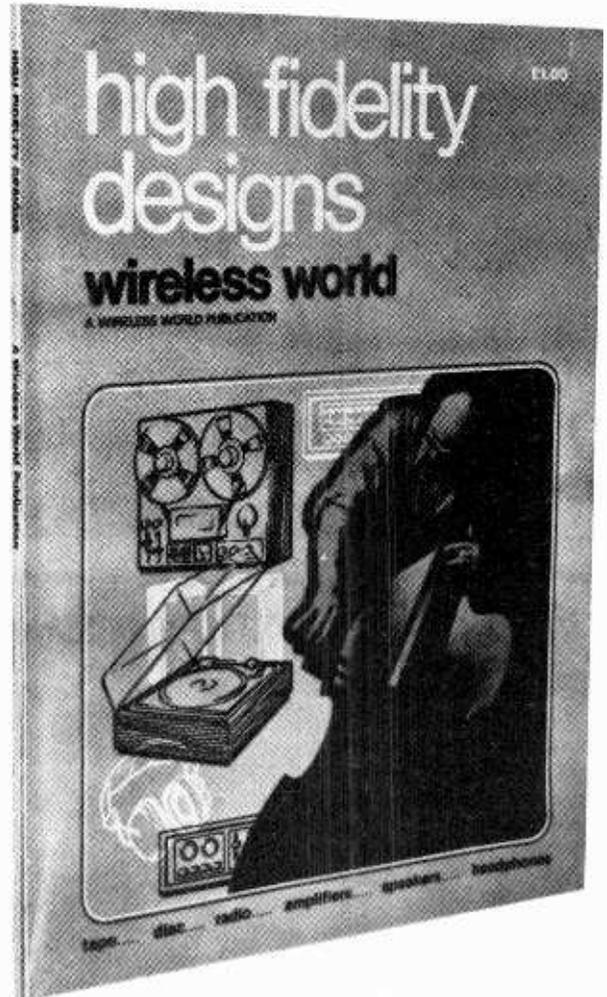
TWO YEARS GUARANTEE ON ALL OUR PRODUCTS

I.L.P. Electronics Ltd,
Crossland House,
Nackington, Canterbury,
Kent CT4 7AD
Tel (0227) 63218

Please Supply _____
 Total Purchase Price _____
 I Enclose Cheque Postal Orders Money Order
 Please debit my Access account Barclay card account
 Account number _____
 Name & Address _____
 Signature _____

You've asked for it!

Time and again we are asked for reprints of Wireless World constructional projects: tape, disc, radio, amplifiers, speakers, headphones. Demand continues long after copies are out of print. To meet the situation we have collected fifteen of the most sought after designs and put them in one inexpensive book. And we've updated specifications where necessary to include new components which have become available. A complete range of instruments is presented, from the Stuart tape recorder and Nelson-Jones f.m. tuner, through the Bailey, Blomley and Linsley Hood amplifiers, to the Bailey and Baxandall loudspeakers – some of which have been accepted as standard in the industry.



high fidelity designs

£1 from newsagents and bookshops
or £1.35 (inclusive) by post from the publishers.

A book from

Wireless World

To: General Sales Department, Room 11, Dorset House,
Stamford Street, London, SE1 9LU

Please send me copy copies of High Fidelity Designs
at £1.35 inclusive. I enclose remittance value £.....
(cheques payable to IPC Business Press Ltd.).

NAME
(please print)
ADDRESS

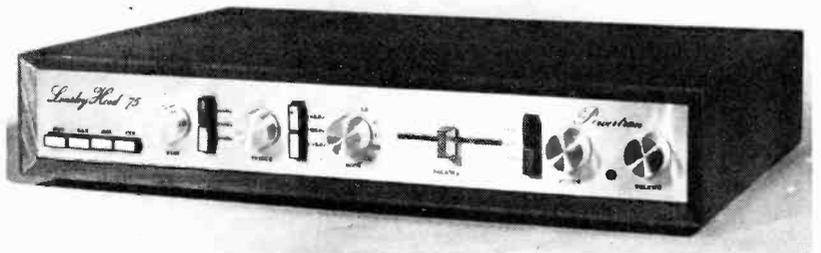
Company registered in England No. 677128
Regd. office; Dorset House, Stamford Street, London SE1 9LU

AMPLIFIER KITS OF *Distinction*

DESIGNER-APPROVED KIT

In Hi-Fi News there was published by Mr Linsley-Hood a series of four articles (November 1972-February 1973) and a subsequent follow-up article (April 1974) on a design for an amplifier of exceptional performance which has as its principal feature an ability to supply from a direct coupled fully protected output stage, power in excess of 75 watts whilst maintaining distortion at less than 0.01% even at very low power levels. The power amplifier is complemented by a pre-amplifier based on a discrete component operational amplifier referred to as the Lincac which is employed in the two most critical points of the system, namely the equalization stage and tone control stage, positions where most conventional designs run out of gain at the extremes of the frequency spectrum. Unusual features of the design are the variable transition frequencies of the tone controls and the variable slope of the scratch filter. There is a choice of four inputs, two equalized and two linear, each having independently adjustable signal level. The attractive slimline unit pictured has been made practical by highly compact PCBs and a specially designed Toroidal transformer.

Hi-Fi News Linsley-Hood 75 W Amplifier
Mk III Version (modifications as per Hi-Fi News April 1974)



Full circuit description
in handbook
(pack 15—price 30p)

FREE TEAK CASE WITH FULL KITS
KIT PRICE only **£62.40** post free (U.K.)

V.A.T. Please add 8%*
to all U.K. orders
(*or at current rate if changed)

SECURICOR DELIVERY: For this optional service
(Mainland only) add £2.00 + VAT
for further information
please write for **FREE LIST**

POWERTRAN
SEE FOLLOWING PAGE

Pack	Price
1 Fibreglass printed-circuit board for power amp.	£0.85
2 Set of resistors, capacitors, pre-sets for power amp.	£1.70
3 Set of semiconductors for power amp. (now using BDY56, BD529, BD530)	£6.50
4 Pair of 2 drilled, finned heat sinks	£0.80
5 Fibreglass printed-circuit board for pre-amp.	£1.30
6 Set of low noise resistors, capacitors, pre-sets for pre-amp.	£2.70
7 Set of low noise, high gain semiconductors for pre-amp.	£2.40
8 Set of potentiometers (including mains switch)	£2.05
9 Set of 4 push-button switches, rotary mode switch	£3.70
10 Toroidal transformer complete with magnetic screen/housing primary: 0-117-234 V. secondaries: 33-0-33 V, 25-0-25 V.	£9.15

11 Fibreglass printed-circuit board for power supply	£0.65
12 Set of resistors, capacitors, secondary fuses, semiconductors for power supply	£3.50
13 Set of miscellaneous parts including DIN skts, mains input skt, fuse holder, inter-connecting cable, control knobs	£4.25
14 Set of metalwork parts including silk screen printed fascia panel and all brackets, fixing parts, etc.	£6.30
15 Handbook	£0.30
16 Teak cabinet	£7.35
2 each of packs 1-7 inclusive are required for complete stereo system	
Total cost of individually purchased packs	£69.75

TRAMPUS

WINDSOR, BERKS.
58/60 GROVE RD.
SEND C.W.O. ADD VAT TO ALL PRICES IN U.K. P&P 15p EXPORTS 80p.

Electronics Ltd.
WINDSOR, BERKS.
58/60 GROVE RD.
SEND C.W.O. ADD VAT TO ALL PRICES IN U.K. P&P 15p EXPORTS 80p.

Digital Displays

SLA7 RED LED 0.3" DIGIT 0-9DP 89p ea
GREEN&YELLOW £1.40
JUNBO LED 0.6" 747 DISPLAY £2.25 ea.
3015F 0-9DP £1 ea.
ZENON FLASH TUBE £4. Data 15p.

LEDS red 13P

LEDS 209 STYLE ONLY 13p ea
TIL 209 WITH CLIP RED 15p ea
TIL 211 & CLIP GREEN 29p ea
LARGE 0.2" & CLIP RED 17p ea
LARGE 0.2" CLIP GREEN 30p ea
209 STYLE OR .2"ORANGE 29p ea
INFRA RED LED £1.2N5777 33p.

PHOTO IC 81P

TEC12 PHOTO AMP/SCMITT/RELAY DRIVER or LED TTL INTERFACE 81p

FLUORESCENT LIGHTS 12V MADE IN UK
8 WATT 13" £3. 13W 22" £3.50

DIGITAL CLOCK

IC AY51224 4 DIGIT CLOCK £3.75
MM5311/4 6 DIGIT CLOCK £7

CASSETTE mechanics £13.75

NEW 8tk CARTRIDGE MECHANISM £8
STEREO CASSETTE MECHANISM £13.75
Suitable for 'PW ASCOT' recorder with heads etc. SEND 15p for DATA

INTEGRATED CIRCUITS

709 DIL14 29p	LM377 2x2Wt 2.87
555 TIMER 54p	LM380 2W AF 89p
703 RF/IF 28p	LM381 2xPre £2
709 T099 23p	LM3900 4xOPA69p
709 DIL 14 28p	MC1303 £1.20
710 DIL 14 34p	MC1306 49p
723 Reg. 54p	MC1310&LED£2.65
741 DIL 8 27p	MC1312 SQ £2.10
741 DIL 14 29p	MC1330 69p
741 T099 29p	MC1339 2xPre £1
747 2x741 70p	MC1350 55p
748 DIL 8 33p	NE536 fetOPA £2
7805 5V £1.40	NE540 Driver £1
7812 & 15 £1.40	NE550 2vRef 79p
76013 6W AF £1	NE555 Timer 55p
8038 SIG GEN £3	NE556 2x" £1.20
CA3028 £1	NE560 PLL £3.15
CA3046 55p	NE561 PLL £3.15
CA3048 £2	NE562 PLL £3.19
CA3052 £1.50	NE565 PLL £2.69
CA3054 £1	SN72709 709 28p
LM300 2-20V £2	SN72741 741 26p
LM301 OPA 45p	SN72748 748 33p
LM304 0-40V £3	SN76660 IF £1
LM307 OPA 49p	SN76611 1Ff1.25
LM308 HiBo 95p	TAD110 & IF £2
LM309K 5V £1.48	TBA810 7WAF 99p
LM372 IF £1.80	ZN414 RX £1.09

SPECIAL OFFERS

2N3055 FULL HIGH SPEC 115W 37p
741C 8PIN DIL 27p. MFC4000B 33p
NE555 TIMER 55p. ZN414 RX £1.09
BC109 9p. 2N3819e 16p. BFY51 15p

7400 TTL

7400 GATES 13p	7473/74/76 29p
7404 INVERT 17p	7475 45p
7401/2/10etc14p	7490 52p
7413 SCMITT 31p	7491/2/3/4 59p
7440 BUFFER 14p	74100 74175 £1
7447 DRIVER 89p	74121 & IF 32p
7470 & 7472 29p	74123 59p
	74141(&7441)73p

TRANSISTORS & DIODES

Price each

AC127 & 128 16p	MATCHING 16p
AC187 & 188 19p	INS. BUSH SET10p
AD149 43p	TIP 41 70p
AD161 & 162 33p	TIP 42 88p
BC107 & 108 9p	TIP 2955 90p
BC109 10p	TIP 3055 55p
BC147/8/9 10p	TIS43 see 2N2846
BC157/8/9 12p	ZTX109&301 13p
BC167/8/9 12p	1N4001 4p
BC177/8/9 18p	1N4004 & 7 7p
BC182/3/4&4L10p	1N4148 & 914 4p
BC212/3/4&4L11p	2N697 14p
BCY70/1/2 17p	2N706&8 11p
BD131 & 132 39p	2N2646 UJT 32p
BFR51	2N2904 & 5 20p
BFR50/51 23p	2N2926royg 9p
BFR50/51 23p	2N3053 17p
BFR88 250V 29p	2N3055 115W 37p
BFY50/1/2 15p	2N3563 & 64 16p
BSX19/20/21 16p	2N3614 49p
MJE2955 90p	2N3702 & 3 9p
MJE3055 65p	2N3704 & 5 10p
MPU131 PUT 49p	2N3706 & 7 9p
OA91 OA81 6p	2N3708 & 9 8p
OA81 & OA91 6p	2N3710 & 11 10p
TIP 29 & 30 52p	2N3819E FET 16p
TIP 31 & 32 69p	2N3823E FET 17p

FULL SELECTION IN OUR FREE LISTS.

NEW TRAMPUS FULL SPEC PAKS

PAK A 10 RED LEDS our choice £1	
PAK B 4 741 OP AMP " £1	
PAK C 4 2N3055 £1. D 12 BC109 £1	
PAK E 10 BC182 £1. F 11 2N3704 £1	
PAK G 8 BFY51 £1. H 9 2N3819e £1	
PAK J 9 2N3053 £1. K 40 1N914 £1	

vero

VERO PINSx36 28p.
COPPER CLAD VEROBOARD 0.1"

2 1/2"x5" 29p 2 1/2"x3 1/2" 26p. 3 1/2"x3 1/2" 31p.
3 1/2"x5" 31p 3 1/2"x 17" £1.50

DIL IC's BOARDS 6x4 1/2" £1.50
24 way edge connector 60p.
36 way 90p. PLAIN 3 1/2"x17" £1.
FACE CUTTER 45p. PEC ETCH PAK 50p

DALopen 69p

PRINTED CIRCUIT BOARD KIT £1.69
DECON NO MESS ETCH PAK NEW 69p
DECON DESOLDER BRAID REEL 59p

HEATSINKS

5F/T05 & 18F/T018 5p ea. TV4 15p.
TV3/T03 16p. EXTRUDED 4" 4Y1 29p.

TGS308 GAS DETECTOR £1.80 ea.
LOGIC PROBE TTL TESTER PEN £5

CAPACITORS

CERAMIC 22pf to 0.1uf 50v 5p.
ELECTROLYTIC: 10/50/100 uf in
10v 5p. 25v 6p. 50v 8p. 2uf/10v 5p.
1000 uf/25v 18p. 200/500 25v 9p.

POTENTIOMETERS (POTS) AB or EGIN

LIN or LOG ROTARY 13p. SWITCH 14p
DUAL 45p. SLIDERS 29p. STEREO 57p
KNOBS 7p. PRESETS 6p. RESISTORS 13p
SWITCHES: SPST 18p. DPDT 25p.

DIN PLUGS ALL 12p. SOCKETS 10p.

ALI CASES ABS/AB7 50p. AB13 65p.
TRANSFORMERS 1A 6v6v or 12v12v
Only £1.34. 100ma type CT 75p.

OIL sockets

TEXAS GOLD
LOW PROFILE ea
8, 14, & 16 PIN 13p

SOLDERCON STRIPS:
100 PINS 50p. 1K £3.

FROM THE SPECIALISTS - POWERTRAN ELECTRONICS

WIRELESS WORLD AMPLIFIER DESIGNS

Component packs for a choice of three outstanding amplifiers are stocked together with packs for a regulated power supply suitable for use with a pair of them. Also stocked are packs for a very well-established pre-amplifier—the Bailey-Burrows design which features six inputs, a scratch and rumble filter and wide range tone controls which may be either rotary or slider operating.

30W BAILEY

- Pk. 1 F/Glass PCB £0.80
- Pk. 2 Resistors, capacitors, pots £1.75
- Pk. 3 Semiconductor set £4.70

30W BLOMLEY

- Pk. 1 F/Glass PCB £0.85
- Pk. 2 Resistors, capacitors, pots £2.15
- Pk. 3 Semiconductor set £5.60

20W LINSLEY-HOOD

- Pk. 1 F/Glass PCB £0.85
- Pk. 2 Resistors, capacitors, pots £2.40
- Pk. 3 Semiconductor set £3.35

60V REGULATED POWER SUPPLY

- Pk. 1 F/Glass PCB £0.75
- Pk. 2 Resistors, capacitors, pots £1.40
- Pk. 3 Semiconductor set £3.10

BAILEY-BURROWS PRE-AMP

- Pk. 1 F/Glass PCB £2.05
- Pk. 2 Resistors, capacitors, pre-sets, transistors £4.95
- Pk. 3R Rotary potentiometer set £1.60
- Pk. 35 Slider potentiometer set (with knobs) £2.70

STUART TAPE RECORDER

A set of three printed-circuit boards has been prepared for the stereo integrated circuit version of this high-performance Wireless World published design.

- TRRP Pk. 1 Reply amplifier F/Glass PCB £0.90
- TRRC Pk. 1 Record amp./meter drive cct. F/Glass PCB £1.40
- TROS Pk. 1 Bias/erase/stabilizer cct. F/Glass PCB £1.00

For details of component packs for this design please write for free list.

TOROIDAL T20 + 20

Developed from the famous Practical Wireless Texan

Designed by Texas engineers and published in a series of articles in **Practical Wireless**. The TEXAN was a remarkable breakthrough in delivering true Hi-Fi performance at exceptionally low cost. Now further developed to include a true Toroidal transformer, this slimline integrated circuit design, based upon a single F/Glass PCB, features all the normal facilities found on quality amplifiers, including scratch and rumble filters, adaptable input selector and headphones socket.

20 WATTS/CHANNEL



FREE TEAK CASE and HANDBOOK with full kits
KIT PRICE

★ STILL ONLY **£28.25** ★
post free (U.K.)

ACTIVE FILTER CROSSOVER

An essential and critical component in a high-quality speaker system is the crossover unit conventionally comprising of a series of passive networks which unfortunately, though introducing reactive impedances between the amplifier and the speakers, result in the loss of the advantage of high amplifier damping factor and renders the speakers prone to overshoots and resonances. An elegant solution to this problem, described by D. C. Read in **Wireless World**, involves the use of a series of active filters splitting the output of the pre-amplifier into three channels, of closely defined bandwidth, each of which is fed to the appropriate speaker by its own power amplifier. A design for a suitable 20-watt amplifier, based on a proven Texas circuit, was also described by Mr Read. The printed-circuit board for this has been designed such that three amplifiers may be stacked and mounted together on a common heat sink to achieve a conveniently compact module.

ACTIVE FILTER

- Pack 1 Fibreglass PCB (accommodates all filters for one channel) £1.05
- 2 Set of pre-sets, solid tantalum capacitors, 2% metal oxide resistors, 2% polystyrene capacitors £4.20
- 3 Set of semiconductors £2.65
- 2 off each pack required for stereo system

READ/TEXAS 20w amp.

- Pack 1 Fibreglass PCB £0.70
- 2 Set of resistors, capacitors pre-sets (not including O/P coupling capacitors) £1.10
- 3 Sets of semiconductors £2.40
- 6 off each pack required for stereo system
- 4 Special heat sink assembly for set of 3 amplifiers £0.85
- 5 Set of 3 O/P coupling capacitors £1.00
- 2 off packs 4, 5 required for stereo system

POWER SUPPLY

- FOR 20W/CHANNEL STEREO SYSTEM
- Pack 1 Fibreglass PCB £0.50
- 2 Set of rectifiers, zener diode, capacitors, fuses, fuse holders £2.60
- 3 Toroidal transformer £4.95

SUITABLE ALSO FOR FEEDING ANY OF OUR HIGH-POWER DESIGNS

- Pack 1 Set of all low noise resistors £0.80
- 2 Set of all small capacitors £1.50
- 3 Set of 4 power supply capacitors £1.40
- 4 Set of miscellaneous parts including DIN sockets, fuses, fuse holders, control knobs, etc. £1.90
- 5 Set of slide and push-button switches £0.90
- 6 Set of potentiometers and selector switch £1.45
- 7 Set of all semiconductors £8.25
- 8 Special Toroidal Transformer £4.95
- 9 Fibreglass PC Panel £2.50
- 10 Complete chassis work, hardware and brackets £4.20
- 11 Preformed cable/leads £0.40
- 12 Handbook £0.25
- 13 Teak Cabinet £2.75

V.A.T. Please add 8%* to all U.K. orders

(*or at current rate if changed)

U.K. ORDERS—Post free (mail order only)

SECURICOR DELIVERY—for this optional service (Mainland only) add £2.00 + VAT

OVERSEAS—Postage at cost + 50p special packing

Dept. WW04

POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NN

SEMICONDUCTORS AS USED IN OUR RANGE OF QUALITY AMPLIFIERS

2N699 £0.25	2N4302 £0.60	BC212K £0.12	BFY51 £0.20	SN72748P £0.58
2N1613 £0.20	2N5087 £0.42	BC182L £0.10	BFY52 £0.20	TIP29A £0.50
2N1711 £0.25	2N5210 £0.54	BC184L £0.11	MJ481 £1.20	TIP30A £0.60
2N2926G £0.10	2N5457 £0.45	BC212L £0.12	MJ491 £1.30	TIP29C £0.78
2N3053 £0.15	2N5459 £0.45	BC214L £0.14	MJE21 £0.60	TIP30C £0.78
2N3055 £0.45	2N5830 £0.30	BCY72 £0.13	MPSA05 £0.30	TIP41A £0.74
2N3442 £1.20	40361 £0.40	BD529 £0.85	MPSA12 £0.55	TIP42A £0.90
2N3704 £0.10	40362 £0.45	BD530 £0.85	MPSA14 £0.35	IN914 £0.07
2N3707 £0.10	BC107 £0.10	BDY56 £1.60	MPSA55 £0.35	IN916 £0.07
2N3711 £0.09	BC108 £0.10	BF257 £0.40	MPSA65 £0.35	IS920 £0.10
2N3819 £0.23	BC109 £0.10	BF259 £0.47	MPSA66 £0.40	5B05 £1.20
2N3904 £0.17	BC125 £0.15	BFR39 £0.25	MPSU05 £0.60	
2N3906 £0.20	BC126 £0.15	BFR79 £0.25	MPSU55 £0.70	
2N4062 £0.11	BC182K £0.10	BFY50 £0.20	SN72721P £0.58	

for further information please write for FREE LIST NOW!

JOHN CRICHTON

Electronic Equipment
558 Kingston Road,
London, SW20

Inland VAT add 8%
Prices shown include P & P, other prices gladly on request.
Carriage extra for overseas orders.
Viewing by appointment please.
Phone 01-640 9534

TEST SET FREQUENCY RESPONSE CT381

Consisting of: sweep generator, indicator response curve, flat-faced tube long persistence. Power supply. Calibrator frequency CT432. Frequency range: 10kc/s-33Mc/s in nine directly calibrated ranges. Accuracy $\pm 3\%$ of the indicated centre frequency. F.M. deviation: (nominal). 0-500kc/s, above-4Mc/s, 0-400kc/s at 1.5Mc/s-4Mc/s, 0-16Kc/s at 600kc/s-1.5Mc/s, falling to 3kc/s at 10kc/s. Output impedance: 75 ohms resistive. Power supplies: Mains 100-120V and 180-250V. Frequency: 50-500c/s. Consumption 340W (nominal). Price £195.

HEWLETT PACKARD

185B. 1GHz SAMPLING OSCILLOSCOPE.

Horizontal Sweep speeds: 10 ranges, 10 nsec/cm to 10 sec/cm, accuracy within $\pm 5\%$. Magnification: 7 calibrated ranges X1, X2, X5, X10, X20, X50 and X100. Increases maximum calibrated sweep speed to 0.1 nsec/cm; with vernier maximum sweep speed is further extended to 0.04 nsec/cm. Intensity and sampling intensity are not affected by magnification. High frequency: Input frequency: 50 to 1000 mc for sweep speeds 200mv and 1000mv; $\pm 3\%$. Time: Approximately 5 sec burst of 50 mc sine wave. Frequency accuracy $\pm 2\%$. In addition the Model 185B provides output signals for X-Y recorders and provides means for controlling the display either manually or externally. Full specification on request. Price £295.

416B RATIO METER

Meter presentation. Per cent reflection: Four full scale ranges: 100%, 30%, 10%, and 3% (equivalent to reflection coefficients of 1.0, 0.3, 0.1, and 0.03). Equivalent VSWR. Two ranges: 1.06 to 1.22 and 1.2 to 1.9. DB: Four ranges: 0 to -10, -10 to -20, -20 to -30, and -30 to -40 db. For use with both Reflection Coefficient and equivalent VSWR scales. Full Spec. on request. Price £180.

- 430C Microwave power meter. £60
- H01-8401A Leveller amplifier. £39
- 8709A Synchronizer. £120
- 8734B Pin modulator 7.0-12.4GC. £95
- 8732A Pin Modulator 1.8-4.5 GC. £85
- 8431A Bandpass filter 2-4GC. £40
- 797D Directional Coupler 1.9-4.1GHz. £30
- 8436A Bandpass filter 8-12.4GC. £95

SOLARTRON

CT. 436 Double Beam Oscilloscope. AC 2.5c/s-6Mc/s (3dB). Rise time: 60 nsec (approx). Sensitivity: 100mV/cm-100V/cm continuously variable. AC X 10. The gain of the amplifier is increased X 10 on all the above ranges to give a sensitivity range from 10mV/cm-10V/cm. Input impedance: Constant on all ranges, 1M Ω in parallel with approximately 30pF. Time base velocity: 1cm/μsec-1cm/sec continuously variable. Linearity: 1% approximately (calculated). Amplitude: 15V pk-pk. Cathode ray tube screen: 3 $\frac{1}{2}$ " dia. flat face. Dimensions: 10" high X 10" wide X 16" long. The overall length is increased to 19" when the DC/AC converter is fitted. Power supply AC input: 100-125V in 5V steps or 200-250V in 10V steps. 45-400c/s. 100 VA. Price £88 plus VAT. Full spec on request.

JF.1601 Modulator/Demodulator. JF.1601 enables measurement of dynamic response to be made on systems and components employing AC carrier techniques. The JF.1601 may be used independently as a general-purpose Modulator or Demodulator. Full spec and price on request.

PYE Precision vernier potentiometer 756B. 1 μ V to 1.90100V in two ranges. Accuracy 0.002%.

TEKTRONIX

230 DIGITAL UNIT.
Digital readout parameters. Pulse amplitude, pulse risetime and falltime, pulse width, time interval.
R116. 10-NS PROGRAMMABLE PULSE GENERATOR with Delay.
PASSIVE PROBE P6006 with 10X attenuation, designed for oscilloscopes having an input resistance of 1 megohm and input capacitance of up to 55pf. Price £10.

MUIRHEAD 2-PH. L.F. DECADE OSCILLATOR Type D880.
Frequency range 0.01c/s-11.2kc/s (continuously variable above 0.1c/s).
V.L.F. 0.01c/s-0.1c/s in steps of 0.01c/s. Hourly frequency stability.
Ranges X1, X10, X100 $\pm 0.05\%$ } After Ranges X0, 1. V.L.F. ± 0.1 } 3 hours.

T.F.801D/1/S.A.M. SIGNAL GENERATOR.
Freq. range: 10 MHz to 485 MHz. Built-in crystal calibrator. Internal and external sine a.m. External pulse modulation. Calibration Accuracy: Using crystal calibrator, within $\pm 0.2\%$ over entire frequency range. R.F. output level 0.1 μ V to 1V source e.m.f.

OA.1094A/3 H.F. SPECTRUM ANALYSER with L.F. extension unit type TM6448.
Freq. range: 100 Hz to 30 MHz. Measures relative amplitudes up to 60 dB. Spectrum width 0-30 KHz. Sweep duration: 0.1, 0.3, 1, 3, 10, 30 sec. and manual. Full spec on request. £250 as seen condition, buyer to collect.

OA.1094A/S H.F. SPECTRUM ANALYSER. Freq. range: 3 MHz to 30 MHz in nine steps, spectrum width 0 to 30 KHz. Sweep distortion: 0.1, 0.3, 1, 3, 10, 30 secs. and manual. Full spec. on request. £150 as seen condition, buyer to collect.

T.111 ROBAND TRANSISTORIZED SUPPLY. Mains input 110V or 230V, output 0-50V at 5 Amperes cont. variable, overload cut-out. As seen £15.

REMSCOPE S01/740 STORAGE OSCILLOSCOPE.
Fluorescence: Yellow, resolution: 40 lines/cm E.H.T.: 8KV, display time: 10 mins-1 hr approx., storage time: 1 week approx.

CD 1212 WIDE-BAND GENERAL-PURPOSE OSCILLOSCOPE.
Employing plug-in pre-amplifiers for single or dual trace displays.

Wide-band pre-amplifier CX 1251. Bandwidth: DC -40Mc/s (-3dB \pm 1dB); 2.5c/s-40Mc/s AC coupled (-3dB \pm 1dB). Rise time 8 nsec approx. Sensitivity: 50mV/cm-50V/cm in nine calibrated ranges with fine gain control. Dual trace pre-amplifier CX 1252. Bandwidth: DC -24Mc/s (-3dB \pm 1dB) AC coupled. Rise time: 14 nsec approx. Sensitivity: 50mV/cm-50V/cm in nine calibrated ranges with fine gain control. Full specification on request. £128.

T.F.801B/3/S.A.M. SIGNAL GENERATOR.
Freq. range: 12 MHz to 485 MHz in five bands. Built-in crystal calibrator. Full spec. on request.

CT. 373 TEST SET. Oscillator: 17c/s-170kc/s $\pm 1\%$, ± 1 c/s at ambient temp. 0°C-45°C. Distortion Meter: Freq. range: 20c/s to 20kc/s, distortion range: 10%, 30%, 100% f.s.d. 0.5% readable. Signal input: approx. 500mV to 130V basic range, 250mV to 1300V extreme limits. Full spec. on request. £30 as seen.

AVO MODEL 3 VALVE TESTER. Enables comprehensive characteristics to be plotted or measures valves on a simple good/bad basis. £55.

AVO CT 160 VALVE TESTER. As above but in portable valise form. £65.

VOLTMETER VALVE CT54 (Micovac), with mains power supply (power supply not available separately). In strong metal case with full operating instructions. 2.4V-480V AC or DC in 6 ranges, 1 ohm to 10 Megohm in 5 ranges. Indicated on 4 in. scale meter. Complete with probe. £12.50 including p. and p. (Leads extra.)

MUIRHEAD FREQUENCY ANALYSER TYPE D-669-B.

Frequency range 30c/s-30kc/s. Accuracy better than 1.5%. Input voltage 300 μ V-100V for full scale deflexion. Smallest indication 15 μ V. Maximum input voltage 300V r.m.s. Price £95. Full spec. on request.

TF.937 F.M./A.M. SIGNAL GENERATOR.
Freq. range 85 KHz to 30 MHz. The carrier freq. can be standardized against a built-in dual freq. crystal calibrator, which is complete with miniature loudspeaker as an aural beat detector. £30 as seen.

TF.114H/S SIGNAL GENERATOR. Frequency range: 10 KHz-72 MHz. Stability: 0.002%. High discrimination, plus crystal calibrator. Good r.f. waveform at all frequencies. Protected thermocouple level monitor. Full spec. on request. £220.

TEST SET DEVIATION FM No 2. The carrier frequency range extends from 2.5Mc/s to 10Mc/s and from 20Mc/s to 100Mc/s in a total of eight bands: the deviation ranges are 0 to 5kc/s, 0 to 25kc/s and 0 to 75kc/s. £48.

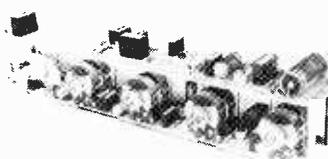
RACAL UNIVERSAL COUNTER/TIMER SA550 (CT488)

8 digit in-line read-out. Facilities include: direct frequency measurement up to 100 MHz; pulse, period, ratio, time interval and totalling measurements. Input sensitivity variable from 300mV to 9V, three independent inputs, self-check etc. Full spec. on request.



HART ELECTRONICS

Audio Kit Specialists since 1961



BAILEY/BURROWS/QUILTER PRE AMP This is the tone control section of the best pre-amp kit currently available. Consider the advantages:—*First quality fibreglass printed circuits with roller tinned finish and all component locations printed on reverse. *Low noise carbon film and metal film resistors throughout. *Finest quality low-noise ganged controls with matched tracks and shafts cut to length. *Well engineered layout for total stability. *Special decoupling and earthing arrangements to eliminate hum loops. *Controls, switches and input sockets mount directly on the boards to TOTALLY ELIMINATE wiring to these components. (We know of one pre-amp kit which claims its controls mount directly on the board—and so they do, by their shaft bushes! You still have to wire them up!)

*We incorporate the Quilter modification which is most important as it reduces distortion and increases the bass and treble control range.

As can be seen from the photograph the tone control unit is very slim (only 1 $\frac{1}{2}$ " from front to back) and may therefore be used in many other applications than our Bailey metalwork which it is designed to fit.

METALWORK AND WOODEN CASES These have been under review for some time:

F.M. TUNER This latest addition to our range is designed to offer the best possible performance allied to the ease of operation given by push button varicap tuning. We have taken great care to look after the constructors' point of view and there are no coils to wind, no RF circuits to wire and no alignment is required, in fact the whole unit can be easily completed and working in an evening as there are only 3 transistors, one IC and two ready built and aligned modules comprising the active components. We have abandoned the concept of having a tuner as large as the amplifier and this new unit has a frontal size of only 1 $\frac{1}{2}$ in. X 4 in. It can be mounted on the side of our Bailey amplifier metalwork thus turning it into a tuner/amplifier whilst only increasing its width by 1 $\frac{1}{2}$ in. Cost of tuner chassis (no case) is £22 for mono, £25.45 for stereo. Metal case £3.55. An extended wooden case to fit tuner and amplifier will be offered shortly.

STUART TAPE CIRCUITS Our printed circuits and components offer the easy way to convert any suitable quality deck into a very high quality Stereo Tape unit. Input and output levels suit Bailey pre amp. Total cost varies, but around £35 is all you need. We can offer tape heads as well if you want new ones.

All above kits have fibreglass PCB's. Prices exclude VAT but P&P is included.

FURTHER INFORMATION ON ALL KITS FREE if you send us a 9 in. X 4 in. S.A.E.

REPRINTS Post free, no VAT.

Bailey 30W 18p.

STUART TAPE RECORDER All 3 articles under one cover 30p.

BAILEY/BURROWS/QUILTER Preamp circuits, layouts and assembly notes 15p.

All prices exclude VAT.

Penylan Mill, Oswestry, Salop

Personal callers are always welcome, but please note we are closed all day Saturday

SEMICONDUCTORS

TRANSISTORS & DIODES

AC126	0.15	BC267A	0.12	BFY50	0.20	2N1306	0.22
AC127	0.16	BC300	0.30	BFY51	0.18	2N1307	0.22
AC128	0.15	BC301	0.28	BFY52	0.19	2N1308	0.23
AC141	0.16	BC303	0.30	BSX19	0.14	2N1309	0.23
AC142	0.18	BC307B	0.10	BSX20	0.15	2N1202	0.32
AC176	0.16	BC328	0.15	BSX60	0.60	2N2904	0.17
AC187	0.20	BC338	0.15	CRS3/05	0.31	2N2905	0.18
AC188	0.20	BC377	0.20	CRS3/10	0.38	2N2905A	0.20
AC128K	0.25	BCY32	1.07	CRS3/20	0.42	2N2926G	0.10
AC141K	0.28	BCY39	1.25	CRS3/40	0.65	2N29260	0.10
AC142K	0.26	BCY70	0.13	OA5	0.60	2N2926Y	0.10
AC176K	0.28	BCY71	0.18	OA9	0.20	2N2926R	0.10
AC187K	0.30	BCY72	0.12	OA10	0.37	2N3053	0.15
AC188K	0.28	BDY60	0.61	OC44	0.08	2N3054	0.38
AD142	0.46	BDY61	0.53	OC45	0.08	2N3055	0.42
AD143	0.40	BDY62	0.45	OC70	0.08	2N3415	0.12
AD149	0.48	BDY90	2.28	OC71	0.08	2N3442	0.80
AL102	0.65	BDY91	2.16	OC75	0.08	2N3714	1.16
AL103	0.65	BDY92	1.75	OC139	0.45	2N3715	1.21
BA102	0.15	BD131	0.32	OC140	0.65	2N3716	1.28
BC107	0.14	BD132	0.44	OC205	1.25	2N3771	1.25
BC108	0.13	BD135	0.32	OC206	1.25	2N3773	2.18
BC109	0.14	BD136	0.34	OC207	1.40	2N3904	0.12
BC147	0.10	BD137	0.36	TIC47	0.35	2N3906	0.12
BC148	0.10	BD138	0.38	2N697	0.11	2N4036	0.38
BC149	0.10	BD139	0.41	2N930	0.14	2N4123	0.12
BC153	0.15	LEDs		2N1302	0.15	2N4124	0.12
BC157	0.11	DL707 7 seg		2N1303	0.15	2N5064	0.25
BC158	0.11	led	0.90	2N1304	0.18	TBA641	0.88
BC159	0.11	MV54 led axial		ICS		LM309K	1.80
BC160	0.28	lead red	0.15	TAA435	0.55		
BC161	0.30	BD140	0.45	TAA611	0.68		
BC171A	0.10	BDY10	0.85	TAA861	0.68		
BC171B	0.10	BDY11	0.90	TBA560	2.90		
BC168B	0.10	BDY20	0.80	TBA570	1.20		
BC261A	0.10	BDY38	0.60	2N1305	0.18		

All prices inclusive VAT. Post & packing 0.20 extra. Matching charge (Gain only) 0.20 extra/pair.

LYNX ELECTRONICS (LONDON) LTD,
8 CULLEN WAY, LONDON NW10
Tel. 01-965 2243

The big three from Wireless World

WIRELESS WORLD ANNUAL 1975

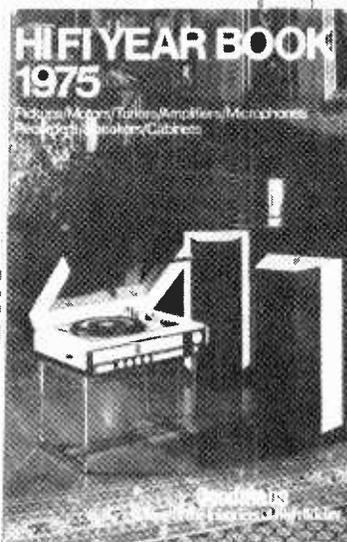
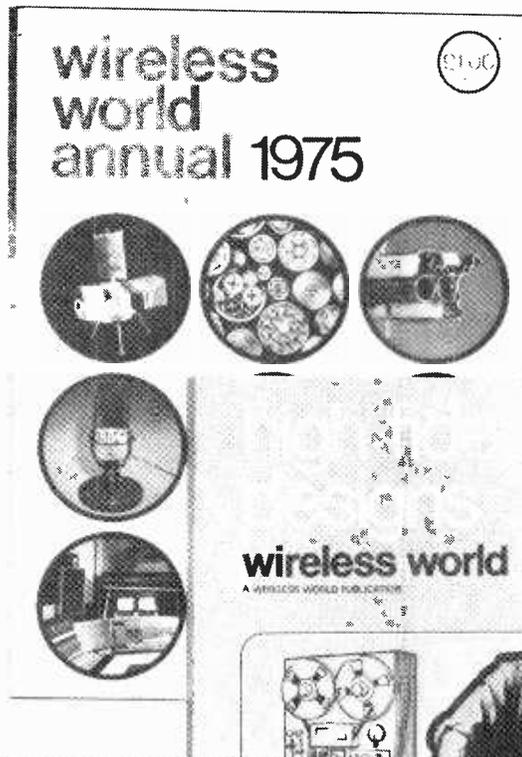
The first ever Wireless World Annual contains 128 pages including features covering all aspects of electronics and communications, including new and established techniques both practical and theoretical. Content includes constructional projects for a general purpose audio oscillator and a small boat echo sounder. There is a reference section packed with useful information.

HIGH FIDELITY DESIGNS

In response to demand for reprints of Wireless World constructional projects, we have collected fifteen of the most popular designs in one book. It covers tape, disc, radio, amplifiers, speakers and headphones. Where necessary, specifications have been updated to incorporate new components which have become available.

HI-FI YEAR BOOK 1975

This is the book that tells you everything you need to know about the hi-fi equipment on the market. Separate illustrated sections cover every major category, together giving prices and specifications of over 2,000 products. And it's got a directory of dealers/manufacturers - plus a host of articles on the latest hi-fi developments and their application.



ALSO AVAILABLE AT LEADING BOOKSTALLS

To: General Sales Department, Room 11, Dorset House, Stamford Street, London SE1 9LU

ORDER FORM

Please send me books as indicated below (state number of copies of each) :

- Wireless World Annual 1975 (at £1.35 each incl.)
- High Fidelity Designs (at £1.35 each incl.)
- Hi-Fi Year Book 1975 (at £2.00 each incl.)

I enclose remittance value £ (cheques payable to IPC Business Press Ltd.)

Name (please print)
Address

Regd. in England No. 677128 Regd. office Dorset House, Stamford Street, London SE1 9LU

TRANSISTORS		Type Price (£)	DIODES						
Type Price (£)	Type Price (£)						Type Price (£)	Type Price (£)	
AC107	0.35	BC119	0.20	BD123	0.98	BF273	0.16	C106F	0.43
AC117	0.24	BC125	0.22	BD130Y	1.42	BF458	0.60	C111E	0.56
AC126	0.25	BC126	0.20	BD131	0.45	BF459	0.60	C1222	0.55
AC127	0.25	BC132	0.15	BD132	0.50	BF461	0.60	C2024	0.20
AC128	0.25	BC134	0.20	BD136	0.46	BF479	0.24	E5024	0.20
AC141	0.25	BC135	0.20	BD137	0.48	BF481	0.30	ME6001	0.17
AC141K	0.25	BC136	0.20	BD138	0.50	BF482	0.30	ME6002	0.17
AC142K	0.19	BC137	0.20	BD139	0.55	BF483	0.24	ME8001	0.18
AC153K	0.28	BC138	0.20	BD140	0.62	BF484	0.24	MJE340	0.68
AC154	0.23	BC142	0.30	BD141	0.62	BF485	0.24	MJE341	0.72
AC176	0.25	BC143	0.35	BD142	0.62	BF486	0.24	MJE342	0.72
AC178	0.27	BC147B	0.15	BD143	0.62	BF487	0.24	MJE343	0.72
AC179	0.27	BC148	0.15	BD144	0.62	BF488	0.24	MJE344	0.72
AC187	0.25	BC149	0.15	BD145	0.62	BF489	0.24	MJE345	0.72
AC187K	0.25	BC149B	0.15	BD146	0.62	BF490	0.24	MJE346	0.72
AC188	0.25	BC152	0.25	BD147	0.62	BF491	0.24	MJE347	0.72
AC188K	0.25	BC153	0.25	BD148	0.62	BF492	0.24	MJE348	0.72
AC193K	0.30	BC154	0.20	BD149	0.62	BF493	0.24	MJE349	0.72
AC194K	0.32	BC157	0.15	BD150	0.62	BF494	0.24	MJE350	0.72
AC Y26	0.25	BC158	0.13	BD151A	0.38	BF495	0.24	MJE351	0.72
AC Y39	0.65	BC159	0.15	BD152	0.38	BF496	0.24	MJE352	0.72
AD140	0.50	BC161	0.15	BD153	0.38	BF497	0.24	MJE353	0.72
AD142	0.52	BC167B	0.15	BD154	0.38	BF498	0.24	MJE354	0.72
AD143	0.51	BC168B	0.15	BD155	0.38	BF499	0.24	MJE355	0.72
AD149	0.50	BC169C	0.13	BD156	0.38	BF500	0.24	MJE356	0.72
AD161	0.48	BC170	0.13	BD157	0.38	BF501	0.24	MJE357	0.72
AD162	0.48	BC171A	0.13	BD158	0.38	BF502	0.24	MJE358	0.72
AF114	0.25	BC172	0.14	BD159	0.38	BF503	0.24	MJE359	0.72
AF115	0.25	BC173	0.14	BD160	0.38	BF504	0.24	MJE360	0.72
AF116	0.25	BC176	0.22	BD161	0.38	BF505	0.24	MJE361	0.72
AF117	0.20	BC177	0.20	BD162	0.38	BF506	0.24	MJE362	0.72
AF118	0.20	BC178	0.22	BD163	0.38	BF507	0.24	MJE363	0.72
AF121	0.32	BC178B	0.22	BD164	0.38	BF508	0.24	MJE364	0.72
AF124	0.25	BC179	0.22	BD165	0.38	BF509	0.24	MJE365	0.72
AF125	0.25	BC179B	0.22	BD166	0.38	BF510	0.24	MJE366	0.72
AF126	0.25	BC182L	0.21	BD167	0.38	BF511	0.24	MJE367	0.72
AF127	0.25	BC183	0.21	BD168	0.38	BF512	0.24	MJE368	0.72
AF129	0.35	BC183K	0.11	BD169	0.38	BF513	0.24	MJE369	0.72
AF147	0.35	BC183L	0.11	BD170	0.38	BF514	0.24	MJE370	0.72
AF149	0.45	BC184L	0.13	BD171	0.38	BF515	0.24	MJE371	0.72
AF179	0.55	BC186	0.25	BD172	0.38	BF516	0.24	MJE372	0.72
AF180	0.55	BC187	0.27	BD173	0.38	BF517	0.24	MJE373	0.72
AF181	0.50	BC208	0.12	BD174	0.38	BF518	0.24	MJE374	0.72
AF182	0.50	BC212L	0.12	BD175	0.38	BF519	0.24	MJE375	0.72
AF186	0.40	BC213L	0.12	BD176	0.38	BF520	0.24	MJE376	0.72
AF239	0.40	BC214L	0.12	BD177	0.38	BF521	0.24	MJE377	0.72
AF279	0.84	BC230	0.13	BD178	0.38	BF522	0.24	MJE378	0.72
AL100	1.10	BC261A	0.28	BD179	0.38	BF523	0.24	MJE379	0.72
AL102	1.10	BC262A	0.28	BD180	0.38	BF524	0.24	MJE380	0.72
AL103	1.10	BC263B	0.15	BD181	0.38	BF525	0.24	MJE381	0.72
AL113	0.95	BC267	0.16	BD182	0.38	BF526	0.24	MJE382	0.72
AU103	2.10	BC268C	0.14	BD183	0.38	BF527	0.24	MJE383	0.72
AU110	1.90	BC294	0.37	BD184	0.38	BF528	0.24	MJE384	0.72
AU113	2.40	BC300	0.60	BD185	0.38	BF529	0.24	MJE385	0.72
BC107	0.12	BC301	0.35	BD186	0.38	BF530	0.24	MJE386	0.72
BC107B	0.14	BC303	0.60	BD187	0.38	BF531	0.24	MJE387	0.72
BC108	0.12	BC307B	0.12	BD188	0.38	BF532	0.24	MJE388	0.72
BC108A	0.12	BC308A	0.10	BD189	0.38	BF533	0.24	MJE389	0.72
BC108B	0.13	BC309	0.15	BD190	0.38	BF534	0.24	MJE390	0.72
BC108C	0.14	BC323	0.68	BD191	0.38	BF535	0.24	MJE391	0.72
BC109	0.13	BC377	1.22	BD192	0.38	BF536	0.24	MJE392	0.72
BC109C	0.14	BC441	1.10	BD193	0.38	BF537	0.24	MJE393	0.72
BC113	0.13	BC461	1.50	BD194	0.38	BF538	0.24	MJE394	0.72
BC114	0.20	BCY42	0.16	BD195	0.38	BF539	0.24	MJE395	0.72
BC115	0.20	BCY71	0.22	BD196	0.38	BF540	0.24	MJE396	0.72
BC116	0.20	BCY87	0.45	BD197	0.38	BF541	0.24	MJE397	0.72
BC117	0.20	BCY88	2.42	BD198	0.38	BF542	0.24	MJE398	0.72
				BD199	0.38	BF543	0.24	MJE399	0.72
				BD200	0.38	BF544	0.24	MJE400	0.72
				BD201	0.38	BF545	0.24	MJE401	0.72
				BD202	0.38	BF546	0.24	MJE402	0.72
				BD203	0.38	BF547	0.24	MJE403	0.72
				BD204	0.38	BF548	0.24	MJE404	0.72
				BD205	0.38	BF549	0.24	MJE405	0.72
				BD206	0.38	BF550	0.24	MJE406	0.72
				BD207	0.38	BF551	0.24	MJE407	0.72
				BD208	0.38	BF552	0.24	MJE408	0.72
				BD209	0.38	BF553	0.24	MJE409	0.72
				BD210	0.38	BF554	0.24	MJE410	0.72
				BD211	0.38	BF555	0.24	MJE411	0.72
				BD212	0.38	BF556	0.24	MJE412	0.72
				BD213	0.38	BF557	0.24	MJE413	0.72
				BD214	0.38	BF558	0.24	MJE414	0.72
				BD215	0.38	BF559	0.24	MJE415	0.72
				BD216	0.38	BF560	0.24	MJE416	0.72
				BD217	0.38	BF561	0.24	MJE417	0.72
				BD218	0.38	BF562	0.24	MJE418	0.72
				BD219	0.38	BF563	0.24	MJE419	0.72
				BD220	0.38	BF564	0.24	MJE420	0.72
				BD221	0.38	BF565	0.24	MJE421	0.72
				BD222	0.38	BF566	0.24	MJE422	0.72
				BD223	0.38	BF567	0.24	MJE423	0.72
				BD224	0.38	BF568	0.24	MJE424	0.72
				BD225	0.38	BF569	0.24	MJE425	0.72
				BD226	0.38	BF570	0.24	MJE426	0.72
				BD227	0.38	BF571	0.24	MJE427	0.72
				BD228	0.38	BF572	0.24	MJE428	0.72
				BD229	0.38	BF573	0.24	MJE429	0.72
				BD230	0.38	BF574	0.24	MJE430	0.72
				BD231	0.38	BF575	0.24	MJE431	0.72
				BD232	0.38	BF576	0.24	MJE432	0.72
				BD233	0.38	BF577	0.24	MJE433	0.72
				BD234	0.38	BF578	0.24	MJE434	0.72
				BD235	0.38	BF579	0.24	MJE435	0.72
				BD236	0.38	BF580	0.24	MJE436	0.72
				BD237	0.38	BF581	0.24	MJE437	0.72
				BD238	0.38	BF582	0.24	MJE438	0.72
				BD239	0.38	BF583	0.24	MJE439	0.72
				BD240	0.38	BF584	0.24	MJE440	0.72
				BD241	0.38	BF585	0.24	MJE441	0.72
				BD242	0.38	BF586	0.24	MJE442	0.72
				BD243	0.38	BF587	0.24	MJE443	0.72
				BD244	0.38	BF588	0.24	MJE444	0.72
				BD245	0.38	BF589	0.24	MJE445	0.72
				BD246	0.38	BF590	0.24	MJE446	0.72
				BD247	0.38	BF591	0.24	MJE447	0.72
				BD248	0.38	BF592	0.24	MJE448	0.72
				BD249	0.38	BF593	0.24	MJE449	0.72
				BD250	0.38	BF594	0.24	MJE450	0.72
				BD251	0.38	BF595	0.24	MJE451	0.72
				BD252	0.38	BF596	0.24	MJE452	0.72
				BD253	0.38	BF597	0.24	MJE453	0.72
				BD254	0.38	BF598	0.24	MJE454	0.72
				BD255	0.38				

CHROMASONIC electronics

Dept 5
56, Fortis Green Road, London, N10 3HN.
telephone: 01-883 3705

INDUCTORS

Denco Maxi-Q Coils

Ferrite Rod Aerials



FRA1 Long & Medium Wave band (300pf) 86p
FRA2 Long & Medium " (500pf) 86p

Tuning Coils in two series:

Range

1	150 khz	to	400 khz
2	515 khz	to	1.545 Mh3
3	1.67 Mhz	to	5.3 Mh3
4	5 Mhz	to	15 Mh3
5	10.5 Mhz	to	31.5 Mhz *
6	30 Mhz	to	50 Mhz *
7	45 Mhz	to	78 Mhz *

* 50 pf tuning, all others based on 300 pf.

Series A Transistor - 48p each

Only available in ranges 1 to 5 inc.
4 Coils complete each range:

- Blue - Aerial Coil
- Yellow - R.F. Interstage
- Red - Osc. Coil for 465 khz I.F.
- White - Osc. Coil for 1.6 Mhz I.F.

give range number; letter 'T' and colour.

Series B Dual Purpose Coils 48p each

For FET or Valve Circuits

All ranges available

5 Coils complete each range:

- Blue - Aerial
- Yellow - Interstage R.F.
- Green - R.F. plus reaction
- Red - Osc. Coil for 465 khz I.F.
- White - Osc. Coil for 1.6 Mhz I.F.

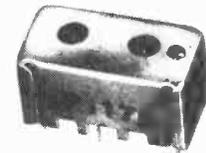
(Note use Red instead of White for ranges 6 & 7.)

Chokes



We stock from 1 µH to 19 mH
Check levels & prices when ordering

TUNING CONDENSERS



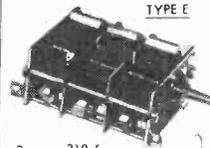
Tuned Block Filter incorporating a Ceramic element. Pre-aligned to 470 Khz. 3db bandwidth 5KHz. Zin 100K. Zout 100K.

LPI175 E1.46

I.F. Transformers



I FT 13	465 khz 1st & 2nd d/tuned	65p
I FT 14	465 khz final single tuned	65p
I FT 15	10.7 Mhz d/tuned	65p
I FT 16	1.6 Mhz 1st & 2nd d/tuned	65p
I FT 17	1.6 Mhz Final d/tuned	65p
I FT 18	465 khz or 1.6 Mhz d/tuned	75p



3 gang 310pf

E3.99

TYPE C804



5pf 80pf

10pf 80pf

15pf 80pf

20pf 80pf

25pf 80pf

50pf 83p

60pf 94p

75pf 94p

100pf 99p

TYPE E

TYPE OO



208 + 176 pf

with screen & trimmers

E1.48

DILECON



100pf 69p

300pf 69p

500pf 69p

83p

Slow Motion Drive

Ratio 6:1 Ref: 4511

TYPE O

365 pf

365 x 365 pf

E1.07

E1.30

VEROBOARD



COPPERCLAD		PLAIN	EXTRA
0.1"	0.15"	0.15"	P&P

2 1/2" x 1"	7p	7p	-	-
2 1/2" x 3 1/2"	26p	21p	12p	-
2 1/2" x 5"	30p	25p	13p	-
3 1/2" x 3 1/2"	30p	25p	-	-
3 1/2" x 5"	34p	34p	25p	-
17" x 2 1/2"	90p	69p	45p	10p
17" x 3 1/2"	E1.21	75p	57p	10p
17" x 5"	-	-	99p	10p

D.I.P. Breadboard 4.15" x 6.15" E1.40
VEROSTRIP (State .1" or .15") 30p
Pin Insertion Tool (State .1" or .15") 63p
Spot Face Cutter 51p
Terminal Pins in Pkts. of 50 (State .1" or .15") 22p

Details of I.C.'s, Rectifiers; Diodes; Bridges; Passive Components; LED's; Clocks; Triacs etc. can be seen on other pages and/or issues of Wireless World; Practical Wireless; and Practical Electronics.

DIODES

AA119	10p	BY103	22p	0A91	8p
AA120	10p	BY105	16p	0A200	11p
AA129	10p	BY126	16p	0A202	12p
BA100	10p	BY127	16p	Z5120	8p
BA102	27p	BY133	23p	Z5140	25p
BA110	44p	BY164	54p	Z5141	42p
BA115	19p	BY176	E1.62	Z5142	32p
BA144	26p	BY182	E1.62	Z5170	10p
BA145	22p	BY250	25p	Z5270	11p
BA148	22p	BZX70	27p	Z5271	16p
BA154	20p	Series		Z5278	36p
BA155	15p	BZY88	11p	IN914	8p
BA156	16p	Series		IN916	10p
BAX16	10p	0A47	11p	IN4009	7p
BB104	45p	0A79	10p	IN4148	5p
BB105B	41p	0A81	8p	IN4448	9p
BY100	16p	0A85	10p	I2S Series	18p
		0A90	8p		

TRANSISTORS

AC107	16p	BC213L	13p	D13V	52p	ZTX301	13p	2N3707	12p
AC126	13p	BC214L	13p	D40N3	59p	ZTX302	17p	2N3708	10p
AC127	13p	BC268	15p	MJ480	93p	ZTX303	14p	2N3709	10p
AC128	13p	BC407	16p	MJ481	E1.18	ZTX304	21p	2N3710	11p
AC176	15p	BCY70	17p	MJ490	E1.01	ZTX311	10p	2N3711	11p
AC187	22p	BCY71	22p	MJ491	E1.42	ZTX312	10p	2N3722	E2.00
AC187K	20p	BCY72	17p	MJ490	E1.42	ZTX341	22p	2N3791	E2.55
AC188	22p	BD115	73p	MJ1000	E1.22	ZTX384	18p	2N3819	27p
AC188K	25p	BD123	89p	MJ2955	E1.88	ZTX500	12p	2N3821	81p
AC188K	39p	BD124	80p	MJ3055	E1.21	ZTX501	13p	2N3823	99p
AC188K	22p	BD132	52p	MJ4000	E1.46	ZTX502	17p	2N3903	15p
AC188K	22p	BD132	52p	MJ4010	E1.95	ZTX503	14p	2N3904	19p
AD100	48p	BD132PR	E1.17	MJE340	45p	ZTX504	42p	2N3905	23p
AD149	48p	BD135	41p	MJE340	45p	ZTX531	22p	2N3906	25p
AD161	37p	BD136	43p	MJE2955	E1.20	ZTX550	17p	2N4056	13p
AD162	38p	BD201	E1.95	MJE3055	72p	2N697	16p	2N4059	19p
AD161/62MP	74p	BD202	E1.46	MPE102	27p	2N706	13p	2N4062	16p
AF114	17p	BF109	74p	MPE103	40p	2N708	16p	2N4289	19p
AF115	17p	BF115	25p	MPE104	44p	2N914	24p	2N4441	85p
AF116	17p	BF160	25p	MPE105	44p	2N930	20p	2N4442	E1.04
AF117	17p	BF167	24p	MPE106	49p	2N1302	20p	2N4443	E1.42
AF118	54p	BF173	24p	MPE111	22p	2N1303	24p	2N4444	E2.06
AF124	32p	BF178	28p	MPSU06	63p	2N1304	24p	2N4871	59p
AF139	34p	BF179	32p	MPSU06	77p	2N1305	24p	2N4901	E1.41
AF172	25p	BF180	32p	OC28	49p	2N1306	24p	2N5067	E1.07
AF239	40p	BF181	32p	OC35	49p	2N1307	27p	2N5129	16p
ASV26	32p	BF184	27p	OC36	49p	2N1308	34p	2N5172	11p
BC107	11p	BF185	27p	OC44	14p	2N1309	34p	2N5191	77p
BC108	11p	BF194	15p	OC45	14p	2N1711	20p	2N5194	91p
BC109	12p	BF195	17p	OC71	14p	2N1718	E4.37	2N5295	52p
BC117	22p	BF196	16p	OC72	14p	2N1893	52p	2N5447	16p
BC147	10p	BF197	16p	OC75	15p	2N2218	22p	2N5449	16p
BC148	10p	BF200	31p	OC76	27p	2N2219	38p	2N5457	46p
BC149	10p	BF244B	27p	OC81	14p	2N2646	54p	2N5458	43p
BC157	13p	BF252	25p	OC83	22p	2N2894	97p	2N5459	43p
BC158	12p	BF263	25p	OC170	27p	2N2904	32p	2N5485	52p
BC159	14p	BF272	E1.19	OC171	32p	2N2905	30p	2N5777	48p
BC167	17p			OC771	E1.54	2N2924	16p	2N6068	44p
BC168B	11p	BFS97	23p	ORP12	65p	2N2925	18p	2N6069	51p
CC169	12p	BFS98	20p	TIP29	53p	2N2926G	10p	2N6070	57p
BC171	20p	BFW10	65p	TIP31	67p	2N3053	19p	2N6071	62p
BC172	17p	BFX29	41p	TIP31A	67p	2N3054	50p	2N6073	67p
BC177	22p	BFX88	26p	TIP32A	79p	2N3055	51p	2N6075	E1.46
BC178	22p	BFY50	22p	TIP41A	79p	2N3375	E3.56	2N6076	16p
BC179	24p	BFY51	22p	TIP42A	97p	2N3442	E1.19	2N6111	54p
BC182L	11p	BFY90	E1.09	TIS43	36p	2N3566	8p	2N6288	60p
BC183L	12p	BR100	42p	TIS88A	36p	2N3638	20p	2N1440	99p
BC184L	12p	BRV39	43p	TIS91	32p	2N3702	13p	2N1411	87p
BC187	27p	BSX20	18p	ZTX107	10p	2N3703	10p	2N1553	87p
BC204	14p	BSX21	22p	ZTX108	10p	2N3704	13p	40321	54p
BC209	14p	BSY95A	14p	ZTX109	15p	2N3705	12p	40430	E1.39
BC212L	12p	BU105/02	E1.95	ZTX300	12p	2N3706	14p	40673	55p

REGULATORS

100mA (TO-39)	500mA * (TO-3)	500mA * (SOT-32)	1A (TO-220)	
5V TBA625A	L005T1 (MVR5V)	L129	TDA1405	7805UC
E1.03	E1.45	E1.39	97p	E2.42
12V TBA625B	L036T1 (MVR12V)	L130	TDA1412	7812UC
E1.03	E1.45	E1.39	97p	E2.42
15V TBA625C	L037T1 (MVR15V)	L131	TDA1415	7815UC
E1.03	E1.45	E1.39	97p	E2.42

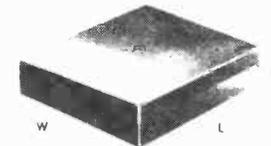
* 600mA; 500mA and 450mA respectively.

DIGITAL SWITCH

BCD encoded digital switch Reading 0 to 9. Suitable for digital clock alarm setting DVM input sealing etc.

1 to 9. E1.49 each.

ALUMINIUM BOXES



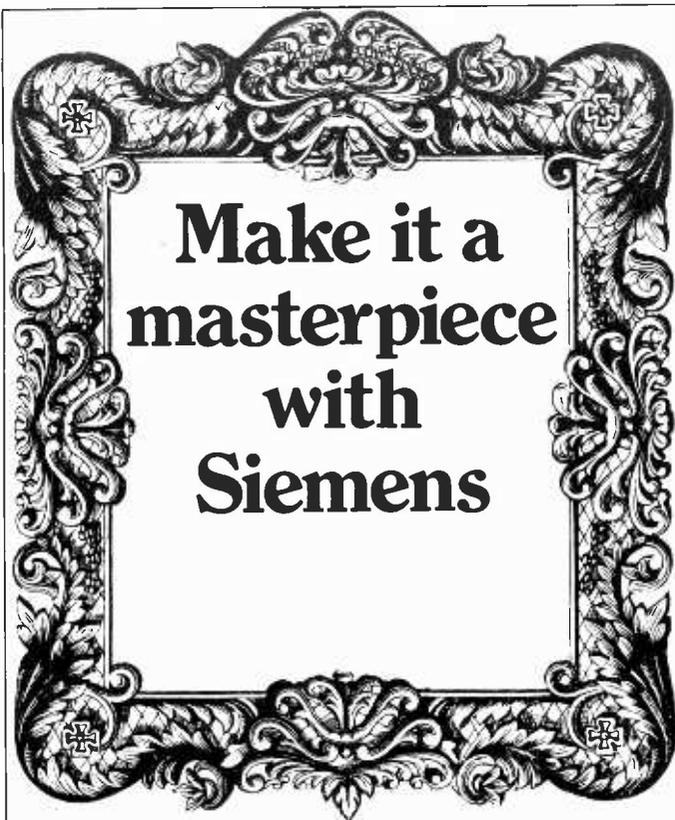
REF (No.)	(L)	(W)	(H)	PRICE	P&P
AB7	2 1/2"	5 1/2"	1 1/2"	45p	15p
AB8	4"	4"	1 1/2"	45p	15p
AB9	4"	2 1/2"	1 1/2"	45p	15p
AB10	4"	5 1/2"	1 1/2"	51p	15p
AB11	4"	2 1/2"	2"	45p	15p
AB12	3"	2"	1"	38p	15p
AB13	6"	4"	2"	61p	17p
AB14	7"	5"	2 1/2"	73p	17p
AB15	8"	6"	3"	92p	17p
AB16	10"	7"	3"	E1.05	20p
AB17	10"	4 1/2"	3"	92p	25p
AB18	12"	5"	3"	E1.04	25p
AB19	12"	8"	3"	E1.38	25p

THYRISTORS SCR'S

V	800mA	4A	8A	
30v	MCR102	32p	106Y	39p
50v			106F	46p
60v	MCR103	44p	2N4441	87p
100v	MCR104	47p	106A	48p
200v	MCR120	51p	106B	53p
400v			106D	67p
600v			106M	E1.50

8% VAT INCLUSIVE PRICES

OVERSEAS CUSTOMERS DEDUCT 2/27
VAT INVOICES ON REQUEST
P&



Make it a
masterpiece
with
Siemens

Quality capacitors without any risk

B32110

MKL Hi-rel lacquer film, with self healing capability - where safety comes first. Some of the first capacitors with moon experience.

B37448

One of the smallest ceramic capacitors available. 4mm pin spacing .01 to .22 63 volts.

B41070

CAN electrolytics 220µ - 10,000µF - 10% +50% tol Surge proof, highly compact, smaller than many you've used before.

B32540/1

Plug in polycarbonate .001-1µF 100v & 250v. 10mm or 7.5mm spacing, compact and reliable.

We now make available to the amateur all the advantages of dealing direct with a franchised distributor.

Quality guaranteed - 9,000 line items.

Send a SAE for details or 25p for our catalogue.

CONCORDE

Concorde Instrument Company, Dept PW,
42 Cricklewood Broadway London NW2 3ET
Tel: 01-452 0161/2/3 Telex: 21492 and at
85 West Regent Street Glasgow G2 2QD
Tel: 041-332 4133

WW-198 FOR FURTHER DETAILS

THE RADIO SHOP

16 CHERRY LANE
BRISTOL BS1 3NG



TELEPHONE
0272-421196

TRIACS

1.6AMP PLASTIC T05

NAS0161W 100V	.27
NAS0161X 100V	.26
NAS0162W 200V	.30
NAS0162X 200V	.28
NAS0164W 400V	.40
NAS0164X 400V	.38
NAS0166W 600V	.55
NAS0166X 600V	.52

6.5AMP ISOLATED TAB

NAS0651W 100V	.46
NAS0651X 100V	.44
NAS0652W 200V	.58
NAS0652X 200V	.56
NAS0654W 400V	.84
NAS0654X 400V	.80
NAS0656W 600V	1.05
NAS0656X 600V	1.00

10AMP ISOLATED TAB

NAS1001W 100V	.63
NAS1001X 100V	.60
NAS1002W 200V	.78
NAS1002X 200V	.74
NAS1004W 400V	1.09
NAS1004X 400V	1.04
NAS1006W 600V	1.34
NAS1006X 600V	1.28

3AMP "CLIPPED TAB"

NAS0301W 100V	.30
NAS0301X 100V	.28
NAS0302W 200V	.36
NAS0302X 200V	.34
NAS0304W 400V	.52
NAS0304X 400V	.50
NAS0306W 600V	.70
NAS0306X 600V	.66

8.5AMP ISOLATED TAB

NAS0851W 100V	.52
NAS0851X 100V	.50
NAS0852W 200V	.67
NAS0852X 200V	.64
NAS0854W 400V	.97
NAS0854X 400V	.92
NAS0856W 600V	1.20
NAS0856X 600V	1.14

16AMP ISOLATED METAL

NAS1601W 100V	.90
NAS1601X 100V	.82
NAS1602W 200V	.95
NAS1602X 200V	.88
NAS1604W 400V	1.40
NAS1604X 400V	1.32
NAS1606W 600V	1.85
NAS1606X 600V	1.75

Devices with Internal Trigger have "W" suffix. "X" denotes Standard Triac.

THYRISTORS

1.6AMP MIN. T05

NAS006P 50PIV	.25
NAS006Q 100PIV	.28
NAS006R 200PIV	.31
NAS006S 400PIV	.40
NAS006T 600PIV	.52

4AMP ISOLATED TAB

NAS106P 50PIV	.26
NAS106Q 100PIV	.30
NAS106R 200PIV	.36
NAS106S 400PIV	.57

6AMP ISOLATED TAB

NAS206P 50PIV	.37
NAS206Q 100PIV	.42
NAS206R 200PIV	.50
NAS206S 400PIV	.77

8AMP ISOLATED TAB

NAS306P 50PIV	.41
NAS306Q 100PIV	.47
NAS306R 200PIV	.59
NAS306S 400PIV	.85

16AMP ISOLATED TAB

NAS806P 50PIV	.50
NAS806Q 100PIV	.58
NAS806R 200PIV	.73
NAS806S 400PIV	1.15

Quantity prices on application, S.A.E.

CLOCK CHIP CT7001

£4.95

The unique 7001 represents a major breakthrough in Clock Chip design. Incorporating many features available for the first time: 365 DAY CALENDAR - 12/24 HR. OPERATION - ALARM - SNOOZE ALARM - SIX DIGIT CAPABILITY - DIRECT DRIVE TO LED DISPLAY - CONTINUOUS OPERATION DURING MAINS FAILURES. Socket 75p

Copy of data available—please send 10p stamp

Special kit comprising 1 7001 & 4 LED 7 segment displays and data sheets and socket £10
704 LED—7 seg. display 3" £1.10 each

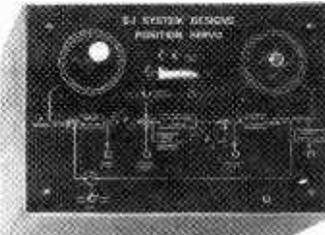
Liquid Crystal Display 3½ digit £5.25

Please add 8% VAT to all listed prices. Postage & packing 15p per order. Send 13p for latest catalogue. Callers welcome

NEW TEACHING AID POSITION CONTROL SYSTEM

FEATURES:

- * Demonstration of basic principles of Feedback systems
- * Continuous rotation system
- * Loop gain and damping adjustable
- * Self-contained unit—no additional patching required
- * Choice of mains or battery operation
- * Compact and portable—weight 8lbs—dimensions 12" x 8½" x 5"
- * Open loop/closed loop changeover by a single switch
- * Low cost



Particularly suitable for OND in Technology

Write for details to:

SJ System Designs, 4 Roundabout Lane, Welwyn, Herts AL6 0TH

WW-187 FOR FURTHER DETAILS



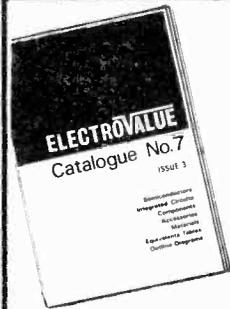
Audio Connectors

Broadcast pattern jackfields, jackcords, plugs and jacks
Quick disconnect microphone connectors
Amphenol (Tuchel) miniature connectors with coupling nut
Hirschmann Banana plugs and test probes
XLR compatible in-line attenuators and reversers
Low cost slider faders by Ruf

Future Film Developments Ltd.
90 Wardour Street,
London W1V 3LE
01-437 1892/3

WW-109 FOR FURTHER DETAILS

ELECTROVALUE



Catalogue 7
issue no 3
now ready

- UP-DATED PRODUCT & PRICE INFORMATION
- REFUND VOUCHER

We have made it just about as comprehensive and up-to-the-minute as possible. Thousands of items from vast ranges of semi-conductors including I.C.s to components, tools, accessories, technical information and diagrams are included as well as a refund voucher worth 25p for spending on orders list value £5 or more. SEND NOW FOR YOUR COPY BY RETURN. It's an investment in practical money-saving and reliability! **30p** post paid

+ E.V. PRICE STABILIZATION POLICY

PRICES shown in Catalogue No. 7, issue 3 will be maintained until March 31st (except in severe cases of market fluctuation) and reviewed only at 3-month intervals, commencing April 1st, instead of making day-to-day price changes.

+ E.V. DISCOUNT PLAN

Applies to all items except the few where prices are shown NETT. 5% on orders from £5 to £14.99; 10% on orders value £15 or more.

+ FREE POST & PACKING

In UK for pre-paid mail orders over £2 (except Baxandall cabinets). If under there is an additional handling charge of 10p.

+ QUALITY GUARANTEE

All goods are sold on the understanding that they conform to makers' specifications. No rejects, seconds or sub-standard merchandise.

ELECTROVALUE LTD

All communications to Dept WW.4.
28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB.
Telephone Egham 3603. Telex 264475 Shop hours: 9-5.30 daily, 9-1 p.m. Sats.
NORTHERN BRANCH: 680 Burnage Lane, Burnage, Manchester M19 1NA.
Telephone (061) 432 4945. Shop hours: Daily 9-5.30 p.m., 9-1 p.m. Sats.
U.S.A. CUSTOMERS are invited to contact ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore PA 19081.

AMATEUR RADIO BULK BUYING GROUP

Why buy from us?

Since our inception we have always aimed at giving the following 5 STAR service:

- ★ All components are brand new to manufacturers' full specifications.
- ★ All components carry manufacturer's full guarantee.
- ★ Orders normally despatched within 48 hours of receipt.
- ★ Full refund offered on any item not in stock.
- ★ All prices include V.A.T.

This service is difficult to match—join the many who now take it for granted.

COMPONENTS FOR POCKET V.H.F. TRANSCEIVER

By D. A. Tong (July and August '74 W.W.)
Many of the components required for this project are in stock as follows:

- Filters: BFB-455A, 37p; CFR-455H, £14
Integrated Circuits: SL612, £1.71; SL630, £1.62
Transistors etc: 40673, 53p; ZTX500, 15p; IN41148, 6p
Also: FX1115, 1p; FX1886, 5p; 2½ in. 25ohm L.S., £1.35



UKW-BERICHTE
VHF-COMMUNICATIONS
We are now the official U.K. agents for this VHF equipment constructors' magazine.

Send for FREE index to past editions to see range of items covered (SAE please). **SUBSCRIPTION: £2.80 for 1975 volume. Plastic Binders—£1.**

Back issues as follows: 1969, 1970, 1971—£2.30 per year; 1972, 1973, 1974—£2.65 per year. A limited number of back issues now held in stock at 85p each post paid.

PLESSEY SL600 ics at LOWEST PRICES

We carry the most comprehensive stocks of SL600 devices anywhere in the country—available for immediate delivery

SL610	£1.71	SL613	£3.72	SL622	£6.58	SL630	£1.62
SL611	£1.71	SL620	£2.58	SL623	£4.81	SL640	£3.15
SL612	£1.71	SL621	£2.58	SL624	£2.45	SL641	£3.15

Full data sheets on all SL600 devices are included in our Data Catalogue. 35 pages crammed with information for 25p plus large 7p sae.

All components are available for the SL600 series SSB Transceiver described by G3ZVC in "Radio Communication", "Ham Radio" and other leading publications. Full details are in our free price list.

DECON DALO PCB MARKER PEN

Available from us complete with spare tip and instruction sheet at only 85p. We also stock a wide range of other products—diodes, transistors, Minitrans, Microwave Modules converters, etc. Javbeam aerials, KVG filters, etc. Write for free price list (enclose sae please) or send 25p plus large 7p sae for our Data Catalogue.

All prices include VAT at 8%. Minimum post and packing charge 15p. Orders should be sent to our mail order address as follows:

A.R.B.B.G., Dept. 503, 20 THORNTON CRESCENT, OLD COULSDON, SURREY CR3 1LH

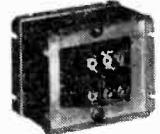
WW—199 FOR FURTHER DETAILS

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS

Pri 120/240V Sec 120/240V Centre Tapped & Screened

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	£	P & P
07	20	1 8	7.0X 7.0X 6.0	2.88	38
149	60	12	9.9X 7.7X 8.6	4.37	45
150	100	5 8	9.9X 8.9X 8.6	4.88	45
151	200	8 0	12.1X 9.3X10.2	8.13	53
152	250	13 12	12.1X11.8X10.2	9.83	73
153	350	15 0	14.0X10.8X11.8	11.88	73
154	500	19 8	14.0X13.4X11.8	13.65	91
155	750	29 0	17.2X14.0X11.8	20.51	*
156	1000	38 0	17.2X16.6X14.0	29.15	*
157	1500	46 0	21.6X13.4X18.1	33.23	*
158	2000	60 0	21.6X15.3X18.1	37.07	*
159	3000	85 0	23.5X17.8X19.7	58.55	*



AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Taps	£	P & P
113	20	1 0	5.8X 5.1X 4.5	0-115-210-240	1.67	30
64	75	2 4	7.0X 6.7X 6.1	0-115-210-240	2.90	38
4	150	3 4	8.9X 7.7X 7.7	0-115-200-220-240	4.12	45
66	300	6 4	9.9X 9.6X 8.6	" " "	5.82	53
67	500	12 8	12.1X11.2X10.2	" " "	8.82	67
84	1000	19 8	14.0X13.4X14.3	" " "	13.68	91
93	1500	30 4	14.0X13.8X14.3	" " "	18.31	*
95	2000	32 0	17.2X16.2X14.0	" " "	24.20	*
73	3000	40 0	21.6X13.4X18.1	" " "	35.09	*

CASED AUTO TRANSFORMERS

115V mains lead input and U.S.A. 2 pin outlets. 20VA £3.13, P. & P. 38p. 500VA £10.45, P. & P. 80p. 1000VA £17.51, Via B.R.S.

LOW VOLTAGE TRANSFORMERS

PRIMARY 200-250 VOLTS 12 AND/OR 24 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Windings	£	P & P
111	0.5-0.25	8	4.8X 2.9X 3.5	0-12V at 0.25A X2	1.47	23
213	1.0-0.5	1 4	6.1X 5.8X 4.8	0-12V at 0.5A X2	1.74	30
73	2 0	1 12	7.0X 6.4X 6.1	0-12V at 1A X2	2.29	38
18	4 2	2 12	8.3X 7.7X 7.0	0-12V at 2A X2	2.86	38
70	6 3	3 8	8.9X 8.0X 7.7	0-12V at 3A X2	4.12	45
108	8 4	5 8	9.9X 8.9X 8.6	0-12V at 4A X2	4.56	45
72	10 5	6 4	9.9X 9.6X 8.6	0-12V at 5A X2	5.14	53
116	12 6	6 12	9.9X10.2X 8.6	0-12V at 5A X2	5.52	53
17	16 8	8 12	12.1X 9.9X10.2	0-12V at 8A X2	7.28	60
115	20 10	18 8	14.0X 9.6X11.8	0-12V at 10A X2	10.39	73
187	30 15	15 8	14.0X12.1X11.8	0-12V at 15A X2	13.59	85
226	60 30	32 0	17.2X15.3X14.0	0-12V at 30A X2	18.83	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
112	0-5	1 4	6.1X 5.8X 4.8	0-12-15-20-24-30V	1.81	30
79	1.0	2 4	7.0X 6.7X 6.1	" " "	2.40	38
3	2.0	3 4	8.9X 7.7X 7.7	" " "	3.46	38
20	3.0	4 8	9.9X 8.3X 8.6	" " "	4.53	45
21	4.0	6 4	9.9X 9.6X 8.6	" " "	5.13	53
51	5.0	6 12	12.1X 8.6X10.2	" " "	6.41	53
117	6.0	8 0	12.1X 9.3X10.2	" " "	7.16	60
88	8.0	12 0	12.1X11.8X10.2	" " "	9.90	67
89	10.0	13 12	14.0X10.2X11.8	" " "	9.87	73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
102	0-5	1 12	7.0X 6.4X 6.1	0-19-25-33-40-50V	2.58	30
103	1-0	2 12	8.3X 7.4X 7.0	" " "	3.38	38
104	2-0	5 8	9.9X 8.9X 8.6	" " "	4.68	45
105	3-0	6 12	9.9X10.2X 8.6	" " "	5.81	53
106	4-0	10 0	12.1X10.5X10.2	" " "	7.60	67
107	6-0	12 0	14.0X10.2X11.8	" " "	12.10	67
118	8-0	18 0	14.0X12.7X11.8	" " "	12.98	85
119	10-0	25 0	17.2X12.7X14.0	" " "	16.99	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
124	0-5	2 4	7.0X 6.7X 6.1	0-24-30-40-48-60V	2.33	38
126	1-0	3 4	8.9X 7.7X 7.7	" " "	3.41	38
127	2-0	6 4	9.9X 9.6X 8.6	" " "	5.08	45
125	3-0	8 12	12.1X 9.9X10.2	" " "	7.52	60
123	4-0	13 12	12.1X11.8X10.2	" " "	8.75	67
40	5-0	12 00	14.0X10.2X11.8	" " "	9.75	73
120	6-0	15 8	14.0X12.1X11.8	" " "	11.30	85
121	8-0	25 00	14.0X14.7X11.8	" " "	15.00	*
122	10-0	25 0	17.2X12.7X14.0	" " "	17.52	*
189	12-0	29 00	17.2X14.0X14.0	" " "	19.98	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref. No.	MA	Weight lb oz	Size cm.	VOLTS	£	P & P
238	200	2	2.8X2.6X2.0	3-0-3	1.54	10
212	1A 1A	1 4	6.1X5.8X4.8	0-6-0-6	1.84	30
13	100	4	3.9X2.6X2.9	9-0-9	1.41	13
235	330, 330	4	4.8X2.9X3.5	0-9, 0-9	1.56	19
207	500, 500	1 00	6.1X5.4X4.8	0-8-9, 0-8-9	1.92	30
208	1A, 1A	1 12	7.0X6.4X6.1	0-8-9, 0-8-9	3.30	38
236	200, 200	4	4.8X2.9X3.5	0-15, 0-15	1.43	19
214	300, 300	1 4	6.1X5.8X4.8	0-20, 0-20	1.93	30
221	700 (D.C.)	1 8	7.0X6.1X6.1	20-12-0-12-20	2.17	38
206	1A, 1A	2 12	8.3X7.7X7.0	0-15-20, 0-15-20	3.46	38
203	500, 500	2 4	8.3X7.0X7.0	0-15-27, 0-15-27	3.00	38
204	1A, 1A	3 4	8.9X7.7X7.7	0-15-27, 0-15-27	3.85	38

BATTERY CHARGER TYPES

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary 2V, 6V, 12V	£	P & P
45	1-5	1 8	7.0X 6.1X 6.1		1.82	38
5	4-0	3 4	8.9X 7.7X 7.7		3.63	38
86	6-0	6 4	9.9X 9.6X 8.6		5.32	53
146	8-0	6 12	9.9X10.2X 8.6		6.07	53
50	12-5	12 0	14.0X10.2X11.8		8.63	67

*Carriage via B.R.S.

Also stocked: SEMICONDUCTORS • VALVES
AVOMETERS • ELECTROSIL RESISTORS

PLEASE ADD 8% FOR V.A.T. including P. & P.

BARRIE electronics

3, THE MINORIES, LONDON EC3N 1BJ

TELEPHONE: 01-488 3316/8

NEAREST TUBE STATIONS, ALDGATE & LIVERPOOL ST.

Europe's Largest Hi-Fi Retailers

AMR

give you the greatest choice

TMK 200 MULTIMETER KIT
Build yourself a quality 20000 opv. multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges: 0/0.6/6/30/120/600/1200V D.C. 0/6/30/120/600/1200V A.C. Current: 0/0.6/6/60/600mA Resistance: 0/10K/1/10 Meg ohms. Decibels: -20 to +83dB. Size 90 x 150 x 35mm.
OUR PRICE £7.95 P&P 30p

AUOIDTRONIC Model ATM1
Top value 1,000 opv pocket multimeter. Ranges: 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistance: 0/150k ohms. Decibels: -10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.
OUR PRICE £3.25 P&P 15p

MODEL C1092
Jewel movement, attractively moulded case with edgewise ohms adjustment. Ranges: 0/15/150/300/1200V AC. (2500 opv). 0-30/300/600V DC. (5000 opv). 0-30/uA/0-300mA DC. Resistance: x 10, x 100, -10 to +16dB. Supplied with battery test leads and instruction booklet. Size: 121 x 73 x 29mm.
OUR PRICE £3.95 P & P 20p

HIKIKI 720X VOM
A versatile, accurate measuring instrument. Ranges: 20,000 opv. 0/6/25/100/500V DC. 0/10/50/250/1000V AC. 0-50uA/250mA. 0-20k/2 Megohms.
OUR PRICE £5.97 P&P 30p

MODEL C7202EN
20,000 opv. DC. 10,000 opv. AC. Mirror scale. Ranges: 6/25/100/500/1000/2500 V. DC. 10/50/100/500/1000 V. AC. DC Resistance: x 10, x 100, x 1000 (3002 centre scale) DC Current 50uA/2.5mA/250mA. -20 to +68 dB.
OUR PRICE £6.95 P & P 30p

MODEL PL436
20,000 opv DC. 8000 opv AC. Mirror scale. Ranges: 6/3/12/30/120/600V DC. 3/30/120/600V AC. 50/800uA/600mA. 10/100k/1Meg/10 Meg Ohm. -20 to +46 dB.
OUR PRICE £6.97 P&P 30p.

HIKIKI 730X
30,000 opv. Overload protection. Ranges: 6/30/60/300/600/1200V DC. 120/600/1200V AC. 60uA/300mA. 2k/200k. 2 Meg Ohm. -10 to 63dB.
OUR PRICE £7.50 P&P 30p

U4323 MULTIMETER
20,000opv. Simple unit with audio V.C. oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/50/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: x 10, x 100, x 1,000, x 10,000 (500). 500k, 5k, 50k (centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £8.00 P&P 30p

U435 MULTIMETER
20,000opv. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A. Resistance: 0.3/30/300k Ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.
OUR PRICE £8.75 P&P 30p

MODEL C7208FM
30,000 opv DC. 15,000 opv AC. Ranges: 6/3/15/60/300/600/1200 V DC. 6-30/120/600/1200 V AC. DC Resistance x 1, x 10, x 100, x 1,000 (50k centre scale) DC Current 30uA/3/30/60mA -20 to +63dB.
OUR PRICE £8.95 P & P 30p

U4324 MULTIMETER
High sensitivity, overload protected, 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.25/0.5/6/60/600mA/30A DC. 0.3/30/300mA. 3A AC. Resistance: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: -10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £9.85 P&P 30p

U91 Clamp VOLT AMMETER
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500mA. Accuracy 4%. Size: 263 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £14.00 P&P 30p

U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 66/70opv. Ranges: 0/0.3/1.5/7.5/30/60/150/300/600V DC. 75mV/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/3mA/30mA/300mA/3A DC. 0.1/5/15/60/150/300mA. 1.5/6A AC. 0/200k/300k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £10.75 P&P 50p

HIKIKI 750X VOLT-OHM-MILLIAMETER
43 ranges: 0-0.3/0.5/1.5/3/12/30/60/150/300/600/1200V DC. 0-3/6/15/30/60/120/300/600/1200V AC. Current: 0-30/60uA/1.5/15/30/150/300mA/6/12A. Resistance: 0-3/300k/3/30Mohms. Decibels: -10 to +17dB. Output: -0-3/6/15/30/60/120/300V. Accuracy 3% DC. 4% AC. Sensitivity: 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 15mm.
OUR PRICE £11.95 P&P 40p

TMK MODEL TW50K
46 ranges, mirror scale. 50kV DC. 50kV AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts: 1.5/3/10/25/50/125/250/500/1000. DC current: 25/50uA/2.5/5/25/50/250/500mA/5/10/25/50mA. Resistance: 10k/100k/1 Meg/10 Meg ohms. -20 to +81.5dB.
OUR PRICE £12.50 P&P 20p

MODEL C7080EN
Giant 7080EN. 30,000 opv. Mirror scale. 20,000 opv. Ranges: 0.2/5/10/25/50/100/250/500V DC. 0.2/5/10/25/50/100/250/500/1000/5000V AC. 0.3A/10A/100A/500A/10A DC. 0.2k/200k/20 Meg. -20 to +50dB.
OUR PRICE £19.95 P&P 35p

MODEL 500
30,000 opv with overload protection. Mirror scale. Ranges: 0/0.5/2.5/10/25/100V DC. 0.2/5/10/25/100/250/500/1000V AC. 0.25/0.5/5/50/500mA. 12A DC. 0.8/8k/6 meg/60 megohms.
OUR PRICE £13.95 Carr. paid

HIKIKI MODEL 700X
100,000opv. Overload protection. Mirror scale. 8000 in meter. Ranges: 0.1/0.5/1/2/30/60/120/300/600/1200V DC. 1.5/3/10/20/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/300mA/5/12A DC. 2k/200k/2M/20Mohms. -20 to +63dB.
OUR PRICE £14.95 P&P 30p

MODEL AS. 1000 VOM
100,000 opv. Mirror scale. 8000 in meter. protection. 0/3/12/60/120/300/600/1200V DC. 0/16/30/120/300/600V AC. 0/10uA/6/60/300mA/12 Amp. 0/2k/200k/2M/200 Meg Ohm. -20 to +17 dB.
OUR PRICE £17.50 P&P 30p.

KAMODEN HM720B FET VOM
Input impedance 10 Megohms. Ranges: 0/1.25/1/2.5/10/50/100V DC. 0/2.5/10/50/100V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/150k/5M 500uA/5mA. Size: 180 x 134 x 78mm.
OUR PRICE £21.00 P & P 40p

KAMODEN 360 MULTIMETER
High sensitivity. DC 100k ohm/V. AC 10k ohm/V. 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/30/60/150/300V AC. Current: 0.1/0.1mA/0.5/5/50/500uA/5mA. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/0/100M ohms. Decibels: -20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.
OUR PRICE £17.50 P & P 40p

KAMODEN 72.200 Multitester
High sensitivity tester. 200,000 opv. Overload protected. Mirror scale. Ranges: -0/0.6/3/30/60/120/300/600/1200V DC. 0/3/12/60/120/300/600/1200V AC. 0/8uA/80uA/0.8mA/8mA/80mA/800mA/8A DC. 0/12A AC. -20 to +62dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £22.50 P&P 30p

MODEL AF. 105 VOM
50,000 opv. Mirror scale. Meter protection. Ranges: 0/3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30uA/6/60/300mA/12 Amp. 0/10k/1m/10/100V Ohms. -20 to 17 dB.
OUR PRICE £12.50 P&P 30p.

TMK MODEL 117 FET ELECTRONIC VOLT METER
Battery operated. 11 Meg input. 20 ranges. Large 4" mirror scale. Size: 148 x 176 mm. 0.3-12000V DC. 3-300V RMS AC. 8-800uA DC current. 0.12-12mA. Resistance: 20 to 2000 Ohms. Decibels: -20 to +51dB. Supplied complete with leads and instructions.
OUR PRICE £18.50 P&P 20p

TMK 100K LAB TESTER
100,000opv. 6% scale. Buzzer shunt. 1000 ohm check. Sensitivity 100,000 opv. DC. 5kV AC. DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. 10/100/2.5/10A. Resistance: 1k/10k/100k/1 Meg/10 Meg ohms. Decibels: -10 to +48dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.
OUR PRICE £19.95 P&P 30p

LB4 TRANSDIODE TESTER
Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE £4.50 P&P 20p

KAMODEN TT35 TRANSISTOR TESTER
High quality instrument to test base lead, current and DC current. Amplification indicator of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.
OUR PRICE £17.50 P & P 40p

U4314 Multimeter & Transistor Tester, 27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/3/10/30/60/150/300/600/1200V DC. 1.5/3/10/30/60/150/300/600V AC. 0.2/5/10/50/100V DC. 0.3/3/30/300mA DC. Resistance: 0.1/1/10/100k ohms/0.5/2/20/200k/2M/200k ohms/2 Mohms. Battery operated. Supplied complete with probe, test leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £11.00 P&P 30p

SINCLAIR DMZ2 DIGITAL MULTIMETER
Will measure AC and DC volts, AC and DC current, and resistance in a total of 20 ranges. The large light emitting diode display will read up to 1999 and automatically indicate polarity. Indication of positive and negative values is also provided. The instrument is fitted with a combined carrying handle and bench stand and sockets are provided for the connection of an external power supply.
OUR PRICE £59.95 P & P 50p

ROSSIAN C118 Double Beam OSCILLOSCOPE
5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.1 to 100 micro-sec/cm. Free running time base. 50kHz-1MHz. Built-in time base. Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.
OUR PRICE £87.00 Carr. paid

MODEL TE15 GRID DIP METER
Transistorised. Operates on 9V battery. Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range: 440kHz-280MHz in six coils. 500uA meter. Battery operation. Size: 180 x 80 x 40mm.
OUR PRICE £17.50 P&P 30p

TRANSISTORISED L.C.R. A.C. BR/B MEASURING BRIDGE
A new portable bridge offering excellent range and accuracy at low cost. Resistance: 8 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10pF-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11000 ± 1% Bridge Voltage ± 1,000cps. Operated from 9-volt battery. 100 microamp meter indication. Size 71' x 6' x 2'.
OUR PRICE £27.50 P&P 30p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter
Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. Ranges: 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5/15/30/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3/7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.
OUR PRICE £52.00 P&P 50p

TE16A TRANSDIODE SIGNAL GENERATOR
5 ranges. 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800Hz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.
OUR PRICE £8.97 P&P 30p

MODEL TE20 RF SIGNAL GENERATOR
Six bands. 120kHz-260MHz. Dual output. RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output: 105-125V. 200-240V AC. Size: 193 x 285 x 150mm. Complete with test leads etc.
OUR PRICE £18.95 P&P 50p

TE-200 RF SIGNAL GENERATOR
Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xial socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 216mm x 170mm.
OUR PRICE £19.95 P&P 50p

TE22 SINE SQUARE WAVE AUDIO GENERATOR
Sine wave output to 200kHz. Square wave on 4 bands. Square 20 cps to 30 kHz. Output impedance 500 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.
OUR PRICE £24.95 P&P 50p

ARF 300 AF/RF SIGNAL GENERATOR
All transistorised compact fully portable. A.F. sine wave 18kHz-220 kHz. AF square wave 18kHz to 200 kHz. Output Square/ sine wave 10V P.P. RF 100kHz to 200MHz. Output 100 Ohms. 220/240V AC operation. Complete with instructions and leads.
OUR PRICE £37.50 P&P 50p

DT 124 POWER UNIT
220-240V AC. Input. Output 6.75 or 9V DC 400mA.
OUR PRICE £2.20 P&P 50p

PS200 Regulated POWER SUPPLY UNIT
Solid state. Variable output 5-20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.
OUR PRICE £19.95 P&P 50p

BATTERY/LEVEL PANEL INDICATOR
250 uA 18mm x 18mm Panel mounting.
OUR PRICE 75p P&P 15p Discounts for quantity.

NEW GOLDRING G102 KIT
Belt drive 2 speed turntable in kit form complete with pick up arm and head shell.
OUR PRICE £16.95 P&P 75p

VU METER TYPE 3
Size: 33mm x 20mm.
£1.25 P&P 15p

T.T.C. SPRITE STEREO HEADPHONES
Feather weight (5 oz) Dynamic stereo headphones providing high quality reproduction at a budget price. Soft removable ear pads and adjustable headband. Speaker size: 28mm. Impedance: 8 Ohms. Frequency response: 30-13000Hz.
OUR PRICE £1.95 P&P 30p

UNIPEX NT100A
The UniPEX NT100A is a compact transistorised PA amplifier. This versatile unit has a maximum output of 10 watts RMS and operates on any 10-16V DC source, negative or positive ground and uses only 1.5A at rated output. Supplied complete with mounting brackets etc. plus full installation and operating instructions.
OUR PRICE £21.75 P&P 60p

ALL PRICES EXCLUDE VAT
Also see following pages



RANK AUDIO RA 2107 STEREO AMPLIFIER
7 1/2 watts rms Inputs for magnetic phono, tuner, tape and aux. Separate bass, treble, balance and volume controls. Headphone socket. Teak case. Unrepeatable offer.
OUR PRICE £17.50 P&P 50p

SPECIAL OFFER! CONVERT YOUR STEREO SYSTEM TO 40 SOUND

This clever unit enables you to add 4D sound to your existing system. Complete with simple connection details. Use this converter (together with 2 extra speakers) to achieve the fantastically 4D quadraphonic sound! The effect of being immersed within the music becomes a thrilling new experience (2 year guarantee).
OUR PRICE £3.95 P&P 50p

WALKIE TALKIES SKYFON NV7
Super low cost transmitter/receivers. 100mW with call buzzer and on/off volume control. 7 transistors. Telescopic rod antenna.
OUR PRICE £31.50 per PAIR P & P 50p
NOT LICENSABLE IN THE U.K.

ELECTRONIC CALCULATORS
We carry a tremendous range of both pocket and desk calculators from as little as £8.50. Owing to the demand it is not possible to include them in this advertisement, so send for our latest price list or call into any branch.

HIGH QUALITY CONSTRUCTION KITS
WE ARE STOCKISTS AT Oxford Road, 42 & 257 Tottenham Court Road, 34 Lisle Street, 152 Fleet Street, 311 Edgware Road, CROYDON BIRMINGHAM KINGSTON LEICESTER NORTHAMPTON SOUTHEND TUNBRIDGE WELLS WOLVERHAMPTON branches or by Mail Order.
All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.
Post and Packing 15p per kit.

- AF20 Mono amplifier..... £5.61
 - AF25 Mixer..... £3.29
 - AF30 Mono pre amplifier..... £3.20
 - AF35 Emitter amplifier..... £2.42
 - AF50 0.5W m.c. amplifier..... £3.75
 - AF305 Intercom..... £7.67
 - AF310 2 Mono Amplifier..... £7.55
 - M160 Multi vibrator..... £2.18
 - M1302 Transistor tester..... £6.33
 - M191 VU Meter..... £5.37
 - M192 Stereo balance meter..... £5.93
 - LF380 Quadraphonic device..... £ 8.42
 - AT5 Automatic board control..... £3.85
 - AT30 Photo cell switch unit..... £6.68
 - AT50 400W track light dimmer/speed control..... £5.18
 - AT56 2,200W track light dimmer/speed control..... £6.75
 - AT60 T channel light control..... £10.82
 - AT65 3 channel light control..... £16.52
 - GU30 Tremolo unit..... £8.10
 - HF61 Diode detector..... £3.87
 - HF65 FM transmitter..... £3.21
 - HF75 FM receiver..... £3.66
 - HF310 FM tuner..... £16.32
 - HF325 Deluxe FM tuner..... £26.33
 - HF330 Decoder (HF310/325)..... £10.55
 - GP10 Stereo pre-amplifier for use with 2 x AF310..... £22.98
 - GP12 Circuit board..... £10.02
 - GP304 Circuit board..... £3.35
 - HF380 lw/vhf aerial amplifier..... £6.02
 - HF395 broadband aerial amp..... £2.10
 - NT10 Stabilised power supply 100mA, 9V..... £6.27
 - NT300 Stabilised p. supply..... £13.16
 - NT310 Power Supply 240 V AC or 2 x 18 V DC at 2 amps..... £5.64
 - NT305 Voltage converter..... £5.64
 - NT315 Power supply 240V AC 104.5/15V DC, 500mA..... £12.06
- Amateur Electronics by Josty-Kit**, the professional book for the amateur - covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.
OUR PRICE £3.30 (No VAT) P&P 25p plus VAT
- AE1 100mW output stage..... £1.55
 - AE2 Pre-amplifier..... £1.32
 - AE3 Diode receiver..... £2.05
 - AE4 Flasher..... £1.26
 - AE6 Astable multi-vibrator..... £1.14
 - AE5 Monostable multi-vibrator..... £1.11
 - AE7 RC generator..... £1.08
 - AE8 Bass filter..... £1.06
 - AE9 Treble filter..... £1.05
 - AE10 GCIR filter..... £1.05

SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.
Over 200 ranges in stock - other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

CLEAR PLASTIC MODEL S0640
Size: 85 x 64mm

50uA	£3.90
100uA	£3.95
200uA	£3.80
500uA	£3.75
50.0-500uA	£3.85
100.0-100uA	£3.80
1mA	£3.85
5mA	£3.75
10mA	£4.20
50mA	£3.75
100mA	£3.75
500mV	£3.75
1A DC	£3.75
1A DC	£3.75
5A DC	£3.75
10A DC	£3.75
5V DC	£3.75

CLEAR PLASTIC MODEL S0830
Size: 110 x 83mm

50uA	£4.40
100uA	£4.35
200uA	£4.30
500uA	£4.25
50.0-500uA	£4.35
100.0-100uA	£4.30
1mA	£4.20
5mA	£4.20
10mA	£4.20
50mA	£4.20
100mA	£4.20
500mA	£4.20
1A DC	£4.20
5A DC	£4.20
10A DC	£4.20
5V DC	£4.20

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm

50uA	£4.05
100uA	£3.95
200uA	£3.90
500uA	£3.85
50.0-500uA	£3.95
100.0-100uA	£3.90
1mA	£3.80
5mA	£3.80
10mA	£3.80
50mA	£3.80
100mA	£3.80
500mA	£3.80
1A DC	£3.80
5A DC	£3.80
10A DC	£3.80
5V DC	£3.80

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.70
100uA	£4.60
500uA	£4.40
50.0-500uA	£4.50
100.0-100uA	£4.55
1mA	£4.40
5mA	£4.40
10mA	£4.40
50mA	£4.40
100mA	£4.40
500mV	£4.40
1A DC	£4.40
5A DC	£4.40
10A DC	£4.40
5V DC	£4.40

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm

50uA	£3.30
100uA	£3.25
200uA	£3.20
500uA	£3.10
50.0-500uA	£3.25
100.0-100uA	£3.20
1mA	£3.05
5mA	£3.05
10mA	£3.05
50mA	£3.05
100mA	£3.05
500mV	£3.05
1A DC	£3.05
5A DC	£3.05
10V DC	£3.05
20V DC	£3.05
30V DC	£3.05
15V AC	£3.05

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

50uA	£4.60
100uA	£4.55
500uA	£4.30
50.0-500uA	£4.40
100.0-100uA	£4.50
1mA	£4.30
5mA	£4.30
10mA	£4.30
50mA	£4.30
100mA	£4.30
500mV	£4.30
1A DC	£4.30
5A DC	£4.30
10V DC	£4.30
20V DC	£4.30
30V DC	£4.30
15V AC	£4.30

EGWISE MODEL PE70
Size: 90 x 34mm

50uA	£4.25
100uA	£4.20
200uA	£4.15
500uA	£4.05
50.0-500uA	£4.20
100.0-100uA	£4.15
1mA	£3.95
5mA	£3.95
10V DC	£3.95
20V DC	£3.95
30V DC	£3.95
15V AC	£3.95

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm

50uA	£3.20
100uA	£3.15
200uA	£3.10
500uA	£3.05
50.0-500uA	£3.15
100.0-100uA	£3.10
1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mV	£2.85
1A DC	£2.85
5A DC	£2.85
10V DC	£2.85
20V DC	£2.85
30V DC	£2.85
15V AC	£2.85

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm

50uA	£3.80
100uA	£3.60
200uA	£3.45
500uA	£3.40
50.0-500uA	£3.60
100.0-100uA	£3.45
1mA	£3.40
5mA	£3.40
10mA	£3.40
50mA	£3.40
100mA	£3.40
500mV	£3.40
1A DC	£3.40
5A DC	£3.40
10V DC	£3.40
20V DC	£3.40
30V DC	£3.40
15V AC	£3.40

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm

50uA	£5.80
100uA	£5.55
200uA	£5.50
500uA	£5.40
50.0-500uA	£5.50
100.0-100uA	£5.50
1mA	£5.35
5mA	£5.35
10mA	£5.35
50mA	£5.35
100mA	£5.35
500mV	£5.35
1A DC	£5.35
5A DC	£5.35
10V DC	£5.35
20V DC	£5.35
30V DC	£5.35
15V AC	£5.35

CLEAR PLASTIC MODEL S0460
Size: 59 x 46mm

50uA	£3.60
100uA	£3.55
200uA	£3.50
500uA	£3.45
50.0-500uA	£3.55
100.0-100uA	£3.50
1mA	£3.30
5mA	£3.30
10mA	£3.30
50mA	£3.30
100mA	£3.30
500mV	£3.30
1A DC	£3.30
5A DC	£3.30
10V DC	£3.30
20V DC	£3.30
30V DC	£3.30
15V AC	£3.30

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5.40
50uA	£4.10
100uA	£4.05
500uA	£3.75
50.0-500uA	£4.05
100.0-100uA	£4.00
1mA	£3.70
5mA	£3.70
10mA	£3.70
50mA	£3.70
100mA	£3.70
500mV	£3.70
1A DC	£3.70
5A DC	£3.70
10V DC	£3.70
20V DC	£3.70
30V DC	£3.70
15V AC	£3.70

AUDIOTRONIC AH101 Stereo Headphone Amplifier
All-in-one, transistor amplifier operates from magnetic ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.
OUR PRICE £8.50 P&P 30p

SINCLAIR Project 80 Modules
Z40 Power Amp £5.95 P & P 15p
Z60 Power Amp £7.45 P & P 15p
Stereo 80 Pre-Amp £13.95 P & P 15p
Active Filter Unit £7.45 P & P 15p
FM Tuner £12.95 P & P 15p
Stereo Decoder £8.95 P & P 15p
P25 Power Supply £5.95 P & P 20p
P26 Power Supply £8.95 P & P 20p
P28 Power Supply £8.45 P & P 20p
Transformer for P28 £4.05 P & P 50p

SINCLAIR Project 80 Packages
2x240 Stereo 80 P25 £25.44 P & P 35p
2x260 Stereo 80 P28 £27.84 P & P 35p
2x260 Stereo 80 P28 £29.84 P & P 35p

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER
complete with printed circuit mounting board
OUR PRICE £1.50 P & P 15p
240° Wide Angle

1mA METERS
MW1-6 50 x 60 mm £6.50 P & P 15p
MW1-8 80 x 80 mm £6.30 P & P 15p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS
Excellent quality at low cost. Input: 230V 50/60Hz. Output 0-260V. MODEL S260 BENCH MOUNTING

1A	£10.50	50p
2.5A	£12.00	50p
5A	£17.50	50p
8A	£30.35	£1.00
10A	£33.75	£1.00
12A	£35.40	£1.00
20A	£85.00	£1.50
25A	£95.00	£1.50
40A	£120.00	£1.50

TO LASKYS CUSTOMER SERVICES DIVISION

Audiotronic House, The Hyde, London NW9 6JJ. Tel: 01-200 1321

Please send me the following items

TOTAL PURCHASE PRICE (inc. P&P and VAT)

I enclose cheque postal order money order

I wish to pay by Barclaycard/Access and my number is

NAME

ADDRESS

SIGNATURE

Registered in England No. 347947 at 12 Lower Grosvenor Place, London SW1 0EX

FOR MAIL ORDER

We offer a speedy and efficient service by mail order. Remember to add 8% VAT to total value of goods including post and packing.

32 Page HI-FI PRICE LIST TICK HERE



CALL INTO YOUR NEAREST LASKYS BRANCH OR SEND COUPON BELOW FOR NEW 32 PAGE HI-FI PRICE LIST

CENTRAL LONDON

481 OXFORD ST. 01-493 8641
3 LITTLE ST. WC2 01-437 8204
34 LITTLE ST. WC2 01-437 9155
118 EDGWARE RD. W2 01-723 9789
193 EDGWARE RD. W2 01-723 6211
207 EDGWARE RD. W2 01-723 3271
311 EDGWARE RD. W2 01-723 0387
346 EDGWARE RD. W2 01-723 4453
382 EDGWARE RD. W2 01-723 4194
109 FLEET ST. EC4 01-353 5812
152.3 FLEET ST. EC4 01-353 2833
10 TOTTENHAM CT. RD. 01-637 2232
27 TOTTENHAM CT. RD. 01-636 3715
33 TOTTENHAM CT. RD. 01-636 2605
42/45 TOTTENHAM CT. RD. 01-636 0845
257/8 TOTTENHAM CT. RD. 01-580 0670

ESSEX

86 SOUTH ST. ROMFORD 20218
205/206 CHURCHILL WEST, VICTORIA CIRCUS, SOUTHEND 0702 612241

GLOUCESTERSHIRE

16/20, PENN ST. BRISTOL 0272-20421

KENT

53/57 CAMDEN RD., TUNBRIDGE WELLS 0892-23242

LEICESTERSHIRE

45 MARKET PLACE, LEICESTER 0533-537678

NORTHAMPTONSHIRE

73 ABBINGTON STREET, NORTHAMPTON 0604-35753

NOTTINGHAMSHIRE

5-7 LOWER PARLIAMENT STREET, NOTTINGHAM

OXFORDSHIRE

16 WESTGATE SHOPPING CENTRE, OXFORD

STAFFORDSHIRE

30 WULFRUM WAY, WOLVERHAMPTON 0902-23384

SURREY

1046 WHITGIFT CENTRE, CROYDON 01-481 3027
38/40 EDEN ST., KINGSTON 01-546 1271
32 HILL ST., RICHMOND 01-948 1441

WARWICKSHIRE

116 CORPORATION ST., BIRMINGHAM 021-236 3503

ALL BRANCHES OPEN FROM 9am to 6pm MON TO SAT

OUR CUSTOMER SERVICES DIVISION at head office will answer all your enquiries - just ring 01-200 1321

EXPORT Personal exports arranged for overseas visitors. Goods specially packed, insured and dispatched to all parts of the world at minimum cost exclusive of VAT. Payment by bank transfer, certified cheque, postal order or money order in any currency.

BARCLAYCARD & ACCESS
Phone your order to 01-200 0037 or call into any branch

NO DEPOSIT TERMS available on most goods for personal callers

CHEQUES TO THE VALUE OF £30 ACCEPTED FROM PERSONAL SHOPPERS WITH BANKERS CARD IN OTHER CASHES AND FOR AMOUNTS IN EXCESS OF £30 PLEASE ALLOW TIME FOR CLEARANCE. BANKERS DRAFTS ACCEPTED.

All prices correct at 13/1/75 but subject to change without notice E.&O.E.
A member of the Audiotronic Group of Companies
ALL PRICES EXCLUDE VAT

REDIFON TELEPRINTER RELAY UNIT NO. 12: ZA-41196 and power supply 200-250V a.c. Polarised relay type 3SEITR. 80-0-80V 25mA. Two stabilised valves CV 286. Centre Zero Meter 10-0-10. Size 8in. x 8in. x 8in. New condition. £8.50. Carr. 75p.

SOLARTRON PULSE GENERATOR TYPE G1101-2: £75.00 each. Carr. £2.00.

TELEPRINTER TYPE 7B: Pageprinter 24V d.c. power supply, speed 50 bauds per min. second hand cond. (excellent order) no parts broken. £15 each. Carriage £3.

INSULATION TEST SET: 0-10 kV negative, earth with amplifier provision for checking ionisation. 110/230V a.c. input. S/hand good cond. £30 + £1 carr.

BRIDGE MEGGER: 250V. (Evershed Vignoles) series 2. £30 each. Carr. £1.

BRIDGE MEGGER: 2,500V., series 1. £30 each. Carr. £1.

CRYSTAL TEST SET TYPE 193: used for checking crystals in freq. range 3000-10,000KHz. Mains 230V 50Hz. Measures crystal current under oscillatory conditions and the equivalent resistance. Crystal freq. can be tested in conjunction with a freq. meter. £17.50. Carr. £1.50.

TYPE 174/1 FREQUENCY SHIFT ADAPTOR (Northern Radio Co.): Convert. mark and space frequencies from the output of one or two Receivers into d.c. pulses. Suitable to operate Teleprinters or similar devices. 110/220V. Further details on request, s.a.e. £55 each. Carr. £1.50.

TELEGRAPH TERMINAL UNIT (A.T.E.) TYPE TFS3: Converts signals from Receivers into d.c. pulses. Complete with monitor. £75 each. Carr. £2.

FURZHILL SENSITIVE VALVE VOLTMETER V.200: Freq. 10Hz-6MHz (can be used beyond 6MHz). Probe in circuit—voltage range 1mV-1kV in 6 decade ranges; full scale deflection 10mV, 100mV-1kV. Without probe 100µV-100V in 6 decade ranges; full scale deflection 1mV, 10mV-100V. Accuracy ±5%. £30 each. Carr. £1.

NOISE FIGURE METER TYPE 113A (Magnetic AB, Sweden): £125 each. Carr. £1.

PRECISION PHASE DETECTOR TYPE 205: Freq. 0.1-15MHz in 5 ranges. Variable time delay microseconds 0-0.1c, 115V input. £55 each. Carr. £1.

ROHDE & SCHWARZ HF MILLIVOLTMETER: 30Hz-30MHz Type UVH, 1mV-1V in 7 ranges, 220V. £75 each. Carr. £2.

ROHDE & SCHWARZ VHF WATTMETER TYPE NAK: with matching indicator, 30 watts, 200-470MHz. £25 each. Post 70p.

PHILLIPS VALVE VOLTMETER TYPE GM6014: 1-300mV in 6 ranges, 70-20dB, probe 1000Hz-30MHz, 300mV maximum. £35 each. Carr. £1.

TF-1345/2 DIGITAL FREQUENCY COUNTER: Range 10KHz-100MHz with extension units. Details on request, s.a.e. £100. Carr. £2.

UHF MICROWAVE MILLIWATTMETER TYPE 14: Direct reading, can be used to measure power from 100MHz upwards. F.S.D. on 4in. scale meter 2.5mW. £40 each. Carr. £1.

MARCONI HF SPECTRUM ANALYSER OA. 1094/3. Further details on request. £250 each. Carr. £5.

Q METER: 30MHz-200MHz. £55. Carr. £1.

ALL U.K. ORDERS SUBJECT TO 8% VALUE ADDED TAX. THIS MUST BE ADDED TO THE TOTAL PRICE (including post or carriage).

If wishing to call at stores, please telephone for appointment.

W. MILLS

3-B TRULOCK ROAD, LONDON, N17 0PG
Phone: 01-808 9213 and Bedford 740605 (STD 0234).

SIGNAL GENERATOR AIRMEC TYPE 701: 30KHz-30MHz, 7 ranges. £65. Carr. £1.50.

TF-1278/1 TRAVELLING TUBE WAVE AMPLIFIER: £125. Carr. £2.

BPL A.C. MILLIVOLTMETER TYPE VM.348-D Mk. 3: 2 millivolts-2 volts, 6 ranges. £30. Carr. £1.

WAYNE KERR WAVEFORM ANALYSER A.321: Low scale 0-1200 c/s. High scale 1-20 Kc/s, 600 ohms. Harmonic level is 0-55 dB in 12 steps. £75. Carr. £1.50.

SPECTRUM ANALYSER TYPE MW.69S (Decca): Further details on request. £200.

MARCONI DUAL TRACE UNIT TM-6456: £30. Post 60p.

SIGNAL GENERATOR TS-403B/U (or URM-61A): (Hewlett Packard). A portable, self-contained, general-purpose test equipment designed for use with radio and radar receivers and for other applications requiring small amounts of RF power such as measuring standing-wave ratios, antenna and transmission line characteristics, conversion gain, etc. Both the output freq. and power are indicated on direct-reading dials. 115V, AC, 50 c/s. Freq.—1800-4000 Mc/s. CW, FM, Modulated Pulse—40-4000 pulses per sec. Pulse Width—0.5-10 microsecs. Timing—Undelayed or delayed from 3-300 microseconds from external or internal pulse. Output—1 milliwatt max., 0 to -127 dB variable. Output Impedance—50Ω. Price: £120 each + £2 carr.

H.V. TRANSFORMER: 8000/8000. Output 300mA. rms. Size: 12in. x 12in. x 36in. 230V input. £40. Carr. £4.

TELEPHONE CABLE: (Twin) 1,300ft. on metal reel. £7.50 per reel. Carr. £1

FIRE-PROOF TELEPHONES: £25.00 each, carr. £1.50.

TF.2000 A.F. SIGNAL SOURCE: £175.00, carr. £1.00.

POWER UNIT: 110/230 volts a.c. input. 28 volts d.c. at 40 amps output. £30.00 each, carr. £3.00.

SMOOTHING UNIT (for the above): £10.00 each, carr. £2.00.

X-BAND MODULATOR CALIBRATOR TYPE MC-4420-X: Mnfr. James Scott. £125 ea., Carr. £1.

HP-766D DUAL DIRECTIONAL COUPLER: 940-1975MHz. £35 ea., 75p post.

BACKWARD WAVE OSCILLATOR TYPE SE-215: 6.3 heater, 105V Anode, 7.9mA. Mnfr. Watkins & Johnson. £85 ea., Carr. £1.

TEKTRONIX TIME MARK GENERATOR TYPE 180-S1: 5, 10, 50 MHz. £65. Carr. £2.

TRANSISTOR ANALYSER TA 1001 (K. & N. Electronics Ltd.): £95. Carr. £3.

POLRAD MICROWAVE RECEIVER MODEL R-B1: Complete with tuning unit RS-T 1,900-4,340 GHz. £150. Carr. £5.

ABSORPTION FREQUENCY METER (Measurements Corporation): Consisting of 3 units 1-45, 2.2-400, 420-1000 Megacycles. £55. Carr. £1.

CHRONOTON MODEL 25E: 0.4-10 seconds in seven ranges. £50. Carr. £1.

AIRMEC MODULATION METER TYPE 409: AM or FM, 3-600 MHz. £95. Carr. £2.

LISTS OF EQUIPMENT AVAILABLE: MOTORS; TELEPRINTERS; AR88 SPARES; TEST EQUIPMENT ETC. Send 10p for above lists.

ALL CARRIAGE QUOTES GIVEN ARE FOR 50 MILE RADIUS OF LONDON ONLY.

Wilkinsons For Telecommunications and P.O. type 3000 and 600 relays



The best known of all Relays with a large variety of contact arrangements, all parts interchangeable, known throughout the world. We have years of experience in building this type of Relay to your own specification. Complete banks of contacts made to order and component parts also supplied. Very highest quality at competitive prices with a quick delivery service. Quotations by return. Home and overseas. We are Specialists in export orders.

P.O. type 2201a MINIATURE UNISELECTORS including Jack 12 outlet 2 bridging 1 non-bridging wipers. 250 ohms 50 volt. This compact ratchet-driven 3-level selector is of unique design and occupies no more space than a standard 3000 type Relay. £8.50 each. P.O. Type 2 Uniselectors 25 outlet 8-level non-bridging wipers 300 ohms. £14 each. Eleven-level 1 bridging 10 non-bridging 65 ohms. £17 each. P.O. Type 3 Uniselectors 25 outlet 4 level including single homing arc 1 bridging 3 non-bridging wipers 100 ohms. £10.50 each. 5 level Mechanisms only £8.50 each. 6 level Banks only £5 each.

MINIATURE DIGITAL INDICATORS size of digit 5/16 in illuminated by 28 volt midgeit flange lamps. weight only 3 3/8 ozs reading 0 to 9 with decimal points £4.50 each.

ROOM THERMOSTAT adjustable between 45-75 degrees F. 10 amp 250 volt bakelite case with control knob £2 each.

CABLE 10/0076 PVC insulated. cotton and nylon braided. colour brown 15 pair £10 per 100 yard coil; 20 pair £15 per 100 yard coil; one coil only 80 yards 38 pair £20.

If you require a pump for water supply or industrial use, why not consult us. We are stockists of the world-famous Stuart Turner centrifugal pump nos. 10, 12 and 90. Cellar Pump type 12/B2 for sump drainage or bilge pumping all in stock now for immediate delivery.

All prices shown are carriage paid UK only but subject to VAT at the standard rate.

L. WILKINSON (CROYDON) LTD., LONGLEY HOUSE, LONGLEY RD., CROYDON, CRO 3LH. Phone 01-684 0236. Grams: WILCO CROYDON

WW—066 FOR FURTHER DETAILS

A & S T.V. COMPONENTS

BRIAN ARDEL

8 Cavendish Crescent, Deacons Hill Road Elstree, Herts.

Northwood 28571 Middx. 01-953 9724 (Elstree)

Stockists of semi-conductor devices for television and audio equipment.

TRANSISTORS

AC188	15p	BF180	31p
AD161	35p	BF196	11p
AF139	30p	BT106	£1.00
BC187	20p	BU208	£2.00
BD124	65p	BY238	12p
BD131	40p	OA90	8p
BD132	40p	R2010B	£1.90
BDX32	£2.00	2N1711	25p

INTEGRATED CIRCUITS

TAA550	40p	TBA920Q	£3.00
TBA120AS	£1.00	TBA990Q	£3.00
TBA480Q	£1.10	TCA270Q	£3.00
TBA520Q	£2.60	SN76013ND	£1.00
TBA530Q	£1.90	ETTR6016	£2.25
TBA540Q	£2.00		
TBA560Q	£2.50	(Colour Triplers from £4.00)	
TBA800	95p		

WHOLESALE AND RENTAL COMPANIES AND TELEVISION DEALERS SUPPLIED

Enquiries invited on 100 lots upwards. **SPECIAL** quotations given plus a **FANTASTIC** bonus for certain stock available.

Many other transistor devices available.

Please add 8% for V.A.T. Minimum order £3.00. Under £6 add 25p. for P. & P. U.K. only.

Terms of business C.W.O.

SCIENTRONICS

greet constructors with Exclusive Introductory Offers

SCIENTRONICS is a new company organised to develop and promote electronic designs of special interest to constructors. We are privileged to offer, as our opening shot, a substantial quantity of selected items no longer part of the manufacturing programme of an internationally famous British manufacturer. These include

transistors by Ferranti. Texas. ITT and others made to stringent specifications e.g., E5401 with a guaranteed gain at 1 micro amp. All these transistors are brand new and guaranteed within the terms of our published specifications. S.A.E. brings full list by return. Leads on components are untrimmed.

TRANSISTORS

GENERAL PURPOSE	NPN(N) PNP (P)	ONE OFF PRICE in p	VCE	HFE Min AT	mA
FRB771	P	7.5	+50	100	1
E 5365A	N	7.5	25	100	1
E 5368B	N	7.5	25	150	1
E 5368C	N	8	25	250	1
E 5369	P	7.5	20	70	1
LOW LEVEL					
E 5401	P	7.5	+30	50	1µA
E 5403	P	7.5	+30	100	10µA
E 5404	N	7.5	+30	100	100µA
E 5405	P	7.5	+30	100	100µA

DRIVERS & SWITCHING (tested for low Vce (sat.))

FRB 772	P	8	40	40	500
E 5370	N	5	20	(15)	10
E 5397	P	6	20	100	100
E 5398	P	6	40	40	60

HIGH FREQUENCY (600 MHz F_T)

E 5399	N	7.5	30	20	3
E 5400	N	7.5	20	10	1
XK 6116	N	6	20	10	1

HIGH VOLTAGE

E 5407	P	9	65	50	10
E 5408	N	7.5	69	50	10

QUANTITY DISCOUNTS (prices in pence per device)

Single	10	100	1000
3	8.5	7.5	3
7	7.5	6.5	4.5
15	7.2	6.8	4.8
30	7.4	6.7	4.9
60	6	6.5	5.5

* Intended for 10V working guaranteed, but almost all would pass for higher voltage operation as indicated—most can be selected for higher voltage working at an extra charge of 1p per device

Send S.A.E. for lists capacitors, resistors, electrolytics, nixie displays, switches, transformers, etc. Trade enquiries invited

ORDERING & GUARANTEE. All goods guaranteed within terms of specification and in stock at time of going to press. Send cheque or money order with order, or if cash, send reg. post. Please state requirements clearly. Satisfaction guaranteed or your money refunded. MIN. ORDER £1. All goods sent post paid in U.K. Overseas postage charged at cost. V.A.T.—Add 8% to total value of order in U.K.

SCIENTRONICS (Dept. WW4)
40 HIGH STREET, SOMERSHAM, HUNTINGDON, CAMBS PE17 3JA
Telephone Somersham (04874) 321



TRANSISTORS AND DIODES

Type	Pc	VCBO	FT MHz	
85Y29 (SNPN)	300mw	15	20	17p
BD107 (SNPN)	11.5w	64	100	65p
2N711B/2G106 (SNPN)	150mw	18	120/150 Tot. Sw. Time 275 nS	45p
2N985 (GNPN)	300mw	15	Tot Sw. Time 115 nS	£1.00
2N1304 (GNPN)	150mw	30		17p
2N1309 (GNPN)	150mw	30	6	32p
2N1046 (GNPN)	50w	100	20	£2.60
2N1146A (GNPN)	90w	70	15	50p
2N1557 (G)	106w	40	0.35	55p
2N2080 (G)	170w	70	0.2	£1.20
2N2082 (G)	170w	40	0.2	£1.20
2N2405 (SNPN)	1w	120	120	57p
2N3054 (SNPN)	29w	90	1.2	45p
2N3055 (SNPN)	115w	100		47p
2N3375 (SNPN)	11.6w	65	500	£3.60
2N4427 (SNPN)	3.5w	40	700	55p
2N5322 (SNPN)	10w	65	325	55p

Type	Pc	VCBO	FT MHz	
AS216/OC26	25p	OC35		
45p	OC42	45p	OC71	
12p	CV7006/OC72	20p		
OC75	25p	OC83	28p	
GET110/NKT303	25p			
OC702	10p	OA10	25p	
RAS50BAF	25p	RAS310AF	25p	
25p	STC	Wire	End	
400PVI1A	4	for	50p	
IN3193	13p	IN3194	14p	
IN3255	20p			

RECTIFIER STACKS

GEX541B1P2	£6.88
GEX541D2P1	£3.50
GEX541N81P1F	£6.00
GEX541HP3F	£6.00
SX751N1B1P1F	£6.00

INTEGRATED CIRCUITS

MC353G Half Adder	£2.20
MC356G 3 Inp OR/NOR	£1.60
GATE	£1.60
MC358AG AC coupled JK	£5.50
Flipflop	£5.50
MC365G Line Driver	£5.50
CA3020 Wideband Pow.	£1.00
Amp.	£1.00
CA3021 Low power video	£1.30
CA3028A RF 1F Amp.	£1.00
CA3038A Operational Amp.	£2.30
CA3055 Pos. Volt. Regulator	£1.35
CA3085 Pos. Volt. Regulator	30p
CD4035AE 4-stage Serial	£2.00
Register	£2.00
CD4017AE Decade Counter	£4.00
Divider	£4.00
CD4047AD Monostable	£4.00
Astable Multivibrator	£4.00

THYRISTORS

GE2N1774 200v, 5a	£1.20
CR1-021C 20v, 1a	25p
CR10-101B 100v, 10a	£1.00
CR10-021 10a	£1.00
CR10-40B 10a	£1.00
CR10-051 10a	£1.00
CR10-017 10a	£1.00
BTX 92 1200R 16a	1200v
	£2.85

CAPACITORS

Daily Electrolytic 9000µF 25v 60p/p 15p; 500µF 50v 35p/p 10p; TCC 16µF + 16µF + 8µF 450v 75p/p 15p; CCL 50µF + 50µF 275v 45p/p 10p; CCL Suppressor Unit Type SU103/1 comprising capacitor Diode and Resistor 45p/p 10p; Dubilier Metallised Paper type 426 100µF 15v 60p/p 25p; RIC 1-81F 440v a.c. 40p/p 10p.

FANS, CENTRIFUGAL BLOWERS & MOTOR

Airmax Type M1/Y3954 (3 blades) Cast Aluminium alloy impeller & casing (corresponds to current type 3965 7 1/2") 230v, 1ph 50c 2900rpm Class "A" insulation 425cm free air weight 9 1/2lbs. incl. p.p. £23.00.

Woods Aerofoil short casing type S. Ref HS395/4/66 Cap. 2.5µF. Non-reverse 220/240v 1ph 50c 0.19a 2700rpm 6" cast alum. impeller 4 blades width casing 2 1/2" total 5 1/2" weight 5 1/2lbs incl. p.p. £13.00. Aerofoil type 7.5 280K 200/250v 1.0a 1ph 50c 2700rpm 550cm free air. 7 1/2" impeller 14 blades incl. p.p. £14.50.

Service Electric Hi-Velocity Fans, suitable for Gas combustion Systems. Steam exhausting. Pneumatic conveying. Cooling Electronic equipment. Air blast for Oil burners. **Secomak** Model 365 (corresponds to 575) Airblast Fan, 440v 3ph 50c 0.75hp 2850rpm, continuous 160cfm, 12 in. w.g. nett weight 44lb, price incl. carr. £45.00. **Secomak** model 350 250v 1ph 50c 0.166hp, 2800rpm continuous 50cfm 2 in. w.g. net weight 34lbs, price incl. carr. £30.00.

Air Controls type VBL4 200/250v 1ph 50c 110cfm free air weight 7 1/2lbs price incl. p.p. £15.50.

Type VBL5 200/250v 1ph 50c 172cfm free air. Weight 10 1/2lbs, price incl. p.p. £19.50.

William Allday Alcosa rotary vane oil free Single Stage Vacuum Pump Model RSPOB 8 HG Rpm 1420 E.E. 3 phase induction motor 1/3hp cont 220/250v, 380/440v, Class E ins. incl. carr. £28.00.

Alcosa blower FAD 3-8cm at 5psi. Rpm 1420. Motor EE 3ph 50c 1hp 1400rpm. incl. carr. £28.00.

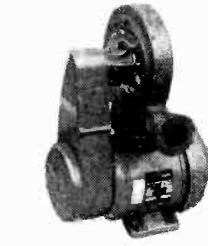
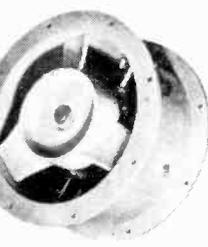
Gast MFG. Vacuum pump 0522-P702-R26K. Motor 110/120v a.c. 1ph 60c 1725rpm, Class E. 10cft to 10in Mercury in 2 mins maintains vacuum. 635mm Mercury. Or as compressor 10psi. incl. or 15psi cont. incl. carr. £28.00.

3 phase 2HP motor 60/50c. 1800/1500 RPM. 208/220/440v £23.50
Cat. 2026391 Potter Instruments flange mounting capstan motor. 0.2HP cont. 110v DC 4 amp £27.50 incl. carr.

Where p.p. not advised add 10p per £ handling and post (in UK). Cash with order. Personal callers welcome. Open Mon.-Wed. 9.30-5.00 Fri.-Sat. 9.30-5.00. Free Car Park adj. **PRICES SHOWN ARE EXCLUSIVE OF V.A.T.**

W. & B. MACFARLANE
126 UXBRIDGE ROAD, HANWELL, LONDON W7 3SL

WW-043 FOR FURTHER DETAILS



Marshall's

A. Marshall & Son (London) Limited Dept. W.W
42-Cricklewood Broadway London NW2 3HD Tel: 01-452 0161
& 85 West Regent Street Glasgow G2 2QD Tel: 041-332 4133

Everything you need is in our new 1975 catalogue. Available now price 25p

Trade and export enquiries welcome

OUR RANGE COVERS OVER 7,000 ITEMS THE LARGEST SELECTION IN BRITAIN

TOP 200 IC'S TTL, CMOS & LINEARS

CA3018A	0.85	CD4043	1.80	NE565	4.48	SN7448	0.90	SN74157	0.95
CA3020A	1.80	CD4044	1.80	SL414	1.80	SN7450	0.16	SN74160	1.10
CA3028A	0.79	CD4045	2.65	SL610C	1.70	SN7451	0.16	SN74161	1.10
CA3035	1.37	CD4046	2.84	SL611C	1.70	SN7453	0.16	SN74162	1.10
CA3046	0.70	CD4047	1.65	SL612C	1.70	SN7454	0.16	SN74163	1.10
CA3048	2.11	CD4049	0.81	SL620C	2.60	SN7460	0.16	SN74164	2.01
CA3052	1.62	CD4050	0.66	SL621C	2.60	SN7470	0.33	SN74165	2.01
CA3089E	1.96	LM301A	0.48	SL623C	4.59	SN7472	0.26	SN74167	4.10
CA3090Q	4.23	LM308	2.50	SL640C	3.10	SN7473	0.36	SN74174	1.25
CD4000	0.36	LM005TL	1.50	SN7400	0.16	SN7474	0.36	SN74175	0.90
CD4001	0.36	LM380	1.10	SN7401	0.16	SN7475	0.50	SN74176	1.44
CD4002	0.36	LM381	2.20	SN7401AN	0.38	SN7476	0.35	SN74180	1.40
CD4006	1.58	LM702C	0.75	SN7402	0.16	SN7480	0.50	SN74181	1.95
CD4007	0.36	LM709	0.38	SN7403	0.16	SN7481	1.25	SN74190	2.30
CD4008	1.63	8DIL	0.45	SN7404	0.19	SN7482	0.75	SN74191	2.30
CD4009	1.18	14DIL	0.40	SN7405	0.19	SN7483	0.95	SN74192	1.15
CD4010	1.18	LM710	0.47	SN7406	0.45	SN7484	0.95	SN74193	1.15
CD4011	0.36	LM723C	0.90	SN7407	0.45	SN7485	1.25	SN74196	1.60
CD4012	0.36	LM741C	0.40	SN7408	0.19	SN7486	0.32	SN74197	1.58
CD4013	0.66	8DIL	0.40	SN7409	0.22	SN7490	0.45	SN74198	2.25
CD4014	1.72	14DIL	0.38	SN7410	0.16	SN7491	0.85	SN74199	2.25
CD4015	1.72	LM747	1.05	SN7411	0.25	SN7492	0.45	SN76003N	2.92
CD4016	0.66	LM748	0.60	SN7412	0.28	SN7493	0.45	SN76013N	1.95
CD4017	1.72	LM14DIL	0.73	SN7413	0.35	SN7494	0.82	SN76033N	1.60
CD4018	2.55	LM3900	0.70	SN7416	0.35	SN7495	0.72	SN76039N	2.92
CD4019	0.86	LM7805	2.00	SN7417	0.35	SN7496	0.75	TA263	1.10
CD4020	1.91	LM812	2.50	SN7420	0.16	SN74100	0.80	TA3300	1.80
CD4021	1.72	LM7815	2.50	SN7423	0.29	SN74107	0.36	TA3550A	2.10
CD4022	1.66	LM7824	2.50	SN7425	0.29	SN74118	1.00	TAAS050	0.60
CD4023	0.36	MC1303L	1.50	SN7427	0.29	SN74119	1.92	TA611C	2.18
CD4024	1.24	MC1310P	2.59	SN7430	0.16	SN74121	0.37	TA621	2.03
CD4025	0.32	MC1330P	0.90	SN7432	0.28	SN74122	0.50	TA661B	1.32
CD4027	0.43	MC1351P	0.80	SN7437	0.35	SN74123	0.60	TBA641B	2.25
CD4028	1.50	MC1352P	0.80	SN7438	0.35	SN74141	0.85	TBA651	1.69
CD4029	3.50	MC1466L	3.50	SN7440	0.16	SN74145	0.90	TBA800	1.40
CD4030	0.87	MC1469R	2.75	SN7441AN	0.85	SN74150	1.50	TBA810	1.40
CD4031	5.19	NE555V	0.70	SN7442	0.65	SN74151	0.85	TBA820	1.15
CD4037	1.93	NE556	1.30	SN7445	0.90	SN74153	0.85	TBA920	4.00
CD4041	1.86	NE560	4.48	SN7446	0.95	SN74154	1.50	DIL sockets	0.17
CD4042	1.38	NE561	4.48	SN7447	0.95	SN74155	1.50		

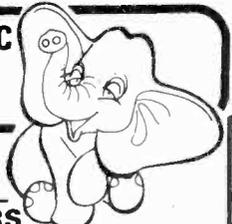
PW TELE TENNIS KIT—£42.50 + VAT Reprint 75p TRY OUR GLASGOW SHOP

POPULAR SEMICONDUCTORS

2N696	0.22	2N3906	0.27	AF139	0.65	BD139	0.71	MPSA56	0.31
2N697	0.16	2N4037	0.42	AF239	0.65	BD140	0.87	OC28	0.765
2N698	0.82	2N4036	0.67	AF240	0.90	BF115	0.36	OC35	0.60
2N699	0.59	2N4058	0.18	AF278	0.70	BF117	0.55	OC42	0.50
2N706	0.14	2A06E	0.15	AF280	0.70	BF154	0.20	OC45	0.32
2N708	0.17	2N4289	1.10	AL102	1.00	BF159	0.07	TIP29A	0.49
2N916	0.28	2N4920	1.10	BC107	1.04	BF180	0.35	TIP29C	0.58
2N918	0.32	2N4921	0.83	BC108	1.04	BF181	0.36	TIP31A	0.62
2N1302	0.185	2N4923	1.00	BC109	0.14	BF184	0.30	TIP32A	0.74
2N1304	0.26	2N5245	0.47	BC147B	0.14	BF194	0.12	TIP33A	1.01
2N1306	0.31	2N5294	0.48	BC148B	0.15	BF195	0.12	TIP34A	1.51
2N1308	0.47	2N5296	0.48	BC1498	0.15	BF196	0.13	TIP35A	2.90
2N1711	0.45	2N5457	0.49	BC157A	0.16	BF197	0.15	TIP36A	3.70
2N2102	0.60	2N5458	0.46	BC158A	0.16	BF198	0.18	TIP42A	0.90
2N2147	0.78	2N5459	0.49	BC167B	0.15	BF244	0.21	TIP2955	0.98
2N2148	0.94	2N6027	0.45	BC168B	0.15	BF257	0.47	TIP3055	0.50
2N218A	0.22	3N12B	0.73	BC169B	0.15	BF258	0.53	TIS43	0.28
2N2219A	0.26	3N140	1.00	BC182	0.15	BF259	0.65	ZTX300	0.13
2N2220	0.25	3N414	0.81	BC182L	0.12	BF261	0.27	ZTX301	0.13
2N2221	0.18	3N200	2.49	BC183	0.12	BF298			

Henry's Radio

LARGEST SELECTION OF ELECTRONIC COMPONENTS AND EQUIPMENT. LOW PRICES— MEAN LESS VAT.



You can build the Texan and Stereo FM Tuner

TEXAN 20 + 20 WATT IC STEREO AMPLIFIER

Features fibre glass PC board. Gardeners low field transformer. 6-ICs. 10 transistors plug diodes etc. Designed by Texas Instruments engineers for Henry's and P.W. 1972. Supplied with full chassis work, detailed construction handbook and all necessary parts. Full input and control facilities. Stabilised supply, overall size 15 1/2 in. X 2 3/4 in. X 6 5/8 in. mains operated. Free teak sleeve with every kit. **£31.00** (Carr. 50p). Built and tested **£37.50**



HENELEC STEREO FM TUNER

Features capacity diode tuning, led and tuning meter indicators, stabilised power supply—mains operated. High performance and sensitivity with unique station indication IC stereo decoder. Overall size in teak sleeve 8 in. X 2 3/4 in. X 6 5/8 in. Complete kit with teak sleeve **£21.00** (Carriage 50p). Built and tested **£24.95**



JOIN THE LARGE BAND OF HAPPY CONSTRUCTORS!

NEW SPECIAL PURCHASE

AM/FM TUNER MODULES

Mullard type LP1179 and LP1171

These two modules together form a high quality AM/FM tuner covering the long, medium and VHF broadcast bands. Requires only 16 resistors and capacitors and a switch to complete.

Supplied with circuits and spec. data.

LP1179

FM Coverage 87-108MHz
Bandwidth 300KHz
Selectivity 35dB
Signal to noise at limiting threshold 40dB
Audio output 75mV

AM Bandwidth 6.5KHz

Sensitivity 1mV

Built-in AGC

Supply 6V negative earth

LP1179 and LP1171 **£4** each or **£7.50** pair

suitable Ferrite aerial **£0.75**



AMPLIFIERS WITH CONTROLS

E1210	12 volt 2 1/2 + 2 1/2 watts 8 ohms	£8.25
SAC14	Mains 7 + 7 watts 8 ohms	£11.75
SAC30	Mains 15 + 15 watts 8 ohms	£14.95
CAO38	9 volt 1 1/2 + 1 1/2 watts 8 ohms	£6.95
CAO68	12 volt 3 + 3 watts 8 ohms	£10.50

AM/FM MODULES

Mullard LP 1186 FM tuner (front end)

with data 10.7MHz o/p **£4.85**

LP1157 AM/Module **£2.50**

LP1171 AM/FM Module **£4.00**

LP1179 AM/FM Front End **£4.00**

Mullard LP1185 10.7MHz IF unit **£4.50**

Gorler Permeability FM tuner (front end) 10.7MHz/o/p **£4.20**

Mullard Modules

LP1157 AM/Type **£2.50**

LP1185 10.7 I.F. Unit **£4.50**

LP1186 10.7 F/M Tuner **£4.85**

Gorler Perm. F/M Tuner **£4.20**

FM AND AM TUNERS AND DECODERS

FM5231 (tu 2)	6-volt FM tuner	£7.95
FM5231 (tu 3)	12-volt version	£7.95
SD4912	decoder for tu 3	£7.95
SP621	6-volt stereo FM tuner	£14.80
Sinclair FM tuner		£11.95
Sinclair decoder for above		£7.95
A1007	9-volt MW-AM tuner	£4.80
A1018	cased FM tuner	£13.95
A1005M (s)	decoder for above	£7.50

PREAMPLIFIERS

Sinclair Stereo 60	Preamplifier	£6.75
E1300	CART/TAPE/MIC INPUTS 9 volt	£2.85
E1310	Stereo 3-30mV/mal cart 9 volt	£4.75
FF3	Stereo 3mV tape head 9 volt	£4.95
3402	Stereo 5-20mV Mag. cart. mains	£5.95
EQ25	Mono 3-250mV Tape/cart/flat. 9 volt	£1.95

POWER SUPPLIES—Mains input (*chassis-rest cased)

470C	6 7/8V 300mA	*P1081 45 volt 0.9A	£7.80
	with adaptors	P12 4 1/2-12 volt	£7.15
P500	9 volt 500mA	0.4-1 amp	£3.20
HC244R	3/6/7 1/9 volt	SE101A 3/6/8/12 volt	£12.75
	400mA stabilised	1 amp stabilised	£12.75
*P11	24 volt 1/2 amp	P1076 3/4/6/7 1/9/12	£4.20
*P15	28 volt 1/2 amp	volt 1/2 amp	£4.20
*P1080	12 volt 1A	SE800A 1-15 volt	£17.50
		0-1/2A stabilised	

SINCLAIR MODULES AND KITS



ST80 stereo preamplifier	£11.95	Package Deals	
Audio filter unit	£6.95	(Carriage/packing 35p)	
Z40 15 watt amplifier	£5.45	2 X Z40, S780, PZ6	£25.00
Z50 25 watt amplifier	£6.95	2 X Z50, S780, PZ6	£27.75
PZ6 power supplies for 1 or 2 Z40	£4.98	2 X Z50, S780, PZ6	
PZ6 power supplies (STA3) for 1 or 2 Z40	£7.98	= Trans	£34.40
PZ8 power supplies (STA3) for 1 or 2 Z50	£7.98	805 Kit	£35.95
Transformer for PZ8	£4.00	Sinclair Special Purchases	
FM tuner	£11.95	* Project 80 stereo	
Stereo decoder	£7.95	preamplifier	£8.75 post 20p
IC20 power amp kit	£7.95	* Project 60S	
PZ20 power supply for 1 or 2 IC20	£5.45	kit	£19.95 post 25p
All above post paid (IGB only)		* Cambridge calculator	£13.50 post 15p

EMI SPEAKERS

Special Purchase

13 X 8 chassis speakers (carr/packing 30p ea or 50p pr) *150 TC 10 watt 8 ohm twin cone **£2.20**

150A built in tweeter 8 ohms **£3.85**
EW 15 watt 8 ohm with tweeter **£5.25**
350 20 watt 8, 15 ohm with tweeter **£7.80** each

*Polished wood cabinet **£4.80** carr. etc. 35p each or 50p pair



EXCLUSIVE 5 WATT IC AMPLIFIERS



Special purchase 5 watt output 8-16 ohm load. 30 volt max DC operation complete with data. Price **£1.50** ea. or 2 for **£2.85**. Printed Circuit Panels **50p**.

UHF TV TUNERS

625-line receiver UHF transistorised tuners. UK operation. Brand new. (Post/packing 25p each)

TYPE A	variable tuning. Slow motion drive	£3.00
TYPE B	4-button push-button (adjustable)	£4.00
TYPE C	variable tuning	£2.50

PA-DISCO-LIGHTING EQUIPMENT



Without doubt UK's best range of modular and complete equipment. Lighting, mixing, microphones, accessories, speakers, amplifiers, lenses, etc., etc. FREE stock lists (Ref. No. 18) on request CALL IN AND SEE FOR YOURSELF AT HENRY'S DISCO CENTRE, 309 EDGWARE ROAD, 01-723 6963.

8 DIGIT POCKET ELECTRONICS CALCULATORS

Sinclair Cambridge Built	£11.00
Sinclair Cambridge Kit	£9.00
Sinclair Cambridge Memory Built	£17.50
Sinclair Scientific Built	£16.00
Sinclair Scientific Kit	£13.50

L450 RECHARGEABLE BATTERY

2v 400mA/HR 50p p.p. 15p.

PHILIPS 12V FLUORESCENT INVERTOR

for 8w fluorescent tube. Supplied with instr. and tube **£3.50** p.p. 30p.

TEST EQUIPMENT MULTIMETERS

(carr/packing 35p)



U4324 20KΩV with case	£9.85
U4311 Laboratory meter	£52.00
U4312 20KΩV with case	£10.75
U4315 20KΩV with case	£10.00
U4317 20KΩV with case	£17.00
U4313 20KΩV with steel case	£13.80
U4317 20KΩV with case	£17.00
U4341 33KΩV plus transistor tester steel case	£11.00
U4323 20KΩV plus 1KHz 465KHz OSC with case	£8.00
ITI-2 20KΩV slim type	£5.95
THL33D (L33DX) 20KΩV robust	£7.50
TP55N 20KΩV (Case £2.00)	£10.75
TPS10S 20KΩV	£8.50
TW20S 20KΩV	£13.00
TW50K 50KΩV	£14.50
S100TR 100KΩV plus transistor tester	£22.50
New Revolutionary Supermeter 800R Multimeter	£18.50
† TE40 AC multivoltmeter	£19.75
† TE15 Grid dip meter	£19.95
440KHz-28MHz	£22.50
† TE85 20 range valve voltmeter	£18.95
† TE200 RF generator	£19.95
† 20Hz-500MHz	£19.95
† TX220 AF generator	£19.95
20Hz-200KHz	£19.50
* HM350 In circuit transistor tester	£14.75
† TT145 Compact transistor tester	£19.75
† G3-38 R/C osc. 20Hz-200KHz	£5.75
* CS42 SWR Meter	£12.95
* SE350A De-luxe signal tracer	£15.50
* SE400 Mini-lab all in one tester	£44.00
C1-5 Scope 500,000KHz (carr £1.00)	£9.97
Radio activity counter 0-10r (carr £1)	£9.97
Mains unit for above (carr 50p)	£3.75

TAPE HEADS

Marnot XRPS/17 1/2-track high	£2.50
Marnot XRPS/18 1/2-track med	£3.50
Marnot XRPS/36 1/2-track med	£5.00
Marnot XRPS/63 1/2-track high	£1.75
Marnot 1/2-tr. Erase 13 X 12E	£0.75
343	
Marnot erase heads for XRPS	£0.75
17/18/36 (XES1)	£0.45
R/RPI record/play 1/2-track	£0.35
H/RP single-track rec/play	£0.35
Bogen type UL290 erase	£1.50
Miniature stereo-cassette rec/play	£2.25

STC & ITT MINIATURE RELAYS

150R 6v	2 p.c.o.	BRAND NEW 60p p.p. 15p
180R 6/12v	2 p.c.o.	
185R 12v	2 p.c.o.	
1250R 12/55	2 p.c.o.	
1700R 18/24v2	p.c.o.	
1800R 24v	4 p.c.o.	
2500R 18/24v2	p.c.o.	
4000R 24v	2 p.c.o.	

10.7 MHZ MINIATURE CERAMIC

IF FILTER 40p per pair p.p. 15p
EP27 low cost SEVEN SEGMENT I.e.d. Digit Height 1/2 inch **£1.35** p.p. 15p.

SL414

Plessey 5w Power Amp IC **£1.65** p.p. 15p

40KHZ ULTRA SONIC TRANSDUCERS

£5.90 p.p. 25p
TAA 960 40KHZ AMP IC **£1.75** p.p. 15p

VAT 8% EXTRA ON ALL ITEMS

TRANSISTORS AND INTEGRATED IC'S

TTL "7400 series" ICs from **16p** each
Cosmos "4000 series" ICs from **00p** each
Linear Op-Amps from **40p** each
Signotics Phase Lock ICs
RCA Linear ICs
TO3 Power Devices in PNP and NPN BC107 and "BC range" from **12p**
Range of "OC" types
Plastic Power Devices, Rectifiers, Zener Diodes up to 10 watts
Power Regulator ICs and many others.
DIL SOCKETS 8 PIN **14p** 14 PIN **15p** 16 PIN **17p** 24 PIN **£1.15** 28 PIN **£1.25**

FREE—SEND NOW FOR OUR NEW FREE LIST No. 36 FOR OUR COMPLETE RANGE OF OVER 10,000 SEMICONDUCTOR DEVICES AT NEW LOW PRICES.



NOMBREX TEST EQUIPMENT

MODEL 35 STABILISED POWER SUPPLY

A Short-circuit proof power supply delivery up to 30v at 1A. Built-in volts and ammeters. **£34.00**

MODEL 40 WIDE RANGE AUDIO SIGNAL GENERATOR

A high stability signal generator using the low distortion Wien bridge principle. Covering 10Hz to 100KHz in four ranges. Adjustable output from 1mV to 1v. Sine and Square wave output. **£34.00**

MODEL 41 RF SIGNAL GENERATOR

Covering 150KHz to 220MHz in eight ranges. Built-in AF mod. Output up to 50mV. Crystal calibration facilities. Large linear scale with slow-motion drive. **£38.00**

MODEL 42 WIDE RANGE RF SIGNAL GENERATOR

Covering 150KHz to 300MHz in eight ranges. Highest range in harmonic. Built-in AF mod. Output up to 50mV. Circular scale. **£24.50**

MODEL 43 RC BRIDGE

Null indicating bridge for resistors and capacitors. Resistance range 10R to 10M ± 2% at Centre Scale. Capacity range 10pF to 10pF ± 2% Centre Scale except 1pF to 10pF range ± 5%. Power Factor Measurement 0-70% **£23.50**

MODEL 44 INDUCTANCE BRIDGE

Measures 1μH to 100H in four ranges ± 5% accuracy. Q measurement from 0.1-1,000 + 10%. **£34.00**

MODEL 45 DIRECT READING FREQUENCY METER

10Hz to 100KHz in four ranges. Input from 10mV to 5v **£36.00**

All models except Model 35 are internally powered from 9v battery (extra). Carriage and packing all models 37p.

NOW OPEN SUPERMARKET—COME AND BROWSE ROUND THE NEW COMPONENTS SUPERMARKET AT 404 EDGWARE ROAD. BARGAINS GALORE. GOODIE BAGS. COMPONENTS, ETC. WATCH FOR FURTHER DEVELOPMENTS!

EXTRA DISCOUNTS
Semi-conductors. Any one type or mixed SN 74 Series 'IC' 12 + EXTRA 10% 25 + EXTRA 15% 100 + EXTRA 20%.

Henry's Radio

Electronic Centres
404-406 Electronic Components & Equipment 01-402 8381
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road, London W2 1BW

Hi Fi and
Electronics
Centres Open
9 am - 6 pm

Prices correct at time of preparation. Subject to change without notice. E & O E

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

AC107 0.22	AD161 &	BC150 0.20	BD151 0.55	BF183 0.44	MJE3440 0.55	2C309 0.39	2N2194 0.39	2N3054 0.19	2N4058 0.13
AC113 0.20	AD162 (M/P)	BC151 0.22	BD132 0.68	BF184 0.28	MPF102 0.46	2C339 0.22	2N2217 0.24	2N3064 0.51	2N4059 0.11
AC115 0.22	AD174 0.75	BC152 0.19	BD133 0.72	BF185 0.33	MPF104 4.11	2C339A 0.18	2N2218 0.22	2N3055 0.45	2N4060 0.13
AC117K 0.32	AD174 0.55	BC153 0.31	BD135 0.44	BF187 0.30	MCF105 4.11	2C344 0.20	2N2219 0.22	2N3391 0.18	2N4061 0.13
AC122 0.13	AD174 0.27	BC154 0.33	BD136 0.44	BF188 0.44	OC20 0.39	2C345 0.18	2N2220 0.24	2N3391A 0.16	2N4062 0.13
AC125 0.19	AD175 0.27	BC157 0.20	BD137 0.50	BF194 0.13	OC20 0.70	2C371 0.18	2N2221 0.22	2N3392 0.16	2N4284 0.19
AC126 0.19	AD176 0.27	BC158 0.13	BD138 0.55	BF195 0.13	OC22 0.52	2C371B 0.19	2N2222 0.22	2N3393 0.16	2N4285 0.19
AC127 0.20	AD177 0.27	BC159 0.13	BD139 0.81	BF196 0.16	OC23 0.54	2C373 0.19	2N2268 0.18	2N3394 0.16	2N4286 0.19
AC128 0.20	AD178 0.39	BC160 0.50	BD140 0.66	BF197 0.16	OC25 0.62	2C374 0.19	2N2369 0.16	2N3395 0.16	2N4287 0.19
AC132 0.16	AD178 0.33	BC161 0.55	BD155 0.88	BF200 0.50	OC26 0.62	2C377 0.33	2N2369A 0.16	2N3402 0.23	2N4288 0.19
AC134 0.16	AD178 0.33	BC167 0.13	BD175 0.66	BF222 1.05	OC26 0.32	2C378 0.18	2N2411 0.27	2N3403 0.23	2N4289 0.19
AC137 0.16	AD178 0.33	BC168 0.13	BD176 0.66	BF257 0.50	OC28 0.55	2C381 0.18	2N2412 0.27	2N3404 0.23	2N4290 0.19
AC141 0.20	AD178 0.33	BC169 0.13	BD177 0.72	BF258 0.66	OC29 0.55	2C382 0.18	2N2446 0.52	2N3405 0.16	2N4291 0.19
AC141K 0.32	AD178 0.33	BC170 0.13	BD178 0.72	BF259 0.95	OC30 0.55	2C383 0.18	2N2447 0.52	2N3406 0.16	2N4292 0.19
AC142 0.30	AD178 0.55	BC171 0.16	BD179 0.77	BF262 0.61	OC35 0.46	2C414 0.33	2N2712 0.22	2N3415 0.17	2N4293 0.19
AC142K 0.32	AD179 0.55	BC172 0.16	BD180 0.77	BF263 0.61	OC41 0.22	2C417 0.28	2N2714 0.23	2N3416 0.31	2N5172 0.13
AC151 0.17	AD180 0.55	BC173 0.16	BD185 0.72	BF270 0.39	OC42 0.27	2C418 0.39	2N2904 0.19	2N3417 0.31	2N5194 0.60
AC154 0.22	AD181 0.55	BC174 0.16	BD186 0.72	BF271 0.33	OC44 0.17	2N388A 0.61	2N2904A 0.23	2N3525 0.83	2N5457 0.35
AC155 0.22	AD181 0.55	BC175 0.24	BD187 0.77	BF272 0.88	OC45 0.14	2N404 0.22	2N2905 0.23	2N3614 0.74	2N5458 0.35
AC156 0.22	AD182 0.41	BC176 0.24	BD188 0.77	BF273 0.33	OC70 0.11	2N405 0.22	2N2905A 0.23	2N3615 0.82	2N5459 0.44
AC157 0.27	AD182 0.41	BC177 0.24	BD189 0.83	BF274 0.39	OC71 0.11	2N406 0.22	2N2906 0.17	2N3616 0.82	2N5461 0.75
AC165 0.22	AD183 0.72	BC178 0.21	BD190 0.83	BF275 0.16	OC72 0.16	2N407 0.22	2N2906A 0.20	2N3617 0.18	2N5462 0.55
AC166 0.22	AD183 0.72	BC179 0.21	BD191 0.83	BF276 0.16	OC74 0.16	2N408 0.22	2N2907 0.22	2N3702 0.13	2N5463 0.46
AC167 0.22	AD183 0.72	BC180 0.27	BD196 0.94	BF277 0.16	OC75 0.17	2N409 0.22	2N2907A 0.24	2N3703 0.13	2N5464 0.46
AC168 0.27	AD183 0.72	BC181 0.27	BD197 0.89	BF278 0.16	OC76 0.17	2N410 0.22	2N2923 0.16	2N3704 0.14	2N5465 0.61
AC169 0.16	AD183 0.72	BC182 0.16	BD198 0.99	BF279 0.16	OC77 0.28	2N411 0.22	2N2924 0.16	2N3705 0.13	2N5466 0.77
AC176 0.22	AD183 0.72	BC183 0.16	BD199 1.05	BF280 0.27	OC78 0.17	2N412 0.22	2N2925 0.16	2N3706 0.13	2N5467 0.86
AC177 0.27	AD183 0.72	BC184 0.22	BD200 1.05	BF281 0.27	OC81 0.17	2N413 0.22	2N2926 0.16	2N3707 0.14	2N5468 0.86
AC178 0.31	AD183 0.72	BC185 0.22	BD205 0.88	BF282 0.27	OC82 0.17	2N414 0.22	2N2926(Y)	2N3708 0.09	2N5469 0.86
AC179 0.31	AD183 0.72	BC186 0.22	BD206 0.88	BF283 0.27	OC83 0.22	2N415 0.22	2N2926(V)	2N3709 0.10	2N5470 0.86
AC180 0.22	AD183 0.72	BC187 0.31	BD208 1.05	BF284 0.27	OC84 0.22	2N416 0.22	2N2927 0.11	2N3710 0.10	2N5471 0.86
AC180K 0.32	AD183 0.72	BC188 0.31	BD209 1.10	BF285 0.27	OC85 0.22	2N417 0.22	2N2928 0.11	2N3711 0.10	2N5472 0.86
AC181 0.22	AD183 0.72	BC189 0.31	BD210 1.10	BF286 0.27	OC86 0.22	2N418 0.22	2N2929 0.11	2N3712 0.10	2N5473 0.86
AC181K 0.32	AD183 0.72	BC190 0.31	BD211 1.10	BF287 0.27	OC87 0.22	2N419 0.22	2N2930 0.11	2N3713 0.10	2N5474 0.86
AC187 0.24	AD183 0.72	BC191 0.31	BD212 1.10	BF288 0.27	OC88 0.22	2N420 0.22	2N2931 0.11	2N3714 0.10	2N5475 0.86
AC187K 0.25	AD183 0.72	BC192 0.31	BD213 1.10	BF289 0.27	OC89 0.22	2N421 0.22	2N2932 0.11	2N3715 0.10	2N5476 0.86
AC188 0.24	AD183 0.72	BC193 0.31	BD214 1.10	BF290 0.27	OC90 0.22	2N422 0.22	2N2933 0.11	2N3716 0.10	2N5477 0.86
AC188K 0.25	AD183 0.72	BC194 0.31	BD215 1.10	BF291 0.27	OC91 0.22	2N423 0.22	2N2934 0.11	2N3717 0.10	2N5478 0.86
AC189 0.24	AD183 0.72	BC195 0.31	BD216 1.10	BF292 0.27	OC92 0.22	2N424 0.22	2N2935 0.11	2N3718 0.10	2N5479 0.86
AC192 0.22	AD183 0.72	BC196 0.31	BD217 1.10	BF293 0.27	OC93 0.22	2N425 0.22	2N2936 0.11	2N3719 0.10	2N5480 0.86
AC192K 0.23	AD183 0.72	BC197 0.31	BD218 1.10	BF294 0.27	OC94 0.22	2N426 0.22	2N2937 0.11	2N3720 0.10	2N5481 0.86
AC193 0.22	AD183 0.72	BC198 0.31	BD219 1.10	BF295 0.27	OC95 0.22	2N427 0.22	2N2938 0.11	2N3721 0.10	2N5482 0.86
AC194 0.22	AD183 0.72	BC199 0.31	BD220 1.10	BF296 0.27	OC96 0.22	2N428 0.22	2N2939 0.11	2N3722 0.10	2N5483 0.86
AC194K 0.23	AD183 0.72	BC200 0.31	BD221 1.10	BF297 0.27	OC97 0.22	2N429 0.22	2N2940 0.11	2N3723 0.10	2N5484 0.86
AC195 0.22	AD183 0.72	BC201 0.31	BD222 1.10	BF298 0.27	OC98 0.22	2N430 0.22	2N2941 0.11	2N3724 0.10	2N5485 0.86
AC195K 0.23	AD183 0.72	BC202 0.31	BD223 1.10	BF299 0.27	OC99 0.22	2N431 0.22	2N2942 0.11	2N3725 0.10	2N5486 0.86
AC196 0.22	AD183 0.72	BC203 0.31	BD224 1.10	BF300 0.27	OC100 0.22	2N432 0.22	2N2943 0.11	2N3726 0.10	2N5487 0.86
AC196K 0.23	AD183 0.72	BC204 0.31	BD225 1.10	BF301 0.27	OC101 0.22	2N433 0.22	2N2944 0.11	2N3727 0.10	2N5488 0.86
AC197 0.22	AD183 0.72	BC205 0.31	BD226 1.10	BF302 0.27	OC102 0.22	2N434 0.22	2N2945 0.11	2N3728 0.10	2N5489 0.86
AC197K 0.23	AD183 0.72	BC206 0.31	BD227 1.10	BF303 0.27	OC103 0.22	2N435 0.22	2N2946 0.11	2N3729 0.10	2N5490 0.86
AC198 0.22	AD183 0.72	BC207 0.31	BD228 1.10	BF304 0.27	OC104 0.22	2N436 0.22	2N2947 0.11	2N3730 0.10	2N5491 0.86
AC198K 0.23	AD183 0.72	BC208 0.31	BD229 1.10	BF305 0.27	OC105 0.22	2N437 0.22	2N2948 0.11	2N3731 0.10	2N5492 0.86
AC199 0.22	AD183 0.72	BC209 0.31	BD230 1.10	BF306 0.27	OC106 0.22	2N438 0.22	2N2949 0.11	2N3732 0.10	2N5493 0.86
AC199K 0.23	AD183 0.72	BC210 0.31	BD231 1.10	BF307 0.27	OC107 0.22	2N439 0.22	2N2950 0.11	2N3733 0.10	2N5494 0.86
AC200 0.22	AD183 0.72	BC211 0.31	BD232 1.10	BF308 0.27	OC108 0.22	2N440 0.22	2N2951 0.11	2N3734 0.10	2N5495 0.86
AC200K 0.23	AD183 0.72	BC212 0.31	BD233 1.10	BF309 0.27	OC109 0.22	2N441 0.22	2N2952 0.11	2N3735 0.10	2N5496 0.86
AC201 0.22	AD183 0.72	BC213 0.31	BD234 1.10	BF310 0.27	OC110 0.22	2N442 0.22	2N2953 0.11	2N3736 0.10	2N5497 0.86
AC201K 0.23	AD183 0.72	BC214 0.31	BD235 1.10	BF311 0.27	OC111 0.22	2N443 0.22	2N2954 0.11	2N3737 0.10	2N5498 0.86
AC202 0.22	AD183 0.72	BC215 0.31	BD236 1.10	BF312 0.27	OC112 0.22	2N444 0.22	2N2955 0.11	2N3738 0.10	2N5499 0.86
AC202K 0.23	AD183 0.72	BC216 0.31	BD237 1.10	BF313 0.27	OC113 0.22	2N445 0.22	2N2956 0.11	2N3739 0.10	2N5500 0.86
AC203 0.22	AD183 0.72	BC217 0.31	BD238 1.10	BF314 0.27	OC114 0.22	2N446 0.22	2N2957 0.11	2N3740 0.10	2N5501 0.86
AC203K 0.23	AD183 0.72	BC218 0.31	BD239 1.10	BF315 0.27	OC115 0.22	2N447 0.22	2N2958 0.11	2N3741 0.10	2N5502 0.86
AC204 0.22	AD183 0.72	BC219 0.31	BD240 1.10	BF316 0.27	OC116 0.22	2N448 0.22	2N2959 0.11	2N3742 0.10	2N5503 0.86
AC204K 0.23	AD183 0.72	BC220 0.31	BD241 1.10	BF317 0.27	OC117 0.22	2N449 0.22	2N2960 0.11	2N3743 0.10	2N5504 0.86
AC205 0.22	AD183 0.72	BC221 0.31	BD242 1.10	BF318 0.27	OC118 0.22	2N450 0.22	2N2961 0.11	2N3744 0.10	2N5505 0.86
AC205K 0.23	AD183 0.72	BC222 0.31	BD243 1.10	BF319 0.27	OC119 0.22	2N451 0.22	2N2962 0.11	2N3745 0.10	2N5506 0.86
AC206 0.22	AD183 0.72	BC223 0.31	BD244 1.10	BF320 0.27	OC120 0.22	2N452 0.22	2N2963 0.11	2N3746 0.10	2N5507 0.86
AC206K 0.23	AD183 0.72	BC224 0.31	BD245 1.10	BF321 0.27	OC121 0.22	2N453 0.22	2N2964 0.11	2N3747 0.10	2N5508 0.86
AC207 0.22	AD183 0.72	BC225 0.31	BD246 1.10	BF322 0.27	OC122 0.22	2N454 0.22	2N2965 0.11	2N3748 0.10	2N5509 0.86
AC207K 0.23	AD183 0.72	BC226 0.31	BD247 1.10	BF323 0.27	OC123 0.22	2N455 0.22	2N2966 0.11	2N3749 0.10	2N5510 0.86
AC208 0.22	AD183 0.72	BC227 0.31	BD248 1.10	BF324 0.27	OC124 0.22	2N456 0.22	2N2967 0.11	2N3750 0.10	2N5511 0.86
AC208K 0.23	AD183 0.72	BC228 0.31	BD249 1.10	BF325 0.27	OC125 0.22	2N457 0.22	2N2968 0.11	2N3751 0.10	2N5512 0.86
AC209 0.22	AD183 0.72	BC229 0.31	BD250 1.10	BF326 0.27	OC126 0.22	2N458 0.22	2N2969 0.11	2N3752 0.10	2N5513 0.86
AC209K 0.23	AD183 0.72	BC230 0.31	BD251 1.10	BF327 0.27	OC127 0.22	2N459 0.22	2N2970 0.11	2N3753 0.10	2N5514 0.86
AC210 0.22	AD183 0.72	BC231 0.31	BD252 1.10	BF3					

-the lowest prices!

74 Series T.T.L. I.C.'S

BI-PAK STILL LOWEST IN PRICE FULL SPECIFICATION
GUARANTEED. ALL FAMOUS MANUFACTURERS



1				25				100+			
SN7400	0.15	0.14	0.13	SN7453	0.15	0.14	0.13	SN74153	£1.00	0.95	0.90
SN7401	0.15	0.14	0.13	SN7454	0.15	0.14	0.13	SN74154	£1.70	£1.65	£1.60
SN7402	0.15	0.14	0.13	SN7460	0.15	0.14	0.13	SN74155	£1.20	£1.15	£1.10
SN7403	0.15	0.14	0.13	SN7470	0.32	0.29	0.27	SN74156	£1.30	£1.15	£1.10
SN7404	0.15	0.14	0.13	SN7472	0.32	0.29	0.27	SN74157	£1.00	0.95	0.90
SN7405	0.15	0.14	0.13	SN7473	0.41	0.39	0.35	SN74160	£1.40	£1.35	£1.30
SN7406	0.39	0.34	0.31	SN7474	0.41	0.39	0.35	SN74161	£1.40	£1.35	£1.30
SN7407	0.39	0.34	0.31	SN7475	0.60	0.58	0.55	SN74162	£1.40	£1.35	£1.30
SN7408	0.25	0.24	0.23	SN7476	0.44	0.43	0.42	SN74163	£1.40	£1.35	£1.30
SN7409	0.25	0.24	0.23	SN7480	0.60	0.58	0.55	SN74164	£1.80	£1.75	£1.70
SN7410	0.15	0.14	0.13	SN7481	£1.10	£1.05	£1.00	SN74165	£1.80	£1.75	£1.70
SN7411	0.25	0.24	0.23	SN7482	0.90	0.86	0.80	SN74166	£1.60	£1.55	£1.50
SN7412	0.28	0.27	0.26	SN7483	£1.20	£1.15	£1.05	SN74174	£1.60	£1.55	£1.50
SN7413	0.32	0.31	0.30	SN7484	£1.00	0.97	0.95	SN74176	£1.10	£1.05	£1.00
SN7416	0.30	0.29	0.28	SN7485	£1.80	£1.55	£1.50	SN74177	£1.25	£1.20	£1.15
SN7417	0.30	0.29	0.28	SN7486	0.35	0.34	0.33	SN74180	£1.25	£1.20	£1.15
SN7420	0.15	0.14	0.13	SN7489	£4.00	£3.75	£3.50	SN74181	£3.95	£3.85	£3.75
SN7422	0.30	0.29	0.28	SN7490	0.65	0.63	0.60	SN74182	£1.25	£1.20	£1.15
SN7423	0.40	0.39	0.38	SN7491	£1.10	£1.05	£1.00	SN74184	£1.80	£1.75	£1.70
SN7425	0.40	0.39	0.38	SN7492	0.74	0.71	0.64	SN74190	£1.95	£1.90	£1.85
SN7426	0.40	0.39	0.38	SN7493	0.74	0.71	0.64	SN74191	£1.95	£1.90	£1.85
SN7427	0.40	0.39	0.38	SN7494	0.85	0.82	0.75	SN74192	£1.95	£1.90	£1.85
SN7428	0.45	0.42	0.40	SN7495	0.85	0.82	0.75	SN74193	£1.30	£1.25	£1.20
SN7430	0.15	0.14	0.13	SN7496	0.98	0.93	0.86	SN74195	£1.10	£1.05	£1.00
SN7432	0.40	0.38	0.36	SN7497	£1.50	£1.45	£1.40	SN74196	£1.20	£1.15	£1.10
SN7433	0.42	0.40	0.38	SN7498	£1.20	£1.15	£1.10	SN74197	£1.20	£1.15	£1.10
SN7437	0.52	0.51	0.50	SN7499	0.74	0.71	0.64	SN74198	£2.75	£2.70	£2.65
SN7438	0.35	0.32	0.30	SN7500	£1.50	£1.45	£1.40	SN74199	£2.50	£2.40	£2.30
SN7440	0.15	0.14	0.13	SN7501	0.60	0.55	0.50				
SN7441	0.74	0.71	0.64	SN7502	0.90	0.88	0.85				
SN7442	0.74	0.71	0.64	SN7503	£1.00	0.95	0.90				
SN7443	£1.20	£1.15	£1.10	SN7504	0.50	0.48	0.45				
SN7444	£1.20	£1.15	£1.10	SN7505	0.50	0.48	0.45				
SN7445	£1.80	£1.50	£1.50	SN7506	0.70	0.68	0.65				
SN7446	£1.20	£1.15	£1.10	SN7507	0.75	0.73	0.70				
SN7447	£1.10	£1.07	£1.05	SN7508	0.85	0.82	0.79				
SN7448	£1.10	£1.07	£1.05	SN7509	£1.30	£1.25	£1.20				
SN7450	0.15	0.14	0.13	SN7510	£1.50	£1.40	£1.30				
SN7451	0.15	0.14	0.13	SN7511	£1.10	£1.05	£1.00				

NOW WE GIVE YOU 50w PEAK (25w R.M.S.) PLUS THERMAL PROTECTION! THE NEW AL60 Hi-Fi Audio Amplifier FOR ONLY £4.25

- Max Heat Sink temp. 90°C
- Thermal Feedback
- Frequency Response 20Hz to 100KHz
- Latest Design Improvements
- Distortion better than 0.1% at 1KHz
- Load—3, 4, 8 or 16 ohms
- Signal-to-noise ratio 80dB
- Overall size 63mm x 105mm x 13mm
- Supply voltage 15-50 volts



Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.P. enthusiast.

FULLY BUILT—TESTED and GUARANTEED

STABILISED POWER MODULE SPM80 £3.25



SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BmT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 20mm. These units enable you to build Audio systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disco Systems, Public Address, Intercom Units, etc. Handbook available. 10p.

TRANSFORMER BMT80 £2.75 p. & p. 40p

STEREO PRE-AMPLIFIER TYPE PA100



Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION:
 Frequency response 20Hz—20kHz ±1dB
 Harmonic distortion better than 0.1%
 Input: 1. Tape head 3-25mV into 50KΩ
 2. Radio, Tuner 75mV into 50KΩ
 3. Magnetic P.U. 3mV into 50KΩ
 All input voltages are for an output of 250mV.
 Tape and P.U. inputs equalised to RIAA curve within ±1dB from 20Hz to 20kHz.

±15dB at 20Hz
 ±15dB at 20kHz
 100 Hz
 8kHz
 better than +65dB
 +20dB
 +35 volts at 20mA
 292 x 82 x 35 mm
 Dimensions

only £14.25

MK 60 AUDIO KIT

Comprising: 2x AL60, 1x SPM80, 1x BMT80, 1x PA 100, 1 front panel, 1 kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklets. Complete Price: £29.75 plus 45p postage.

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16 1/2" x 11 1/2" x 3 1/2", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets etc. Kit price: £9.95 plus 45p postage.

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as "out-of-spec" from the maker's very rigid specifications, but are ideal for learning about I.C.'s and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UC00	= 12 x 7400	0.54	UC46	= 5 x 7446	0.54	UC80	= 5 x 7480	0.54
UC01	= 12 x 7401	0.54	UC48	= 5 x 7448	0.54	UC81	= 5 x 7481	0.54
UC02	= 12 x 7402	0.54	UC50	= 12 x 7450	0.54	UC82	= 5 x 7482	0.54
UC03	= 12 x 7403	0.54	UC51	= 12 x 7451	0.54	UC83	= 5 x 7483	0.54
UC04	= 12 x 7404	0.54	UC53	= 12 x 7453	0.54	UC84	= 5 x 7484	0.54
UC05	= 12 x 7405	0.54	UC54	= 12 x 7454	0.54	UC85	= 5 x 7485	0.54
UC06	= 8 x 7406	0.54	UC60	= 12 x 7460	0.54	UC86	= 5 x 7486	0.54
UC07	= 8 x 7407	0.54	UC70	= 8 x 7470	0.54			
UC10	= 12 x 7410	0.54	UC72	= 8 x 7472	0.54			
UC20	= 12 x 7420	0.54	UC73	= 8 x 7473	0.54			
UC30	= 12 x 7430	0.54	UC74	= 8 x 7474	0.54			
UC40	= 12 x 7440	0.54	UC76	= 8 x 7476	0.54			
UC41	= 5 x 7441	0.54	UC80	= 5 x 7480	0.54			
UC42	= 5 x 7442	0.54	UC81	= 5 x 7481	0.54			
UC43	= 5 x 7443	0.54	UC82	= 5 x 7482	0.54			
UC44	= 5 x 7444	0.54	UC83	= 5 x 7483	0.54			
UC45	= 5 x 7445	0.54	UC86	= 5 x 7486	0.54			

LINEAR I.C.'s—FULL SPEC.

Type No.	1	25	100+
72702	0.50	0.48	0.45
72709	0.25	0.23	0.20
72709P	0.20	0.19	0.18
72710	0.35	0.33	0.30
72711	0.30	0.29	0.28
72711C	0.28	0.27	0.26
72711P	0.30	0.29	0.28
72717	0.85	0.80	0.75
72748P	0.38	0.36	0.34
SL201C	0.59	0.45	0.40
SL701C	0.50	0.45	0.40
SL702C	0.50	0.45	0.40
TA265	0.70	0.60	0.50
TA293	£1.00	£0.95	£0.90
TAA550A	£1.85	£1.80	£1.70
PA703C	0.28	0.28	0.24
PA709C	0.20	0.19	0.18
PA711	0.35	0.33	0.30
PA712	0.35	0.33	0.30
PA800	£1.50	£1.45	£1.40
76003	£1.50	£1.45	£1.40
76023	£1.50	£1.45	£1.40
76660	0.95	0.93	0.90
LM350	£1.00	0.97	0.95
NE35	0.85	0.83	0.80
NE556	0.95	0.93	0.90

DTL 930 SERIES LOGIC I.C.'s

Type	1	25	100+
BP930	0.15	0.14	0.13
BP932	0.18	0.15	0.14
BP933	0.18	0.15	0.14
BP935	0.18	0.15	0.14
BP936	0.18	0.15	0.14
BP944	0.18	0.15	0.14
BP945	0.30	0.28	0.25
BP946	0.15	0.14	0.13
BP948	0.20	0.19	0.18
BP951	0.70	0.65	0.60
BP962	0.15	0.14	0.13
BP9093	0.45	0.43	0.40
BP9094	0.45	0.43	0.40
BP9097	0.45	0.43	0.40
BP9099	0.45	0.43	0.40

DUAL-IN-LINE SOCKETS

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C.'s TWO Ranges PROFESSIONAL & NEW LOW COST.
 PROF. TYPE No. 1-24 25-99 100mp
 TSO 14 pin type 35p 35p 27p
 TSO 16 pin type 38p 35p 32p
 TSO 24 " " 75p 70p 68p
 LOW COST No.
 BPS 14 " " 16p 14p 12p
 BPS 16 " " 17p 15p 13p
 BPS 8 pin type 15p 13p 11p

NUMERICAL INDICATOR TUBES

Type Description Price
 S015F Minuton £1.50
 MAN 3M. L.E.D. 7-segment 0-127 £1.90

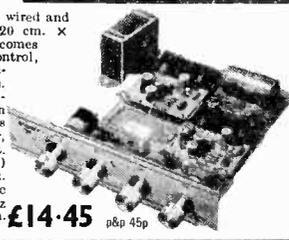
All indicators 0.9" x Decimal point All side viewing. Full data for all types available on request.
SHP80 STEREO HEADPHONES. ±16 ohms impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume controls. £4.95

BI-PAK 1975

CATALOGUE & LISTS
Send S.A.E. and 10p

THE STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm. x 14 cm. x 5.5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 20Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ±12dB at 60Hz typically 0.25% at 1 watt. Treble con. ±14dB at 14kHz.



£14.45 p&p 45p

3 TERMINAL POSITIVE VOLTAGE REGULATORS

TO-3 Plastic Encapsulation	
PA7805/L129 5V (Eqv. to MVR5)	£1.35
PA7812/L130 12V (Eqv. to MVR12V)	£1.35
PA7815/L131 15V (Eqv. to MVR15V)	£1.35
DA7818 18V	£1.35

TRANSFORMERS

T461 (Use with AL10) £1.60 P. & P. 22p.
 T538 (Use with AL20 & AL30) £2.30 P. & P. 22p.
 BMT80 (Use with AL60) £2.75 P. & P. 40p.

POWER SUPPLIES

PS 12. (Use with AL10, AL20 & AL30) 95p
 SPM 80. (Use with AL60) £3.25

PA 12. PRE-AMPLIFIER SPECIFICATION

RTVC

EMI SPEAKERS AT FANTASTIC REDUCTIONS

LE-4 SPEAKERS

Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14" x 9" with 8" x 5" unit for mid-range and twin 3" high frequency units to give monitor type quality and performance. **Specification** - Size 33" x 14" x 16" approx. Impedance 8 ohms. Power handling 25W RMS. (Peak 50 watts) Frequency range 35 Hz-20 KHz. **Our Price £29.00** (normally £56.97) +£5 p & p.

EMI 350 KIT *20 WATT SPEAKER SYSTEM

System consists of a 13" x 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts). Complete with crossover components and circuit diagrams. **£5.50** +£1 p & p.

System consists of a 13" x 8" (approx.) elliptical woofer unit with a 8" x 5" (approx.) mid-range unit incorporating parasitic tweeter and crossover components. **Technical Specification:** Bass Unit: Flux density - 100 K, speech coil - 1 1/2". Cone. Triple laminated paper with P.V.C. surround. Mid-Range Unit: Flux density - 33 K, speech coil - 1" with parasitic tweeter. Power handling: 20 watts RMS. Impedance - 8 ohms, frequency response - 20 Hz to 18,000 Hz.

Our Price £7.50 Complete +£1.35 p & p.

EASY TO BUILD SPEAKER KITS

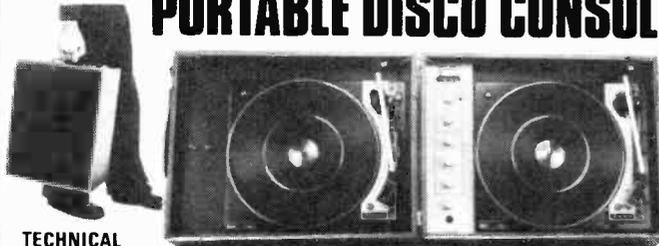
These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" x 8" woofer, 3 1/2" tweeter and matching crossover. Easily put together with just a few basic tools. **Specification (each speaker):** Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20-20,000 Hz. Size 20" x 11" x 9 1/2" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair. **£18.95 pair complete** +£4.50 p & p. Complete with crossover components and circuit diagrams.

*DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Outputs 20 watts RMS into 8 ohms (suitable for 15 ohms). Inputs - 4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling. **INPUT SENSITIVITIES** - Input - 1. Crystal mic, guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) - Inputs - 2), 3), 4). Medium output equipment - ceramic cartridge, tuner, tape recorder, organs, etc. - all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12 1/2" x 6" x 3 1/2". **£17.00** +£1.15 p & p.

*PORTABLE DISCO CONSOLE



TECHNICAL SPECIFICATION:

Pre-amp - Output - 200mV. Auxiliary inputs - 200mV and 750mV into 1 meg. Mic input - 6mV into 100K. 240 volt operation. **Turntables capacity** - 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than -35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter). **Finish** - Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.

Console size - Unit Closed - 17 1/2" x 13 1/2" x 8 1/2" (approx.) Unit Open - 35 1/2" x 13 1/2" x 4 1/2" (approx.)

This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.

The unit is finished in black PVC with contrasting simulated teak edgeing, diamond spun turntable with matching control panel.

Yours for only £49.00 +£5.60 p & p.

*PUSH BUTTON CAR RADIO KIT- THE TOURIST II

NO SOLDERING REQUIRED!



NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly.

Fine tuning push button mechanism is fully built and tested to mate with printed circuit board. **TECHNICAL SPECIFICATION:** (1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) Integrated circuit output stage, pre-built three stage IF Module. Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide, 2" high and 4 1/2" deep approx. **£8.00** +90p p & p.

Speaker including baffle and fixing strip £1.65+37p p & p Car Aerial Recommended-fully retractable £1.37+32p p & p. **The Tourist I Kit** For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist II. **Price £7.00** +90p p & p.



*COMPLETE STEREO SYSTEM

System 1a. £62.00 40 Watt Amplifier, Viscount III - R102 now 20 watts per channel. (40 watts peak).

All systems include: **Viscount III amplifier** - volume, bass, treble and balance controls, plus switches for mono/stereo, on/off function and bass and treble filters. Plus headphone socket.

Specification: 20 watts per channel into 8 ohms (40W peak). Total distortion@10W@1kHz 0.1% P.U.T. (for ceramic cartridges) 150mV into 3 Meg. P.U.T. (for magnetic cartridges) 4mV at 1kHz into 47K, equalised within ± 1dB R.I.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. **Tone controls and filter characteristics:** Bass: +12dB to -17dB @60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @15kHz. Treble filter: 12dB per octave. **Signal to noise ratio: (all controls at max.)** -58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13 1/2" x 9" x 3 1/2".

Garrard SP 25 deck with magnetic cartridge, de luxe plinth and hinged cover. **Two Duo Type IIa matched speakers** - Enclosure size approx 19 1/2" x 9 1/2" x 7 1/2" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. Complete System with these speakers £62.00 + £5.50 p & p.

System 2. £82.00 Viscount III amplifier (As System 1a) Garrard SP 25 deck (As System 1a) **Two Duo Type III matched speakers** - Enclosure size approx 27" x 13" x 11 1/2" Finished in teak simulate. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts R.M.S., 8 ohms frequency range - 20 Hz to 18,000 Hz. Complete System with these speakers £82.00 + £6.50 p & p.

PRICES: SYSTEM 1a
Viscount III R102 amplifier £27.00+£1.60 p & p
2 Duo Type IIa speakers £26.00+£5.50 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover £21.00+£2.80 p & p

PRICES: SYSTEM 2
Viscount III R102 amplifier £27.00+£1.60 p & p
2 Duo Type III speakers £39.00+£6.40 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover £21.00+£2.80 p & p

total: £74.00
Available complete for only: £62.00 +5.50 p & p

total: £87.00
Available complete for only: £82.00 +£6.50 p & p

Scotland P & P Surcharge System 1a £1.75 System 2 £3.50

*8 TRACK HOME CARTRIDGE PLAYER

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system. Unsound module and the Stereo 21. Technical specification Mains input, 240V. Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx. Yours for only **£12.95** +£1.45 p & p.



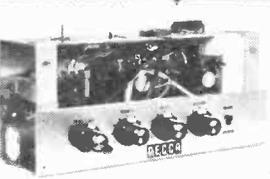
Mail orders to Acton. Terms C.W.O. All enquiries stamped addressed envelope. Goods not despatched outside U.K. Leaflets available for all items listed thus* Send stamped addressed envelope. All items subject to availability. Prices correct at 1st March 1975 and subject to change without notice. All prices include V.A.T. at 8% rate.



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

DECCA STEREO AMPLIFIER CHASSIS

Specification: 4+4 watts into 8 ohms. Input Sensitivity 4mV into 47K (for magnetic cartridges). AC Mains only 240V. Controls - volume, bass, treble, on/off, mono/stereo switch. Chassis size 11" x 5 1/2" x 3 1/2" approx. **£5.95** +£1 p & p.



RTVC

21A HIGH STREET, ACTON, LONDON W3 6NG
323 EDGWARE ROAD, LONDON W2

Personal Shoppers EDGWARE ROAD: 9 a.m.-5.30p.m. Half day Thurs.
ACTON: 9.30a.m.-5p.m. Closed all day Wed.

VALVES

A1065	1.25	ECL80	0.55
AR8	0.80	ECL82	0.35
ATP4	0.50	ECL83	0.70
B12H	3.00	ECL86	0.50
CY31	0.50	EF36	0.20
DAF96	0.50	EF37A	1.60
DF96	0.55	EF40	0.75
DK96	0.55	EF50	0.30
DL92	0.40	EF80	0.30
DL96	0.60	EF83	1.25
DY86/87	0.40	EF85	0.35
DY802	0.45	EF86	0.35
E88CC/01	1.20	EF89	0.30
E180CC	0.70	EF91	0.45
E182CC	1.25	EF92	0.50
E180	0.40	EF95	0.40
EAB8C80	0.40	EF183	0.35
EAF42	0.75	EF184	0.35
EB91	0.30	EFL200	0.75
ECB33	1.00	EL33	2.50
ECB41	0.25	EL34	0.70
EBF80	0.40	EL36	0.80
EBF83	0.50	EL41	0.80
EBF89	0.40	EL81	0.60
EC25	0.35	EL82	0.50
ECC81	0.40	EL84	0.30
ECC82	0.35	EL85	0.60
ECC83	0.35	EL86	0.45
ECC84	0.35	EL90	0.45
ECC85	0.40	EL504	0.80
ECC86	0.90	EM31	0.60
ECC88	0.50	EM80	0.55
ECC189	0.70	EM84	0.40
ECF80	0.40	EM87	0.45
ECF82	0.40	EM81	0.50
ECF801	0.75	EY81	0.45
ECH42	0.80	EY86	0.40
ECH81	0.35	EY88	0.50
ECH83	0.45	EZ40	0.70
ECH84	0.45	EZ41	0.75

PL509	1.35	U191	0.75	VR150/30	0.45	3D6	0.40	6AK5	0.40	6C6	0.50	6L6	0.40
PL802	0.95	U801	0.75	X66	0.85	3S4	0.40	6AK8	0.40	6CB6	0.50	6L7G	0.50
PY33	0.60	UABC80	0.40	Z800U	2.70	3V4	0.85	6AL5	0.30	6CH6	1.45	6SA7	0.50
PY80	0.40	UAF42	0.65	Z801U	2.70	5B/254M	4.90	6AL5 W	0.55	6CL6	0.75	6SATGT	0.40
PY81	0.40	UBCA1	0.60	Z900T	1.20	5B/255M	4.90	6AN6	0.45	6D6	0.55	6SCGT	0.40
PY82	0.40	UBFA0	0.40	1A3	0.55	5R4GY	0.90	6AM8	0.45	6EA8	0.85	6SG7	0.50
PY83	0.40	UBF89	0.40	1L4	0.25	5UAG	0.50	6AQ5	0.45	6F7	1.10	6SJ7G	0.55
PY88	0.45	UBL1	1.00					6AQ5W	0.70	6F8G	0.75	6SJ7GT	0.35
PY500	1.00	UBL21	0.70					6AS6	0.80	6F23	0.90	6SK7	0.55
PY800	0.45	UCC85	0.45					6AT8	0.45	6F32	0.75	6SLTGT	0.50
PY801	0.50	UCF80	0.75					6AU6	0.40	6F33	3.50	6SN7GT	0.50
QVQ03-10	1.40	UCH42	0.75					6AV8	0.45	6H6	0.35	6SQ7	0.55
QVQ06-40A	8.00	UCH81	0.45					6AX4GT	0.75	6J4WA	1.25	6V6G	0.55
R19	0.60	UCL82	0.45					6AX5GT	1.00	6J5	0.65	6V6GT	0.50
RV03-12	1.10	UCL83	0.85					6B7	0.70	6J5GT	0.50	6X4	0.40
R90	0.60	UF41	0.70					6BA6	0.35	6J6	0.30	6XS6	0.50
SC1400	3.00	UF80	0.35	3A4	0.60	5V4G	0.55	6BE6	0.40	6J7	0.60	6Y6G	0.60
SC1800	5.00	UF85	0.45	1R5	0.40	5Y3GT	0.55	6BG6G	0.80	6J7G	0.40	6Z4	0.65
SP81	0.60	UF89	0.50	1S4	0.30	5Z3	0.80	6B8J6	0.85	6K6GT	0.50	6-30L2	0.90
SP81	0.75	UL41	0.70	1T4	0.30	5Z4	0.80	6BQ7A	0.60	6K7	0.55	6-30L2	0.90
TT21	5.00	UL84	0.40	1X2A	0.60	5Z4TG	0.55	6BR7	1.20	6K7G	0.30	7B7	0.80
U25	0.85	UY41	0.45	1X2B	0.75	6AB7	0.60	6BW6	1.00	6K8GT	0.50	7Y4	0.80
U26	0.75	UY85	0.40	2D21	0.50	6AC7	0.60	6B7W	1.00	6K25	1.00	9D6	0.60
U27	0.65	VR105/30	0.45	2K25	0.90	6A6H	0.70	6C4	0.40	6L6	1.25	12A6	0.55

VAT 8% EXTRA



30F5	1.00	957	0.50
30FL1	1.00	1629	0.70
30FL12	1.10	2051	1.00
30FL14	0.90	5933	3.00
30L15	0.95	6057	0.75
30L17	0.95	6060	0.70
30P12	1.00	6064	0.60
30P19	1.00	6065	1.00
30P31	0.95	6060	2.30
30PL13	1.10	6146	2.25
		6146B	3.25
		8020	5.00
		9001	5.00
		9002	0.50
		9003	0.70
		9004	0.35
		9006	0.35

VIDICON TUBES EMI types 9677A & 9677C £20.00 ea.

30PL14	1.10	DG7-5	12.00
35L6GT	0.75	DG13-2	18.00
35W4	0.50	DG13-34	12.00
35Z4GT	0.70	MW13-34	35.00
50C5	0.50	VCR139A	8.00
50C5A	0.60	39P1	4.50
5DCC6G	1.10	5DCC6G	1.10
5DCC6G	1.10	88J	8.00
75C1	0.75	88L	9.00
75C1	0.75	88J	8.00
75C1	0.75	88L	9.00
75C1	0.75	88J	8.00
75C1	0.75	88L	9.00

SPECIAL VALVES CV235 45.00 M503-2J42 42.00 K301 7.00 KRN2A 6.00 725A 23.00

TRANSISTORS

Please write or phone for current price of any of the transistors, diodes shown below.

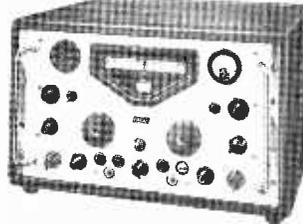
AC113	AF178	BF167	GET116	OC36	SX754	2N2062
AC125	AF186	BF185	GET116	OC42	ZR11	2N2147
AC127	AF212	BFY51	NKT222	OC44	ZR21	2N2411
AC128	AF228	BFY52	OA5	OC45	1N23A	2N2989
AC176	ASV27	BFY90	OA47	OC70	1N25	2N3053
AC178	ASV28	BSY27	OA70	OC73	1N32A	2N3054
AC179	ASV28	BSY38	OA71	OC78	1N38A	2N3055
AC180	BC108	BSY85A	OA73	OC79	1N43	2N3390
AC181	BC118	BSY85A	OA79	OC81	1N70	2N3391
AC182	BC119	BV126	OA91	OC82	1N277	2N3730
AC183	BC136	CRS1/10	OA200	OC82D	1N415C	2N3731
AC184	BC137	CRS1/30	OA202	OC82DM	1N4148	2N3819
AC185	BC172	CRS1/40	OA2200	OC83	2N458A	2N4038
AC186	BC172A	CRS1/30	OC29	OC89	2N4058	2N4058
AC187	BC172A	CRS1/30	OC29	OC140	2N918	2N4061
AC188	ADZ11	CRS3/20	OC26	OC170	2N1304	2N4785
AC189	ADZ12	CRS3/40	OC28	OC172	2N1305	2N5295
AC190	ADZ12	CRS3/40	OC28	OC200	2N1307	3N128
AC191	ADZ12	CRS3/40	OC28	OC206	2N1309	3N154
AC192	ADZ12	CRS3/40	OC28	OC206	2N1309	3N159
AC193	ADZ12	CRS3/40	OC28	OC206	2N1309	3N159

VALVES AND TRANSISTORS

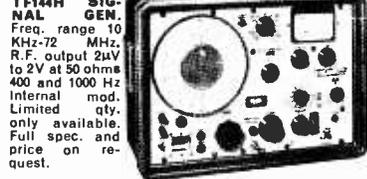
Telephone enquiries for valves, transistors, etc., retail 749 3934; trade and export 743 0899.

OTHERS IN STOCK inc. integrated circuits, CRT & special valves. Min. Mail Order £1. U.K. Postage £1-£2, 17p, £2-3. 22p, over £3 free. C.O.D. 25p extra.

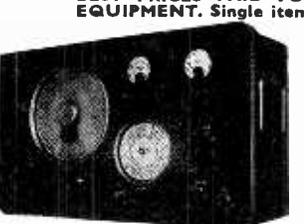
Many of these valves are imported and prices vary for each delivery, so we reserve the right to change prices for new stock when unavoidable.



RACAL RECEIVERS Models RA17, RA17 Mk. II, RA 17L, RA17W, RA17E. In condition for working "as seen" to brand new in cabinets. Prices on application. DIVERSITY SWITCH TYPE MA168B, solid state, £45.00.

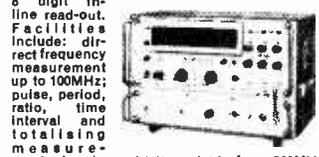


TF144H SIGNAL GEN. Freq. range 10 KHz-72 MHz. R.F. output 2µV at 50 ohms. 400 and 1000 Hz internal mod. Limited qty. available. Full spec. and price on request.



TF801B/2. Spec as for TF801D but minor circuit differences. Working order. £95.

BEST PRICES PAID FOR TEST AND COMMUNICATION EQUIPMENT.



8 digit in-line read-out. Facilities include: direct frequency measurement up to 100MHz; pulse, period, ratio, time interval and totalling measurements. Input sensitivity variable from 300mV to 9V, three independent inputs, self-check etc. Full spec. on request. £145.

KAHN SSB ADAPTOR MODEL RSSB=62-1B. Designed for receivers with 455-500kHz I.F. (eg Collins 511; AR88D etc) at 100mV (max) input. Features: Electronic A.F.C., carrier frequency diversity to combat fading; 20 sec R.C. memory to maintain tuning during severe fading; individual carrier meters; nullifiers; low distortion production demodulator. Full spec & P.O.A.

HEWLETT-PACKARD

175A OSCILLOSCOPE with 1750A dual trace vert plug-in and 1781B delay time base plug-in. 50MHz minimum bandwidth at 50mV/CM. T/B modes: main, main single, mixed, main delayed. Full spec. & P.O.A. 185A SAMPLING OSCILLOSCOPE. 800MHz, complete with 188A 1mV/CM dual trace plug-in, 1GHz probe and manual. Full spec & P.O.A. 524C ELECTRONIC COUNTER/TIMER direct reading to 10MHz, extended to 500MHz depending on converter plug-in, also period and time measurement. 8 digit in-line display on Nixie tubes. £165 with one plug-in (as below) 524B model, spec as for 524C but display on 6 neon lamp decades and 2 meters £115 with one of the following plug-ins: 526A Video amp, 525A; 10-100MHz, 525B; 100-220 MHz, 525C; 100-500MHz, £45 extra; 540B TRANSFER OSCILLATOR. Measures frequency up to 12.4GHz. May be used on its own or with freq. counter. P.O.A. 200AB AUDIO OSCILLATOR 19kHz. 600ohm balanced or unbalanced, small size. £25. 300A HARMONIC WAVE ANALYSER Freq. 0-16kHz. Full spec & P.O.A.

TF1400S DOUBLE PULSE GENERATOR WITH TM 6000/S SECONDARY PULSE UNIT. For testing radar, nucleonics, scopes, counters, filters etc. SPEC. TF1400S. Rep. to freq. 10Hz to 100kHz, pulse width 0-1 to 100µ sec., delay -1.5 to +3000µ sec., rise time 30N sec. SPEC. TM 6000/S. As for TF1400S except pulse width 0.5 to 25µ sec., delay 0 to +300µ sec. £250.

TEKTRONIX OSCILLOSCOPES

Oscilloscopes 585 DC to 100MHz. Separate time bases with delay and 5X magnifier. Time base A: 0.05 microsecs to 2 sec/cm in 24 stages also continuously variable between steps. Time base B: 2 microsecs to 10 sec in 18 stages. Delay 1 microsec to 10 sec. Complete with type 81 adaptor enabling use of all letter series plug-ins. Type 80 plug-in (less probe) also available. 541A-33MHz. Choice of plug-ins. P.O.A. LA265A(545A)-33MHz. separate time bases with delay. P.O.A. 545-133MHz. Separate time bases with delay. Price on application. PLUG-IN UNITS CA-24 MHz dual trace 50MV-20V. G-20 MHz differential 50MV-20V. L-30 MHz fast rise time 5MV-20V. D-High gain differential 1MV-50V. N 600MHz sampling 10MV-cm. 53/54C. Dual trace 33MHz, 60MHz, 0.05-20V.

ROHDE & SCHWARZ

Z-g DIAGRAPH TYPE ZDU. 30-420 MHz, 50Ω. Directly measures multi-terminal networks, phase shift, phase angle etc. with complementary POWER SIGNAL GENERATOR TYPE SMLM High Freq. resolution, internal/external mod., up to 3V out. P.O.A. POLYSKOP SWOB 1. 0.5-400MHz 75Ω. P.O.A. VHF WATTMETER & MATCHING INDICATOR 30/80W. 230MHz, 75Ω. P.O.A. VHF VOLTMETER TYPE UDDN P.O.A. MICROWAVE POWER METER TYPE NRD. 0-3200MHz at 50Ω. 0-200mW in 4 ranges, built-in calibration check with measuring head £125. FREQUENCY SYNTHESIZER TYPE XUA. 30Hz-30MHz with FREQUENCY INDICATOR TYPE FKM. 15-30MHz; 30-100MHz. P.O.A. 3 PHASE AUTO TRANSFORMER, wye input 400v, wye output 241.5/230/218.5v 50A 18kVA. Made by Westinghouse of U.S.A. Brand new in original cases £60. Including UK transport.

MARCONI

MARCONI TF 995A/5 FM/AM SIGNAL GENERATOR. Four additional tuning controls facilitate narrow band measurements: 3 Int. A.M. mod Freq. of 400, 1000, 1500Hz at up to 50% F.M. deviation ± 5kHz ± 120kHz. Output 0.1µV-200mV depending on termination. Freq. Range 1.5-220MHz. P.O.A. FM SIG GEN TS1077/1. Range 19.7-102.5MHz. 0.2µV-200mV. Piston attenuator at 52 ohms output, FM modulation at 1000Hz at up to 100kHz deviation inc. tuning, etc. £75. TF 1258A VHF SPECTRUM ANALYSER for analysis and measurement of Radar Equipment. Frequency range 190 to 230MHz with crystal check points. Sweep width 0.5 to 5MHz. Output pulse delay (a) 85-175µ sec. (b) 0.7-1.4 mSec with X1 and X2 multiplier and ±2, x1, x2 multiplier. Output 2µV to 200mV with x10 multiplier. £200. DISTORTION FACTOR METER TF142F. Range 100Hz-8kHz. Distortion at 100kHz imp. 0.05%-50%. 0.5v input at 100kHz imp. £70. NOISE GENERATOR TF1053 (CT207). Range 100-600MHz. Noise factor up to 150 (21.7db) at 75 ohms. Audio power up to 500mW. £95. MARCONI OA 1094/3 SPECTRUM ANALYSER with L.F. extension unit. Freq. range 100MHz. Full Spec. & P.O.A.

PLEASE NOTE

Unless offered as "as seen" ALL EQUIPMENT ordered from us is completely overhauled mechanically and electrically in our own laboratories

FOR EXPORT ONLY TRANSmitters:

BC 610 Hallicrafters. RCA ET 4336 also modified version of increased output to 700w. COLLINS TYPE 231D 4/5kw., 10 channel, autotune and manual tuning. All above complete installation and spare parts. TRANSmitters 18, 19HP, 35, 82. C-13 TRANSmitters RACAL COMMUNICATIONS EQUIPMENT We are able to offer a comprehensive selection from the range of this modern high class equipment including: recovers, L.F. Converters, SSB adaptors, panoramic adaptors, diversity switches, transmitter driver units, linear amplifiers can be built to customers' requirements. Please send us your enquiries.

ARRS SPARES. We hold the largest stock in U.K. Write for list. R.F. METER 0-8 amp. 2 1/2" (U.S.A.) £1-90 P. & P. 15p.

TELEPHONE TYPE "J" (Tropicalised) 10 line MAGNETO TELEPHONE SWITCHBOARD

50 line AUTOMATIC PRIVATE TELEPHONE SWITCHBOARD Price of each of the above on application.

TEST EQUIPMENT for direct line for all enquiries regarding test equipment only, phone 01-748 5490.

PLEASE ADD 8% VAT

COLOMOR (ELECTRONICS) LTD. 170 Goldhawk Rd., London, W.12 Tel. 01-743 0899

Open 9-12.30, 1.30-5.30 p.m. except Thursday 9-1 p.m.

G. F. MILWARD

ELECTRONIC COMPONENTS

Wholesale/Retail:

369 Alum Rock Road, Birmingham B8 3DR. Tel. 021-327 2339



CALLING ALL INDUSTRIAL BUYERS!!



We are glad to say that it is now possible to supply from stock the following integrated circuits. **ALL ARE BRANDED, FULL SPECIFICATION** devices offered at unbeatable prices! This is **YOUR** chance to cut manufacturing costs and greatly increase profit margins!

	1/99	100/499	500/1000		1/99	100/499	500/1000		1/99	100/499	500/1000
7400	£0-15	£0-125	£0-10	7442	£0-645	£0-537	£0-43	7494	£0-495	£0-412	£0-33
7401	£0-15	£0-125	£0-10	7443	£1-275	£1-062	£0-85	7495	£0-63	£0-525	£0-42
7402	£0-15	£0-125	£0-10	7445	£0-855	£0-712	£0-57	7496	£0-72	£0-60	£0-48
7403	£0-15	£0-125	£0-10	7446	£1-05	£0-875	£0-70	74104	£0-315	£0-262	£0-21
7404	£0-18	£0-15	£0-12	7446A	£1-05	£0-875	£0-70	74105	£0-315	£0-262	£0-21
7405	£0-18	£0-15	£0-12	7447	£1-05	£0-875	£0-70	74107	£0-315	£0-262	£0-21
7406	£0-375	£0-312	£0-25	7447A	£1-05	£0-875	£0-70	74121	£0-315	£0-262	£0-21
7407	£0-375	£0-312	£0-25	7448	£0-855	£0-712	£0-57	74122	£0-45	£0-375	£0-30
7408	£0-15	£0-125	£0-10	7450	£0-15	£0-125	£0-10	74123	£0-63	£0-525	£0-42
7409	£0-15	£0-125	£0-10	7451	£0-15	£0-125	£0-10	74141	£0-75	£0-625	£0-50
7410	£0-15	£0-125	£0-10	7453	£0-15	£0-125	£0-10	74151	£0-69	£0-575	£0-46
7412	£0-195	£0-162	£0-13	7454	£0-15	£0-125	£0-10	74153	£0-69	£0-575	£0-46
7413	£0-345	£0-287	£0-23	7460	£0-15	£0-125	£0-10	74155	£0-69	£0-575	£0-46
7416	£0-345	£0-287	£0-23	7472	£0-255	£0-212	£0-17	74156	£0-69	£0-575	£0-46
7417	£0-345	£0-287	£0-23	7473	£0-153	£0-262	£0-21	74160	£1-005	£0-837	£0-67
7420	£0-15	£0-125	£0-10	7474	£0-315	£0-262	£0-21	74161	£1-005	£0-837	£0-67
7423	£0-27	£0-225	£0-18	7475	£0-465	£0-387	£0-31	74162	£1-005	£0-837	£0-67
7425	£0-27	£0-225	£0-18	7476	£0-315	£0-262	£0-21	74163	£1-005	£0-837	£0-67
7426	£0-27	£0-225	£0-18	7480	£0-435	£0-362	£0-29	74166	£1-425	£1-187	£0-95
7427	£0-27	£0-225	£0-18	7482	£0-75	£0-625	£0-50	74174	£1-20	£1-00	£0-80
7430	£0-15	£0-125	£0-10	7483	£0-825	£0-687	£0-55	74175	£0-975	£0-812	£0-65
7432	£0-25	£0-225	£0-18	7485	£1-275	£1-062	£0-85	74192	£1-275	£1-062	£0-85
7437	£0-27	£0-225	£0-18	7486	£0-315	£0-262	£0-21	74193	£1-275	£1-062	£0-85
7438	£0-27	£0-225	£0-18	7490	£0-465	£0-387	£0-31	74198	£2-10	£1-75	£1-40
7440	£0-15	£0-125	£0-10	7492	£0-465	£0-387	£0-31	74199	£2-10	£1-75	£1-40
7441A	£0-825	£0-687	£0-55	7493	£0-465	£0-387	£0-31				

To secure the above prices, all orders for these devices must exceed £10 in total value. Price rating is established by TOTAL NUMBER OF DEVICES ORDERED. Any mix may be made. For special quotations for large orders ring 021-327 2339 NOW!!!

MICROWAVE DEVICES		
CL8300	Gunn effect oscillator	9-4GHz £40
CL8370	ditto	9-5GHz £10
CL8380	ditto	10-5GHz £10
CL8390	ditto	11-5GHz £10
CL8430	ditto	9-35GHz £40
CL8450	ditto	9-35GHz £40
CL8470	ditto	9-35GHz £40
BXY27	Varactor Diode, "S" Band, Cut-off	70GHz £1
BXY28	Varactor Diode, Cut-off	100GHz £1
BXY32	Frequency Multiplier, "X" Band	150GHz £1
BXY35A/C	ditto	25GHz £1
BXY36C/D	ditto	75GHz £1
BXY37C/D	ditto	100GHz £1
BXY38C/E	ditto	120GHz £1
BXY39C/D	ditto	150GHz £1
BXY40D/E	ditto	180GHz £1
BXY41C/D/E	ditto	200GHz £1

12 VOLT FLUORESCENT LIGHTING



Inverter transformers 13/15W (circuit included)	70p
"Current economy" transistor (600 ma.)	50p
"Maximum light" transistor (1-3A)	50p
Resistors/capacitors to suit	15p
Lampholders (long lead) (needed with cases)	Pair 30p
(short lead)	Pair 20p
White enamel case 2 1/2 in (postage 30p)	70p
Tube, 2 1/2 in-13W	45p
(Note: tube only supplied if case ordered, to prevent postal damage).	
13W fitting ready built and tested—including tube (postage 30p)	£3-75
Post/packing, 25p per order except where shown.	

NEW! NEW! NEW! NEW!

An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly. Method: Spray copper laminate board with light sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light. (No need to use ultra-violet.) Spray with developer, rinse and etch in normal manner. Light sensitive aerosol spray **£1.00** plus postage Developer and Etchant **50p** plus postage

Single-sided Copper-clad Fibreglass Board **75p** sq. ft.
Double-sided Copper-clad Fibreglass Board **£1.00** sq. ft.
Boards cut to any multiple of 6". Max. size 3' x 4'.

1,000,000 POTENTIOMETERS

We have bought a huge assortment of volume controls. Pre-sets, sliders, etc. All are in manufacturer's original packing. Manufacturing quantities of some types available. Write or phone for details.

Sample bag 100 mixed £2.50

ELECTROLYTIC CAPACITORS

Several thousand of each of the following types. Silly price to clear!

ALL NEW STOCK

5µf 10V	35p dozen
10µf 10V	35p dozen
50µf 10V	35p dozen
100µf 10V	35p dozen
330µf 16V	45p dozen
330µf 25V	60p dozen
330µf 35V	80p dozen
2200µf 16V	£1 dozen
15000µf 25V	50p each

HOBBY CORNER!

BRAN TUB !!!

- ★ Resistors, Wire-wound and Carbon
- ★ Capacitors, Silver-mica, Paper, Ceramic, Polyester and Electrolytic
- ★ Controls, Volume, Pre-set, Carbon, Wire
- ★ Diodes, Silicon, Germanium, Zener
- ★ Transistors, Silicon, Germanium

All the above are new and unused stock. We have made up packs of 2lb gross weight, all are different in content, and contain a mixture of components from the above list. This is a fantastic, unrepeatable offer that will enable you to get a good stock of spares at a tiny fraction of normal price!

To make things even more interesting — TWENTY OF THESE BAGS ALSO CONTAIN A POUND NOTE! TWENTY CUSTOMERS WILL BE VERY PLEASED INDEED!

And the price that we are asking? Only **£1.50** including both postage and VAT!

Rush your order now! This offer is only made to reduce our surplus stock! It is unlikely that in these days of rising prices we shall ever be able to repeat!

£1	100 1/4 WATT RESISTORS 100 CERAMIC CAPACITORS 100 DIODES	POSTAGE 25p	PACK No. 1
£1	100 RESISTORS 100 CERAMIC CAPACITORS 100 POLYSTYRENE CAPACITORS	POSTAGE 25p	PACK No. 2
£1	100 RESISTORS 100 CERAMIC CAPACITORS 50 MULLARD POLYESTER CAPACITORS	POSTAGE 25p	PACK No. 4
£1	20 ASSORTEED UNUSED MARKEO, TESTED TRANSISTORS BC108 ETC.	POSTAGE 25p	PACK No. 5
£1	1 TRANSISTORISED SIGNAL TRACER KIT 1 TRANSISTORISED SIGNAL INJECTOR KIT	POSTAGE 25p	PACK No. 6
£1	100 RESISTORS 100 CAPACITORS (ASSORTED TYPES)	POSTAGE 25p	PACK No. 8

REMEMBER! ALL GOODS PLUS 8% V.A.T.

G. F. MILWARD, 369 Alum Rock Rd., Birmingham B8 3DR. Postage (minimum) per order 25p.

MAPLIN ELECTRONIC SUPPLIES

Get your 1975
CATALOGUE!

Includes dozens of useful and interesting circuits you can build; data; hundreds of pictures, transistor equivalents list and hundreds of new lines. Packed with information. Only 40p

SUPERSONIC SAME-DAY-SERVICE - MEANS QUALITY COMPONENTS - FAST!

RESISTORS

CARBON FILM
1W 10 to 1M : 5%, 1M2 to 10M : 10% E12
1W 10 to 100 : 5%, 1M2 to 10M : 10% E12
110 to 910k : 5% E12 & E24 1p each.

METAL OXIDE
1W 100 to 1M : 2% E12 & E24 4p each

WIREWOUND
3W 0.22Ω, 0.27Ω, 0.33Ω, 0.47Ω : 10%
10:5% 17p each
1.2Ω to 270Ω:5% E12 13p each

Other ranges stocked. See our catalogue for details.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades. 33p
E24: 1.1, 1.3, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades.

POTENTIOMETERS

Rotary miniature carbon track
1" spindle. Values available:
5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M.
Log, single-gang 16p. Lin. single-gang (+1k) 16p
Log or Lin. single-gang with switch 16p
Log or Lin. dual-gang without switch 49p
Slider 60mm track. Metal-cased: overall length 86.15mm less knob (7p extra).
Log. or Lin. 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M.
2M. Single-gang 36p. Dual-gang 45p
Presets: 0.1W Vertical or Horizontal.
100Ω, 220Ω, 470Ω, 1k, 2k, 4k7, 10k, 22k, 47k, 100k, 220k, 470k, 1M 7p each.

CAPACITORS

Sub-miniature
Axial lead electrolytic

Mfd V	Price	Mfd V	Price
1.63 6p	88	63 6p	
1.5 63 6p	88	16 6p	
2.2 63 6p	88	63 14p	
3.3 63 6p	100	4 6p	
4.7 63 6p	100	10 6p	470 6.3 6p
6.8 40 6p	100	25 6p	470 10 14p
6.8 63 6p	100	40 6p	470 25 16p
10 25 6p	100	63 16p	470 40 25p
10 63 6p	150	6.3 6p	680 8.3 14p
15 16 6p	150	15 6p	680 16 16p
15 40 6p	150	25 6p	680 25 25p
15 63 6p	150	40 14p	680 40 28p
22 10 6p	150	63 16p	1000 4 14p
22 25 6p	220	4 6p	1000 10 16p
22 63 6p	220	10 6p	1000 16 25p
33 6.3 6p	220	16 6p	1000 25 28p
33 16 6p	220	25 14p	1500 6.3 16p
33 40 6p	220	40 16p	1500 10 25p
47 4 6p	220	63 25p	1500 16 28p
47 10 6p	330	4 6p	2200 6.3 25p
47 25 6p	330	10 6p	2200 10 28p
47 40 6p	330	16 14p	3300 6.3 28p
47 63 6p	330	63 28p	4700 4 28p

SWITCHES

Rotary adjustable stop, 1 pole, 2 to 12 wavy; 2 pole, 2 to 6 wavy; 3 pole, 2 to 4 wavy; 4 pole, 2 or 3 wavy 36p each.
Slide Sub-min. DPDT 9p
Slide min. DPDT 13p
Push to make non-locking SPST 14p
Push-on, push-off locking DPDT 250V 4A 36p
Rocker white DPST 250V 10A 40p
Rotary mains DPST 250V, 2A 24p
Toggle with ON/OFF plate DPDT 250V 1.5A 25p

BCD OUTPUT SLIDE SWITCH
Marks the end of the old-fashioned thumb-wheel switch. With 7-segment type read-out. Full details in our catalogue. £1.38

TRANSISTORS & DIODES

AC127	18p	BFY52	20p
AC128	18p	BY126	13p
AC176	17p	BY127	13p
AD161/162MP	93p	BY164	49p
BA100	9p	series	13p
BA145	22p	MPF102	36p
BC107	11p	OA91	6p
BC108	10p	OA200	7p
BC109	13p	OC71	20p
BC109C	15p	SC146D	88p
BC142	23p	T1543	28p
BC143	26p	W005	30p
BC147	10p	W04	33p
BC148	10p	1N914	4p
BC149	12p	1N4001	6p
BC168C	12p	1N4002	6½p
BC169C	12p	1N4003	7p
BC178	17p	1N4004	7½p
BC182L	10p	1N4005	8p
BC183L	12p	1N4006	8½p
BC184L	12p	1N4007	9p
BC212L	14p	1N4148	4p
BC213L	15p	2N1302	20p
BC214L	15p	2N1303	20p
BCY71	22p	2N1304	30p
BD131	45p	2N1711	24p
BD132	54p	2N2219	25p
BD131/132MP	£1.20	2N2646	45p
		2N2905	33p
		2N2926 Ye12p	
BD135	36p	Gn	13p
BD139	49p	2N3053	18p
BD140	69p	2N3055	49p
BF258	35p	2N3819	22p
BF259	25p	2N5459	51p
BFX29	30p	7400	16p
BFX30	33p	7413	39p
BFX34	30p	7447	£1.10
BFX85	36p	7473	54p
BFX87	30p	7474	45p
BFX88	25p	7490	82p
BFY50	20p	7493	82p
BFY51	22p	74121	39p

L.E.D. RED.

2mcd 1" 15p
Panel mtg. clip 5p
(Other colours and 7-seg. displays in our catalogue.)

INTEGRATED CIRCUITS

CA3046 (14-pin DIL) (TO99)	69p
LH0042CH (TO99)	£4.25
MC1310P (14-pin DIL) (MC1496 (UA796) (14-pin DIL) MFC600B MFC6040 NE555V (8-pin DIL) SG1495 (14-pin DIL) SG3402 (14-pin DIL) µA741C (8-pin DIL) µA741C (14-pin DIL) µA747C (14-pin DIL) µA748C (8-pin DIL) ZN414 (TO18)	£2.50
MC1496 (UA796) (14-pin DIL)	78p
MFC600B	59p
MFC6040	89p
NE555V (8-pin DIL)	65p
SG1495 (14-pin DIL)	£2.70
SG3402 (14-pin DIL)	£1.69
µA741C (8-pin DIL)	36p
µA741C (14-pin DIL)	45p
µA747C (14-pin DIL)	£1.05
µA748C (8-pin DIL)	39p
ZN414 (TO18)	£1.20

VOLTAGE REGULATORS

µA7805 5V 1.5A (TO3)	£1.75
µA7815 15V 1.5A (TO3)	£1.75
MVR 5V, 12V, 15V 500mA (TO3)	£1.60
µA78M05 5V 500mA (Plastic power)	£1.05
µA78M15 15V 500mA (Plastic power)	£1.05
µA78L05 5V 100mA (TO92)	60p
µA78L15 15V 100mA (TO92)	60p
µA723C variable 2 to 37V (TO99) or 14-pin DIL	75p

Our catalogue contains application circuits and data for all the above I.C.s and many more.

DISCOUNTS

Details in our catalogue. Start collecting MES Discount Vouchers NOW!

PLUGS AND SOCKETS

DIN	PLUG	CHASSIS SOCKET
2-pin	8p	6p
3-pin	9p	7p
4-pin	10p	7p
5-pin A(180°)	10p	7p
5-pin B(240°)	10p	7p
6-pin	10p	9p
7-pin	10p	8p

JACK PLUGS

2.5mm plastic barrel	9p
2.5mm metal barrel	15p
3.5mm plastic barrel	9p
3.5mm metal barrel	15p
1/2 in. std. mono plastic barrel	13p
1/2 in. std. mono metal barrel	24p
1/2 in. std. stereo plastic barrel	18p
1/2 in. std. stereo metal barrel	30p

JACK CHASSIS SOCKETS

2.5mm open-type metal	9p
3.5mm open-type metal	9p
1/2 in. std. mono open-type metal	13p
1/2 in. std. mono moulded with 2 break contacts	14p
1/2 in. std. stereo open-type metal	15p
1/2 in. std. stereo moulded with 3 break contacts	21p

In-line sockets also stocked: see catalogue

PHONO

Plastic-topped plug	12p
Screened plug	5p
Chassis socket single	5p
Chassis socket twin	7p

MAINS CONNECTORS

P360 3-pin 1.5A chassis plug with line socket	33p
SA2190 3-pin 5A chassis plug	25p
SA1862 Line socket for SA2190	28p
P437 3-pin 5A chassis socket with line plug	66p

TRANSFORMERS

LT700 min. output Pri. 1k2: Sec. 50 200mW	50p
Sub-min mains 6-0-6V 100mA 12-0-12V 50mA (Size both approx. 30x27x25mm)	95p
Min. mains 0-6V 500mA, 0-6V 500mA, 0-12V 250mA, 0-12V 250mA, 0-20V 150mA, 0-20V 150mA, 0-24V 125mA, 0-24V 125mA	£1.55
Mains MT3AT: Sec: 12-15-20-24-30V 2A	£3.98
Mains MT206AT: Sec: 0-15-20V 1A, 0-15-20V 1A	£3.98

ORGAN CONSTRUCTION

A Full-Scale Electronic Organ that you can build to your own specification.

FULL CONSTRUCTIONAL DETAILS IN OUR LEAFLETS

Leaflet MES 51: price 15p, describes a fully polyphonic basic organ which can later be used as the basis of a large sophisticated instrument. Leaflet MES 52: price 15p, continues the description of the MES 50 series organs and shows you how to add a second keyboard with lots more stops. Further leaflets to follow at approx. two-monthly intervals.



THE AMAZING DMO2

A ready-built, tested and guaranteed digital master oscillator. Accurately generates the top 13 notes for your organ system and reduces the complete tuning of your organ to ONE SIMPLE adjustment. New design gives selectable C to C output ranges of (approx.) 4k to 8k (highest) or 2k to 4k or 1k to 2k, etc., right down to 16Hz to 32Hz! And this new compatible design is even smaller: only 3.5in. X 3.7in., including gold-plated edge connexion. DMO2 includes built-in variable depth and rate frequency shift tremulant. DMO2 £12.25 DMO2T £14.25 SAJ 110: 7-stage frequency divider in 14-pin DIL package. Sine or square wave input. Square wave output may be converted to saw-tooth. £1.80 each or 6 for £9.94 or 12 for £18.16.

ORGAN COMPONENTS

Keyboards high quality, fully sprung.
Flat-front 48-note F to E £15.95
Sloping-front 49-note C to C £15.95
Sloping-front 61-note C to C £20.35
Swell pedal with 10k log. pot £6.33
*Spring line unit (short) £3.05
*Spring line unit (long) £8.29
*Reverberation driver module £5.34
*S.a.e. please, for full details: leaflet MES 24.
Gold-clad phosphor-bronze wire 30p per yd.
Palladium earth bar 15p per octave length
Contact blocks 2-make (GB2) 22p
Stop tabs, rocker type, not engraved (white, red, grey or black) with DPDT switch 59p

"ELECTRONICS TODAY INTERNATIONAL" 4600 SYNTHESISER

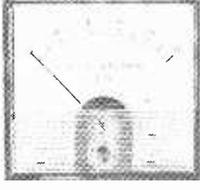
We stock all parts for this brilliantly designed synthesiser. This includes all the PCBs, metalwork and drilled and printed front panel giving a truly professional finish. Authoritative opinions agree the ETI International Synthesiser is technically superior to most of today's models. Complete constructional details in our booklet, available shortly. S.a.e. please, for price lists and specification. We also stock all parts for the P.E. Synthesiser and Minisonic.



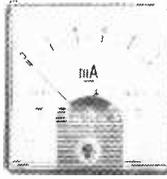
P.O. Box 3, Rayleigh, Essex. Tel: Southend-on-Sea (0702) 44101.

VAT. Please add 8% to the final total. Post and packing FREE in U.K. (15p handling charge on orders under £1) First-class post pre-paid envelope supplied free with every order.

STD. NATO SYNCHROS EX STOCK

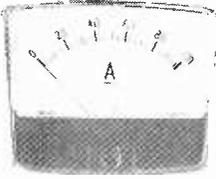


AVAILABLE IN 5 CASE SIZES FROM
£2.90 (exc)
TYPE TAD



AVAILABLE IN 3 CASE SIZES FROM
£2.80 (exc)
TYPE SA

FOR YOUR PRODUCTION REQUIREMENTS USE ALPS PANEL METERS PRICE LIST—SAE PLEASE!



AVAILABLE IN 3 CASE SIZES FROM
£2.85 (exc)
TYPE SR



RAPID DELIVERY! LOW COST! HIGH QUALITY QUANTITY DISCOUNTS SA65E FROM
£5.00 (exc)
TYPE SA65E

SPECIALIST STOCKISTS OF SERVOMOTORS, SYNCHROS, MAGSLIPS & CONNECTORS

Servo and Electronic Sales Ltd

(Established 1953)
Post Orders and Technical enquiries to: 24 HIGH ST., LYDD, KENT. TEL: LYDD 20252 (STD 0679)
VAT No. 201-1296-23 Also at 45a HIGH ST., ORPINGTON, KENT. TEL: ORP 31066 TELEX 965265

SOLAR CELLS. Ferranti silicon MS18E, active area 390 sq. mm. Open CCT voltage 550mV at 3000 lumens/sq. ft. Sht. Cct. Current 60mA. Optimum load 90 ohms. Dia. 34mm. Thickness. 6mm. mtg thrd 1/4-28 unf 2A. Ex made up panel. **£1.35** (inc. P. & P. and VAT)

TELEPRINTER PAPER. Standard rolls. 1 ply **£3.80** per doz. 2 ply **£3.80** per doz. 3 ply **£4.10** per doz. 4 ply **£4.40** per doz. All P.P. U.K. Telex your order now!

INDUCTION GENERATOR. Requires a supply voltage of 50V 50Hz and provides an output of 7V per 1000 r.p.m. directly proportional to speed. This instrument has a wide variety of applications, e.g., anemometers, measuring shaft speed etc. In brand new condition **£5.25** post paid

ITT OFFICE INTERCOM. 20-way with modern manual SWB facilities. Lightweight desk sets. Brand new in cartons **£160** inc. P. & P. and VAT. Spare desk sets **£7.50** ea.

50-FOOT TELESCOPIC (WIND UP) AERIAL MASTS complete with guys. Reduce to 11 feet. Largest tube 5" dia. Non-rotatable **£85** inc. carr. up to 50 mts of Lydd and VAT XS. Carr. charged over this distance. One only rotatable at **£100**.

UNLESS INDICATED OTHERWISE ALL PRICES INCLUDE 8% V.A.T.

LEMANIA AIRCREW CHRONOGRAPHS
Stainless Steel case with screw back; luminous hands and markings. One fifth sec. sweep hand controlled independently of main movement by press to start, stop and return to zero button. 15 jewel movement. Many of these watches are as new but all have been completely overhauled and checked for accuracy. Fitted strap. White face **£18.25**; Black face **£19.20** inc. P. & P. All watches: **Inspection against remittance**

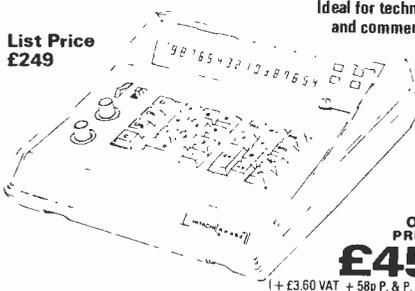
GS WATCHES all with brushed stainless steel case with screw back and black faces. Manufactured by CYMA, VERTEX, RECORD, etc. to a standard specification. Completely overhauled. Fitted strap. **£8.80** inc. P. & P.—We also have limited quantities of these watches by OMEGA, LONGINES, BUREN, HAMILTON, JAEGER LE COULTRE and IWC at **£15.25** inc. P. & P.

DRY REED INSERTS
Overall length 1.85in. (Body length 1.1in.) Diameter 0.14in. to switch up to 500mA at up to 250v. D.C. Gold clad contacts. **70p** per doz.; **£4.10** per 100; **£29.80** per 1,000; **£270** per 10,000. All carriage paid U.K.
Heavy duty type (body length 2in.) diameter 0.22in. to switch up to 1A. at up to 250V. A.C. Gold clad contacts. **£1.38** per doz.; **£8.78** per 100; **£51.40** per 1,000; **Changeover Heavy Duty type** **£2.70** per doz. All carriage paid U.K.
Operating Magnets 90p per doz.; **£6.80** per 100; **£65** per 1000. All carriage paid U.K.
Operating Coils for 12v supply to accept up to four standard reeds **£2.20** per doz.; **£12.30** per 100. All carriage paid U.K.

UNREPEATABLE SPECIAL OFFER!
MAINS OPERATED HITACHI DESK TOP CALCULATORS
KK 562 and KK 562A

Ideal for technical and commercial use

List Price **£249**



OUR PRICE **£45**
(+ £3.60 VAT + 58p P. & P. U.K.)
£200 SAVED

These fine calculators made available by a company's cash flow problems (not ours by the way!), have a 16 digit display, 2 memories, preselected decimal point (fully floating during use) performs addition, subtraction, multiplication, division, raises to power, extracts square roots, chain and constant processes.
Order with confidence by mail or send first for full details (S.A.E. please).

PATRICK & KINNIE

191 LONDON ROAD · ROMFORD · ESSEX
ROMFORD 44473 RM7 9DD

E.H.T. POWERUNIT. 110/240V. 50Hz giving 5Kv. at 50 m/a. METERED OUTPUT. **£17.50**. P.P. £1.

COPPER LAMINATE P.C. BOARD
8½ x 6 x ¼ inch, **25p** sheet, 3 for **65p**. P.P. 10p.
10 x 4 x ¼ inch, **14p** sheet, 5 for **65p**. P.P. 15p.
10½ x 5½ x ¼ inch, **25p** sheet, 3 for **65p**. P.P. 10p.
14 x 6½ x ¼ inch, **35p** sheet, 3 for **90p**. P.P. 15p.
Offcut pack, (smallest 4 x 2 inch), **65p**. P.P. 10p. (300 sq. inches)

PRECISION A.C. MILLIVOLTMETER (SOLARTRON). 1.5mv. to 15v., 60dB to 20dB. 9 ranges. Excellent condition. **£22.50**. P.P. £1.50.

TELEPHONE DIALS (New) £1 each.
EXTENSION TELEPHONES (Type 706). Various colours. **£3.75**. P.P. 60p.
RATCHET RELAYS (310 ohm). Various types. **£1.10**. P.P. 15p.
UNISELECTORS (New) 25 way, 12 Bank (Non bridging), 68 ohms. £6. P.P. 30p.
1,000 TYPE KEY SWITCHES.
Single 2 x 4 c/o Locking **50p**. P.P. 10p. Bank of 4—2 x 4 c/o each switch (one biased), **£1.20**. P.P. 15p.

OVERLOAD CUT-OUTS. Panel mounting (1½ x 1½ x ¼in.), 800 M/A/1.8 amp.-10 amp. **45p**. P.P. 5p.

U.K. ORDERS 8% V.A.T. SURCHARGE

QUADROPHONIC DECODER MODULE. C.B.S./S.O. Type, using I.C. MC 1312P. With slight modification direct substitute for P.E. "RONDO" Board. Complete with Data. **£4** each.

S.T.C. CRYSTAL FILTERS (10.7 Mhz).
445-LQU-901A (50 KHz spacing), **£3**. P.P. 20p.
445-LQU-901B (25 KHz spacing), **£4**. P.P. 20p.
V.H.F./U.H.F. POWER TRANSISTORS (Type BLY38). 3 watt output at 100-500 Mhz, **£2.25**. P.P. 10p.

HIGH CAPACITY ELECTROLYTICS
2,200µf. at 50v. (2 x 1 ¼in.) **50p**. P.P. 10p. 2,200µf. at 100v. (1 ½ x 4in.) **85p**. P.P. 10p. 3,150µf. at 40v. (1 ½ x 4in.) **75p**. P.P. 10p. 10,000µf. at 25v. (1 ½ x 4 ¼in.) **75p**. P.P. 10p. 16,000µf. at 16v. (2 x 4in.) **75p**. P.P. 10p. 21,000µf. at 40v. (2 ½ x 4in.) **£1**. P.P. 15p. 28,000µf. at 100v. (4 x 2in.) **£1.10**. P.P. 15p

H.D. ALARM BELLS. 6in. Dome, 6/8v. D.C. **£2.50**. P.P. 50p.

MULTICORE CABLE. 6-core (6 colours), 14/0076 Screened P.V.C. **20p** per yard; 100 yards at **£15**. P.P. 1p per yard. 7-core (7 colours) 7/22mm. Screened P.V.C. **20p** per yard; 100 yards **£15**. P.P. 1p per yard. 30-core (15 colours) **25p** per yard; 100 yards **£20**. P.P. 1p per yard.

RIBBON CABLE (8 colours)
10m. **£1.50**. P.P. 15p; 100m. 8-core, 7/ mm. Bonded side by side in ribbon form. **£11**. P.P. 50p.

WE REGRET THAT ALL ORDERS VALUE UNDER £5 MUST BE ACCOMPANIED BY THE REMITTANCE.

HIGH - SPEED MAGNETIC COUNTERS. 4 digit (non reset) 24v. or 48v. (state which), 4 x 1 x 1in. **60p**. P.P. 10p.
5 digit (non reset) 24v. **90p**. P.P. 10p.
3 digit 12v. (Rotary Reset) 2 ½ x 1 ½ x 1 ¼in. **£1.20**. P.P. 10p.
6 digit (Reset) 240v. A.C. **£3.50**. P.P. 10p.

RELAYS. SIEMENS/VARLEY. PLUG-IN. Complete with transparent dust cover and base. 2 pole c/o. **35p**; 6-make contact **40p**; 4-pole c/o contact **50p** each. P.P. 5p each. 6-12-24-48v. types in stock.
12v. 2 c/o 5 amp. RELAY, 60p. P.P. 10p.
240v. A.C. RELAY (PLUG-IN TYPE). 3 c/o 10 amp. contact with base. **85p**. P.P. 10p.
P.A.R. BISTABLE RELAY (Latching) 24v. D.C. 4c/o contact. **75p**. P.P. 10p.
24v. A.C. RELAY (PLUG-IN). 3 pole c/o. **75p**. P.P. 5p. 2-pole change over. **55p**. P.P. 5p.
BULK COMPONENTS OFFER. Resistors/Capacitors, 600 new components. **£2.50**. P.P. 25p. Trial order 100pcs. **60p**. P.P. 15p.
REGULATED POWER SUPPLY. Input 110/240v., output 9v. D.C. 1 ½ amp., 12v. D.C. 500 m/a. **£4.50**. P.P. 40p.
MINIATURE "ELAPSED TIME" INDICATORS. (0-5000 hours), 45 x 8mm. **75p**.

TRANSFORMERS

L.T. TRANSFORMER. Prim. 110/240v. Sec. 0/24/40v. 1 ½ amp. (Shrouded) **£1.75**. P.P. 30p.

L.T. TRANSFORMER. Prim. 200/250v. Sec. 20/40/60v. at 2 amp. (Shrouded) **£2.75**. P.P. 40p.

L.T. TRANSFORMER (H.D.). Prim. 200/250v. Sec. 18v. at 27 amp.; 40v. at 9.8 amp.; 40v. at 3.6 amp.; 52v. at 1 amp.; 25v. at 3.7 amp. **£17**. P.P. £2.

L.T. TRANSFORMER. Prim. 240v. Sec. 16-0-16v. at 2 amp. **£1.85**. P.P. 30p.

L.T. TRANSFORMER. Prim. 110/240v. Sec. 23-0-23v. at 1.8 amp.; 50v. at 300 m/a.; 3.15-0-3.15v. at 300 m/a. **£1.90**. P.P. 30p.

POWER UNIT (TRANSFORMER/RECTIFIER). Prim. 240v., output 17½v. (unsmoothed) at 1 amp. **£1.50**. P.P. 35p.

L.T. TRANSFORMER ("C" CORE). Prim. 110/240v. Sec. 1/3/9/27v. at 10 amps. **£7**. P.P. £1.

L.T. TRANSFORMER ("C" CORE). Prim. 200/240v. Sec. 1-3-8-9v. All at 1.5 amp.; 50v. at 1 amp. **£2.25**. P.P. 30p.

L.T. TRANSFORMER. Prim. 110/240v. ("C" CORE). Sec. 13.5v. at 4 amp.; 39v. at 2 amp. **£2.75**. P.P. 30p.

L.T. TRANSFORMER. ("C" CORE). 110/240v. 1-3-9-20-20v. All at 2 amps. **£3.50**. P.P. 40p. Same secondaries but at 4 amps. **£5**. P.P. 50p.

L.T. TRANSFORMER ("C" CORE). 110/240v. Sec. 1-3-9v. All at 10 amps; 35v. at 1 amp.; 50v. at 750 m/a. **£5.75**. P.P. 75p.

Ex-BEA CONTROL UNITS by UNIVAC

A free-standing, modern style diecast case consisting of:

2-50way gold-plated plug and sockets; sub-assembly with 3-multiway switch assemblies; 4-decade push button assembly with electrical reset; 2-decade push button assembly with electrical reset; single-bank 8-push button assembly; 1-decade lamp assembly; 1-2-decade lamp assembly; 1-12 X 3-lamp assembly; 4-decade thumb wheel assembly; 16-bit inline card code assembly; 6-15way plug and sockets.

Limited stocks at **£12.50** ea plus £2 carriage

ALSO MODERN STYLE TYPEWRITER KEYBOARD

with 21 separate function keys. Housed in slimline diecast case. Transistorised.

No information but a "buy" at **£15** ea plus £2 carriage

EX-MINISTRY CT436 Double Beam Oscilloscope DC-6 megs. Max Sensitivity 10mv/cm. Small compact. Size 10 X 10 X 16 in. Suitable for Colour TV servicing. Price **£85** each including copy of manual.

SOLARTRON CD1212 with DUAL TRACE PLUG-IN DC-24MHZ

TB-100 nanosecs per cm. to 5 secs. per cm. in 24 calibrated ranges. 20 nanosecs per cm. with times 5 expansion. 5" flat-faced tube. Trace locator. 0-2 microsec. signal delay. Built-in calibrator. 1KHz square wave. 200 micro volts to 100 volts in 18 calibrated ranges. Complete with manual. **£95** each.

TEKTRONIX VIDEO WAVEFORM MONITORS
Type 527RM—**£250**.
Type 529RM—mod 188D **£475**.

CLEARANCE LISTS AVAILABLE. S.A.E.

TELEPHONES

STANDARD 300 Series. BLACK only **£1.00** ea. P. & P. 50p.
MODERN STYLE 706 BLACK OR TWO-TONE GREY **£3.75** ea. P. & P. 35p. **STYLE 7006** TWO-TONE GREEN **£3.75** ea. P. & P. 35p. **HANDSETS**—complete with 2 insets and lead **75p** ea. P. & P. 37p. **DIALS ONLY**. **75p** ea. P. & P. 25p.
STILL AVAILABLE MODERN STANDARD TELEPHONES IN GREY OR GREEN WITH A PLACE TO PUT YOUR FINGERS LIKE THE 746. **A CHANCE NOT TO BE MISSED £3.00** ea. P. & P. 35p.

HIGH-VALUE—PRINTED BOARD PACK

Hundreds of components. transistors, etc.—no two boards the same—no short-leaded transistor computer boards. **£1.75** post paid.

Beehive Trimmer 3/30 pf.
Brand new. Qty 1-9 **13p** ea. P. & P. 15p.
10-99 **10p** ea. P. & P. 25p. 100-999
7p ea. P. & P. free.

Vast quantity of good quality components
—NO PASSING TRADE—so we offer
3 LB. of ELECTRONIC GOODIES
for **£1.50** post paid.

CAPACITOR PACK 50 Brand new components only **50p**. P. & P. 17p.

P.C. MOUNT SKELETON PRE-SETS.
Screwdriver adjust 10, 5 and 2.5M @ **2p** ea.
1M, 500, 250 and 25K @ **4p** ea. Finger adjust 10, 5 and 2.5M @ **3p** ea. 1M, 500, 250 and 25K @ **5p** ea. Min P. & P. 10p.

1000pf FEED THRU CAPACITORS. Only sold in packs of 10—**30p**. P. & P. 10p.

RECTANGULAR INSTRUMENT FANS.
American Ex-eq. Size 4 1/2 X 4 1/2 X 1 1/2. 115 Volt. Very quiet **£3** ea. P. & P. 37p.

DELIVERED TO YOUR DOOR 1 cwt. of Electronic Scrap chassis, boards, etc. No Rubbish. FOR ONLY **£4**. N. Ireland £2 extra.

P.C.B. PACK S & D. Quantity 2 sq. ft.—no tiny pieces. **50p** plus P. & P. 20p.

TRIMMER PACK. 2 Twin 50/200 pf ceramic; 2 Twin 10/60 pf ceramic; 2 min strips with 4 preset 5/20 pf on each; 3 air spaced preset 30/100 pf on ceramic base. ALL BRAND NEW 25p the LOT. P. & P. 10p.

PHOTOCELL equivalent OCP 71. **13p** ea.

MULLARD OCP70 10p ea.

GRATTICULES. 12 cm. by 14 cm. in High Quality plastic. **15p** each. P. & P. 5p.

FIBRE GLASS PRINTED CIRCUIT BOARD. Brand New. Single or Double sided. Any size **1 1/2p** per sq. in. Postage **20p** per order.

CRYSTALS. Colour 4.43MHz. Brand New. **£1.25** ea. P. & P. 10p.

HF Crystal Drive Unit. 19in. rack mount. Standard 240V input with superb crystal oven by Labgear (no crystals) **£5** ea. Carr. £1.50.

ROTARY SWITCH PACK—6 Brand New switches (1 ceramic; 1-4 pole 2 way etc.). **50p**. P. & P. 20p.

BOURNS TRIMPOT POTENTIOMETERS. 20; 50; 100; 200; 500 ohms; 1; 2; 2.5; 5; 10; 25K at **35p** ea. ALL BRAND NEW.

RELIANCE P.C.B. mounting 270; 470; 500 ohms; 10K at **35p** ea. ALL BRAND NEW.

VENNER Hour Meters—5 digit. wall mount—sealed case. Standard mains. **£3.75** ea. P. & P. 45p.

TRANSFORMERS. All standard inputs. Gard/Part. 450-400-0-400-450. 180 MA. 2 X 6.3v. **£9** ea.

FANTASTIC VALUE
Miniature Transformer. Standard 240V input. 3V 1 amp output. Brand New. **65p** ea. P. & P. 15p. Discount for quantity.

LOW FREQUENCY WOBBLATOR

DON'T FORGET YOUR MANUALS S.A.E. WITH REQUIREMENTS

For alignment of Receivers, Filters, etc. 250KHz to 5MHz. effective to 30MHz on harmonics. Three controls—RF level, sweep width and frequency. Order LX63. Price **£8.50** P. & P. 35p.
As above but can have extended cover range down to 20KHz by addition of external capacitors. Order LX63E. Price **£11.50** P. & P. 35p.
Both models can be used with any general-purpose oscilloscope. Requires 6.3V AC input. Supplied connected for automatic 50Hz sweeping. An external sweep voltage can be used instead. These units are encapsulated for additional reliability. with the exception of the controls (not cased, not calibrated).

20HZ to 200KHZ

SINE AND SQUARE WAVE GENERATOR

In four ranges. Wien bridge oscillator thermistor stabilised. Separate independent sine and square wave amplitude controls. 3V max sine, 6V max square outputs. Completely assembled P.C. Board, ready to use. 9 to 12V supply required. **£8.85** each. P. & P. 25p. Sine Wave only **£6.85** each. P. & P. 25p.

WIDE RANGE WOBBLATOR

5 MHZ to 150 MHZ (Useful harmonics up to 1.5 GHZ) up to 15 MHZ sweep width. Only 3 controls, preset RF level, sweep width and frequency. Ideal for 10-7 or TV IF alignment, filters, receivers. Can be used with any general purpose scope. Full instructions supplied. Connect 6-3V AC and use within minutes of receiving. All this for only **£6.75**. P. & P. 25p. (Not cased, not calibrated.)

TRANSISTOR INVERTORS

TYPE A
Input: 12V DC
Output: 1.3kV AC 1.5MA
Price **£3.45**

TYPE B
Input: 12V DC
Output: 1.3kV DC 1.5MA
Price **£4.70**

TYPE C
Input: 12V to 24V DC
Output: 1.5kV to 4kV AC 0.5MA
Price **£6.35**
Postage & Packing **36p**

TYPE D
Input: 12V to 24V DC
Output: 14kV DC 100 micro amps at 24V.
Progressively reducing for lower input voltages
Price **£11**

MAKE YOUR SINGLE BEAM SCOPE INTO A DOUBLE WITH OUR NEW LOW PRICED SOLID STATE SWITCH. 2 HZ to 8 MHZ. Hook up a 9 volt battery and connect to your scope and have two traces for ONLY **£6.25**. P. & P. 25p.
STILL AVAILABLE our 20 MHZ version at **£9.75**. P. & P. 25p.

Unless stated - please add £2.00 carriage to all units.

VALUE ADDED TAX not included in prices—please add **8%**

Official Orders Welcomed, Gov./Educational Depts., Authorities, etc., otherwise Cash with Order

Open 9 am to 6.30 pm any day (later by arrangement.)



CHILTMEAD LTD



7/9 ARTHUR ROAD, READING, BERKS. (rear Tech. College, Kings Road) Tel.: Reading 582605/65916

BI-PRE-PAK

Bargains in Semi-Conductors, components, modules & equipment.

Today's big value in transistors!
offers **ALL AT 50p EACH**

★ **Tested and Guaranteed**

B79	4	IN4007 Sil. Rec. diodes, 1,000 PIV 1 amp plastic
B81	10	Reed Switches, 1" long, 1/8" dia. High Speed P.O. type
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked.
H38	30	Short lead Transistors, NPN Silicon Planar types
H39	6	Integrated Circuits, 4 Gates BMC 962, 2 Flip Flops BMC 945
H41	2	Sil Power transistors comp pair BD131/132
H63	4	2N3055 type NPN Sil. power transistors. Below spec. devices
H64	4	3819 N Channel FETs 2N3819 in plastic case



★ **Unmarked untested**
PACKS ALL AT 50p EACH

B1	50	Germanium Transistors PNP, AF and RF
B66	150	Germanium Diodes Min. glass type
B83	200	Transistors, manufacturers rejects, AF, RF, Sil. and Germs.
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202
B86	100	Sil. Diodes sub. min. IN914 and IN916 types
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.
H67	10	3819N Channel FETs plastic case type

Bi-Pre-Pak X-Hatch Generator Mk. 2



Four-pattern selector switch
3" X 5 1/4" X 3"
Ready-built
and tested
In kit form

£9.93
£7.93

Is invaluable to industrial and home user alike. Improved circuitry assures reliability and still better accuracy. Very compact: self-contained. Robustly built. Widely used by TV rental and other engineers. With reinforced fibreglass case, instructions, but less batteries. (Three U2 type required.)

SUNDRY

MAINS TRANSFORMERS

A. 18V 1 amp (suitable for SS.103)	£1.50
B. 25V 2 amp (suitable for SS.110)	£2.00
C. 30V 2 amp (suitable for SS.140)	£3.25

BRIDGE RECTIFIERS

Type A 45V/1A 27p. B & C 100V/2A **38p**

MAINS RELAYS

230/240V AC. 3-pole change-over. Heavy duty contacts **60p**
Ex-GPO Telephone Handsets, each **55p**



Made and sold direct by Bi-Pre-Pak

Stirling Sound

Today's most challenging values!

AMPLIFIER MODULES

SS100	Active tone control unit to provide Bass and Treble facilities (stereo).	£1.60
SS101	Pre-amp for stereo ceramic cartridges, radio and tape.	£1.60
SS102	Pre-amp for low-output stereo magnetic cartridges, radio and tape.	£2.25
SS103	Compact I.C. amp. 3 watts R.M.S. Single channel (mono). On P.C.B. size 3" X 2". Needs 6-22V supply.	£1.75
SS103-3	Stereo version of above. (Two I.Cs.)	£3.25
SS105	A compact all-purpose power amp. Can be run from 12V car battery. Size 2 1/2" X 1 3/4". Useful 5w output (mono). Excellent value.	£1.95
SS110	Similar in size to SS105 but will give 10w output (mono). Two in stereo give first-class results, suitable for many domestic applications.	£2.40
SS140	Beautifully designed. Will give up to 40w R.M.S. into 4Ω. Excellent S.N.R. and transient response. Fine for P.A., disco use, etc. Operates from 45V DC. Two in bridge formation will give 80w R.M.S. into 8Ω.	£3.60

FM Tuners

SS201	Front End Assembly. Ganged tuning with well engineered slow-motion geared drive in robust housing. A.F.C. facility. Requires 6-16V. Excellent sensitivity. 88-108MHz.	£6.25
SS202	I.F. Stage (with I.C.). Designed to use with SS201 uses I.C. Carefully checked before despatch.	£5.25
SS203	Stereo Decoder. Designed essentially for use with SS201 and SS202, this excellent decoder can also make a stereo tuner of almost any single channel FM tuner. Supplied ready aligned. A L.E.M. can easily be fitted.	£5.62
SS300	POWER SUPPLY STABILISER. Add this to your unstabilised supply to obtain a steady working voltage from 16 to 60V for your audio system. Money saving and very reliable.	£5.62

● **ALL MODULES TESTED & GUARANTEED**

● **FULLY DETAILED & WELL PRINTED INSTRUCTIONS**

● **Postage—Add 15p for packing & postage (UK) + 8% VAT to total value.**

Plastic Power Transistors

40 WATT SILICON

Type No.	Gain	VCE	Polarity	Price
40N1	15	15	NPN	20p
40N2	40	40	NPN	30p
40P1	15	15	PNP	20p
40P2	40	40	PNP	30p

90 WATT SILICON

Type No.	Gain	VCE	Polarity	Price
90N1	15	15	NPN	25p
90N2	40	40	NPN	35p
90P1	15	15	PNP	25p
90P2	40	40	PNP	35p



There's more in our latest catalogue: More bargains—better price-values. Send large S.A.E. (6p stamp please) for your free copy. **COMPONENTS, EQUIPMENT, AND OF COURSE, SEMI-CONDUCTORS.**

TERMS OF BUSINESS VAT Add 8% to total value of order including postage and packing charges. No VAT on overseas orders. **POST & PACKING** Add 15p for UK orders. Minimum mail order acceptable—50p. Overseas orders, add £1. Any difference will be credited or charged **PRICES** Subject to alteration without notice. **AVAILABILITY** All items available at time of going to press when every effort is made to ensure correctness of information.

BI-PRE-PAK LTD

Co Reg No 820919

222 224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX SSO 9DF.

TELEPHONE: SOUTHEND (0702) 46344.

To BI-PRE-PAK, 222-224 WEST RD,
WESTCLIFF-ON-SEA, ESSEX

Please send
for which I enclose inc. VAT
NAME
ADDRESS

ww3

BENTLEY ACOUSTIC CORPORATION LTD.

7A GLOUCESTER ROAD, LITTLEHAMPTON, SUSSEX. Tel. 6743
ALL PRICES SHOWN INCLUDE V.A.T.

0B2	0.40	6AX4	0.75	6AK9	0.45	12AV8	0.50	30P4MR	AC/TH11-00	EBP89	0.32		
0Z4	0.47	6BR8	0.30	6L1	2.00	12AX7	0.33	1.00	AL60	1.00	EBL21	2.00	
1A3	0.45	6BA6	0.28	6LG0T	0.58	12AY7	0.70	30P12	0.65	ARP3	0.80	EC2	1.00
1A50T	0.60	6RC8	0.60	6L7(M)	0.60	12BA6	0.45	30P19	0.75	ATP4	0.50	EC53	1.00
1A7GT	0.85	6BE6	0.35	6L18	0.55	12BE6	0.50	30P4	0.75	AZ1	0.25	EC54	1.00
1B3GT	0.50	6B6G	0.80	6L19	2.00	12BH7	0.50	30P11	0.85	AZ41	0.25	EC88	0.70
1C9	0.70	6BH6	0.80	6L12	0.38	12BH7	0.50	30P11	0.85	AZ41	0.25	EC88	0.70
1G6	1.00	6BJ6	0.55	6L19T	0.75	12E1	3.00	30P11.3	0.95	LG43	2.00	EC92	0.75
1H5GT	0.60	6BK7A	0.60	6N7GT	0.60	12J5GT	0.33	30P11.4	1.10	CL33	1.80	EC92	1.50
1L4	0.28	6BQ5	0.31	6PL12	0.34	12J7GT	0.60	30P11.5	0.80	CV6	0.53	EC93	1.50
1L15	0.60	6BQ7A	0.55	6Q7G	0.50	12K15	1.00	35A3	0.65	CV63	0.75	EC93	0.85
1LN5	0.60	6BR7	1.00	6Q7GT	0.50	12K7GT	0.50	35C5	0.75	CV988	0.25	EC94	1.00
1N5GT	0.85	6BR8	1.50	6Q7(M)	0.55	12K7GT	0.45	35D15	0.75	CV1C	1.00	EC94	0.84
1R5	0.45	6BS7	1.40	6R7G	0.80	12Q7GT	0.45	35L7	0.75	CV31	0.50	EC94	0.60
1R4	0.33	6BW6	0.60	6R7(M)	0.75	12S4GT	0.55	35ZGT	0.75	D63	0.25	EC98	0.33
185	0.40	6BH7	0.70	6SA7	0.44	12S6T	0.50	35ZGT	0.75	DAC32	0.60	EC98	0.35
104	0.80	6BX6	0.25	6S6GT	0.33	12SH7	0.35	35ZGT	0.75	DAF96	0.50	EC98	0.50
1U5	0.75	6BY7	0.30	6S6T	0.44	12SH7	0.44	35ZGT	0.75	DC90	0.60	EC98	0.85
2D21	0.45	6BZ6	0.49	6S17	0.44	12SK7	0.55	42	0.50	D14	1.00	EC98	0.44
2K15	0.65	6C3	0.83	6S17	0.55	12SK7	0.55	42	0.50	DF91	0.60	EC98	0.65
2X2	0.60	6C5G	0.50	6SK7GT	0.45	12SNTGT	0.50	50B5	0.85	DF96	0.50	EC98	0.45
3A4	0.50	6C6	0.40	6S6GT	0.45	12SQT	0.75	50C5	0.80	DH63	0.50	EC98	1.20
3B7	0.45	6C9	1.00	6G7GT	0.70	12SQT	0.75	50E15	0.75	DH76	0.45	EC98	0.45
3D6	0.40	6CB6A	0.40	6U7G	0.45	12SRT	0.75	50L6GT	0.65	DH77	0.45	EC98	0.45
3Q4	0.60	6C12	0.33	6V6G	0.17	14H7	0.55	72	0.60	DH81	0.75	EC98	0.75
3Q5GT	0.60	6C17	0.28	6V6GT	0.45	14H7	0.55	72	0.60	DK32	0.65	EC98	0.75
3V4	0.40	6CG8A	0.75	6X6GT	0.45	18	1.00	85A2	0.60	DK40	0.70	EC98	0.70
4C86	0.55	6CL6	0.65	6Y6G	0.80	18A	1.00	85A2	0.60	DK92	0.70	EC98	0.70
5C08	0.55	6CL6	0.65	6Y7G	1.00	19AGG	0.50	85A3	0.60	DK96	0.60	EC98	1.25
5R4GT	0.80	6CM7	0.75	7A7	1.00	19GG	0.60	90CV	2.40	DL92	0.40	EC98	0.70
5T3	0.40	6CU5	0.75	7B6	0.75	19H1	2.00	90C1	0.75	DL94	0.70	EC98	0.33
5U4G	0.40	6CW4	1.00	7B7	0.70	20D1	0.60	150B2	0.75	DM71	1.50	EC98	0.40
5V4G	0.50	6D3	0.60	7P7	1.50	20P2	0.75	301	1.00	DW4/350	0.50	EC98	0.40
5Y3GT	0.45	6E7	0.75	7H7	0.75	20P2	0.75	301	1.00	EC98	0.35	EC98	0.40
5Z3	0.75	6D7A	0.75	7R7	0.80	20P2	0.75	301	1.00	EC98	0.35	EC98	0.40
5Z4	0.45	6EW6	0.75	7V7	1.50	20P1	0.55	303	1.00	EC98	0.35	EC98	0.40
5Z4GT	0.45	6E5	1.00	7Y4	0.75	20P3	0.60	305	1.00	EC98	0.35	EC98	0.40
6B30L2	0.60	6F24	0.75	7Z4	0.80	20P4	1.00	307	1.00	EC98	0.35	EC98	0.40
6A8G	1.25	6F1	1.00	7Z4	0.80	20P4	1.00	307	1.00	EC98	0.35	EC98	0.40
6A7C	0.49	6F6G	0.50	9B6W	0.75	20P5	1.30	956	0.30	EC98	0.35	EC98	0.40
6A15	0.27	6F13	0.70	10C2	0.75	25A9G	0.60	1821	1.00	EC98	0.35	EC98	0.40
6A16	0.60	6F14	0.75	10D1	0.70	25L6G	0.65	4033X	1.00	EC98	0.35	EC98	0.40
6A18	0.65	6F15	0.65	10DE7	0.75	25Y6G	0.70	5763	1.50	EC98	0.35	EC98	0.40
6A19	0.60	6F18	0.55	10F1	0.75	25Z4G	0.40	6057	1.00	EC98	0.35	EC98	0.40
6A25	0.60	6F23	0.55	10P9	0.65	25Z5	0.80	6060	1.00	EC98	0.35	EC98	0.40
6A26	0.38	6F25	0.85	10P18	0.55	25Z6G	0.70	6067	1.00	EC98	0.35	EC98	0.40
6A28	0.60	6F25	1.00	10L14	0.45	28D7	1.00	7193	0.53	EC98	0.35	EC98	0.40
6A5	0.60	6P28	0.30	10LD11	0.70	30A5	0.65	7476	1.00	EC98	0.35	EC98	0.40
6A8MA	0.55	6P28	0.87	10LD12	0.40	30C1	0.40	9002	5.00	EC98	0.35	EC98	0.40
6A8N	0.70	6P32	0.50	10PL12	0.38	30C15	0.70	9006	0.30	EC98	0.35	EC98	0.40
6A95	0.45	6G6G	0.50	10P13	0.75	30C17	0.80	A1834	1.00	EC98	0.35	EC98	0.40
6A98	0.40	6G8A	0.75	10P14	0.20	30C18	0.70	A2134	1.00	EC98	0.35	EC98	0.40
6A5	0.60	6GK5	0.65	10P18	0.42	30F5	0.75	A3042	1.00	EC98	0.35	EC98	0.40
6AR5	1.00	6G8A	0.75	12A5	0.45	30F11	0.67	AC2PEN	1.00	EC98	0.35	EC98	0.40
6AR6	1.00	6H6GT	0.25	12AC6	0.70	30FL2	0.67	AC2PEN	1.00	EC98	0.35	EC98	0.40
6A87	1.00	6J5GT	0.45	12AD6	0.65	30FL2	0.90	AC2PEN	1.00	EC98	0.35	EC98	0.40
6AT6	0.45	6J6	0.30	12AE6	0.65	30FL13	0.55	1.00	EC98	0.35	EC98	0.40	
6AU6	0.30	6J7G	0.30	12AT6	0.40	30FL14	0.70	AC9/PEN	0.60	EC98	0.35	EC98	0.40
6AV6	0.45	6J18A	0.65	12AT7	0.34	30FL1	0.30	1.00	EC98	0.35	EC98	0.40	
6AW8A	0.95	6K7G	0.30	12AU7	0.45	30L15	0.70	AC/PEN(7)	0.60	EC98	0.35	EC98	0.40
						30L17	0.85	1.00	EC98	0.35	EC98	0.40	

EL35	2.50	N308	1.00	PY81	0.35	U10	1.00	Transistors and Diodes	AF121	0.33	BY213	0.28	OA211	0.75	
EL57	2.50	N339	1.00	PY82	0.30	U12/14	1.00	AF124	0.28	BY215	1.93	OC19	1.38		
EL41	0.90	P61	0.50	PY83	0.38	U16	1.00	1N1124A	0.58	AF125	0.18	CG12E	0.22	OC22	0.42
EL81	0.60	PAB70	0.58	PY88	0.40	U17	0.75	1N4744A	0.15	AF126	0.20	CG12E	0.22	OC23	0.42
EL83	0.55	PA8	0.45	PY89	0.45	U18/20	1.00	1N4952	0.55	AF128	0.72	CG11A	0.22	OC24	0.42
EL84	0.31	PC8	0.60	PY90	0.95	U19	0.75	2N3404	0.20	AF178	0.75	FSM41A	0.25	OC25	0.42
EL85	0.44	PC95	0.60	PY90A	0.95	U22	0.75	2N966	0.58	AF180	0.53	GD4	0.38	OC28	0.66
EL86	0.38	PC97	0.35	PY90	0.40	U25	0.60	2N1756	0.55	AF186	0.61	GD5	0.31	OC29	0.69
EL90	1.20	PC90	0.40	PY801	0.40	U26	0.66	2N2147	0.94	AF239	0.42	GD6	0.31	OC36	0.47
EL506	0.60	PC84	0.30	PZ39	0.48	U31	0.40	2N2297	0.25	AS927	0.47	GD8	0.28	OC38	0.47
EL91	1.25	PC85	0.44	QZ21	0.50	U33	1.50	2N2369A	0.15	AY128	0.36	GD9	0.22	OC41	0.56
EL96	0.45	EM6	0.45	QV03/10	1.35	U35	1.50	2N2853	0.65	BCY10	0.50	GET119	0.27	OC71	0.12
EM1	0.65	PC89	0.90	QW5/20/100	0.45	U37	1.75	2N3053	0.36	BA102	0.50	GD12	0.22	OC43	1.30
EM3	0.65	PC89	0.45	QW5/20/100	0.45	U45	1.00	2N3121	2.75	BA115	0.15	GD14	0.55	OC44	1.10
EM4	0.40	PCF80	0.40	Q895/101.00	0.47	U47	0.60	2N3703	0.22	BA126	0.20	GD15	0.44	OC45	0.12
EM5	0.40	PCF82	0.40	Q8150/15	0.49	U49	0.66	2N3709	0.22	BA129	0.14	GD16	0.22	OC46	0.17
EM7	0.70	PCF84	0.69	Q8150/15	0.50	U45	0.45	2N3866	1.10	BA130	0.11	GET113	0.22	OC65	1.24
EM803	0.60	PCF86	0.60	QV047/1.00	1.50	U76	0.70	2N3988	0.65	BA153	0.17	GET118	0.22	OC70	0.14
EL506	0.60	PCF87	0.80	R11	1.00	U78	0.40	2823Z	0.65	BCY10	0.50	GET119	0.27	OC71	0.12
PCF85	0.44	R16	1.75	U153	0.35	AA119	0.17	BCY12	0.55	GET573	0.42	OC72	0.12		
PCF86	0.50	R17	0.88	U191	0.50	AA129	0.17	BCY34	0.25	GET578	0.47	OC74	0.25		
PCF87	0.80	R18	0.78	U192	0.30	AA213	0.10	BCY38	0.25	GET578	0.47	OC74	0.25		
PCF88	0.50	R19	0.60	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF89	0.50	R20	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF90	0.50	R21	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF91	0.50	R22	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF92	0.50	R23	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF93	0.50	R24	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF94	0.50	R25	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF95	0.50	R26	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF96	0.50	R27	0.68	U193	0.40	AC107	0.17	BCY39	0.28	GET578	0.47	OC74	0.25		
PCF97	0.50	R28	0.68	U193											

Samson's

(ELECTRONICS) LTD.
9 & 10 CHAPEL ST., LONDON, N.W.1
01-723 7851 **01-262 5125**
 ADJACENT TO EDGWARE ROAD MET. LINE STATION

CURRENT RANGE OF NEW L.T. TRANSFORMERS FULLY SHROUDED TERMINAL BLOCK CONNECTIONS ALL PRIMARIES 220/240v

Type	Sec. Taps	Amps	Price	Postage
1A	25-33-40-50v	15	£14.00	75p
1B	25-33-40-50v	10	£12.00	75p
1C	25-33-40-50v	6	£8.50	60p
1D	25-33-40-50v	3	£7.50	60p
2A	4-16-24-32v	12	£10.00	75p
2B	4-16-24-32v	8	£8.00	60p
2C	4-16-24-32v	4	£4.95	45p
2D	4-16-24-32v	2	£3.50	40p
3A	24-30-36v	10	£9.00	60p
3B	24-30-36v	5	£7.50	60p
3C	24-30-36v	2	£7.50	40p
4A	12-20-24v	20	£12.00	75p
4B	12-20-24v	10	£7.50	60p
4C	12-20-24v	5	£4.95	40p
5A	3-12-18v	20	£10.00	60p
5B	3-12-18v	10	£6.95	60p
5C	3-12-18v	5	£4.50	40p
6A	48-56-60v	2	£4.50	40p
6B	48-56-60v	1	£3.50	40p
7A	6-12v	20	£7.90	60p
7B	6-12v	10	£4.50	40p
7C	6-12v	5	£3.50	40p
8A	17-32v	8	£3.00	60p
9A	12-24v	1	£2.50	30p
9A	9-15v	2	£2.50	30p
11A	8-0-8v	2	£2.50	30p

PLEASE ADD 8% V.A.T.

HEAVY DUTY UNSHROUDED TYPES 9 INCH FLYING LEADS ALL PRIMARIES 240v.

Type No.	Sec. Volt Tap.	Amps.	Price	Carr.
1	24-30-36	20	£14.95	£1.00
2	12-20-24	30	£14.95	£1.00
3	3-12-18	30	£14.95	£1.00
4	6-12	50	£14.95	£1.00

TRANSFORMERS FOR LINSLEY HOOD AMPLIFIERS

Fully shrouded, terminal block connections. Pri. 220-240v. Screen tap. Sec. 30-25-0-25-30v., 2 amps. £4.75, carr. 40p. Heavy duty type 36-25-0-25-36v. 5 amps. £9.75, carr. 50p.

STEP DOWN 240/110v AUTO TRANSFORMERS

3000 watts. Built into steel case with two American 2 pin grounded socket outlets. Carry handle, 6 ft. mains lead. £29.50, carr. £2. Without case and fittings £22.00, carr. £1.50.
 Other Types Available. 80-1500 watts, fully shrouded, with American socket outlet and 6 ft. mains lead. Let us know your requirements. Lists available.

PARMEKO POTTED HT TRANSFORMERS

No. 1, Pri. 115-220-230v. Sec. 400-0-400v. 400 M/A. £5.75. Carr. 75p. No. 2, Pri. 115-220-230v. Sec. 350-0-350v. 200 M/A. 6.3v. 6A., 5v. 3A., £4.50. Carr. 75p. No. 3, Pri. 115-220-230v. Sec. 330-0-330v. 200 M/A. 6.3v. 6A., 5v. 3A., £4.00. Carr. 75p. No. 4, Pri. 115-220-230v. Sec. 630-0-630v. 105 M/A. 2A., 5v. 4A. £4.50. Carr. 75p. No. 5, Pri. 200-220-240v. Sec. 250-0-250v. 320 M/A. 6.3v. 10A. £4.50. Carr. 75p.

HT TRANSFORMERS BY FAMOUS MAKERS

No. 1, Pri. 110-210-230-250v. Sec. 230v. 200 M/A. and 6.3v. 7A. Potted type. £3.00. Carr. 50p. No. 2, Pri. 110-220-240v. Sec. 250v. 80 M/A. 15v. 2A., 6.3v. 4.5A. Open type table top connections. £2.25. Carr. 35p. No. 3, Pri. 220-240v. Sec. 250-0-250v. 75 M/A. 6.3v. 3A. £1.75. Carr. 35p. No. 4, Pri. 110-220-240v. Sec. 70v. 1A. and 30v. 1A. Separate windings, potted type. £3.75. Carr. 50p. No. 5, Pri. 220-240v. Sec. 187.5v. 60 M/A and 500v. 31 M/A. Separate windings, potted type. £4.75. Carr. 75p. No. 6, Pri. 220-240v. Sec. 140v. 195v. 6.3v. 1.25A. and 50v. 1A. £3.50. Carr. 50p.

PARMEKO L.T. TRANSFORMERS

Open types. Pri. 110-220-240v. Sec. 30v 5-5 amps and 12v. 2-2 amps. Table top connections. £4.95, P.P. 75p. Pri. 240v. Sec. 26v. 10 amps and 12v. 0.1 amps. Table top connections. £5.50, P.P. 75p. Potted types. Pri. 115-230v. Sec. 24-30-32v 2 amps. £2.75, P.P. 35p. Pri. 220-240v. Sec. 50v. 0.4 amps. £1.50, P.P. 35p. Pri. 115-230v. tapped 40-45 50v 5 amp. £8.50, P.P. 75p. Pri. 115-220-230v. Sec. 6.6v. twice, and 5v. 6A. £4.75. Carr. 75p.

GARDNERS C CORE L.T. TRANSFORMERS

Table top connections. Primaries 200-220-240v. No. 1 Size 2.65-0-2.65v. 42 amps. £4.50, P.P. 70p. No. 2. 25v 10 amps and 2.5v amps twice. £3.50, P.P. 60p. No. 3. 24v 3 amps. £3.00, P.P. 40p. No. 4. 25-0-25v. 154 M/A and 7v. 1.35 amps. £1.75, P.P. 25p. No. 5. 36v 350 M/A. £1.00 P.P. 25p. No. 6. 73v. tapped at 68v. 0.6 amp and 6v. 1 amp. £3.00, P.P. 35p. No. 7. 4.2v. 1 amp. 75p. P.P. 25p.

GRESHAM MULTI TAPPED L.T. TRANSFORMERS

Pri. 110-220-240v. Sec. 21-22-23-27-28-30v 10a and 23-24-26v. 2.5A. Twice and 15-16-18v 15a Twice and 25-0-25v. m/a three times. C. core type. Table top connections £10.00, carr. £1.00.

GRESHAM E.H.T. TRANSFORMERS

Pri. 240v. Sec. 230v M/A. 6.3v. 1.5A. Table top connections. Size. 5 x3½ x 3¼ ins. £3.00. Carr. 50p.

L.T. SMOOTHING CHOKES

C core type: 140 M/H 5A £3.00, P.P. 75p. 10 M/H 25A. £8.75, carr. £1.00. 15 M/H 3.8A. £1.75, P.P. 35p. Potted types 4-6 M/H 11A. £3.00, P.P. 50p. 100 M/H 2A. £2.50, P.P. 50p. 130 M/H 1.5A. £1.00, P.P. 25p. Open type 150 M/H 3A. £3.00, P.P. 50p. 50 M/H 2A. £1.50, P.P. 25p. 4.8 M/H 10A. £2.50, P.P. 40p. Swinging types. C core. 7.5 M/H 6A-75 M/H 0.5A. £3.75, P.P. 50p. 10 M/H 4A-100 M/H 0.5A open type £2.50, P.P. 25p. 50 M/H 5A-100 M/H 0.5A C core £2.25, P.P. 35p.

AMOS "C" CORE CHOKES

10 M/H 25 amps., £8.75, carr. £1.00.

H.T. SMOOTHING CHOKES GARDNER 'C' CORE TYPES

10H 250 M/A £2.00, post. 40p. 20H 180 M/A £2.00, post. 40p. 12H 100 M/A 85p, post. 50p. 20H 25 M/A 85p, post. 25p. PARMEKO Potted types, 10H 180 M/A £2.00, post. 40p. 5.2H 350 M/A £2.50, post. 50p. 10H 300 M/A £2.50, post. 50p. 5H 100 M/A 75p, post. 25p. 15H 75 M/A 75p, post. 25p. 50H 25 M/A 75p, 25p.

HEAVY DUTY HT CHOKES

Parmeko potted type. 9 H 500 M/A 5 KV WKG. £8.50, carr. £2.00. Gardners enclosed type. 1 H 1 amp. £3.50, carr. £1.00. Gardner C core type. 10 H 350 M/A £3.00, carr. 75p.

CONSTANT VOLTAGE TRANSFORMERS

Input 240v + 20% - 10% output 240v + or - 0.5% 30 watts enclosed in metal case, 5½x4x4 ins. £2.00, P.P. 50p.

DRAKE ISOLATION 240/110V TRANSFORMERS

Pri. Tapped 10-0-200-220-240 Sec. 110v 400 watts. Shrouded. £6.50, carr. 75p. Pri. 200-220-240v. Sec. 110v 50 watts unshrouded. Table top connections. £2.25, p.p. 40p.

HOWELLS "C" CORE TRANSFORMERS

Pri. 200-220-240v. screen. Sec. 70-0-70v. 10 amp. table top connections. size 7x7x7 inches. £15.00, carr. £2.00. Pri. 220-240v. Sec. 18-0-18v. 12.5 amps conservatively rated. Table top connections £10.00, carr. £2.00.

PLEASE ADD 8% VAT TO ALL ORDERS INC. CARR.

SPECIAL OFFER OF RELAYS

Orron relays: MK2P plug-in type. 230v AC 2 CO contacts. 75p. MK3P plug-in type. 12v DC 3 CO contacts. 75p. MK2P plug-in type. 12v DC 2 CO contacts. 65p. MK3P plug-in type. 24v DC 2 CO contacts. 65p. MK3 12v DC 3 CO contacts. MK3 24v AC 3 CO contacts. Single hole fixing. 60p. Postage: 1-3 relays, 20p; 4-6, 30p.
 Keyswitch relays: KMK3 230v AC 3 CO contacts. 5 hole fixing, 60p. KMK1 230v AC 1 CO contact. 5 hole fixing, 45p. KMK3 12v AC 3 CO contacts. 5 hole fixing, 60p. Diamond H relay 230v AC 3 CO contacts. 5 hole fixing, 60p. Postage: 1-3 relays, 20p; 4-6, 30p.

RELAY CONTROL CO. American Miniature relays 6v. DC. 1 CO contact. Size 1½x1½ ins. 35p, post. 5p.

MINIATURE RELAYS. ITT, PLESSEY, VARLEY TYPES

28052 12-15v DC 4 CO, 60p. 43002 15-24v DC 2 CO, 50p. 125052 4 CO 24-30v DC, 50p. 250052 35-45v DC, 50p. 500052 40-60v DC 2 CO, 50p. Postage 5p each.

G.P.O. RELAYS

3000 type. 100v. 25 amp. make contact 60p. 2000-1300 1 normal CO 40p. 750 3M. 1B. 1 CO normal contacts 40p. post on all relays 10p.
 Diamond H relays type BR115AIT-3C. 150x2 24v DC. Sealed type. 75p, P.P. 10p.

Dorman Loadmaster SP circuit breakers type M3. AC 240-440v 20 amps. Overall size 3x2x1 ins. £1.25, P.P. 20p.

ITT LEVER SWITCHES

Type 601 AAO 72-42 4 CO contacts, overall size 1½x2½ ins. White lever gold flash contacts, 60p. Three for £1.50, post paid.

PLESSEY MINIATURE MICRO SWITCHES

Type LIC 7134. One CO one break. Gold flash contacts. Size 1½x1½ ins. Three for 50p, post paid.

MOTOR START CAPACITORS TUBULAR TYPES

4 MFD 250v AC. 2.6 MFD 500v DC. 2.5 MFD 360v AC. 2.2 MFD 250v AC. All at 50p, P.P. 10p. Eire Miniature 2-2 MFD 400v Size 1½x1½ inches. 25p post paid. TCC 8 MFD 800v DC WKG electrolytics 75p, P.P. 15p.

TRANSFORMERS

CASED TRANSFORMERS

Housed in smart resin-coated steel cases, with 3-core power, cable and outlet socket, fused primary winding. Isolation types are fitted with 3-pin outlet sockets, and are available with 110 volt or 240 volt output. (Please state) Auto types are fitted with 2-pin flat style sockets up to 500 VA. 3-pin sockets from 750 to 3000 VA. See Auto and Isolation sections for prices. Plugs extra.

SAFETY ISOLATING

Pri. 120/240V. Sec. 120/240V. Centre Tap with screen

VA (WATTS)	REF. No.	PRICE Cased	PRICE Plugs	PRICE Open	Post
60	149	7.35	0.80	4.00	0.38
100	150	8.22	0.80	4.60	0.52
200	151	10.20	0.80	7.40	0.52
250	152	11.58	0.80	8.88	0.65
350	153	14.10	0.80	10.80	0.80
500	154	15.68	0.80	12.38	1.00
750	155	24.63	1.00	18.72	1.20
1000	156	32.19	1.00	26.50	1.20
1500	157	38.18	1.00	30.34	0.8A
2000	158	45.20	1.40	34.68	0.8A
3000	159	66.50	2.40	53.35	0.8A

MINIATURE & EQUIPMENT

Primary 240V with Screen

Sec. 1	Sec. 2	Sec. 1	Sec. 2	TYPE	PRICE	Post
3-0-3	—	200	—	238	1.23	0.10
0-6	0-6	500	500	234	1.30	0.10
0-6	0-6	1000	1000	212	1.95	0.22
0-9-0	—	100	—	13	1.23	0.10
0-9	0-9	330	330	235	1.43	0.10
0-8-9	0-8-9	500	500	207	1.75	0.22
0-8-9	0-8-9	1000	1000	208	2.30	0.30
15-0-15	—	40	—	246	1.23	0.10
0-15	0-15	200	200	230	1.30	0.10
0-20-0	—	30	—	241	1.23	0.10
0-20-0	0-20	150	150	237	1.30	0.10
0-15-20	0-15-20	500	500	205	2.47	0.38
0-20	0-20	300	300	214	1.72	0.22
0-20	3500	—	No Screen	1116	3.00	0.40
20-12-0	—	700	—	221	2.31	0.30
12-20	(D.C.)	—	—	—	—	—
0-15-20	0-15-20	1000	1000	206	3.22	0.38
0-15-27	0-15-27	500	500	203	2.73	0.38
0-15-27	0-15-27	1000	1000	204	3.52	0.38

12 and 24 VOLTS PRIMARY 200-240 Volts.

AMPS	TYPE	PRICE	Post
12V	24V	—	—
0.3	0-15	242	1.34
0.5	0-25	111	1.38
1	0	213	1.58
2	1	71	2.08
4	2	18	2.58
6	3	70	3.80
8	4	108	4.20
10	5	72	4.80
12	6	116	5.01
15	6	17	6.22
20	10	115	9.47
30	15	187	11.95
40	20	232	13.26
60	30	226	15.30

30 VOLTS

PRIMARY 200/240V. SECONDARY 12, 15, 20, 24, 30V.

Ref. No.	PRICE	Post
0.5	1.72	0.22
1	2.21	0.38
2	3.26	0.38
3	4.10	0.42
4	4.68	0.52
5	5.80	0.52
6	11.7	0.52
8	8.8	0.67
10	8.9	0.67

50 VOLTS

PRIMARY 200/240V. SECONDARY 19, 25, 33, 40, 50V.

AMPS	Ref.	PRICE	Post
0.5	102	2.33	0.30
1	103	3.00	0.38
2	104	4.57	0.42
3	105	5.20	0.52
4	106	6.89	0.52
6	107	11.17	0.67
8	118	14.19	0.97
10	119	15.47	0.97

60 VOLTS

PRIMARY 200/240V. SECONDARY 24, 30, 48, 60V.

AMPS	Ref.	PRICE	Post
0.5	124	2.08	0.38
1	126	2.96	0.38
2	127	4.63	0.42
3	125	6.84	0.52
4	123	7.94	0.67
5	40	8.86	0.67
6	120	10.15	0.82
8	121	13.58	1.00
10	122	18.15	1.00
12	189	16.00	1.10

BRIDGE RECTIFIERS

ONE AMP	Price
50 P.I.V.	0.25
100 P.I.V.	0.25
200 P.I.V.	0.30
600 P.I.V.	0.30

FOUR AMP

Price	
100 P.I.V.	0.55
200 P.I.V.	0.59
400 P.I.V.	0.65
600 P.I.V.	0.75

TWO AMP

Price	
50 P.I.V.	0.35
100 P.I.V.	0.40
200 P.I.V.	0.45
400 P.I.V.	0.50

SIX AMP

Price	
50 P.I.V.	0.65
100 P.I.V.	0.70
200 P.I.V.	0.85
400 P.I.V.	0.90

POWER UNIT TYPE CC12-05

Output switched 3, 4.5, 6, 7.5, 9, 12 Volts at 500 mA DC. Operates from 240 V mains, suitable for Radios, Tape Recorders, Record Players etc. Size 7.5 x 5.0 x 14.0 cm. Price £3.95. Post 25p.

NEW! 2" AND 4" PANEL METERS

SIZE	60mm High	Wide x 40mm	SIZE	110mm High	Wide x 43mm
Deep	45mm		Deep	82mm	
Movement	1R		Movement	1R	
	Dhms			Dhms	
0-50 micro A	1250		0-50 micro A	1400	
0-100 micro A	580		0-100 micro A	730	
0-500 micro A	170		0-500 micro A	260	
0-1 mA	170		0-1 mA	200	
0-5 mA	170		0-5 mA	200	
0-10 mA	6		0-10 mA	6	
0-50 mA	0.5		0-50 mA	0.5	
0-100 mA	0.5		0-100 mA	0.5	
0-500 mA	0.5		0-500 mA	0.5	
0-1 AMP	0.5		0-1 AMP	0.5	
0-2 AMP	0.5		0-2 AMP	0.5	
0-25 Volt	15K		0-25 Volt	15K	
0-50 Volt	50K		0-50 Volt	50K	
0-300 Volt	300K		0-300 Volt	300K	
g Meter	170		g Meter	200	
VU Meter	5250		VU Meter	5250	

VU Meters are complete with detectors Modern wide view. Price 2" £3.15 Post 10p. Price 4" £3.95 Post 10p. Lamps 55p per set.

C1000 MULTI-METER

Compact General Purpose Mini Multimeter Input Resistance 100

SERVICE TRADING CO

INSULATED TERMINALS
Available in black, red, white, yellow, blue and green. New 12p



RELAYS

SIEMENS PLESSEY, etc. MINIATURE RELAYS			
1	2	3	4
52	4-8	2 c/o	70p*
58	5-9	6 c/o	80p*
185	8-12	6 M	60p*
230	9-18	2 c/o	70p*
430	15-24	4 c/o	80p*
700	12-24	2 c/o	60p*

(1) Coil ohms; (2) Working d.c. volts; (3) Contacts; (4) Price HD=Heavy Duty. All Post Paid. (*Including Base)

OPEN TYPE RELAYS

- 6 VOLT D.C.** 1 make con. 35p. Post 10p.
- 9 VOLT D.C. RELAY** 3 c/o 5 amp contacts. 70 ohm coil 75p. Post 10p.
- 12 VOLT D.C. RELAY** 3 c/o 5 amp contacts 120 ohm coil 75p. Post 10p.
- 24 VOLT D.C.** 3 c/o 600 ohm coil 75p. Post 10p. 2 HD c/o 700 ohm coil 75p. Post 10p. 4 c/o 300 ohm coil 85p. Post 10p.

ENCLOSED TYPE RELAYS

- 24 VOLT D.C.** M.f.g. ITT 3 h.d. c/o contacts 55p. Post 10p. Base 15p extra.
- 55 VOLT A.C.** 3 heavy duty c/o contacts. Price 55p. Post 10p. Base 15p.
- 100 VOLT A.C.** 2 c/o sealed type, octal base 75p. Post 10p. Base 15p.
- 240 VOLT A.C. RELAY** 240V. A.C. heavy duty 3 c/o contacts. Price 75p. Post 10p. Octal base 15p extra.
- 220/240 VOLT AC RELAY** 3 c/o 5 amp cont. Sealed M.f.g. ISKRA. £1.25. Post 10p. Base 15p extra.
- ARROW 230/240V AC** 2 c/o 15 amp contacts Amp connectors. £1.00 Post 10p.
- 110 VOLT A.C.** 2 c/o, 20 amp. £1.25 Post 10p.
- CLARE-ELLIOT Type RP 7641 G8** Miniature relay. 675 ohm coil. 24 volt D.C. 2 c/o 70p. P.P. MANY OTHERS FROM STOCK. PHONE FOR DETAILS.

BLOWER UNIT
200-240 Volt A.C. BLOWER UNIT Precision German built. Dynamically balanced, quiet, continuously rated, reversible motor. Consumption 60mA. Size 120mm. dia. x 60mm. deep. Price £3.00. Post 30p.

PRECISION CENTRIFUGAL BLOWER
Mfg. Airflow Developments Ltd., continuously rated, smooth running. 230/240v A.C. motor. £6.50. Post 50p.

SUB-MINIATURE REED RELAY 3-9 VOLT D.C.
1 make, size 1 1/2" X 1 1/2" X 1 1/2". OUTSTANDING VALUE ONLY £1.00 for six. £1.50 for ten. Post 15p. (Min. order six)

VERY SPECIAL OFFER
Miniature Roller Micro Switch, 5 amp. c/o contacts. NEW. Price 10 for £1.50. Post 10p. (Min order 10). As above less roller/lever 20 for £2.00. Post 10p. (Min. order 20). Ditto. Press to break. 20 for £1.50 Post 10p.

'HONEYWELL' PUSH BUTTON, PANEL MOUNTING MICRO SWITCH
Each bank comprises of a change-over rated at 10 amps 240 volt A.C. Black knob 1 in. dia. Fixing hole 3/8 in. Prices: 1-bank 30p, 3-bank 50p. (Illustrated) inc. P. & P. Special quotes for quantities.

COIN MECHANISM (Ex-London Transport)
Unit containing selector mechanism for 1p, 2p & 5p coins. Micro switches, relays, solenoid-operated hopper. 24 volt D.C. Precision built to high standard. Incredible VALUE at only £2.50 Post 60p.

230-250 VOLT A.C. SOLENOID
Similar in appearance to illustration. Approximately 1 1/2 lb. pull. Size of feet 1 1/8" X 1 1/8". Price £1.00 Post 15p.

24 VOLT DC SOLENOIDS
UNIT containing: 1 heavy duty solenoid approx. 25 lb. pull at 1 in. travel. 2 solenoids of approx. 1 lb. pull at 1/2 in. travel. 6 solenoids of approx. 4 oz. pull at 1/4 in. travel. Plus 1 24V D.C. 1 heavy duty 1 make relay. Price: £2.50. Post 60p. ABSOLUTE BARGAIN.

600 WATT DIMMER SWITCH
Easily fitted. Fully guaranteed by makers. Will control up to 600 watts of all lighting except fluorescent at mains voltage. Complete with simple instructions. £2.75. Post 25p

2000 WATT POWER CONTROL
For Power tools. Heating. Lighting etc. incorporating 13 amp outlet and mains lead. £8.00 Post 27p.

METERS NEW! 2 1/2 in. FLUSH ROUND
available as D.C. Amps 1, 5, 10, 15 or A.C. Amps 1, 5, 10, 15, 20. Both types £2.00. Post 15p.

VOLTMETER 0-300V. A.C. £2.00. Post 15p.

VARIABLE VOLTAGE TRANSFORMERS

Carriage extra
INPUT 230 v. A.C. 50/60
OUTPUT VARIABLE 0/260 v. A.C.
BRAND NEW. All types.
200W (1 Amp) £9.00
0.5 KVA (Max. 2 1/2 Amp) £10.00
1 KVA (Max. 5 Amp) £14.70
2 KVA (Max. 10 Amp) £28.10
3 KVA (Max. 15 Amp) £31.25
4 KVA (Max. 20 Amp) £72.50
(Max. 37.5 Amp) £102.50
1 Amp OPEN TYPE (Panel Mounting) £9.00

300 VA ISOLATING TRANSFORMER
115/230-230/230 volts. Screened. Primary two separate 0-115 volts for 115 or 230 volts output. Secondary two 115 volts at 150 VA each for 115 or 230 volts output. Can be used in series or parallel connections. Fully tropicalised Length 13.5 cm. Width 11 cm. Height 13.5 cm. Weight 15 lb. SPECIAL OFFER PRICE Only £5.00 Carr. 80p.

LT TRANSFORMERS
0, 10, 17, 18 volt @ 10 amp. £7.90 Post 60p
0, 6, 12 volt @ 20 amp. £9.00 Post 60p
0, 12, 24 volt @ 10 amp. £9.20 Post 60p
0, 6, 12, 17, 18, 20 volt @ 20 amp. £10.40 Post 60p
Other types to order at short notice—Phone your enquiries.

AUTO TRANSFORMERS
Step up step down 0-115/200/220/240 volts
At 75 watt £2.64 Post 36p. 150 watt £3.18 Post 36p. 300 watt £8.20 Post 50p. 500 watt £9.20 Post 65p. 1000 watt £12.00 Post 80p.

20 r.p.m. GEARED MOTOR
230/240 volt 20 r.p.m. motor. £1.00 Post 10p.

9/12 VOLT DC GOVERNED REVERSIBLE MOTOR
Machine-cut gear train, giving final speed of 2 r.p.m., with cam driving 3 spindle-miniature micro-switches (removable). Sub-12mm long. 6mm dia. Built to PO spec. in heavy metal tinged case. £3.75 Post 25p.

BODINE TYPE N.C.I. GEARED MOTOR
(Type 1) 71 r.p.m. torque 10 lb in. Reversible 1/70th h.p. cycle 38 amp.
(Type 2) 128 r.p.m. torque 20 lb in. Reversible 1/80th h.p. 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 £6.25 Post 50p. or less transformer £3.75 Post 40p.
These motors are ideal for rotating aerials, drawing curtains, display stands, vending machines, etc. etc.

BENDIX MAGNETIC CLUTCH
A superb example of Electro-mechanics! The main body is in two sections. The coil section is fixed and has a 3/8 in. sleeve. The drive section rotating on the outer perimeters. The uniting plate has 3/8 in. ID bearing concentric with main section and 18-tooth cog wheel. When energized transmission is extremely powerful. 24V d.c. at 240 MA. OUR PRICE JUST £2.50 Post 30p.

POWER RHEOSTATS
New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10, 25, 100, 150, 250, 500, 1k, 1.5k, 2.5k ohm. £1.70 Post 10p. 50 WATT 1.5, 10, 25, 50, 100, 500, 1k ohm. £2.10 Post 10p. 100 WATT 1/10, 25/50, 100/250/500/1k/1.5k/2.5k/5k ohm £3.30 Post 15p.
Black Silver Skirted knob calibrated in Nos. 1-9. 1 1/2 in. dia brass bush. Ideal for above Rheostats, 22p ea.

GENERAL ELECTRIC POWERGLAS TRIACS
10 amp. Glass passivated plastic Triac. Latest device from U.S.A. Long term reliability. Type SC 146E 10 amp. 500PIV. £1.00 Post 5p. (Inclusive of data and application sheet) suitable Diac 18p.

INSULATION TESTERS (NEW)
Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L 8 in., W. 4 in., H. 6 in., weight 6 lb.
500 VOLTS, 500 megohms £28.00. Post 60p.
1,000 VOLTS, 1,000 megohms £34.00. Post 60p.

VAT
All prices are subject to 8% VAT. (8p in the £)
To all orders add 8% VAT to total value of goods including carriage/packaging.

STROBE! STROBE! STROBE!

* FOUR EASY TO BUILD KITS USING XENON WHITE *
* LIGHT FLASH TUBES, SOLID STATE TIMING + *
* TRIGGERING CIRCUITS, PROVISION FOR EX- *
* TERNAL TRIGGERING. 230-250v. A.C. OPERATION. *
* RANGE OF 4 STROBE KITS FROM STOCK. *
* PRICES FROM £6.30-£22.00. SAE FOR *
* DETAILS. *

COLOUR WHEEL PROJECTOR

* Complete with oil filled *
* colour wheel. 100 watt lamp. *
* 200/240V A.C. Features ex- *
* tremely efficient optical *
* system. £20.50. Post 50p. *
* I R.P.M. MOTOR and *
* COLOUR WHEEL *
* 200/240 volt A.C. 1 r.p.m. motor, and wheel £5.60. *
* Post 40p (Motor not available separately.) *
* Extra colour effect wheels from stock. SAE for details. *

* **BIG BLACK LIGHT** *
* 400 Watt. Mercury vapour ultra violet lamp. *
* Extremely compact and powerful source of u.v. *
* Innumerable industrial applications also ideal for *
* stage, display, discos etc. P.F. ballast is essential *
* with these bulbs. Price of matched ballast and bulb *
* £16.00. Post £1. Spare bulb £7.00. Post 40p. *

* **BLACK LIGHT FLUORESCENT U.V. TUBES** *
* 2ft. 20 watt £4.25 Post 25p (For use in stan bi-pin *
* fittings.) MINI 12in. 8 watt £1.60 Post 15p. 9in. 6 *
* watt £1.30. Post 15p. Complete ballast unit and holders *
* for either 9" or 12" tube. £1.70. Post 25p. (9in. X 12in. *
* measures approx.) *

U.D.1. SINGLE CHANNEL. 750 watt MANUAL/AUTO DIMMER

* 750W Solid State Fader, with three functions. Manual *
* fade. Auto fade-up. Auto fade-down. Automatic *
* cycling up and down. Functions selected with three *
* position rocker switch. Two ranges of cycling for *
* 'Flashing' or 'Slow blending'. Ready built module 6" X 3" *
* glass fibre board incorporating 10 amp TRIAC. Two *
* or more modules for top quality colour blending and *
* flashing effects. PRICE £15.00 Post 30p. *

* **50 in 1 ELECTRONIC PROJECT KIT** *
* 50 easy to build Projects. No soldering no special tools *
* required. The Kit includes Speaker, meter, Relay, Transformer, *
* plus a host of other components and a 56-page instruction *
* leaflet. Some examples of the 50 possible Projects are: Sound *
* level Meter, 2 Transistor Radio, Amplifier etc. etc. Price £7.75 *
* post 25p (price including VAT & Post £8.64). *

'GENTS' 6" ALARM BELL
200/250 volt AC/DC. Brand New. Price: £5.00 Post 60p. (Illustrated)

'STC' 6" RED ALARM BELL
Brand New. Price: £4.00 Post 50p. 24/48V DC.

'FRACMO' 240VOLT A.C. 50 cycle SINGLE PHASE GEARED MOTOR
33 r.p.m. 30 lb. ins. Reversible, fitted with mounting feet. Brand New. £14.00 Post 60p. (Total price incl. VAT £15.77)

240 VA. C. SOLENOID OPERATED FLUID VALVE
Rated 1 p.s.i. will handle up to 7 p.s.i. Forged brass body, stainless steel core and spring 1/4 in. b.s.p. inlet/outlet. Precision made British mfg. PRICE: £2.00. Post 25p. NEW original packing

UNISELECTOR SWITCHES—NEW
4 BANK 25 WAY FULL WIPER 25 ohm coil, 24v. D.C. operation £6.90. Post 30p.
8 BANK 25 WAY FULL WIPER 25 ohm coil, 24 v. D.C. £7.90. Post 30p.
8 BANK 25 WAY FULL WIPER 24 v. D.C. operation £9.50. Post 40p.

VENNER TIME SWITCH TYPE MSQP
200/250 Volt 2-ON/2-OFF every 24 hours at any manually pre-set time. 20 amp contacts. Fitted die-cast case. Tested and in good condition £4.75 Post 25p.

A.C. MAINS TIMER UNIT
Based on an electric clock, with 25 amp. single-pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders, Lights, Electric Blankets, etc. Attractive satin copper finish. Size 135 mm X 130 mm X 60 mm. Price £2.00. Post 20p. (Total inc. VAT & Post £2.38).

PROGRAMME TIMERS
230/240 Volt A.C. 15 RPM Motors. Each cam operates a c/o micro switch. Ideal for lighting effects, animated displays etc. Ex equipment tested, similar to illustration.
2 cam model £2.00 post 30p
4 cam model £2.50 post 30p
8 cam model £4.75 post 30p
8 cam model, each cam fully adjustable. 6 r.p.m. M.f.g. by Magnetic Devices £7.50 Post 30p.

THE NEW NELSON-JONES FM TUNER



PUSH-BUTTON VARICAP DIODE TUNING
(6 Position) ('WW' JUNE '73)

Exclusive Designer Approved Kits

What are the important features to look for in an FM tuner kit? Naturally it must have an attractive appearance when built, but it must also embody the latest and best in circuit design such as:—

- MOSFET** front end for excellent cross modulation performance and low noise.
- 3 GANG** tuning for high selectivity.
- VARICAP** tuning diodes in back to back configuration for low distortion.
- CERAMIC** filters for defined IF response.
- INTEGRATED** circuit IF amplifiers for reliability and excellent limiting/AM rejection.

- PHASE LOCKED** Stereo decoder with Stereo mute, see below
- LED** line tuning indicators.
- PUSH BUTTON** tuning (with AFC disable) over the FM band (88-104).
- IC STABILISED** and S/C protected power supply.
- CABINET** double veneered against warp.

The Nelson-Jones Tuner has all of these features and many more, and more importantly the design is fully proven not just with a few prototypes but with many thousands of working tuners spread across the world.

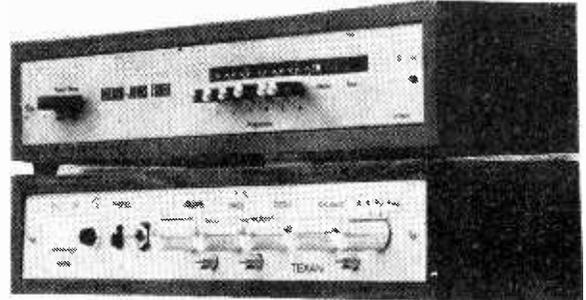
Typ. Specn: 20 dB quieting 0.75uV. Image rejection —70dB.I.F. Rejection —85 dB

Basic tuner module prices start as low as **£12.96**, with **complete** kits starting at **£26.95** (mono) + P.P. 65p, and of course all components are available separately. Our low cost **alignment service** is available to customers without access to a signal generator. Please send large SAE for our latest price lists which details all of the many options and special low prices for complete kits. All our other products remain available.

PORTUS AND HAYWOOD PHASE LOCKED DECODER (W.W. Sept. '70). Still the lowest distortion P.L. decoder available. THD typically 0.05% (at Nelson-Jones Tuner O/P level)! Supplied complete with Red LED. Price **£7.02** when bought with a **complete** N-J tuner kit or **£8.29** if bought separately (P.P. 21p.)

PLEASE NOTE. Existing tuners are readily convertible and kits/parts are available for this purpose.

TEXAN AMPLIFIER. We have designed the tuner case and metalwork to match the Texan amplifier (see photograph). Complete designer approved Texan kits are available at **£33.48** plus P.P. 65p including Teak Sleeve.



NEW LOW COST STEREO TUNER Available as basic or complete kits

Basic stereo tuner **£15** post free.
Basic mono tuner **£12** post free.
6 position push button units with integral pots **£3.24**.



No alignment required. Mullard LP1186 front end module used with Ceramic IF and IC amplifier. Push button tuning (6 position) with **Interstation Mute**, restricted range **AFC**, single LED tuning indicator, phase locked IC decoder, and complete metalwork and veneered cabinet. Complete with IC regulated PSU and full assembly instructions. (Mechanically identical to N-J Tuner.)

TYP. SPECIFICATION
2µV for 30dB S/N
Image rejection 40dB
IF rejection 65dB

PRICE Complete stereo kit **£28.42**
Complete mono kit **£24.19**
P. & P. 65p

ACCESS AND BARCLAYCARDS WELCOMED

VAT at 8% is included in all prices

INTEGREX LIMITED, Portwood Ind. Est., Church Gresley, Burton-on-Trent, Staffs DE11 9PT.

Phone Swadlincote (0283 87) 5432 Telex 377106

TAUT SUSPENSION MULTIMETERS

Made in USSR



U4312—low sensitivity high accuracy AC/DC Multimeter. 39 ranges covering AC/DC volts up to 900V and AC/DC current up to 6 amps. Mirror scale. Accuracy 1%DC, 1.5%AC.

Price £10.75

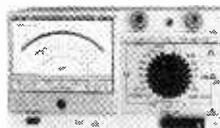
U4313—high sensitivity high accuracy AC/DC multimeter. 39 ranges covering AC/DC volts up to 600V and AC/DC amps up to 1.5A. Mirror scale. Accuracy 1.5%AC, 2.5%DC.

Price £13.80

U4315—high sensitivity medium accuracy AC/DC multimeter. 43 ranges covering AC/DC volts up to 1000V and AC/DC current up to 2.5A. Accuracy 2.5%DC, 4%AC.

Price £10.00

Note: The above instruments, although extremely resistant to overload, do not incorporate any protection.



U4317—high sensitivity high accuracy AC/DC multimeter. 42 ranges covering AC/DC volts up to 1000V and AC/DC current up to 5 amps. Mirror scale. Accuracy 1.5%DC, 2.5%DC. Meter incorporates transistorized cut-out protective relay. **Price £17.00**

POWER TRANSISTORS

OC22	0.60	ASZ15	0.80
OC23	0.60	ASZ16	0.80
OC24	0.60	ASZ17	0.80
OC25	0.50	ASZ18	0.80
OC26	0.40	BD115	0.80
OC28	0.70	BD116	0.65
OC29	0.60	BD121	0.65
OC35	0.50	BD123	0.80
OC36	0.65	BD124	0.60
AD149	0.45	BD131	0.40
AD161	0.38	BD132	0.50
AD162	0.38	BD133	0.55
ADZ11	1.25	BD135	0.30
ADZ12	1.25	BD136	0.32

AC CLAMP VOLT-AMMETER



TYPE U91

Made in USSR

Measurement ranges:

10-25-100-250-

500A 300-600V

Accuracy: 4%

Price £14.00

OUR NEW CATALOGUE COVERING VALVES, SEMICONDUCTORS, TEST EQUIPMENT AS PASSIVE COMPONENTS IS NOW READY. PLEASE SEND £0.20 FOR YOUR COPY.

LINEAR INTEGRATED CIRCUITS

—Please note reductions in prices—

Mullard TAA263. Direct coupled three stage low level amplifier for use from DC to 600 kc/s. Supply voltage 6-8v. Typical power gain 77 db. into 150Ω load. Output power 10mW. T072 four-lead encapsulation **£0.65***

Mullard TAA293. Medium frequency amplifier with frequency response of 600 kc/s. Nominal supply voltage 6v. Typical power gain 89 db. Maximum power dissipation 160 mW. Power output 10 mW into 150Ω load. T074 ten-lead encapsulation **£0.65***

Mullard TAA320. Metal oxide silicon low frequency pre-amplifier consisting of a MOST stage followed by a bi-polar transistor. Gate to source voltage 9-14v. Total power dissipation 200 mW. Drain current 1 µA. Output conductance 0.65 mmho. T018 3-lead encapsulation **£0.60***

L.E.D. TYPE HP5082/4850

Red Light GASP Light Emitting Diodes giving bright diffused light of 0.8 mcd at forward voltage of 1.6V and DC current of 20 mA. Plastic wide angle lens 0.200" diameter. Ideal for panel lights, etc. Price for 12 pieces £1.75 incl. VAT and p.&p.

1-AMP SILICON RECTIFIERS

20 pieces	1N4001	50 p.i.v.	£1.12
"	1N4002	100 p.i.v.	£1.25
"	1N4003	200 p.i.v.	£1.35
"	1N4004	400 p.i.v.	£1.45
"	1N4005	600 p.i.v.	£1.55
"	1N4006	800 p.i.v.	£1.85
"	1N4007	1000 p.i.v.	£2.10

This is a special offer and minimum quantity of 20 pcs must be ordered. These prices are inclusive of P.P. and VAT.

Prices do not include VAT and carriage except where indicated. When remitting cash with order please add £0.50 per multimeter and £0.15 per £ for other items, subject to a minimum charge of £0.25. VAT at prevailing rate should then be added to the total.

MINIMUM ACCOUNT ORDER CHARGE £10.00 PLUS VAT. OTHERWISE CASH WITH ORDER PLEASE

Z & I AERO SERVICES LTD

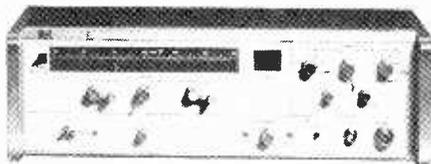
Tel. 727 5641 44A WESTBOURNE GROVE, LONDON W2 5JF Telex 261306

WW—156 FOR FURTHER DETAILS

FANTASTIC INSTRUMENT BARGAINS

In this updated list of high-quality equipment which is surplus to our present requirements we have included two excellent laboratory digital voltmeters and a limited number of DC Power Supplies. You will notice also that there are substantial price reductions. Please check the availability of instruments and ask for a quotation by telephone or telex. Equipment may be viewed by prior appointment. Calibration to BSC release may be arranged if required. Please ask for a quotation. Delivery to any destination can be arranged.

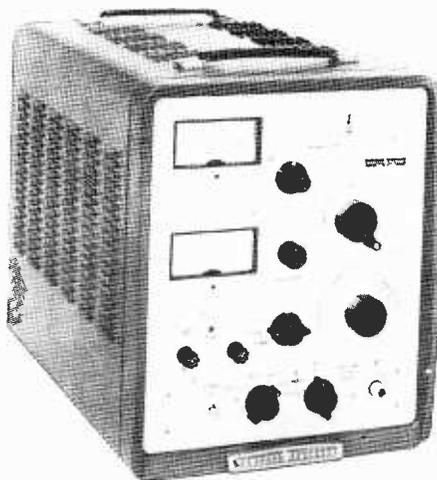
	Sale Price Range
	£
AUDIO (Professional)	
Crown	
Stereo Recorders	384.00-500.00
BRIDGES etc	
Wayne Kerr	
601Z. LCR Bridge. Wide frequency range	192.00
SR268. Source & Detector	288.00
CALCULATORS	
Canon	
Briefcase size with charger and printer	20.00
COUNTERS & TIMERS	
Hewlett Packard	
5216 12MHz. 7 Digits	320.00
5246 50MHz. 6 Digit Counters	180.00-270.00
5252A 350MHz. Pre-Scaler plug-ins	96.00-115.00
5253B 512MHz. Converter plug-ins	96.00-182.00
Marconi	
TF1417/2. 0-15MHz. 6 Digits	86.00
TF2401. Main Frames	On Application
TM7558. Plug-ins	On Application
TM8094/1.0.3-2.5GHz. Plug-ins	On Application
DEVIATION METERS	
Marconi	
TF91D. 4-1024MHz	182.00-220.00
DIGITAL VOLTMETERS	
Dana	
3800A Digital Multimeter	
0.1%. Max RDG 1999	98.00-140.00



5230 DVM. 0.02% 10µV	
Max RDG 119999	360.00-450.00
5330 DVM. 0.02% 1µV	
Max RDG 119999	590.00-640.00
Dynamco	
DM2022. DV. 0.02%	
10µV resolution-2kV	130.00-290.00
DM2140/A1/B1. Mean AC. Converters	192.00
DM2140/A1/B3. RMS AC. Converters	61.00
Hewlett Packard	
3440 and Range of plug-ins (complete)	576.00
Solartron	
LM1420. 2. DC. 0.05%	
2.5µV resolution to 1kV	96.00-190.00
LM1420. 2. BA-DC and	
RMS/Mean AC	330.00-400.00

OSCILLOSCOPES

	Sale Price Range
	£
Coscor	
CDU150. DC-35MHz.	
5mV-50V/DIV dual trace	380.00
Telegipment	
D53S with 2 X 'A' amps. Storage.	
Dual Trace	290.00
A. DC-15MHz. Single Trace	
Amplifier plug-ins	10.00-20.00
POWER SUPPLIES	
Farnell	
30/10/5.0-30V. 10A. Pre-set	40.00-50.00
SSE. 0-15V. 1A. Pre-set	22.00-40.00
Roband	
30/10. 0-30V. 10A	35.00-45.00
RECORDERS	
Bell & Howell	
5-124 Ultra Violet Light Beam. 18	
Channels (Galvos to 13kHz avail-	
able at extra charge)	60.00
6-127. As above with 12 Channels	180.00
SIGNAL SOURCES	
Advance	
SG70. Audio Oscillator.	
600 Ohms. 4 Watts	100.00-180.00



General Radio		
1362. UHF Oscillator	(both need a	80.00
1363. UHF Oscillator	power supply)	90.00
Hewlett Packard		
200CD. Audio Oscillator		30.00-60.00
612A.0.45-1.23GHz. Internal or		
External Amplitude Modulation		300.00

REMEMBER—these prices are unaffected by inflationary pressures. JUST COMPARE the 1974/75 replacement values.



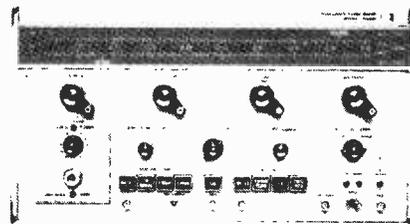
Carston Electronics Limited

Shirley House, 27 Camden Road, London NW1.
Tel: 01-267 4257

Sale Price Range

£

Marconi	
TF144H/4. 10kHz-72MHz. Xtal check	
Int/Ext. AM. 50 Ohms	290.00-320.00
TF801D/1. 10MHz-470MHz. Int/Ext.	
AM and Pulse modulation	320.00
TF2005. 20Hz-20kHz.	
Twin Oscillators	220.00-290.00
Wayne Kerr	
0.22D. 10kHz-10MHz. Video Oscillator	160.00
SPECTRUM ANALYSERS	
Hewlett Packard	
8551B/851B. 10MHz-12GHz	2,310.00
SWEEP GENERATORS	
Hewlett Packard	
8690B with 8693B. 3-7.8GHz	
plug-ins	660.00-750.00
TELEPHONE TV AND MICROWAVE	
Hewlett Packard	



423A. 12.6GHz Crystal Detectors	28.00
3701/02/03. Microwave Link Analyser	2,420.00
Marconi	
OA 2090A. White Noise Test Set	712.00
(Filters also available at extra charge)	
TF2909 TV Test Set. Grey Scale	
625 lines	Price to be advised
Richmond Hill	
TSP. TV Studio Precision Signal	
Generator Sin 2 P & B.	
Window. Staircase (Requires all	
drives)	310.00
Siemens	
REL3K53. Contact Fault Locators.	
1MHz Test signal variable levels.	
High sensitivity	95.00
STC	
74166. Milliwatt Test Sets	36.00-45.00
74184B. Selective Measuring Sets	132.00
74216. Noise Generator. 20Hz-4kHz	90.00-180.00
74306B. Oscillators 10kHz-20MHz	80.00-110.00
74600. RF Attenuators. 10 steps each	
unit total Att: 0.9; 9.0; 90.0dB	15.00
74832B. Selective Level Measuring Set	80.00-100.00
Wandel & Goltermann	
TFPS75. 1.3MHz. Selective Oscillators	140.00
TFPM43. 14MHz. Selective Meters	225.00
VZM1 Differential Phase Meters (TV)	
VZMG1 Sampling Attachments (complete)	318.00
WAVE ANALYSERS	
Airmec/Racal	
248A. 5-300MHz. Harmonic Analysers	132.00
ASSOCIATED EQUIPMENT	
Hewlett Packard	
412A. DC Electronic Multimeter	20.00
Marconi	
TFB93 Audio Power Meter 20µW-10w	90.00
TF2606 Differential Voltmeter. 0-1000V	120.00
Radiometer	
RV24. DC Electronic Multimeter	60.00
Siemens	
Multizet. RF Voltmeter 0-100V	5.00*

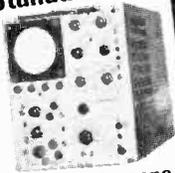
*Uncalibrated.

WHEN YOU NEED FIRST-CLASS EQUIPMENT TRY CARSTON FIRST. YOU PAY LESS AND THE SERVICE IS UNCHANGED.

BONANZA

LIMITED QUANTITY
Made to meet the most stringent Government Service Standards

DC-40MHz DUAL TRACE



Solartron C.T.484 oscilloscope.
3% accuracy. Dual Trace Displays.

DUAL TRACE Y AMPLIFIER. Bandwidth: D.C.-24 Mc/s. Rise Time: 14 nanosecs. Sensitivity: 50 mV/cm. Input Impedance: 1 M.ohm 26pF. Measuring Accuracy: ±5% direct. ±3% with calibrator.
TIME BASE. 100 nanosecs/cm-5 secs/cm or continuously variable up to 12 secs/cm. Sweep expansion X 5. Accuracy ±3%.
X AMPLIFIER. Bandwidth: D.C.-150 Kc/s. Sensitivity: 200 mV/cm and 1 V/cm. Input Impedance: 1 M.ohm 40 pF.
INTERNAL CALIBRATOR. Accuracy: ±3%.
WIDE BAND Y AMPLIFIER. PLUG ALSO AVAILABLE. Bandwidth: D.C.-40 Mc/s. Rise Time: 8 nanosecs. Sensitivity: 50 mV/cm. Input Impedance: 1M.ohm 22pF Measuring Accuracy: ±5% direct. ±3% with calibrator.
P.O.A.

£149.50

Power Supplies Various

Advance 4-15V 1 amp PM1
0-6V 5 amp PM18
15-30V 3 amp PM2
30-50V 1 amp PM3
30-50V 3 amp PM6

Coutant ACT 200/12/12
ED 200/12/12
ELV 100/6

P.O.A.

6V 25A

Power Supplies

10% VARIABLE VOLTAGE HIGH CURRENT HIGH STABILITY HIGH RELIABILITY

These power supplies were designed for continuous operation in computer equipment. Manufactured to highest engineering standard for long-term reliability and stability. Independent voltage and current meters. C Core Transformer.
Manufacturer's price probably in excess of £200.

£25

FABULOUS RANGE OF SIGNAL GENERATORS

H.P. VHF Signal Gen. 608B
10MHz to 400MHz **£175**
H.P. UHF Signal Gen. 612A
450MHz to 1250MHz **£495**
H.P. UHF Signal Gen. 614A
800MHz to 2100MHz **£225**
H.P. Sweep Oscillator 693D
4GHz to 8GHz **£450**
801B.3 **£155**
TF10D **£275**
General Radio UHF Unit Oscillator
+ PSU 250MHz to 960MHz p.o.a.
Marconi PHM/AM Signal Generator TF2003 400KHz to 12.5MHz p.o.a.
Marconi 801A as is **£25.00**
CALLERS ONLY. NO GUARANTEE

NEW TOUCHLESS RETRO-REFLECTIVE TACHOMETER

FEATURES

- Reads RPM from as far as 24" away!
- Four ranges: 0-1,000, 3,000, 10,000, 30,000 RPM*
- Instant field calibration
- Reads low or high speed on any type of machinery
- Battery powered—built-in voltage checker
- "Touchless" (no torque loss) measurements
- Direct reading, mirror type scale
- Hand portable (only 32 oz.) (0.9 Kg)
- Accuracy: 1% if full scale
- Aluminium case—baked enamel finish
- Reads on marked shafts as small as 1/16 dia.
- Marking tape provided
- Complete solid-state circuitry
- Push-button reading
- Hidden probe cable, extends to 24" (60cm)



ONLY £89.50

MULTI OUTPUT POWER SUPPLIES Ex-Computer offered at mere fraction of original manufacturer's cost.

APT 13334 Mk III
Input 200/240V. +10V -5Amp. -10V -2Amp. +24V -2Amp. +20V -5Amp. -20V -2Amp. **PRICE £19.50**

Advances DC197
6V 7.5Amp. 6V 11Amp. 28V 9Amp. **PRICE £35**

BRAND NEW MINIATURISED STRIP CHART RECORDER BY RUSTRAK Model 88

This recorder indicates the magnitude of applied currents of voltages by a continuous distortion free line on pressure sensitive paper. Moving coil movement scale calibrated 1 milliamp D.C. internal resistance 100 ohms. Chart Drive motor 240V 50Hz.
Chart speeds 90" per hour **£39**
1" per hour **£45** or 6" or 12"

SINGLE PEN RECORDER by Record Electrical

3" chart sensitivity 1 milliamp chart speed 1 and 6" per hr. Size 8" x 11" x 6". Offered complete with pen assembly. Listed at over £120—this month's special price due to bulk purchase.

1mA version **£50**
500µA version **£60**

AC CLAMP VOLTAMMETER

Clamp-on Voltammeter is used for measurements of AC voltages and currents without breaking circuits.

Specification

Measurement ranges:—Current 10-25-100-250-500 Amps. Voltage 300, 600 V. Accuracy 4%. Scale length 60mm. Overall dimensions 283x94x36mm. Weight 1.5 lbs.

£12.50

Combined Stroboscope-Tachometer. 200 to 6000 flashes per minute. 200 to 6000 r.p.m. Accuracy 3% or better. Beam angle 80°. Flash Duration: 10 to 25 microseconds. Light colour Xenon white 500°. Compact lightweight (27 oz.) easy to use on/off and on switch.

Potentiometers

TEN TURN 360° ROTATION

Res Ohms	Linearity Per cent	Manufacturers	Model	Price
50	0.5	Beckman	ARS	£2.25
100	0.5	Beckman	A.S.	£2.00
200	0.5	Beckman	A.	£2.00
500	0.1	Beckman	S.	£2.50
500	1.0	Relicon	HEL107-10	£2.25
2K	0.5	Beckman	SA1101	£3.00
2K	0-25	Beckman	721B	£3.00
2K		Reliance	GPM15	£2.00
2K		General Controls	GPA15/4	£2.00
5K		Relicon	07-10	£2.50
5K		Colvern	CLR2503	£3.00
10K	0-1	Beckman X	A.	£3.50
15K		Colvern	CLR2402	£3.00
25K	0-5	Helipot	SAJ337	£3.00
30K	0-1	Beckman	A 88	£3.50
30K	0.5	Beckman	SA1692	£3.00
50K		Reliance	07-10	£2.25
50K	0-5	Beckman	07.5	£2.25
100K	0.1	Beckman	A	£3.00
100K		Beckman	A	£3.50
		Colvern	2501	£2.25

THREE TURN 780° ROTATION

100/100 Beckman Type C **£3.00**

FIFTEEN TURN 5400° ROTATION

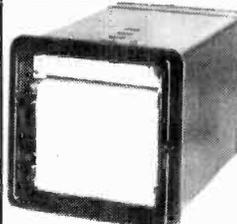
25K/25K Beckman B 10 watts **£6.50**
46K/46K Beckman B 10 watts **£6.50**

NEW "Strobette" STROBOSCOPE-TACHOMETER



ONLY £49.50

FANTASTIC BUYS IN PEN RECORDERS



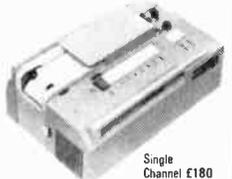
10 CHANNEL EVENT RECORDER

Response time 100 milliseconds. Chart width 110mm. Chart length 50ft. Inv. capacity 72 hours. Chart speeds 20-60-180-600-1800-5400 mm/hour. Size 160 x 160 x 255mm. Weight 9 lbs. Price complete with accessories.

£52.00

HIGH SPEED PEN RECORDER

Chart length 175 ft. Footage indicator. Width of recording channel 80mm. Chart speeds (selected by push buttons) 1.2-6-12-30-60-120-300-500-3000mm per minute. Full deflection current 8mA. Internal impedance 210 ohms. External impedance 800 ohms. Dimensions 320x340x175mm. Weight 35 lbs. Price complete with accessories.



PORTABLE AC/DC RECORDING VOLTMETER

Fitted with separate zero-marking pen. Accuracy 1.5% DC. 2.5% AC. Measurements ranges—AC and DC: 5-15-150-250-500mA 1.5-5 Amps 5-15-50-150-250-500V. DC only 150mV. Frequency range 45 to 1000 c/s. Chart width 100mm. Chart speeds 20-60-180-600-1800-5400 mm/hour. Price complete with accessories.

£78.00



MINIATURE PEN RECORDER

Chart width 80mm. Chart length 40ft. Chart speeds: Slow 20-80-180 mm/hour. Fast 600-1800-5400 mm/hour. Dimensions 120x120x285mm. Weight 7.7 lbs. (3.5 Kg). Price complete with accessories.



£39.00

Carriage and packing charge extra on all items unless otherwise stated.

Please note: all instruments offered are second-hand and tested and guaranteed 12 months unless otherwise stated.

NEW CATALOGUE AVAILABLE EARLY IN THE NEW YEAR. WRITE IF YOU WISH TO RECEIVE A COPY. ADD 8% VAT TO ALL PRICES

ELECTRONIC BROKERS LIMITED

49-53 Pancras Road, London NW1 2QB. Telephone 01-837 7781

PROMPT DESPATCH MAIL ORDER. CALLERS WELCOME MON-FRI 9 A.M. to 5.30 P.M.

ALL MAIL ORDER BY RETURN. C.O.D. SERVICE WELCOME

C. T. ELECTRONICS

We are open from 9.30 a.m.—6.00 p.m. Monday-Saturday

V.A.T.
Unless otherwise stated all prices are EXCLUSIVE of V.A.T. Please add 8% to all orders. Carriage: orders under £5 plus 20p. Over £5 post free.

All mail order and enquiries to 270 Acton Lane, Chiswick, London, W4 5DG. Tel: 01-994 6275

SEMICONDUCTORS

AC107	35p	BCY32	95p	MM1712	60p
AC125	25p	BCY34	60p	MPF102	45p
AC126	25p	BCY33	65p	MPF103	
AC127	27p	BCY39	£1.00	(2N5457)	35p
AC128	25p	BCY55	£1.50	MPF104	
AC178	25p	BCY70	22p	(2N5458)	35p
AC188	30p	BCY71	22p	MPF105	
ACY17	23p	BCY72	22p	(2N5459)	40p
ACY18	30p	BD121	75p	OA47	10p
ACY19	30p	BD123	75p	OA70	10p
ACY20	25p	BD124	65p	OA73	10p
ACY21	30p	BD131	40p	OA81	10p
AD140	60p	BD132	50p	OA90	10p
AD142	50p	BD153	75p	OA91	10p
AD149	60p	BD156	75p	OA200	10p
AD161	44p	BDY11	£1.40	OA210	10p
AD162	44p	BDY17	£1.60	OA211	35p
AF14	23p	BDY19	£1.9	OC216	90p
AF115	25p	BDY20	£1.40	OC219	85p
AF116	25p	BF152	20p	OC22	35p
AF117	25p	BF194	14p	OC26	65p
AF118	60p	BF195	15p	OC28	60p
AS221	60p	BF196	15p	OC35	30p
AS223	30p	BF197	20p	OC36	65p
BA102	35p	BF200	30p	OC42	40p
BA103	35p	BF203	30p	OC44	20p
BA112	50p	BF224J	30p	OC45	25p
BA114	16p	BFX29	30p	OC70	15p
BA156	15p	BFX34	30p	OC71	12p
BC107	12p	BFX85	30p	OC72	20p
BC108	12p	BFX86	30p	OC75	25p
BC109	14p	BFX88	30p	OC77	40p
BC113	15p	BFY10	35p	OC81	25p
BC115	15p	BFY44	50p	OC82	25p
BC116	16p	BFY50	25p	OC84	25p
BC117	20p	BFY51	25p	OC84	25p
BC118	12p	BFY52	25p	OC139	30p
BC147	11p	BFY53	25p	OC170	23p
BC148	11p	BFY90	65p	OC171	30p
BC149	12p	BSW63	65p	OC200	60p
BC153	15p	BSW68	80p	OC201	60p
BC157	14p	BY127	20p	OC202	75p
BC158	15p	BY164	65p	OC207	75p
BC169	15p	IS100	15p	TIP29A	45p
BC182	12p	IS103	15p	TIP30	55p
BC183	12p	MJ340	50p	TIP31A	37p
BC184	14p	MJ481	95p	TIP32A	80p
BC186	25p	MJ2801	£1.23	TIP33A	£1.00
BC212	14p	MJ2901	£1.85	TIP34A	£1.40
BC218	16p	MJE340	50p	TIP35A	£3.20
BC213	14p	MJE370	75p	TIP36A	£3.50
BC214	14p	MJE371	90p	TIP41A	70p
BC301	25p	MJE520	65p	TIP42A	85p
BC302	25p	MJE2955	£1.20	TIP29B	54p
BC303	40p	MJE3055	75p	TIP30B	60p
BCY30	40p	MM1613	45p		
BCY31	55p				

QTY. DISCOUNTS: 12+ 10%; 25+ 15%; 100+ 20%

METAL BOXES

2N2218	25p
2N2219	23p
2N2220	20p
2N2221	20p
2N2222A	25p
2N2336	70p
2N2477	30p
2N2640	50p
2N2646	£1.50
2N2904	25p
2N2906	25p
2N2907	23p
2N2926	12p
2N3053	23p
2N3054	50p
2N3055	65p
2N3232	70p
2N3255	85p
2N3643	30p
2N3702	14p
2N3703	12p
2N3704	12p
2N3705	12p
2N3706	12p
2N3707	12p
2N3708	12p
2N3709	12p
2N3771	£1.70
2N3772	£2.00
2N3773	£2.50
2N3519	35p
2N3220	35p
2N3366	85p
2N3904	22p
2N3905	22p
2N4058	12p
2N4059	12p
2N4060	12p
2N4061	12p
2N4126	17p
2N4286	15p
2N4287	15p
2N4288	15p
2N4289	15p
2N4290	15p
2N4444	£1.90
2N4871	35p
2N5069	£1.10
2N5191	90p
2N5194	£1.10
40360	50p
40361	50p
40362	50p
40689	90p
40678	70p
D5151	£1.00

ALUMINIUM BOXES WITH SLOPING TOP PANEL—IDEAL FOR PRE-AMPS, ETC., USING SLIDER CONTROLS
 AB20 8" Long 9" Wide 3 1/2" High at back 2" High at front 6" Slope to front with P.K. Screws £2.20
 AB21 As above but 10" Long £2.20
 AB22 As above but 12" Long £2.60

ELECTRONIC COMPONENTS

BARGAIN COMPONENT PACKS ALL COMPONENTS NEW & UNUSED
 £1 plus 25p p.p. per pack, £5 for 5 packs p/fee Pack No.
 1 500 Carbon resistors, 1/2, 1, 2 watt.
 2 100 Electrolytic Condensers.
 3 250 Ceramic, Polystyrene, Silver Mica, etc., Condensers.
 4 250 Polyester, Polycarbonate, Paper, etc., Condensers.
 5 25 Potentiometers, assorted.
 6 250 High-stab. 1%, 2%, 5% resistors.
 7 50 Assorted Tagstrips.
 8 1lb. Assorted nuts, bolts, washers, spacers, etc.
 9 25 Assorted switches, rotary, lever, micro, toggled, etc.
 10 50 Preset-Potentiometers.
 11 Trial mixed component pack £1.
 12 Jumbo mixed pack £5.

POTENTIOMETERS
 Linear or Log Single Double
 Rotary Pots 15p 42p
 Rotary Switched 25p —

★★SPECIAL OFFERS★★

MINIATURE MAINS TRANSFORMER.
 PRI 240V. SEC. 12V, 100MA. Manuf.: Hinchley
 Size: 36 x 45 x 40mm. F.C. 53mm.
 Price 1-45p. 100-60p. ea. 1,000-50p. ea. 10,000-40p. ea.

3 CORE PVC INSULATED MAINS CABLE.
 GREY ML6650, 3 x 7/0-2mm. Price 100m-£4.50.
 1,000m-£35. 10,000m-£330.

0.47 mfd. 50V MYLAR FILM CAPACITOR.
 Size: 1" x 0.33" x 0.65" P.C. Mount. Price 100-4p ea. 1,000-3p. ea.

240V. A.C. SOLENOID. Reversible operation; twin coil. Size approx. 2 1/2 x 1 1/2 x 1 1/2 in. 90p ea. 33 unmarked OCT71 transistors £1.00
 25 Unmarked 250mW Zener diodes, 4-7V, 5-1V, 6-2V, 7-5V, 9-1V, 10V, Measured and tested £1.00
 Please state voltage required. £1.00
 50 GE Diode OA47 equivalent. £1.00

TRANSFORMER: DOUGLAS PRI, 0, 115, 200, 220, 240 SEC. 25-0-25-0-6V, 21A, £4.50 + 50p p.p.

TRANSFORMER
 PRI. 0, 115, 160, 205, 225, 245. SEC. 35-0-35, 1-2A £4.50 + 50p p.p.

MULTICORE CABLE. 25-way, individually screened, 14/0076. £1.00 per yard + V.A.T. Postage by weight.

IMHOFF 19" RACKING CABINETS. 13 1/2" high, 22" wide, 13" deep. Brand new. £10.00 each + V.A.T. Carriage £1.00.

SIEMENS CONTRACTORS. Over 1,000 in stock. All types. Phone or write for details.

METAL OXIDE RESISTORS TR45/5 in stock. All values. 1-off price 3p each. Discount on quantity.

10 TURN TRIMPOTS by Bourns, Mec, Palnton, etc. All values in stock. 50p each. Discount on quantity. £1.00 ea.

DIGITAL INTEGRATED CIRCUITS

SN7400	18p	SN7410	18p	SN7427	42p	SN7443	£1.00
SN7401	18p	SN7411	23p	SN7428	50p	SN7445	£1.70
SN7402	20p	SN7412	22p	SN7430	20p	SN7446	£2.00
SN7403	20p	SN7413	40p	SN7432	42p	SN7447	£1.90
SN7404	20p	SN7415	30p	SN7433	70p	SN7448	£1.75
SN7405	20p	SN7417	30p	SN7437	50p	SN7450	20p
SN7406	30p	SN7420	20p	SN7438	50p	SN7451	20p
SN7407	30p	SN7422	30p	SN7440	20p	SN7453	20p
SN7408	20p	SN7423	30p	SN7441AN	75p	SN7454	20p
SN7409	40p	SN7425	30p	SN7442	75p	SN7460	20p

LINEAR I.C.s

LM309K	5V. 1A. Voltage Reg. £2.10
LM723C	2-37V. 150mA Voltage Reg. £1.95
MFC4000	250mW Audio £1.75
TBA800	5 Watt Audio £1.50
703C	Op Amp D.I.L./TO39 £4.50
741C	Op Amp £1.14
D.I.L./TO39	35p
748C	Op Amp D.I.L. £1.75
747C	Dual Op Amp £1.20
2N414	Radio I.C. £1.25
FAD100	Radio I.C. Inc. Filter £1.90
CA3014	£1.55
CA3018	£1.00
CA3028	£1.20
CA3036	£1.90
CA3046	£1.50
CA3048	£2.35
CA3075	£1.60
CA3090Q	£4.85
MC1303L	£2.20
MC1310P	£2.80

TO3 VOLTAGE REGULATORS

L005	5V 650mA
L036	12V 600mA
L037	15V 450mA

TO3 VOLTAGE REGULATORS

L005	5V 650mA
L036	12V 600mA
L037	15V 450mA



P.B. ELECTRONICS LTD.

SCOTLAND

57 HIGH STREET, SAFFRON WALDEN, ESSEX TEL: (0799) 22876 TELEX: 817201

62 LARGO ROAD, ST. ANDREWS, FIFE, SCOTLAND TEL: ST. ANDREWS 2641 TELEX: 76404

HALF PRICE OFFER FIBRE GLASS CIRCUIT BOARD

BOARD SIZE	RESIST COATED FIBRE GLASS RESIST COATED												PAPER	
	5/64" or 3/32" or 1/8"—1 oz				1/32"—1 oz				1/16"—1 oz				1/16"—1 oz	
	Single Sided		Double Sided		Single Sided		Double Sided		Single Sided		Double Sided		Single Sided	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
75mm x 100mm	14p	12p	15p	13p	8p	8p	8p	8p	16p	15p	14p	13p	8p	8p
100mm x 150mm	27p	24p	29p	26p	15p	14p	19p	15p	33p	30p	29p	26p	15p	14p
150mm x 200mm	53p	48p	56p	51p	30p	27p	37p	30p	66p	60p	60p	54p	30p	27p
200mm x 250mm	88p	80p	92p	84p	51p	45p	63p	51p	£1.10	£1.00	£1.02	92p	51p	45p
250mm x 250mm	£1.10	£1.00	£1.15	£1.05	65p	55p	80p	65p	£1.38	£1.25	£1.30	£1.15	65p	55p
12" x 6"	80p	70p	85p	75p	55p	45p	65p	55p	£1.00	90p	£1.10	£1.00	55p	45p
12" x 12"	£1.60	£1.40	£1.65	£1.45	£1.05	85p	£1.25	£1.05	£1.95	£1.75	£2.10	£1.90	£1.05	85p

Extra Discounts 5 sheets 5%, 10 sheets 10%, 20 sheets 20%, 50 sheets and above 30%.
 All goods add 8% VAT + post and packing 30p. 10 sheets or more free. Hurry limited stocks delivery subject to availability. Prices may be changed without notice.
 P.S. We also specialise in printed circuit board manufacture. Lowest prices, fastest delivery.

FRENCH RADIO-ELECTRONIC WHOLESALE

would like to buy in Great Britain

ELECTRONIC COMPONENTS: Valves, Semi-conductors, Capacitors.

ACCESSORIES: Radios, Radiograms, Tape recorders, Audio leads, Plugs, Jacks, Stereo headphones, etc.

We are interested in buying HI-FI equipment, Stereo, Tape recorders, Pocket radios, etc.

S. A. CERUTTI & CIE

201/203 Bd Victor Hugo, 59000 LILLE, FRANCE

Robotics

John F. Young

The object of this book is to present a comprehensive and orderly account of the principles and practice of robotics. It will provide a valuable source of reference for research workers and those in related fields.

1973 304 pp., illustrated 0408705222 £6.00

Obtainable through any bookseller or from

NEWNES-BUTTERWORTH

Borough Green, Sevenoaks,
Kent TN15 8PH. Tel. Borough Green 2247.



PETITE PRECISION!

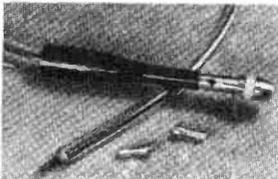
A 12V DC POWER TOOL FOR THE DESIGN
AND RESEARCH ENGINEER

AVAILABLE IN KIT FORM OR SEPARATES



Diameter 33mm
Weight 160g
Length 125mm
Torque 105cmg
RPM approx 3000 at 12V DC
Power 9/14V DC Batteries or AC/DC transformer

PRECISION EXAMPLE OF FRENCH ENGINEERING



Now in use by the following:
GPO, BBC, Atomic Energy Authority, British Nuclear Fuels, Weekend TV, Ministry of Defence, Hospitals, Opticians, etc.

UK DISTRIBUTOR

PRECISION PETITE LTD
(Les Applications Rationnelles Paris)

119A HIGH STREET, TEDDINGTON,
MIDDX, UK.
TEL. 01-977 0878

SAE for leaflets, price list and order form



THESE DATES ARE NOW MORE IMPORTANT THAN EVER

APRIL 11-12-13

HEATHROW HOTEL LONDON AIRPORT

HIGH FIDELITY 75

THE ONLY SPRING HI-FI EXHIBITION

FRIDAY APRIL 11 10AM-8PM
SATURDAY APRIL 12 10AM-8PM
SUNDAY APRIL 13 11AM-6PM

See and hear a wide variety of leading brand names in the spacious comfort of the Heathrow Hotel. The list of famous names to be seen and heard at High Fidelity 75 includes: -

ALPHA AKG	FISHER HARMAN KARDON	NIPPON SOUND PICKERING POLY PLANER QUASAR REVOX SALORA SANSUI SENNHEISER SERVO SOUND STANTON STAX. TEAC
AR LOUDSPEAKERS	ISOPHON JBL JMR	TDK TAPES TOSHIBA TRIO VIDEOTONE WHARFEDALE YAMAHA
ATRON BIB BOSE	KENSONIC ACCUPHASE	
CAMBRIDGE AUDIO	KLH LEAK LENTEK MARANTZ MARSDEN HALL MONITOR AUDIO	
CELESTION DENON EAGLE ESS	EPI MICROTOWER	
	NAD NAKAMICHI	

LASKEYS SOUND ADVICE BUREAU

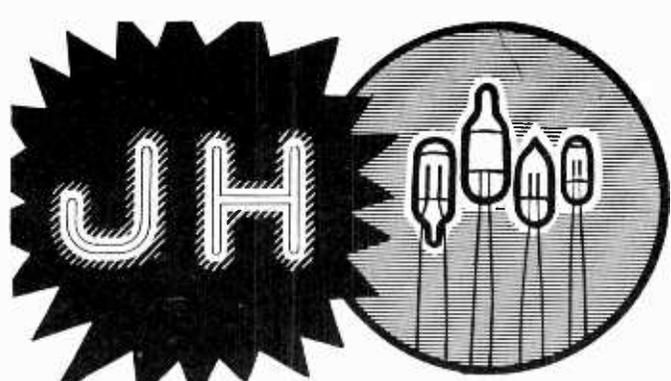
- * No parking problems.
- * Continuous free bus service to and from Hounslow West tube station.
- * Choice of bars and restaurants.

AC125 11p AC126 11p AC127 11p AC128 11p AC141 18p AC142 18p AC176 11p AC187 12p AC188 11p AD140 46p AD142 55p AD143 50p AD149 43p AD161 36p AD162 36p AF14 13p AF15 13p AF16 13p AF17 13p AF18 50p AF121 33p AF124 30p AF125 30p AF126 30p AF127 30p AF139 33p AF181 45p AF186 48p AF239 38p BC107 9p BC108 9p BC109 10p BC115 20p BC135 17p BC136 17p BC137 17p BC138 17p	BC142 35p BC143 35p BC148 7p BC149C 8p BC157 8p BC158 12p BC159 12p BC169C 12p BC171 12p BC177 18p BC178 17p BC179 18p BC182 10p BC183 10p BC184 11p BC212 11p BC213 10p BC214 14p BC237 12p BC238 11p BC239 12p BC307 11p BC308 11p BC309 12p BCY70 18p BCY71 22p BD115 55p BD121 100p BD123 100p BD124 65p BD131 40p BD132 45p BD153 65p BD156 60p BDY60 75p BDY61 65p	BF115 22p BF167 23p BF170 23p BF173 25p BF177 26p BF178 26p BF179 33p BF180 33p BF181 33p BF182 33p BF184 22p BF185 22p BF194 11p BF195 12p BF196 14p BF197 15p BF200 32p BF257 32p BFR39 30p BFR40 30p BFR41 30p BFR49 30p BFR80 30p BFR81 30p BFR82 30p BFX29 30p BFX30 30p BFX84 26p BFX87 20p BFX88 24p BFY50 14p BFY51 14p BFY52 14p BSX19 16p BSX20 16p BSX21 22p BU105 22p M1490 95p	M1491 130p M1E340 45p M1E370 72p M1E371 84p M1E520 68p M1E521 80p M1E2955 95p M1E3055 65p MPSA12 50p MPSA06 30p MPSA56 32p MPSU06 62p MPSU66 78p OC26 40p OC28 55p OC35 48p OC36 52p OC41 15p OC42 15p OC44 11p OC45 11p OC70 11p OC71 11p OC72 11p OC73 50p OC74 30p OC81 12p OC82 12p OC83 20p OC84 18p OC200 50p OC201 50p TIP41A 65p TIP42A 70p TIP2955 70p ZTX107 12p ZTX108 10p	ZTX109 13p ZTX300 14p ZTX301 14p ZTX302 18p ZTX303 15p ZTX304 24p ZTX500 15p ZTX501 15p ZTX502 19p ZTX503 45p 2N404 26p 2N696 15p 2N697 13p 2N698 30p 2N706 12p 2N708 18p 2N914 18p 2N918 40p 2N929 20p 2N930 18p 2N1131 18p 2N1132 18p 2N1302/3 17p 2N1304/5 21p 2N1306/7 170p 2N1308/9 180p 2N1377/3 26p 2N1613 20p 2N1711 20p 2N2218 21p 2N2219 20p 2N2220 19p 2N2221 20p 2N2222 20p	2N2369 14p 2N2484 30p 2N2905 18p 2N2905 18p 2N2906 20p 2N2926RB 7p 2N29260 8p 2N2926YG 9p 2N3053 18p 2N3054 45p 2N3055 49p 2N3441 80p 2N3442 140p 2N3702/3 11p 2N3704/5 11p 2N3705/6 10p 2N3707 11p 2N3708/9 9p 2N3771 170p 2N3772 180p 2N3773 220p 2N3866 70p 2N3903/4 15p 2N3905/6 15p 2N4058 15p	2N4059 10p 2N4060 13p 40360 35p 40361 36p 40362 38p 40409 50p 40410 50p 40411 200p 40594 65p 40595 75p 40600 69p	SIGNAL DIODES BA100 10p BAX13 5p BAX16 6p OA47 7p OA70 9p OA79 10p OA81 8p OA85 10p OA90 7p OA91 7p OA95 7p OA200 8p OA202 10p IN914 4p IN916 6p IN4148 4p	RECTIFIER DIODES BY100 15p BY126 12p BY127 12p BY133 15p BYZ10 55p BYZ11 55p BYZ12 55p IN4001 5p IN4004 6p IN4007 7p PL4004 10p PL7004 20p	ZENER DIODES 3.3V to 33V 400mW 9p 1.3W 18p 1.5W 27p 10W 55p 20W 70p	OTHER BA145 15p BA148 13p TUNNEL AEY11 50p Varicap BB105 25p Low Noise ZIJ 75p	BRIDGE RECTIFIERS 50V 100V 400V 600V 250mA 16p — — — 3 Amp 22p 24p 27p 30p 2 Amp 30p 35p 45p 48p 6 Amp 55p 60p 78p	SCR—THYRISTORS 50V 100V 400V 600V 1 Amp 42p 48p 60p 78p 3 Amp 43p 49p 78p — 7 Amp — 80p 84p — 16 Amp — 82p 98p —	TRIACS 100V 400V 500V 3 Amp 85p 99p 120p 6 Amp 88p 120p 150p 10 Amp 109p 154p 165p 16 Amp 145p 180p 200p Other 40430 90p, 40486 75p, 40669 95p, DIAC. For use with above triacs 21p.																
TTL 74 SERIES INTEGRATED CIRCUITS 7400 14p 7425 37p 7475 48p 7401 15p 7427 37p 7476 34p 7402 15p 7430 14p 7480 65p 7403 18p 7432 30p 7482 87p 7404 18p 7437 37p 7483 120p 7405 20p 7440 20p 7485 140p 7406 42p 7441 70p 7486 41p 7407 42p 7442 70p 7489 340p 7408 18p 7445 216p 7490 45p 7409 28p 7447 85p 7491 80p 7410 14p 7448 90p 7492 50p 7412 30p 7450 20p 7493 45p 7413 30p 7451 20p 74100 200p 7414 72p 7460 20p 74107 45p 7416 33p 7470 30p 74121 34p 7417 36p 7472 27p 74122 76p 7420 14p 7473 36p 74141 75p 7422 25p 7474 34p 74142 250p					CA3048 Transistor Array 50p LM301 Op Amp with ext comp 8 PIN DIL 40p LM307 Op Amp with int. comp. 50p LM3900 Quad "current mirror" Amp. 75p MC1312 4 channel SQ Decoder 220p MC3401 Quad Op Amp +ve rail only 75p MF0800 Electronic Attenuator 90p MFC8070 Zero Voltage Switch 250p NE536 FET Op Amp TO99 182p NE555 Timer 8 PIN DIL 50p NE556 Dual 555 14 PIN DIL 100p NE560 Phase Lock Loop 16 PIN DIL 325p NE561 PLL with Am Demod 16 PIN DIL 290p NE562 PLL with VCO 16 PIN DIL 290p NE565 Precision PLL 14 PIN DIL 290p NE566 PLL Function Generator 8 PIN DIL 200p NE567 PLL Tone Decoder 8 PIN DIL 250p 709 Op Amp with ext comp 8/14 PIN DIL 26p 710 Diff. Voltage Comp 14 PIN DIL 35p 741 Op Amp with int comp 8 PIN DIL 25p 747 Dual 747 14 PIN DIL 70p 748 Op Amp with ext comp 8 PIN DIL 38p ZN414 TRF Radio Receiver 110p ICL8038 VCO Function Gen. 14 PIN DIL 290p					C-MOS LOGIC ICs—NEW LOW PRICES CD4001AE 37p CD40012AE 37p CD40013AE 37p CD40013AE 67p CD40017AE 84p CD40017AE 183p CD40018AE 250p CD40020AE 253p CD40023AE 37p CD40024AE 148p CD40025AE 37p CD40027AE 198p CD40028AE 325p CD40030AE 82p CD40046AE 199p CD40047AE 154p					Fixed VOLTAGE REGULATORS Positive: 1 Amp Plastic 12V MC7805 140p LM340-05 175p — 200 mA (TO5) 15V MC7812 140p LM340-12 175p 7812 90p 15V MC7815 140p LM340-15 175p 7815 90p 18V MC7818 140p LM340-18 175p — 24V MC7824 140p LM340-24 175p — Negative: 1 Amp Plastic 5V MC7905 250p 18V MC7918 250p 12V MC7912 250p 24V MC7924 250p 15V MC7915 250p					OPTO-ELECTRONICS OCP70 40p ORP12 50p Red LED 16p OCP71 85p ORP60 55p Green/Yell 35p 2N5777 40p ORP61 55p					ACCESSORIES Low Profile DIL Sockets by Texas 8 pin 12p 14 pin 13p 16 pin 14p Mica — 2 Bushes (for TO-3 & TO-66) 5p Data sheets on advertised I.C.s 10p each				

Minimum Order £2 P. & P. 15p Please add 8% VAT to total

All goods brand new Visitors, by appointment, welcome. Colleges, schools, etc. orders welcome.

TECHNOMATIC LIMITED
54 SANDHURST ROAD, LONDON NW9 Tel: 01-204-4333

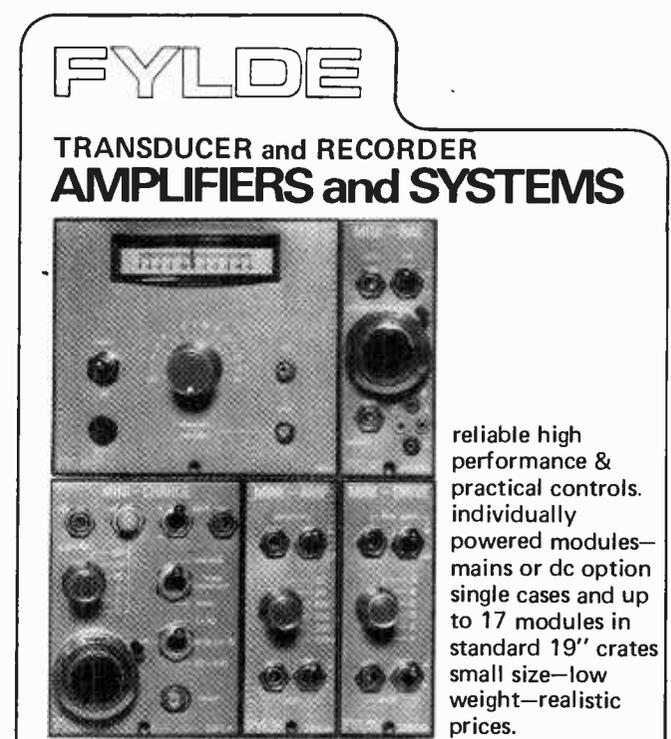


indicator lamps and light sources

Miniature **Specials**
Lens Ended Green Fluorescent Wire Ended

*For industrial use in instruments on circuit boards.
*For domestic use as indicators on washing machines, amplifiers, door bells.
*Long life, high reliability * Low current drain * Small size

JH Associates Ltd Sales Office: 52 Silver Street, Stansted, Essex. (0279) 814929



FYLDE

TRANSDUCER and RECORDER AMPLIFIERS and SYSTEMS

reliable high performance & practical controls. individually powered modules—mains or dc option single cases and up to 17 modules in standard 19" crates small size—low weight—realistic prices.

FYLDE

Fylde Electronic Laboratories Limited.
49/51 Fylde Road Preston PR1 2XQ
Telephone 0772 57560

APPOINTMENTS VACANT

DISPLAYED APPOINTMENTS VACANT: £6.08 per single col. centimetre (min. 3cm).

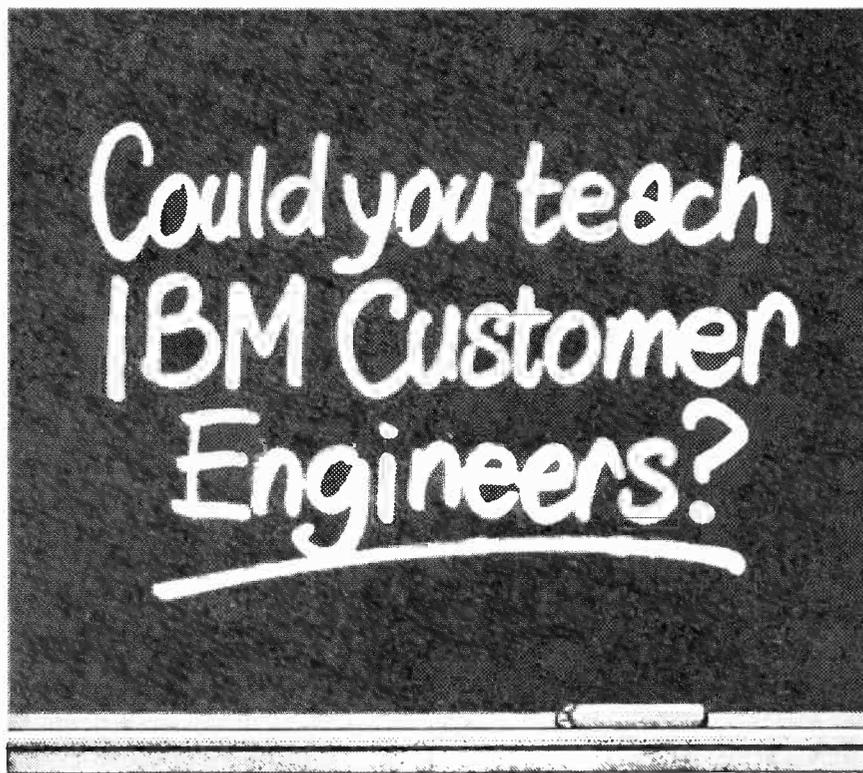
LINE advertisements (run on): 86p per line (approx. 7 words), minimum three lines.

BOX NUMBERS: 35p extra. (Replies should be addressed to the Box number in the advertisement, c/o Wireless World, Dorset House, Stamford Street, London SE1 9LU).

PHONE: Allan Petters on 01-261 8508 or 01-261 8423.

Classified Advertisement Rates are currently zero rated for the purpose of V.A.T.

Advertisements accepted up to 12 noon Thursday, March 27th, for the May issue subject to space being available.

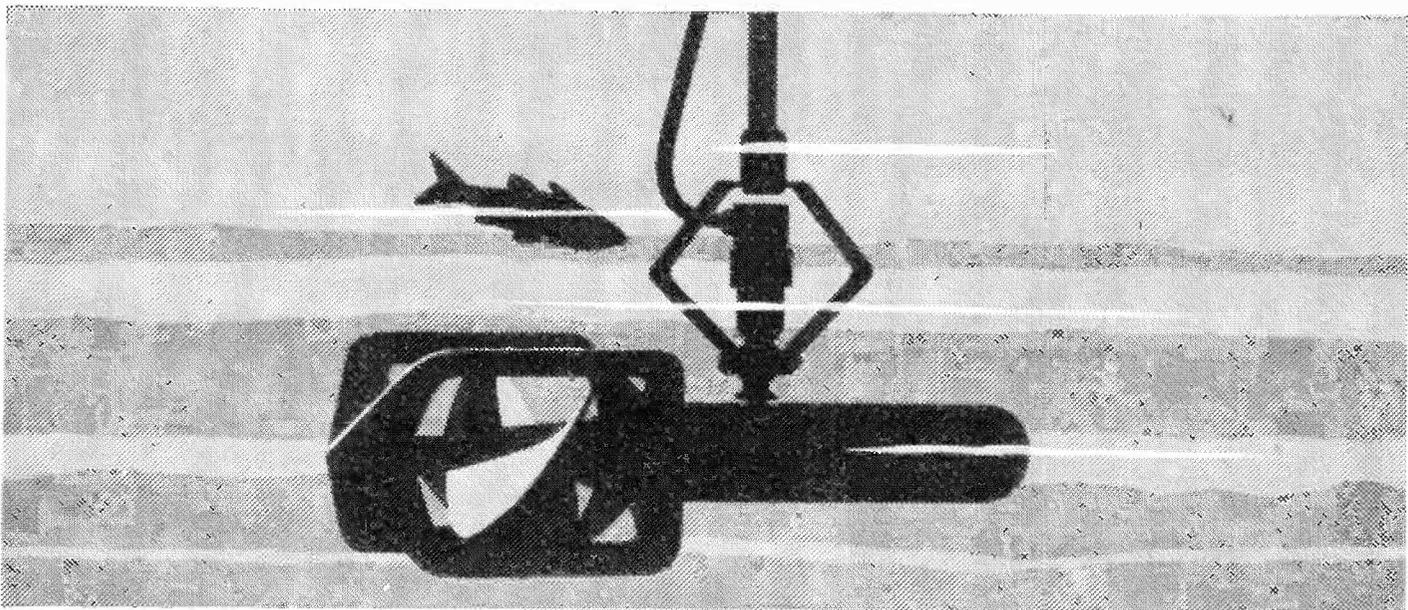


We have a number of opportunities for instructors to train our customer engineers to service and maintain data processing equipment including the latest 370 Systems and Software.

If you're an experienced or potential instructor with a background in software and/or electronics, educated to HNC, C & G standard or perhaps you've had similar service experience – now's the chance to find out more about these secure, well paid positions, based in NW London. Salaries start from £3000 and career development prospects and training are excellent.

If you are interested please write to:
Anne Dare, IBM United Kingdom Limited,
389 Chiswick High Road, London W4 4AL.
Quoting ref: WW/92418.

IBM



DRAUGHTSMEN/ILLUSTRATORS and TECHNICAL AUTHORS

Marine Electronics

West Country

The Plessey Marine Research Unit is engaged in a broad range of research and development in the field of electronics and underwater acoustics. New projects are now creating a number of openings for Draughtsmen/Illustrators and Technical Authors. They will be assisting in the preparation of Admiralty Handbooks describing advanced sonar systems. The equipments contain the most modern digital circuitry employing TTL Logic, ROM's, RAM's and thin film techniques. The research and design laboratories are situated on a country estate at Templecombe, Somerset. Good educational and housing facilities are available in nearby towns like Yeovil, Sherborne and Wincanton, while the Dorset coast is less than an hour away.

Principal Draughtsman/Illustrator

An experienced Draughtsman/Illustrator is required to take charge of the Illustration Section in a new Technical Publications Department.

The successful candidate must be capable of liaison with customers on technical matters relating to drawings and illustrations. He should be familiar with circuit diagram presentation to BS3939.

It will be an advantage if the candidate has been concerned with technical publications produced to Admiralty Specification NWS 1/70

REF.DI.50

Senior Draughtsmen/Illustrators

This is an ideal opportunity for illustrators to join an enthusiastic team in a new department engaged in the preparation of MOD(N) Handbooks.

They will work in liaison with the Technical Authors and ideally have had a minimum of five years' relevant experience, with a sound knowledge of circuit diagram presentation to BS 3939. An understanding of reprographics is desirable.

REF.DI.100

Draughtsmen/Illustrators

They should have had a minimum of three years' experience as illustrators in the Electronic industry, but

draughtsmen with a leaning to illustrative work and the ability to prepare good quality diagrams for photographic reproduction should apply. An understanding of reprographics is desirable.

REF.DI.200

Technical Authors

To prepare original material for publication, originate draft text illustrations; prepare final copy after approval; read and correct camera copy and printers' proofs. Would work largely on own initiative under limited supervision. Should be educated to O.N.C. standard in electrical engineering or equivalent standard in appropriate subjects coupled with an engineering apprenticeship or service in HM Forces, or other practical experience.

REF.TA.516

Plessey Marine employs in the region of 1,700 people divided between locations' in Somerset, Newport, S. Wales, and Ilford, Essex. Highly competitive salaries and excellent conditions of employment are offered. Generous holiday entitlement. Pension/Life Assurance scheme. Relocation expenses will be paid.

For further information please telephone, or write giving details of age, qualifications and experience, to The Personnel Manager, Plessey Marine Research Unit, Wilkinstroop House, Templecombe, Somerset. Tel: Templecombe (0963 7) 551.

4541

PLESSEY



Radio Operators. How to see more of your wife without losing sight of the sea.



Join the Post Office Maritime Service. We have openings for Radio Operators at several of our coastal stations.

The work is just as interesting, just as rewarding as aboard ship, but you get home to see your wife and family more often. You need a United Kingdom General or First Class Certificate in Radiocommunications, or an equivalent certificate issued by a Commonwealth Administration or the Irish Republic.

Starting pay for a man of 25 or over is £2,270, plus cost of living allowance with further

annual increases after that. Though we're happy to take people from 19 up.

In addition to your basic salary, you'll get an average allowance of £450 a year for shift duties and there are opportunities for overtime.

Other benefits include a good pension scheme, sick pay and prospects of promotion to Senior Management.

For more information, write to: ETE Maritime Radio Services Division (L533), ET 17.1.1.2., Room 643, Union House, St. Martins-le-Grand, London, EC1A 1AS.

**Post Office
Telecommunications**

RADIO OFFICERS

Do you have PMG I, PMG II, MPT 2 years operating experience?

Possession of one of these qualifies you for consideration for a Radio Officer post with composite signals organisation.

On satisfactory completion of a 7-month specialist training course, successful applicants are paid on a scale rising to £3,096 pa; commencing salary according to age—25 years and over £2,276 pa. During training salary also by age, 25 years and over £1,724 pa with free accommodation.

The future holds good opportunities for established status, service overseas and promotion.

Training courses commence at intervals throughout the year. Earliest possible application advised.

Applications only from British-born UK residents up to 35 years of age (40 years if exceptionally well qualified) will be considered.

Full details from:

**Recruitment Officer,
Government Communications Headquarters,
Room A/1105, Priors Road, Oakley,
Cheltenham, Glos GL52 5AJ
Telephone Cheltenham 21491 Ext 2270**

STAFF REQUIREMENT

SAMUELSON FILM SERVICE LIMITED

require

TV TECHNICIAN

to develop their SAMCINEVISION Department.

The position calls for an enterprising, inventive and reliable technician who thoroughly understands CCTV and can maintain the range of equipment and TV viewfinder systems operating with Motion Picture Cameras. A certain amount of location work with film units will be involved and there will be a requirement to instruct others on the use of the Samcinevision TV Viewfinder Systems.

Further development and design possibilities will be part of the responsibility of the successful applicant.

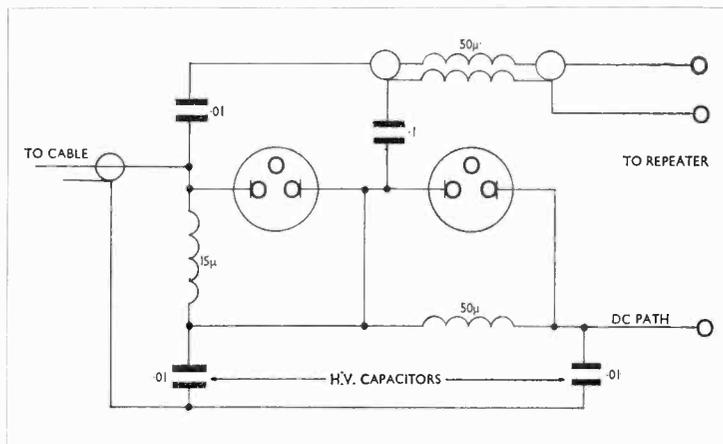
Salary is negotiable, non-contributory pension scheme.

Please send written application, stating experience and salary expected, in confidence, to:

**DAVID SAMUELSON,
Samuelson Film Service Limited,
303, Cricklewood Broadway,
London, N.W.2.**

Electronic Engineers

This can
work from
1 to 45 MHz
-can you?



The above power separating filter is only one example of the sort of work that our engineers do in the design and development laboratories of the Submarine Systems Division of S.T.C.

We are looking for graduate or similarly qualified engineers with experience of a year or more in electronic design and development. An analogue background will be preferred.

This is what we have to offer :-

A Secure Future :

We are the world's largest supplier of repeatered submarine telephone cable systems. Most of our product is exported and our order books are healthy. We are also the technological leaders in our field and through our design and development teams we are continuously improving on our fine record of innovation and reliability.

Benefits :

Excellent starting salary. Your salary progression will be determined by your performance, responsibilities and potential. First class large company benefits include 4 weeks, 2 days holiday. Generous relocation expenses will be paid where appropriate.

A Satisfying Job :

Working in an area of advanced technology, you will design and develop wideband analogue amplifiers, filter networks (using C.A.D.),

repeater supervisory circuits, terminal transmission equipment or advanced test gear. You will be designing a product of supreme quality, for once laid a system must operate for 25 years without fault or maintainance.

Training :

We shall offer training to those whose experience of analogue circuitry is limited. Encouragement is given to engineers who wish to obtain corporate membership of the I.E.E.

Career Development :

You will be given every opportunity to develop and take responsibility. There is much scope for advancement in the Engineering Department and other functions of the company. Promotion is given on the basis of merit.

Travel :

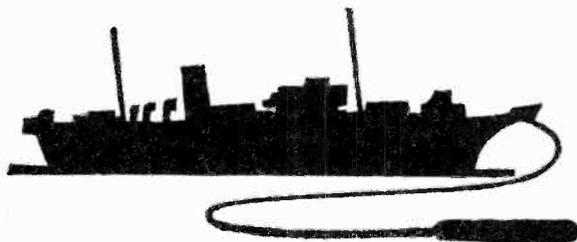
Opportunities may exist for you to spend periods abroad on cable laying and commissioning operations. In 1975 this might take you to Spain, Italy, the Greek Islands, Australia, New Zealand or New Guinea.

Interested?

If you would like our special information pack 'phone David Stenhouse on 01-476 1401, or write to him at:-

*Standard Telephones and Cables Limited,
Submarine Systems Division,
Henley Road, North Woolwich, London, E.16*

Standard Telephones and Cables Limited
A British Company of ITT



AVIONICS IN EDINBURGH

ELECTRONIC ENGINEERS

FERRANTI in Edinburgh are involved in many important defence contracts including the Multi Role Combat Aircraft.

We need Engineers of experience and technical capability to join expert teams on a variety of interesting projects with high technological content. We are looking for

TEST SPECIFICATION WRITERS
TEST ENGINEERS
TRIALS ENGINEERS
TECHNICAL AUTHORS
SERVICE ENGINEERS

and would be particularly interested to hear from candidates with qualifications and experience in any of the following areas: **DIGITAL AND ANALOGUE TECHNIQUES, MICROWAVE ENGINEERING, LASERS AND OPTICS, ELECTRONIC DISPLAYS, AUTOMATIC TEST TECHNIQUES, AIRBORNE RADAR, INERTIAL NAVIGATIONAL SYSTEMS.**

Priority will be given to incoming staff for Scottish Special Housing. The Company operates a contributory pension and life assurance scheme, and will assist with relocation expenses where necessary. Salary up to £3,000.

Apply in writing with details of qualifications and experience to the:

Staff Appointments Officer
Ferranti Limited
Ferry Road
Edinburgh EH52XS
Tel: 031-332 2411

FERRANTI

4502

TELEVISION IN SOUTH AFRICA

Leading Manufacturer of Sony and Blaupunkt television receivers wishes to engage Technical Personnel for Servicing Establishments in Johannesburg, Capetown, Durban, Pretoria, Port Elizabeth, Bloemfontein and Klerksdorp as follows:

REGIONAL SERVICE CO-ORDINATORS

with Management and Workshop experience in colour television receiver servicing. SALARY up to R10,000 (£6,250) p.a.

SENIOR COLOUR TV TECHNICIANS

with Supervisory experience in a Servicing Workshop. SALARY up to R8,000 (£5,000) p.a.

BENCH and FIELD TECHNICIANS

with experience in Colour TV Receiver Installations and Servicing. SALARY up to R7,000 (£4,375) p.a.

Qualifications required are appropriate City and Guilds with Colour Endorsement or equivalent—or valid equivalent experience. Ex-Navy, Army and R.A.F. personnel with suitable service qualifications and experience will be considered.

Company vehicles are provided. A Pension and Medical Aid Scheme is available. Passages to South Africa and place of appointment are paid for selected applicants and their families.

Apply to

Mr. L. W. Turner,
 Personnel & Electronics Ltd.,
 MBM Associates International,
 Warley Chambers,
 Warley Road,
 Hayes, Middx. UP4 0PX

4528

TEST AND CALIBRATION ENGINEERS

We have vacancies for

TEST ENGINEERS to fault-find and test a wide variety of electronic control and nucleonic equipment.

CALIBRATION ENGINEERS with experience in the maintenance, repair and calibration of our high-grade electronic test and laboratory equipment.

Academic qualifications, whilst desirable, are less important than sound experience. Minimum age 25 years. These positions would be ideal for ex-service men.

Good rates of pay, 4 weeks holiday, pension and sick pay schemes.

Ring Sylvia Borra 01-692 1271 Ext 393

or write to her at

The Personnel Department

4538

GEC-ELLIOTT PROCESS INSTRUMENTS

Century Works, Connington Road.

Lewisham, London SE13 7LN

**FEDERAL STATUTORY CORPORATIONS SERVICE COMMISSION,
LAGOS, NIGERIA**

**VACANCIES IN
THE NIGERIAN PORTS AUTHORITY**

1. Applications are invited from suitably qualified candidates for the following vacancies in the Nigerian Ports Authority:

- (i) Senior Communication Engineers
- (ii) Communication Engineers Grade I
- (iii) Communication Engineers Grade II

2. (a) **QUALIFICATIONS**

A good University degree or its equivalent in Radio and Telecommunications Engineering giving exemption from the graduateship of a relevant and recognised professional institution.

(b) **EXPERIENCE**

Post-qualification experience in one or more of the following or related fields of:—
MF/HF/VHF Transmitters/Receivers, Radar, Echo Sounders, Telephones including private Automatic Branch Exchange Equipment; plus a minimum of 5 years' post-qualification experience for (i); 4 years post-qualification experience for (ii); and 2 years post-qualification experience for (iii).

3. **SALARY**

- (i) SAP.2: N4,250/N4,500 x 130—N4,760
 - (ii) SAP.1: (Upper): N3,280 x 120—N4,120
 - (iii) SAP.1: N2,040 x 84—2,208/2,580 x 110—
N3,130/N3,280 x 120—N4,120.
- } (Pre-Udoji)

4. **CONDITIONS OF SERVICE**

For Nigerian candidates pensionable appointment will normally be offered, although contract terms, if so preferred, may be approved. Non-Nigerian candidates will normally be offered contract terms which includes:—

- (a) Contract addition of 50% of Basic Salary
- (b) Outfit and other approved allowances
- (c) Terminal Gratuity of 25% of total Contract Salary earned.

5. Furnished accommodation will be provided where possible at the rate of $8\frac{1}{3}\%$ of salary, up to maximum of N300 per annum. Alternatively, rent subsidy may be granted in accordance with the current Conditions of Employment (Officers).

NOTE: For appointment on contract additional verifiable ability/effectiveness, at the right level, on installation/maintenance problems may be acceptable in lieu of the full formal qualifications stipulated above.

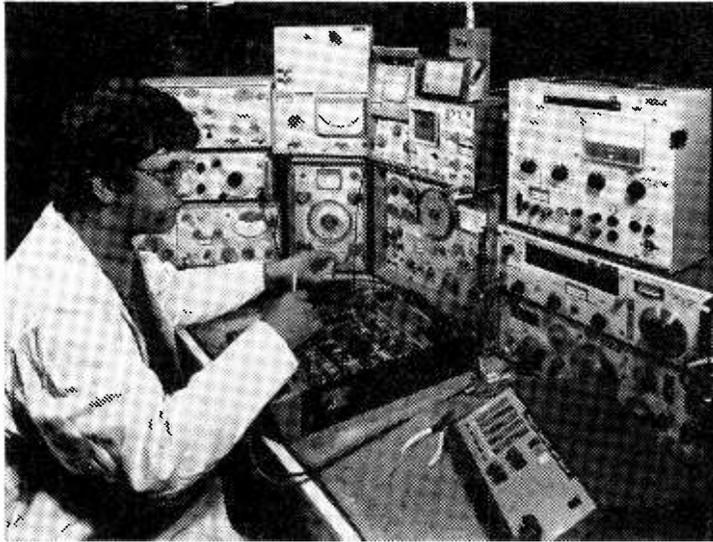
6. **METHOD OF APPLICATION**

Application forms are obtainable from:
The Nigerian Ports Authority Representative,
Nigeria House, 9, Northumberland Avenue, London, W.C.2.

7. **CLOSING DATE**

Completed application forms with photostat copies of certificates and two recent passport photographs of the applicant duly signed at the back by the applicant must be submitted to reach the Nigerian Ports Authority Representative at the above address not later than 15th March 1975.

Electronics Test Engineers: career openings that affect all sorts of people...



... you most of all, naturally. Mainly because, by joining the world's largest exporter of radio-telephone equipment you will inevitably open up for yourself career advantages that very few companies can provide. Pye Telecom is growing at an ever-increasing rate - and the potential for its products has as yet been only fractionally utilised.

But the work you do will also be vital to an incredible number of others. Very frequently, life itself depends on the efficiency of the UHF and VHF equipment you'll be working on. Police, firemen and ambulance staff are a small sample of the extensive range of users. Which explains the exacting specifications of the test procedures in operation - and why previous fault-finding and testing experience is an essential requirement. If it relates to communications equipment, so much the better, but this is not absolutely essential. More important is practical proficiency, which may well have been gained in the armed forces.

Find out more right now by phoning or writing to Mrs Audrey Darkin at:



Pye Telecommunications Ltd

Cambridge Works, Elizabeth Way,
Cambridge CB4 1DW. Tel: Cambridge 58985

A member of the Pye of Cambridge Group

4496

THE OPEN UNIVERSITY OPERATIONS AREA SENIOR MAINTENANCE TECHNICIAN

A vacancy exists in the Audio-Visual Department of the Operations Area of the Open University for a Senior Maintenance Technician.

The person appointed will supervise the Audio-Visual Workshop which handles repair and maintenance of video-tape equipment, television cameras, film projectors, professional broadcasting sound recording equipment, slide and overhead projectors and all equipment housed in the Lecture Theatre of the University. The operation of such equipment will also be necessary from time to time.

A lively interest in the audio-visual field is necessary to keep up to date on new developments and to modify and adapt equipment and methods as required.

The successful candidate should have either HNC/HND (Electronics) plus an electrical/electronics apprenticeship, and a minimum of 7 years relevant experience in inspection testing, maintenance of audio-visual equipment, or Science degree (Electronics) and a minimum of 3 years relevant experience.

Salary within scale Technician Grade 6: £2844—£3,450 per annum.

Further particulars and application forms are available from the Personnel Manager (OT4), The Open University, P.O. Box 75, Walton Hall, Milton Keynes, MK7 6AL. Applications should be returned as soon as possible. [4510]

MAJOR RECORD COMPANY IN WEST-END

requires

AUDIO ENGINEER

with Electronic and Mechanical experience for their Studios Technical Department.

For further details ring

SUE CAMBRAY
on: 01-262 5495

[4524]

R.F. Engineer

Leading Manufacturers of Audio equipment have a vacancy on their development team at King's Lynn for an experienced R.F. Engineer who will be engaged in the development of their high quality products.

Good salary commensurate with experience.

Applicants write giving details of experience to:

Mr. D. J. Chesney
Personnel Manager,
Dynatron Radio Ltd.,
Hansa Road,
Hardwick Industrial Estate,
King's Lynn, Norfolk.

[4516]

DYNATRON

WIRELESS TECHNICIANS

There are vacancies at Home Office Wireless Depots throughout England and Wales for Wireless Technicians to assist with the installation and maintenance of VHF and UHF Systems. Ability to drive a car and possession of a current driving licence is desirable.

Salary

is £1530 (at 17), £1865 (at 21) and £2210 (at 25) rising to £2575 a year plus a cost of living supplement of £19.14 a month.

A London Weighting Allowance of up to £410 a year is also payable for staff employed in London.

A Secure Future

with a good pension scheme, good prospects of promotion and a generous leave allowance.

Qualifications

Candidates should have good experience in Telecommunications and preferably hold a City and Guilds Intermediate Telecommunications Certificate or equivalent.

Interested?

Then write or telephone for further details and application form to Mr C B Constable, Directorate of Telecommunications, Home Office, 60 Rochester Row, London SW1P 1JX. Telephone 01-828 9848 Extension 734.

4522



Home Office

B&W manufacturers of Monitor Loudspeakers

B & W of Worthing is a fast-growing independent company manufacturing high-fidelity loudspeakers —acknowledged to be among the world's finest. Due to further planned development we are looking for a:

DESIGN ENGINEER

This new opening is a unique opportunity for a senior engineer (age 30-40) to join our research team, where laboratory facilities are probably better than any in the UK hi-fi industry.

Applicants should have good academic qualifications, preferably with a post-graduate degree to Ph.D. standard, and be capable of original thinking.

Salary will meet the requirements of the right man.

Please write with fullest details to the Managing Director.

B&W electronics
Meadow Road Worthing BN11 2RX



1973

4558

TV Systems Commissioning Engineer to lead teams overseas.

The growth of Pye TVT, international manufacturer of TV broadcast systems and equipment, has created a vacancy for a Senior Installation and Commissioning Engineer to work on either studio or transmitter systems.

The man we want will be a self-reliant and fully-experienced broadcast engineer capable of leading a small installation team. He will have to spend up to six months a year working overseas, mainly outside Europe.

We recognise the responsibilities of this position in the salary and generous overseas allowances we offer. Other company benefits include re-location expenses to Cambridge where applicable.

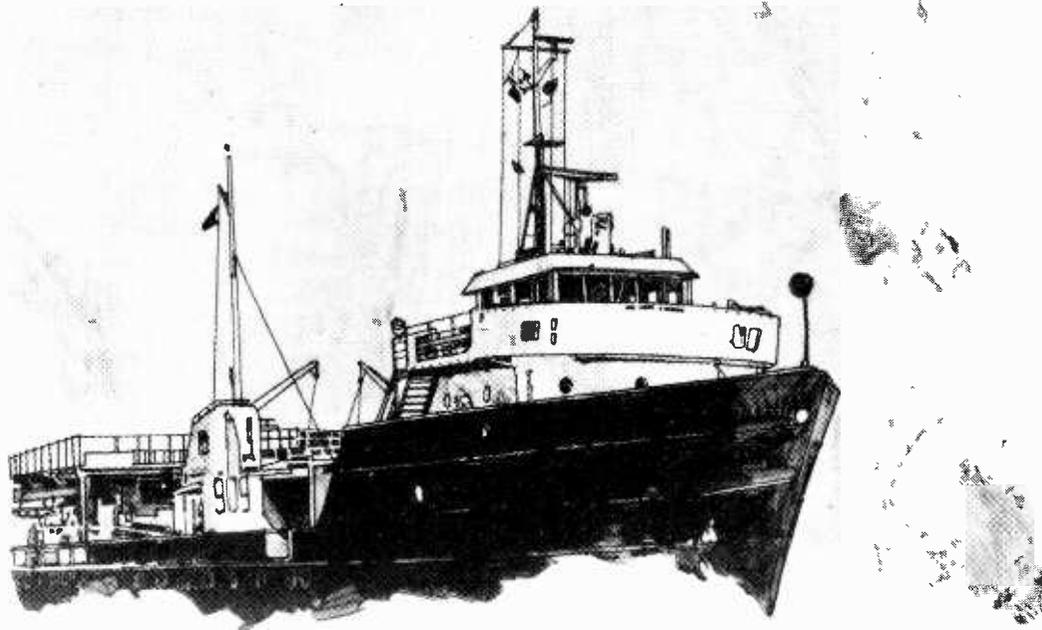
Please write, with brief details of qualifications and career so far, to:

Mrs J. A. Macnab, Personnel Manager

4562



Pye TVT Limited
P.O. Box 41 Coldhams Lane
Cambridge CB1 3JU



Oil Exploration

G.S.I. Ltd, a subsidiary of Texas Instruments requires technicians with approximately four years experience in maintenance and repair of digital and analogue electronic equipment and qualified to ONC/HNC or City & Guilds (F.T.C.).

The openings available are in overseas marine seismic operations and are based on a 26 month contract with opportunities for home leave during this period.

The type of people we are looking

for are single men who want a career that involves travel, work on ship-board Texas Instruments navigation and seismic digital recording equipment but will still be prepared to get their hands dirty.

If you feel that you fit the qualifications listed and are looking for a job that is not "9 a.m. to 5 p.m."

contact David Kennedy, Personnel Department, G.S.I. Ltd, Canterbury House, Sydenham Road, Croydon, Surrey. Tel: 01-686 6511, ext 257.

Geophysical Service International Ltd.

4560

VISUAL AND AURAL AIDS TECHNICIAN

Applications are invited from suitably qualified persons to maintain and repair a range of Audio and Video equipment including T.V. Receivers in schools and other Education Establishments.

Average weekly earnings including bonus up to £50 per 40 hour week.

CROYDON

Applications to (or further particulars may be obtained from) The Superintendent, Croydon Education Committee, Service Centre, Princess Road, Croydon, CR0 2QZ. Tel: 01-684 9393. [4506

THE MOTOR INDUSTRY RESEARCH ASSOCIATION ELECTRONICS ENGINEER

Required

To work with a small team in the design, development and commissioning of a wide range of specialised instrumentation and test equipment. Practical experience should include the design and construction of equipment using analogue and digital integrated circuits.

Preference will be given to graduate engineers, but applications are also invited from candidates with equivalent qualifications and relevant experience.

Apply in writing to the Personnel Manager, The Motor Industry Research Association, Watling Street, Nuneaton, Warwickshire CV10 0TU, giving age, experience, qualifications and current salary, and quoting CHGM. [4530

HER MAJESTY'S GOVERNMENT COMMUNICATIONS CENTRE

HANSLOPE PARK MILTON KEYNES MK19 7BH

has vacancies in the following fields of R & D work:

- (a) HF Communications
- (b) VHF/UHF Communications
- (c) Communication Field Trials
- (d) Acoustics
- (e) Optics including Infra-Red
- (f) Microwave
- (g) General Circuit Design—Analogue, Digital
- (h) Statistics/Operational Analysis/Systems Analysis

Most posts will be at Hanslope Park but some will be in London.

Candidates for post (h) should be experienced scientists/engineers who have specialised later in one of the required fields. An ability to deal with non-technical people is essential.

Appointments will be made within the grades of Higher Scientific Officer except for (e), (f) and (h) where appointments may also be made within the Senior Scientific Officer grade. In addition to the salary scales quoted, all posts attract the Threshold Agreement Payment (£229 p.a.) and a non-contributory pension.

HIGHER SCIENTIFIC OFFICER

Applicants should be under 30 years of age but this requirement may be waived if special qualification or experience can be offered. They should have one of the following qualifications:

- (a) A degree in a scientific or engineering subject
- (b) Degree-standard membership of a Professional Institution
- (c) A Higher National Certificate or Higher National Diploma in a scientific or engineering subject
- (d) A qualification equivalent to (c) above

In addition the following relevant experience is required:

- (a) Applicants with 1st or 2nd class honours degrees—at least 2 years post-graduate experience.

- (b) Applicants with other qualifications—at least 5 years post qualification experience.

Salary Scale: £2,461—£3,371 with entry point dependent upon experience beyond the minimum required.

SENIOR SCIENTIFIC OFFICER

Applicants should be at least 25 and under 32 years of age, although the upper age limit may be waived if experience of special value can be offered.

Applicants should have obtained a 1st or 2nd class honours degree and have had a minimum of four years appropriate post-graduate experience. Salary Scale: £3,157—£4,441. Entry will normally be at the minimum of the scale but applicants with experience of special value may be entered above the minimum.

Applications, stating the field of work and grade required, should be made to

Administration Officer
HM Government Communications Centre
Hanslope Park
Hanslope
MILTON KEYNES MK19 7BH

[4478

PROJECT DEVELOPMENT ENGINEER

To consolidate and further develop an established product and also look after the engineering and test requirements of the product in production. H.N.C. in Electrical/Electronic Engineering, with some years electro-mechanical experience would be required.

Applications giving full career details should be sent in confidence to:

Mrs. J. I. Standfield,
Personnel Officer,
GEC Medical Equipment Limited,
East Lane,
North Wembley,
Middlesex.



[4518

OMAN

DHOFAR REGION TELEVISION SERVICE

We are recruiting on renewable one-year contracts

Staff—Engineers—Management

for the complete maintenance and operation of the television service.

If you work in television please apply for further information:

- MANAGEMENT
- PROGRAMME STAFF
- ENGINEERS (STUDIO, TX & M/W & O.B.)
- OPERATIONS STAFF/ENGINEERS
- ACCOUNTS & ADMINISTRATION
- OFFICE STAFF
- LIGHTING
- ELECTRICIANS
- NEWSCASTING etc.

Let us discuss with you your abilities for these interesting and important positions.

Phone: Tony Owers 01-573 7352 for more information.

- ★ VERY GOOD SALARY
- ★ FREE FAMILY PASSAGE
- ★ NO INCOME TAX PAYABLE IN OMAN
- ★ FREE FURNISHED ACCOMMODATION
- ★ SPECIAL END-OF-CONTRACT BONUS
- ★ WE PAY LOCAL EDUCATION FEES
- ★ COMPREHENSIVE FREE INSURANCE, HEALTH, DENTAL, ETC.
- ★ HARD WORK IS NECESSARY



PERSONNEL & ELECTRONICS LTD.

4557

GOVERNMENT OF BOTSWANA

EXECUTIVE ENGINEER

Required by the Department of Posts and Telecommunications to be responsible to the Assistant Director of Telecommunications for (a) co-ordination of planning, installation and maintenance of all telecommunications equipment, (b) supervision of Senior Assistant Engineers, (c) expenditure control, (d) preparation of annual estimates and (e) short term planning for network extension.

Candidates, between 40-55 years of age, must possess a recognised degree in Telecommunications Engineering and have at least 5 years' professional experience.

Starting salary up to maximum of £4,610 in scale £2,800 to £5,350 according to qualifications and experience, which includes an allowance normally tax-free in scale £660 to £1,752.

Engagement is for one tour of 24-36 months in the first instance. Gratuity 25% of total basic salary. Generous leave. Subsidised accommodation. Family passages. Children's education allowances and holiday visit passages. Interest-free car loan and tax-free Appointment Grant payable in certain circumstances.

The post described is partly financed by Britain's programme of aid to the developing countries administered by the Ministry of Overseas Development.

For further particulars you should apply, giving brief details of experience to: CROWN AGENTS, M Division, 4 Millbank, London SW1P 3JD, quoting reference number M2K/740818/WF.

**crow
agents**

4545

Technical Officer (Components)

British Airways Group Management Services has a vacancy for a Technical Officer to organise and supervise the Central Technical Stores of the Telecommunications Engineering Department.

He will be expected to maintain a close liaison with manufacturers and distributors and keep abreast of rapidly changing technology in the compartment field. He will also work closely with the Accounts and Purchasing sections of Group Management Services.

The responsibilities also include arranging for the shipping and transport of equipment and components to UK and overseas stations, clearing equipment through Customs as required, meeting the requirements of maintenance terms for the supply of components, advising of suitable alternatives where appropriate and providing a technical advisory service on components and accessories.

Applicants should have at least five years' experience in an electronics design or maintenance environment, and preferably an HNC or equivalent certificate in electronics or communications. Experience in purchasing and components supply would be an advantage.

The job is based at Heathrow Airport and carries a starting salary of £3,341 which includes a London Weighting Allowance of £200.

Additional benefits include an excellent contributory pension scheme, a first-class sports and social club and opportunities for concessional holiday air travel worldwide.

Please write, giving details of age and experience, quoting reference 458/WW/MA, to:

Manager Selection Services, British Airways, PO Box 10, Heathrow Airport—London. Hounslow TW6 2JA.

**British
airways**



14556

Applications are invited from Marine Electronic/ Communications Engineers

with a minimum of five years experience. The positions are available with a rapidly expanding Middle East Company and call for a wide background in the maintenance and servicing of Marine Electronics, Radar and Communications equipment. Applicants should show evidence of having recognised and qualified experience in any three of the following fields:

1. Low and medium Power MF/HF Transmitters and Receivers.
2. Low Power Solid State SSB Transceivers.
3. Marine VHF Radio Telephone Equipments.
4. Marine navigating Radar equipments and other navigational aids.
5. Gyro Compass and ship steering Servo Systems.

Successful applicants, following interviews in London will be engaged on a contract basis in the Arabian Gulf. Initial salary will be in the region of £3,500-£4,000 p.a. plus fringe benefits and bachelor status accommodation, one month's overseas leave, return air passage paid annually, plus earned gratuity. Possibilities would be available for married status after proving ability in this area. Replies only will be sent to engineers actively servicing equipments at this time in a similar senior position. Reply in confidence to:

The Managing Director,
P.O. Box 1788,
Dubai,
United Arab Emirates.

14565

UNIVERSITY OF
NEWCASTLE UPON TYNE
Department of Photography
and Teaching Aids Laboratory

Colour Television Engineer

To be responsible to the Head of the Film and Television Section for the operation of an off-air colour recording, playback and transcription service. He will begin to assist in the immediate planning of a new colour system to be commissioned in 1976 for the new Dental School and Medical School and for the subsequent phased development of colour CCTV throughout the rest of the University.

Applicants should have several years' experience of colour programme origination and video tape recording, and preferably some experience of administration and television planning. He must be familiar with colour and monochrome studio equipment of all types, and capable of establishing and maintaining professional standards.

Salary at a suitable point on the scale £1,683-£2,931 plus a threshold payment of £229.68 per annum, according to age, qualifications and experience. For an exceptionally well qualified and experienced candidate the appointment may be made on the higher scale £2,757-£4,341 (plus threshold) (scales are under review). Membership of an appropriate University superannuation scheme will be required.

Further particulars may be obtained from the Registrar, The University, Newcastle upon Tyne, NE1 7RU, with whom applications (three copies) stating age, education, job experience, availability for interview and names of two referees, should be lodged not later than 30th April 1975. Please quote reference W.W. 4568

Audio experts wanting a new deal

Come to Pye Limited Audio Products, where we offer a great deal in our new deal for 1975. Leading makers of stereo equipment, car radios, radiograms, etc., we have increased our already high rates of pay.

To maintain our reputation for quality which makes our growth and prosperity possible, we need more:

Audio and RF Fault Finders

Men aged 21+ to strengthen our Test/Diagnosis Department. You should ideally be capable of working with a minimum of supervision and have—or be studying for—a C & G qualification in Electronic/Radio Servicing. Alternatively you should have at least two years in similar work.

Production Engineers

For production methods and measurement, and assisting with direct labour analysis. Preferably applicants should have an ONC or MLWSP and practical experience of consumer electronics.

We can offer, besides the new rates, excellent career prospects and a number of company benefits which include a subsidised canteen and discounts on the products we make.

For further details, please write or ring:
The Personnel Department.

4553



**Pye Limited
Audio Products**
Caxton Way Stevenage
Tel: Stevenage (0438) 50241

Storno *LIMITED*,

Manufacturers of modern FM radio communication systems for all branches of industry, transport and Public Authorities require additional

TEST TECHNICIANS

based in Camberley to assist in the final testing of personal and mobile radio equipment and sophisticated control systems.

Knowledge of RF, digital and thick film techniques desirable with academic levels to ONC or C. & G. Final, but for an applicant with exceptional experience and knowledge these qualifications may be waived.

Pleasant working conditions, good salary and overtime. Opportunities for further study and training.

Hours: Monday–Thursday:

8.15 am–1.00 pm. 1.30 pm–4.45 pm.

Friday:

8.15 am–1.00 pm. 1.30 pm–3.30 pm.

Apply: The Personnel Officer,

**Storno
LIMITED**,

Frimley Road,

Camberley, Telephone: 0276 29131

Storno *SERVES THE NATION...*

14555

M E R C U R Y

PROJECT ENGINEERS BROADCAST TELEVISION

To cover and extend our increasing international commitments, we are seeking to further expand our team of engineers working on broadcast television systems design and installation.

This work involves both static studio installations and Outside Broadcast vehicle construction, and may be located at Uxbridge or Westbury, Wiltshire.

The potential ability and confidence to assume total responsibility for the planning and execution of complete broadcast systems is an essential requirement, together with the personality to deal with a wide variety of people in the course of this work.

The engineers we are looking for will have formal qualifications to at least HNC level or equivalent, with detailed knowledge of one or more aspects of broadcast television. Experience of operational work within this sphere will be particularly useful. Overseas travel, occasionally for extended periods will be involved.

In return, we can offer you a varied, demanding and rewarding career with a young, vigorous company which is rapidly expanding and establishing a considerable reputation for itself in a highly competitive field.

Please write giving FULL details of your qualifications and experience or phone for an application form to:—

UXBRIDGE 39876/39613
MERCURY ELECTRONICS,
6 ROCKINGHAM WHARF,
ROCKINGHAM ROAD,
UXBRIDGE, MIDDLESEX

14547

ENGINEER

(With TV Service
Experience)



R.S. Components Limited, Britain's biggest distributor of electronic components, requires an experienced Engineer or Service Manager who is currently employed on TV service work. Ideally, he should be between 25–45 and possess a good academic background.

This is a new post and an exciting opportunity for an engineer who is eager to further his experience by becoming our technical adviser on component requirements in the field of TV and Audio Equipment servicing.

Duties will include component evaluation, specification and assisting in answering customers' telephoned enquiries. Additionally, the candidate will be expected to maintain a close liaison with the service industry and manufacturers.

We can guarantee an interesting career which may occasionally involve travel in the U.K.

This new important post commands a good salary commensurate with ability and there is every opportunity for advancement. Excellent working conditions, generous holiday entitlement and pension scheme.

Write giving brief résumé of your career to date or ring for an application form to

**Chief Engineer
R.S. Components Limited
13–17 Epworth Street, London
EC2P 2HA. Tel: 01-253 1222**



**An Electrocomponents
Group Company**

4559

TV Systems: Senior Installation and Commissioning Engineers

Help Pye TVT continue to grow as a leading international designer and manufacturer of TV broadcasting systems and equipment.

We want Senior Installation and Commissioning Engineers, self-reliant and able to lead small teams of engineers on projects involving modern generation, colour television, transmitter (VHF and UHF) and professional broadcast studio equipment. They will have several years' practical experience in broadcasting and hold qualifications involving or leading to membership of the I.E.R.E. or I.E.E.

Since many of our projects are overseas, usually outside Europe, they will be required to spend considerable periods abroad, for which generous overseas allowances will be paid in addition to basic salary and adequate subsistence expenses. Appointments are based in Cambridge and relocation expenses will be paid where applicable.

Please apply, with brief details of experience, to:
Mrs. J. A. Macnab, Personnel Manager.



Pye TVT Limited
P O Box 41 Coldhams Lane
Cambridge CB1 3JU

4566

CENTRAL BIRMINGHAM HEALTH DISTRICT ELECTRONICS TECHNICIAN

(M.P.T. II)

A vacancy exists in the electronics section of the Medical Physics and Biomedical Engineering Department for an experienced Technician with H.N.C. or equivalent, competent to take responsibility for the servicing and development of biomedical electronic equipment throughout the Teaching District and to act as Deputy Head of the section. Experience of medical electronics advantageous, but good general electronic experience essential.

Salary: £2,601—£3,390 per annum,
plus Threshold.

Further particulars and application form from the

**PERSONNEL OFFICER,
QUEEN ELIZABETH MEDICAL CENTRE,
EDGBASTON,
BIRMINGHAM B15 2TH.**

[4542

TONGA SUPERVISING BROADCASTING TECHNICIAN

required by the Tonga Broadcasting Commission to be responsible for the operation and maintenance of the Commission's two 10 Kilowatt sound transmitters, to install and maintain studio equipment, to run a radio retail store involving technical supervision in purchasing, selling and repairing of receivers and other equipment.

Candidates, under 55 years of age, **MUST** have a City and Guilds Telecommunications Technician Final Certificate Course 271 or equivalent with 10 years' experience in the operation of studio and transmitter equipment as well as in all aspects of a small broadcasting station with particular emphasis on sound transmitters.

Salary in scale £2,125 to £3,400 pa which includes an allowance normally tax free in scale £504 to £1,404 pa and 20% cost of living allowance.

Gratuity 20% of Local salary. Tour of 2 years.

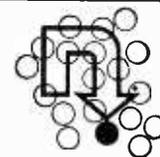
Benefits include free passages, Government housing at moderate rental. Holiday visit passages and generous paid leave. An appointment grant of £300 and car loan of £600 may be payable.

The post described is partly financed by Britain's programme of aid to the developing countries administered by the Ministry of Overseas Development.

For further particulars you should apply, giving brief details of experience, to CROWN AGENTS, M Division, 4 Millbank, London SW1P 3JD, quoting reference number M2K/740928/WF.

**Crown
agents**

4508



Opportunities in the ELECTRONICS FIELD

Men with analogue or digital qualifications/
experience seeking higher paid posts in:
TEST - SERVICE - DESIGN - SALES.
Phone Mike Gernat. Ref. WW.

**NEWMAN APPOINTMENTS
360 Oxford St. W1
01-629 7306**

[94

**ST. HELIER HOSPITAL
Carshalton, Surrey**

MEDICAL PHYSICS TECHNICIAN GRADE II

required for District Medical Physics Department.

Salary scale from £2,601 to £3,390 p.a. plus £312 London Weighting Allowance. Further details can be obtained from Chief Technical Officer —

01-644 4343

[4529

CITY OF LONDON POLYTECHNIC

SENIOR ELECTRONICS TECHNICIAN (GRADE 5)

required immediately in the Department of Biological Sciences for the maintenance, design and operation of electronic and other instruments, especially those used in Neurophysiology. The successful candidate must possess the relevant qualifications at HND/HNC or CGLI level, together with at least seven years relevant experience (including training period). Salary £2,439—£2,895 plus £411 London Weighting (starting point dependent on qualifications and experience). Apply, in writing, giving full details of qualification, experience, etc. and including the names and addresses of two referees, to the Laboratory Superintendent, Biological Sciences, Calcutta House Precinct, Old Castle Street, London E1 7NT.

[4554]

University of Surrey Audio Visual Aids Unit

TECHNICIANS

(T4 £2247—£2628)
(T2B £1860—£2187)

The AVA Unit is responsible for projection and allied services in 26 Central Lecture Theatres, and also provides services of photography, film and television for teaching and research throughout the University.

These new posts are for skilled technicians who will be responsible for installation, maintenance and repair of a wide range of Audio Visual equipment ranging from slide projectors to television. The Unit is well equipped for electronic and mechanical servicing, and instrument making and repair work.

For the Grade 2B post experience in one or more of these fields is essential, although training in specific techniques will be given where necessary.

For the Grade 4 post experience in electronic servicing is essential and candidates should hold an ONC or equivalent qualification.

Applications immediately on forms available from: Assistant Secretary (Personnel), University of Surrey, Guildford, or Tel: Guildford 71281 Ext. 452

[4543]

SERVICE ENGINEER

We are the distributors of World renowned Tandberg Products and are looking for a Service Engineer who has had experience in the Service and Repair of domestic Hi-Fi Equipment. Up to date Service Facilities and good working conditions, 5 day week with 3 weeks Annual Holiday. Wages up to £2,500 per annum depending on experience.

Please apply in writing with details of Career to date to Mr. D. D. Hamilton, London Manager, Farnell-Tandberg Ltd, 167, Hermitage Road, London N4 1LZ.

[4578]

Electronics Engineer

Our Research Function carries out innovative research through a number of project groups supported by certain essential specialised services. We are seeking an Electronics Engineer to join the Laboratory Services group in trouble shooting, maintenance and some development work.

Responsible to the Laboratory Manager, he will provide a service to all of the departments in our new research laboratories where the electronic equipment includes infra-red, ultra-violet, NMR and mass spectrometers as well as chromatographic equipment, calculators and recorders. There is also a Fourier transform NMR instrument incorporating a small computer.

The man we are looking for will be in his late twenties or thirties, qualified to HNC or possible degree level and he will have had some experience of service and development work preferably in a multi-disciplinary academic or industrial research laboratory. Specific experience in the field of NMR electronics would be an advantage. The person we appoint will be working largely without direct supervision and he should therefore be capable of accepting this degree of responsibility.

Roche Products Limited is part of one of the world's largest and most successful pharmaceutical companies and is itself one of the leading companies in the U.K. Working conditions are excellent and the Conditions of Service include some valuable fringe benefits.

Please apply in writing, quoting reference R50 to the Personnel Manager.



Roche Products Limited,
PO Box 8, Welwyn Garden City, Herts AL7 3AY

[4534]

Service Area Planning Engineers

£2488 - £3019

The Independent Broadcasting Authority requires two Junior Engineers to assist Engineers in charge of field teams with the planning and execution of the UHF television service area surveys, RBL tests and other field work. The people appointed to the posts will also assist with the general UHF television and independent local radio planning work of the section.

Candidates should preferably be qualified to HNC or equivalent level and should have some basic knowledge of radio wave propagation and television principles, plus experience of radio frequency measurement.

The posts are based at Crawley Court, near Winchester, Hampshire, however a considerable amount of travelling throughout the UK will be involved for which appropriate allowances will be payable. Candidates should have a current driving licence and should preferably have the ability to climb aerial support structures up to about 150 feet.



INDEPENDENT
BROADCASTING
AUTHORITY

Please write or telephone for an application form quoting Ref. DT/2670 to:- Miss Vanessa Aldred, Independent Broadcasting Authority, Crawley Court, Winchester, Hants. SO21 2QA. Tel: Winchester 822327.

[4561]

Radio Technology TELECOMMUNICATIONS OFFICERS

International Radio Monitoring Station, Baldock, Herts

... concerned with the installation and maintenance of electronic equipment such as radio receivers, spectrum analysers, and direction finding equipment and will include the use of a wide range of test equipment.

Radio Interference Branch, Stanmore, Middx

... duties include: the development of equipment for detection, location, measurement and suppression of radio interference; the technical control and inspection of amateur radio stations, the tracing of illicit radio transmitters and the development of methods of detecting unlicensed television receivers.

Mobile Services Branch, Central London (2 posts)

... responsible for technical advice in connection with Maritime Mobile Services and Land Mobile and Fixed services between 30-1000MHz. The work also covers the preparation of specifications for equipments for these services and the type-approval testing of such equipment; the assignment of frequencies and application of computer techniques to frequency assignment problems.

Candidates (aged at least 23) must have ONC in Engineering (with a pass in Electrical Engineering 'A') or in Applied Physics, or an equivalent qualification. In addition, they should normally have had at least 5 years' relevant experience.

Salary starting between £2,800 and £3,300 (according to age) and rising to £3,500. Central London salaries quoted; less elsewhere. Prospects of promotion. Non-contributory pension scheme.

For full details and an application form (to be returned by 10 April, 1975), write to Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB, or telephone BASINGSTOKE 29222 ext 500 (or, for 24 hour answering service, LONDON 01-839 1992). Please quote reference T/8921.

HOME OFFICE

4537

ELECTRONICS TECHNICIAN JUNIOR ENGINEER

Systems Company requires 20/30 years old Engineer for development, Commissioning and Maintenance of mini-computer based remote batch terminals.

Good opportunity for either an experienced Man to establish himself in a fast growing and friendly Company or for a Young Man to acquire experience of the latest technology in mini computers and peripherals.

Full training will be given. Some travel U.K. Salary range £1,800-£2,600 p.a. Write or phone: Peter Rogers or Steve Clifford.

TASK TERMINALS LTD.

117, Cleveland Street,
London, W.1.
01-637 4516

[4521]

SIEMENS MEDICAL ENGINEERING

Service and Sales Engineering

Service and Sales Engineers required for Electro-Medical Department, to work in the London area. Previous experience in this field an advantage, but knowledge of electronics essential.

Applications to:

SIEREX LTD.,
Heron House, 109 Wembley Hill Road,
Wembley, Middlesex, HA9 8BZ.

[4520]

ELECTRONIC CRAFTSMEN

Is your present job routine and uninteresting?

We are a research establishment and our craftsmen are engaged on a wide variety of work in the fields of prototype and small batch wiring and assembly, test and inspection, maintenance fault finding and repair. Why not join us and enjoy working in first class conditions in the country.

You can expect gross earnings including overtime of £45 per week, and we can offer good housing at low rental (for applicants who reside outside the radius of our Assisted Travel Area) together with 3 weeks paid holiday with holiday bonus, free pension and excellent sick benefit scheme.

Applicants who should have served a recognised apprenticeship or have had equivalent training together with experience in one of the fields detailed should phone Tadley 4111 (STD 073 56 4111) Ext. 5230, or write to:

**INDUSTRIAL RECRUITMENT OFFICER
(PA/79/WW) PROCUREMENT EXECUTIVE
MINISTRY OF DEFENCE
AWRE ALDERMASTON
READING, BERKS.
RG7 4PR.**

[4316]

HARINGEY Education Services

Full-time Laboratory Technician

required at Stationers' Company's School, Mayfield Road, N.8, to work 35 hours per week x 52 weeks per annum.

Salary rising to £2,677 per annum including threshold payments. Commencing salary according to qualifications and experience.

Minimum Qualifications: Ordinary National Certificate or Ordinary National Diploma; City and Guilds Laboratory Technicians Certificate; 4 G.C.E. passes with 2 at 'A' Level in appropriate subjects; Membership of Institute of Science Technology OR an equivalent suitable qualification OR 5 years suitable experience. Qualifications in Electronics would be an advantage.

Candidates will be responsible for the maintenance of the Language Laboratory and will be required to assist in the upkeep of Audio Visual aids throughout the school and help monitor a computer link-line.

The post is ideal for a candidate who wishes to gain experience in the maintenance of a fairly wide range of equipment.

Application forms obtainable from Chief Education Officer, Somerset Road, N.17, to be returnable 7th March, 1975.

[4536]

BRUNEI TELEVISION ENGINEER

- * Posting Bandar Seri Begawan
- * Engagement for three years initially
- * Gratuity 25% of total salary drawn
- * Free family passages
- * Furnished quarters at reasonable rental
- * Children's education allowances and holiday visit passages
- * Interest free car loan
- * There is no income tax payable in Brunei at present

The Brunei Television Service require a Supervisory Engineer (Transmitters) to be responsible to the Superintending Engineer for the efficient operation and maintenance of all transmitting equipment; also routine inspection and maintenance of aerials and feeders on towers 400/450 ft. high and to undertake the training of local staff. Candidates, preferably under 55 years of age, must hold a recognised qualification in colour television engineering, and have spent at least 5 years in a supervisory position in a PAL colour television transmitting station. Experience should include parallel operation of Band III transmitters of 5KW and higher output towers and the installation, operation and maintenance of microwave link equipment. Salary, according to qualifications and experience in the scale £3,166 to £5,750 approximately.

For further particulars you should apply, giving brief details of experience, to CROWN AGENTS, M Division, 4 Millbank, London SW1P 3JD, quoting reference number M2K/740804/WF.

**crown
agents**

4509

Aerial Maintenance Engineer

£3238-£3928

We require an experienced Aerial Engineer in the Station Operations and Maintenance Department to be responsible for the maintenance of UHF, VHF and SHF Transmitting and Receiving Aerial Systems.

The post is based at the Authority's North Regional Office in Leeds and the duties will mainly be confined to stations within the North of England, although duties throughout the UK may from time to time be required.

The work will require the successful applicant to travel extensively in the fulfillment of his duties (a car will be provided). In addition, because of the nature of the broadcasting service, duties outside 'normal office hours' will be required.

A minimum of three years' experience in the microwave transmission field on work involving aerial arrays and coaxial line assemblies and filters used in broadcasting bands is essential.

Applicants should preferably be qualified to HNC level or equivalent and/or should be able to demonstrate a sound theoretical understanding of aerial and transmission line systems.

Applicants should possess a current driving licence and should be prepared to climb masts up to 1250 feet in height.

The commencing salary will be within the above range, depending upon qualifications and experience.



Please write or telephone for an application form quoting reference number 2596 to: Vanessa Aldred, Independent Broadcasting Authority, Crawley Court, Winchester, Hants. Telephone: Winchester 822599.

4567

**GUY'S HOSPITAL
MEDICAL PHYSICS
TECHNICIAN GRADE II
AND
ELECTRONICS TECHNICIAN/
ENGINEER GRADE III**

**Department of Clinical Physics and
Bioengineering**

The Grade II Technician is a member of a team of physicists and technicians engaged in a variety of clinical instrumentation projects. ONC, HNC or higher qualification required together with 2 years electronics experience in Technician III Grade or other relevant technical experience. Basic salary from £2,601—£3,390, starting point according to experience.

The Grade III Technician post is for an Electronics Technician/Engineer engaged upon maintenance, repair and calibration of a wide range of electromedical equipment. ONC/HNC in electronics required plus at least 3 years electronic instrument maintenance experience. Basic Salary from £2,190—£2,817.

Apply to Personnel, Guy's Hospital, London SE1 9RT. Telephone 01-407 3662 Ext. 68. [4514]

RADIO TECHNICIAN FOR CENTRAL AMERICA

Needed to work in Guatemala with the Radio Schools Movement, training a team of Guatemalans in the maintenance and repair of station equipment. A British Volunteer Programme post.

Information:
Paddy Coulter, Overseas Volunteers/CIIR, 41 Holland Park, London W.11. [4577]

**KILLINGBECK HOSPITAL,
YORK ROAD, LEEDS 14**

AN

ELECTRONIC TECHNICIAN (MEDICAL PHYSICS TECHNICIAN III)

is required for the Cardiovascular Unit. The hospital is the Regional Cardio-thoracic Centre.

The work involves the servicing of patient monitoring and biochemical analysis equipment.

Basic qualifications required: ONC, HNC or HND. Experience in repair of audio-amplifiers or TV servicing would be an advantage.

Salary Scale:—£2,190—£2,817 per annum, plus current cost of living allowance.

Application form and job description from Personnel Officer, Seacroft Hospital, York Road, Leeds LS14 6UH. Telephone 648164 Ext. 253. [4533]

4533

BEACON BROADCASTING

the Local Radio Station for Wolverhampton
and the Black Country

invites applications for the post of

CHIEF ENGINEER

The applicant must have a sound technical knowledge of local sound broadcasting and should ideally have had experience in setting up a local station and all the I.B.A. technical requirements.

Write giving details of past experience to:

BEACON BROADCASTING LIMITED
56/57 QUEEN STREET, WOLVERHAMPTON

[4549]

TEST ENGINEERS

Thorn Automation Limited, a recognised leader in the field of Electronic Industrial Control Equipment wish to appoint several Test Engineers to test a wide range of electronic industrial control equipment.

Applicants should have had experience in the testing of electronic control equipment, together with some experience in digital logic techniques and S.C.R. regulations.

The company is situated in pleasant rural surroundings within easy reach of new housing developments and several large towns.

If you would like to know more about these interesting and rewarding positions telephone or write to:

Peter Williams,
Personnel Officer,
THORN AUTOMATION LIMITED,
P.O. Box 4, Rugeley, Staffs WS15 1DR
Telephone Rugeley 5151



4569

APPOINTMENTS

REDIFON TELECOMMUNICATIONS LTD., London, S.W.18, have a vacancy for an enthusiastic, practical man with some experience of Volume Production Testing in the electronics industry. Phone: 01-874 7281 and ask for Len Porter. [4288]

THE MIDDLESEX HOSPITAL, London, W.1. Department of Clinical Measurement. Applications are invited for the post of Medical Physics Technician Grade III in the Department of Clinical Measurement. Qualifications will be based on Whitley Councils Professional and Technical B Scales. Duties will include a wide variety of work with apparatus used for physiological measurement and candidates should possess suitable qualifications i.e. some electronics experience and an ONC; HNC, HND or some other appropriate science degree. Applications should be made to the Establishment Officer, The Middlesex Hospital, London WIN 8AA as soon as possible. [4512]

UNIVERSITY College Hospital Medical School. Applications are invited for a post of audiovisual technician to work on a Psychiatric Research Project and the use of video-tapes for teaching purposes under Dr. D. A. Sturgeon, Department of Psychological Medicine at St. Pancras Hospital. The post is funded by a Grant from the Leverhulme Trust and will be available for two years. Salary according to age and qualifications within the range of £1,860 to £2,187 plus London Weighting—£410 and Threshold Payments. Applications to and further particulars from Dr. D. A. Sturgeon, Department of Psychological Medicine, St. Pancras Hospital, 4, St. Pancras Way, London, N.W.1. [4513]

SITUATIONS WANTED

EXPERIENCED Radio/Technician 23-years, single. Requires rewarding employment overseas/U.K. C & G TT4. Fully conversant with modern radio telephones/UHF/VHF/control systems practice. Available at reasonable short notice. Box No. WW 4505.

SITUATIONS VACANT

ELECTRONICS ENGINEER required for Central London recording studio. Experience in audio electronic work. Must be keen and prepared to work long hours. Box No. WW 4548.

ELECTRONIC Wireman and Tester. A vacancy exists with a small, West Country manufacturing company, for an Electronics Wireman, to work on printed circuits, to lay out circuits, to make prototypes, to evaluate, test and fault-find on standard and prototype units, and to generally carry out quality control inspection. Applicants must have previous industrial experience of this work. Qualifications are not important, provided that the individual has experience and enthusiasm. Applications, giving full details of age, experience, etc., to Box No. WW 4519.

ELECTRONIC engineer to design equipment for use of the physically handicapped. Knowledge/interest in medical electronics, digital systems, communications, computers preferred. Interesting range of work with small Company in pleasant location. Grange Electronics Ltd., Stone Lane, Wimborne, Dorset. [4551]

ARTICLES FOR SALE

AUTOMATIC TEST SET, teleprinter, tape punch, tape reader. Suitable for parts. Housed in double 19in. datum case on R. S. J. wheeled dolly. £60. Medway 55888 and 33168. [4546]

ARVAK ELECTRONICS. 3 Channel Sound-Light Converters from £17; Strobes, £21; Rainbow Strobes, £133. Free catalogue. 98A (W), West Green Road, (Side Door), London N15 5NS. 01-800 8656. [23]

BRENNEL M.K. 6 deck, new, unused, bought for WW Stuart Tape—Recorder project, but latter never built. Cost £85. Offers to Box No. WW 4503.

CLEARING distributor stocks, transistors, diodes, components, etc. Sample pack 65p incl., postage or send stamp for list. Redhawk Sales Ltd. 10 Maple Lodge Close, Rickmansworth, Herts. Mail Order Only. [4499]

CONSTRUCTION AIDS—Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards—masters, negatives and board, one-off or small numbers. Send 9p for list. Ramar Constructor Services, 29 Shelbourne Road, Stratford on Avon, Warwks. Tel. Stratford on Avon (std 0789) 4879. [28]

DIGITAL CLOCK CHIP, AY-5-1224, with data and circuit diagram, £3.66 plus VAT. 'Jumbo' LED digits (16mm high) type DL-747, only £2.04 each plus VAT, post free. Greenbank Electronics, 94 New Chester Road, Wirral, Merseyside L62 5AG. [83]

HEATH 10-102 DC—5MHz Scope. Solid-State. Like new. Less than 25 operating hours. £60. 26 Oberon Close, Hartford, Huntingdon, Cambs. [4515]

LADDERS unvarnished 14ft. 1in. closed, 25ft. 4in. extd. £21.40 delivered. Tel: Telford 586644. [13]

Classified continued on page 97

Articles for Sale—Continued

COLOUR, UHF and TV SPARES. Colour and UHF lists available on request. 625 TV. If unit, suitable for Hi-Fi amp or tape recording, £6.75, P/P 35p. Television construction cross hatch kit, £3.85, P/P 15p. Bush CTV 25. New convergence panels plus yoke and blue lat., £3.85, P/P 40p. New Philips single standard convergence panels complete, incl. 16 controls, coils, P.B. switches, leads and yoke £5.00, P/P 40p. New Colour Scan Coils, Mullard or Plessey plus convergence yoke and blue lateral, £10.00, P/P 40. Mullard AFI025/05 Convergence Yoke, £2.50, P/P 35p. Mullard or Plessey Blue Laterals, 75p P/P 20p. BRC 3000 type Scan Coils, £2.00 P/P 40p. Delay Lines DL20, £3.50, DL1E, DL1, £1.50, P/P 25p. Lum Delay Lines, 50p, P/P 15p. EHT Colour Quadrupler for Bush Murphy CTV 25 111/174 series, £8.25, P/P 35p. EHT Colour Tripler IIT TH25/ITH suitable most sets. £2.00 P/P 25p. KB CVCI Dual Stand, convergence panels complete incl. 22 controls £2.75, P/P 35p. CR1 Base panel, 75p P/P 15p. Makers Colour surplus/salvaged Philips G8 panels part complete; Decoder, £2.50, IF incl. 5 modules, £2.25. T. Base, £1.00, P/P 25p. CRT base, 75p, P/P 15p. GEC 2040 panels, Decoder, £3.50. T. Base £1.00, P/P 35p. CRT Base 75p, P/P 20p. B9D valve bases 10p, P/P 6p. VARICAP TUNERS. UHF ELC 1043 NEW, £4.50. Philips VHF for Band 1 and 3, £2.85 incl. data. Salvaged VHF and UHF Varicap tuners, £1.50, P/P 25p. UHF TUNERS NEW, Transistorised. £2.85 or incl. slow motion drive, £3.85. 4 position and 6 pos. push-button transistorised, £4.95. All tuners P/P 35p. MURPHY 600/700 series complete UHF Conversion Kits incl. tuner, drive assy., 625 IF amplifier, 7 valves, accessories housed in cabinet plinth assembly, £7.50 P/P 50p. GEC 405/625 Dual standard switchable IF amplifier and output chassis incl. cct., £1.50 P/P 35p. THORN 850 Dual standard time base panel, 75p P/P 35p. PHILIPS 625 IF amplifier panel incl. cct., 75p P/P 30p. VHF turret tuners AT7650 incl. valves for K.B. Featherlight, Philips 19TG170, GEC 2010, etc., £2.50. PYE miniature incremental for 110 to 830, Pam and Invicta, £1.00. A.B. miniature with UHF injection suitable K.B. Baird, Ferguson, 75p. New fireball tuners Ferguson, HMV, Marconi, £1.80 P/P all tuners 30p. Mullard 110° mono scan coils, new suitable all standard Philips, Stella, Pye, Ekco, Ferranti, Invicta, £2.00, P/P 35p. Large selection LOPTS. FOPTS available for most popular makes. 200+200+100 Microfarad 350v Electrolytic, £1.00 P/P 20p. MANOR SUPPLIES, 172 WEST END LANE, LONDON, N.W.6. Shop premises, callers welcome. (No. 28, 59, 159 Buses or W. Hampstead Bakerloo and Brit. Rail). MAIL ORDER: 64 GOLDERS MANOR DRIVE, LONDON. N.W.11. Tel. 01-794 8751.

LOW COST IC MOUNTING. Use Soldercon IC socket pins for 8 to 40 pin DIL's. 70p (plus 5p VAT) for strip of 100 pins, £1.50 (plus 12p VAT) for 3 strips of 100, £4 (plus 32p VAT) for 1,000. Instructions supplied. Send for sample. SINTEL, 53c Aston Street, Oxford. Tel: 0865 43203. [67]

OLD COPIES, Wireless World, April 1913-14 (No. 1 Vol. Bound), January 1929—June 1932 (Bound), July 1932—December 1938 (Loose). Offers: J. Greaves, 82, Hodge Hill Common, Birmingham B36 8AG. [4525]

P.D.P. 8 MINICOMPUTER with ASR33 Interface; but without peripherals, £425. P.D.P. 8/S in rack cabinet, c/w A.S.R. 33 & stats. software, £850. I.C.L. 1901/2 processor with K.S.R. 33 typewriter, £650. I.C.L. 2501 cassette tape unit, £225 Monroe Model 1210 'Monrobot', small desk COMPUTER incorporating A.S.R. 33 on stand & mag. memory drum, £225. A.S.R. 33 Teletype in A.S.C.I.I., £225. Elliott tape punch & reader with handlers, £32. Friden tape reader, £9. FLEXO-WRITERS: Model 2 c/w desk etc., £385. Model 1, £125. Model 1 (upper case), £45. Singer PROGRAMMABLE PRINTING CALCULATOR, 30 step, 5 memory, £48. Singer Calculator displaying 'stack' on C.R.T., £28. (These calculators are D.T.L./T.T.L. & offer interesting potential. Ferranti mag. memory DRUM, £29. S Band Travelling Wave Tube Amplifier, c/w T.W.T., £45. ITEL AUTOMATIC 'GOLFBALL' TYPEWRITERS and ITEL TERMINALS from £250 s/hand, and £700 NEW. Descriptive Stock List, 25p (refundable). COMPUTER APPRECIATION, Castle St., Bletchingley, Surrey RH1 4NX. Godstone 3106. [4571]

PYE VHF mobile AM10 Boot mount multi channel Radio C/ with controls cables cradle accessories and Aerial just over-hauled as new, £50. Phone 01-464 8417 evenings. [4550]

THYRISTORS BT106 Branded Product 95p each. Tantalum Bead Capacitors 1mf 35V 22mf 16V. All at 10p each. Prices are exclusive of VAT. CWO plus p. & p. 10p. Pace Electronics Ltd., 138 Glebe Road, Deanshanger, Milton Keynes. MK19 6NB. [4497]

TRIO Model 9R-59DS Receiver very little use, £25. Griffiths, Eymore House, Trimpey, Bewdley, Worcs. Tel. Arley 449. [4511]

VACUUM is our speciality, new and second-hand, rotary pumps, diffusion outfits, accessories, coaters, etc. Silicone rubber or varnish outgassing equipment from £40. V. N. Barrett (Sales) Ltd., 1 Mayo Road, Croydon. 01-684 9917. [24]

VALVES AND TRANSISTORS—Valves 1930—1975, 2,000 types stocked, many obsolete. List 15p. Transistors list 15p. Cox Radio (Sussex) Ltd., The Parade, East Wittering. Tel: West Wittering 2023. [4520]

**BRENT AND HARROW AREA HEALTH AUTHORITY
NORTHWICK PARK HOSPITAL,
Watford Road, Harrow, Middx. HA1 3UJ Tel: 01-864 5311**

ELECTRONICS TECHNICIAN (GRADE II)

Required to supervise the work of 4 Technicians and to provide a maintenance service to the Harrow Health District. The successful applicant would also be expected to develop a full range of services in the medical engineering field. Previous health service experience an asset but not essential.

Salary: £2,406—£3,141 plus £312 London Weighting plus £228 Threshold payments.

If interested please contact Miss P. Knight, Personnel Department, Ext. 2001. [4523]

60 KHz MSF Rugby and 75 KHz Neuchatel Radio Receivers. Signal and Audio outputs. Small, compact units. Two available versions. Toolex, Bristol Road, Sherborne (3211), Dorset. [21]

600,000 CAPACITORS-POLYESTER C280-250v & 400v, values from 0.01UF to 2.2UF mixed 100-£1.00, 1000-£8.00. Electrolytics from 1UF to 1000UF, 10v to 63v mixed, 100-£1.50, 500-£6.00. Electronic Mailorder, Ramsbottom, Bury, Lancs. [4531]

51MM B. & H. 631 Sound Projector C/W Speaker & Transformer, £135. Hilton, 9 West Hill, Dartford 20009. [4574] writer, £650. I.C.L. 2501 cassette tape unit, £225.

ARTICLES WANTED

SURPLUS Components, Equipment and Computer panels wanted for cash. Ring: Southampton 772501. [4540]

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [63]

WANTED WW copies for March 1971 and June 1973 to complete 40 years collection. Good price paid. Bovill, 12, Gorselands Close, Dartnell Park. West Byfleet, Surrey. Tel: Byfleet 46163. [4507]

WE BUY modern 16mm sound projectors. Burgess Lane & Co. Ltd., Thornton Works, Thornton Avenue, Chiswick W.4. 994 5752/5953. [4387]

CAPACITY AVAILABLE

AIRTRONICS LTD., for Coil Winding—large or small production runs. Also PC Boards Assemblies. Suppliers to P.O., M.O.D., etc. Export enquiries welcomed, 3a Waterland Road, London, SE13 7PE. Tel. 01-852 1706. [61]

BATCH Production Wiring and Assembly to sample or drawings. Deane Electricals, 19B Station Parade, Ealing Common, London, W.5. Tel: 01-992 8976. [20]

CAPACITY available to the Electronic Industry. Precision turned parts, engraving, milling and grinding both in metals and plastics. Limited capacity available on Mathey SP33 JIG BORER. Write for lists of full plant capacity to C.B. Industrial Engineering Ltd., 1 Mackintosh Lane, E9 6AB. Tel. 01-985 7057. [14]

CAPACITY available for the Assembly of Electronic or Electrical Components P.C.B.'s, etc. Small or large batch production. Remploy Ltd., Jupiter Road, Norwich NR6 6SU. [31]

DESIGN, development, repair, test and small production of electronic equipment. Specialist in production of printed circuit assemblies. YOUNG Electronics Ltd., 184 Royal College Street, London, NW1 9NN. Tel: 01-267 0201. [29]

ENGINEER makes anything unusual. Inventors models, displays, Special tools and equipment. Seymour, 30 Devonshire Drive, Stapleford, Nottingham. [4229]

EXPERIENCED Constructor Seeks P.C.B. Production Homework. Modest Fees. Please contact: John Francis, 8, Portnall House, Portnall Road, London, W9 3BH. Phone: 01-969 3742. [4517]

LABELS, NAMEPLATES, FASCIAS on anodised aluminium or perspex. Any quantity, superb quality, fast delivery. G.S.M. GRAPHICS LTD., 1-5 RECTORY LANE, GUISBOROUGH (Tel: 02873-4443), YORKS. [26]

SMALL Batch Production, wiring assembly, to sample or drawings. Specialist in printed circuit assemblies. D. & D. Electronics, 42 Bishopfield, Harlow, Essex. Tel: Harlow 33018. [17]

BUSINESS OPPORTUNITIES

LONDON COMPANY requires Partner to establish an independent local branch of expanding business in one of a number of selected areas throughout the British Isles. Box No. WW 4498.

COURSES

RADIO and Radar M.P.T. and C.G.L.I. Courses. Write: Principal, Nautical College, Fleetwood, FY7 8JZ. [25]

NEW GRAM AND SOUND EQUIPMENT

GLASGOW HI FI, Recorders, Video, Communications Receiver always available we buy sell and exchange for photographic equipment. Victor Morris Audio Visual Ltd., 340 Argyle Street, Glasgow, G.2. 31 Sauchiehall Street, Glasgow, G.1; 8/10 Glassford Street, Glasgow, G.2. Tel: 041-221 8958. [11]

RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

HRO Rx5s, etc., AR88, CR100, BRT400, G209, S640, etc., etc. in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [65]

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [64]

SERVICE AND REPAIRS

SCRATCHED TUBES. Our experienced polishing service can make your colour or monochrome tubes as new again for only £2.75, plus carriage £1. With absolute confidence send to Retube Ltd., North Somercote Louth, Lincs, or 'phone 0507-85 300. [27]

TAPE RECORDING ETC.

IF QUALITY, durability matter, consult Britain's oldest transfer service. Quality records from your suitable tapes. (Excellent fund raisers for schools). Modern studio facilities with Steinway Grand.—Sound News, 18 Blenheim Road, London, W.4. 01-995 1661. [4302]

IF QUALITY, durability matter, consult Britain's oldest transfer service. Quality records from your suitable tapes. (Excellent fund raisers for schools). Modern studio facilities with Steinway Grand.—Sound News, 18 Blenheim Road, London, W.4. 01-995 1661. [4504]

VALVES WANTED

WE buy new valves, transistors and clean new components, large or small quantities, all details, quotation by return.—Walton's, 55 Worcester St., Wolverhampton. [62]

The Shop Window for the Very Best...



**COMBINED
PRECISION
COMPONENTS
(PRESTON) LTD**

194-200 North Rd,
Preston PR1 1YP
Tel: 55034
Telex: 677122

TOSHIBA VALVES

Type	Price Each (p)	Type	Price Each (p)
DY87	30.0	AD149	40
DY802	30.0	AD161	38
ECC82	28.0	AD162	38
EF80	29.5	AF114	24
EF183	34.5	AF115	21
EF184	34.5	AF116	22
EH90	35.5	AF117	19
PC900	24.5	AF118	50
PC909	40.0	AF139	35
PC9189	41.0	AF178	45
PCF80	31.5	AF178	45
PCF86	39.0	AF181	45
PCF801	42.0	AF239	40
PCF802	40.0	AF240	60
PCLB2	39.0	BC107	11
PCLB4	39.0	BC108	10
PCLB5	44.5	BC109	14
PCLB6	41.0	BC109C	14
PFL200	59.5	BC113	13
PL36	55.5	BC116A	19
PL84	28.0	BC117	14
PL504	64.5	BC125B	15
PL508	67.0	BC132	25
PL519	£1.50	BC135	15
PY88	35.5	BC137	19
PY800	33.0	BC138	25
PY500A	85.0	BC142	23
		BC143	25
		BC147	11
		BC147A	11
		BC148	10
		BC149	19
		BC153	15
		BC154	15
		BC157	14
		BC158	10
		BC159	11
		BC173	18
		BC178B	20
		BC182L	12
		BC183L	12
		BC187	25
		BC214L	15
		BC328	28
		BC337	18

SEMI CONDUCTORS

Type	Price Each (p)	Type	Price Each (p)
AC127	17	BD124	75
AC128	13	BD131	45
AC141K	25	BD132	39
AC142K	25	BD160	£1.39
AC151	20	BD135	48
AC154	18	BD237	52
AC155	18	BDX32	£2.40
AC156	20	BF115	20
AC176	22	BF160	15
AC187	19	BF167	20
AC187K	24	BF173	20
AC188	17	BF178	35
AC188K	26	BF179	40
AD142	45	BF180	31
		BF181	32
		BF184	25
		BF185	25
		BF194	8
		BF195	8
		BF196	10
		BF197	12
		BF198	23
		BF200	25
		BF218	30
		BF224	33
		BF258	34
		BF336	28
		BF337	35
		BF355	54
		BFX86	28
		BFY50	19
		BFY52	20
		BT106	£1.20
		BU105/02	£1.95
		BU108	£2.10
		BU208	£2.95
		E1222	30
		MJE340	45
		OC71	15
		OC72	18
		R2008B	£2.00
		R2010B	£2.00
		RCA16334	80
		RCA16335	80

DIDES

Type	Price Each (p)
BA115	7
BA148	14
TAA550	49p
TAA700	£2.95
TBA120AS	£1.00
TBA120SQ	£1.00
TBA480Q	£1.40
TBA520Q	£2.35
TBA530Q	£1.75
TBA540Q	£1.75
TBA560CQ	£2.40
TBA800	£1.50
TBA920Q	£2.90
TBA990Q	£2.90
TCA270Q	£2.90
ETTR6016	£2.00
SN76013ND	£1.50

INTEGRATED CIRCUITS

Type	Price Each
BA115	7
BA148	14
TAA550	49p
TAA700	£2.95
TBA120AS	£1.00
TBA120SQ	£1.00
TBA480Q	£1.40
TBA520Q	£2.35
TBA530Q	£1.75
TBA540Q	£1.75
TBA560CQ	£2.40
TBA800	£1.50
TBA920Q	£2.90
TBA990Q	£2.90
TCA270Q	£2.90
ETTR6016	£2.00
SN76013ND	£1.50

NEW TOSHIBA TUBES

19" A49/191X	£48.95
20" 510D/1922	£50.75
22" A56/120X	£54.25

EHT MULTIPLIERS MDNOCROME (BRC)

Type	Price Each
2HD 950MK1	960
2TQ 950MK2	1400
2DAK 1500 (17" & 19")	
2TAK 1500 (23" & 24")	

EHT MULTIPLIERS - COLOUR

11TAQ IIT CVCL 2 & 3	£4.50
IITN GEC/Sobell	£4.50
11TAZ GEC 2110	£4.95
11TAM Philips G8	£4.50
11TBD Philips 54	£4.50
3TCW Pye 691/693	£3.50
11H Decca 30 Series	£4.50
11TAQ Decca 'Bradford'	£4.50
3TCU Thorn 3000/3500	£5.00
11HAA Thorn 8000	£1.90
11HAB Thorn 8500	£4.25

PRICES SUBJECT TO 8% V.A.T.
All goods subject to settlement
discount of 5% 7 days and 2%
monthly.
No postage charges or minimum
order values.
Write or phone for full details now.

...In Prices, Quality and Service.

B. BAMBER ELECTRONICS

20 WELLINGTON STREET, LITTLEPORT, CAMBS.
TEL: ELY (0353) 860185 (TUESDAY-SATURDAY)

TEST EQUIPMENT

FENLAND 3 + 3 AUDIO MIXER, 6-channel, separate bass, treble, and slider fade on each channel. Mint condition, solid state £50.

RACAL 125MHz DIGITAL FREQUENCY METER, Type 801R/2, 0.01V to 1V sensitivity, 8-digit readout, new condition, £275.00

ROHDE AND SCHWARZ SIGNAL GENERATOR, SMAF, 4-300MHz, AM/FM, attenuation to 0.05 microvolt, deviation and modulation metered, complete, but needs attention, £300.00

ROHDE AND SCHWARZ FREQUENCY DEVIATION METER, FMV, AM/FM, 20-300MHz £300.00

MARCONI UHF SIGNAL GENERATOR, TF762B, 300-600MHz, £50.00

MARCONI STANDARD SIGNAL GENERATOR, TF867/2, 15kHz-30MHz, £100.00

MARCONI AMPLITUDE MODULATOR, TF1102, £35.00

MARCONI VALVE MILLIVOLT-METER, TF899A, £30.00

MARCONI STANDARD SIGNAL GENERATOR, TF144H, 10kHz-72MHz, £195.00

WAYNE KERR VHF FREQUENCY STANDARD, 12-channel, £20.00

AIRMEC BRIDGE HETERODYNE DETECTOR, Type 775, £65.00

AIRMEC SIGNAL GENERATOR, Type 201, 30kHz-30MHz, £75.00

HEWLETT PACKARD UHF SIGNAL GENERATOR, Type 614A, 800-2300MHz, £175.00

SOLARTRON DIGITAL VOLTMETER, Type LM1420/2, with "TRUE RMS AC UNIT", 10mV-1000V, 5-digit display, new condition, £400.00

ROHDE AND SCHWARZ POWER SIGNAL GENERATOR, SMLM, 30-300MHz, up to 5V output, £300.00

GRESHAM LION 625-LINE PULSE/BAR/STAIRCASE GENERATOR, £25.00

TEKTRONIX 524D SCOPE, DC-10MHz, £70.00

PYE MF TRANSMITTERS

2 X 5B254Ms in final, VFO 340 to 540kHz (can be modded upward), 2 X 5B254Ms in Modulator, cw/mcw (can be modded for AM), units complete, but no PSUs, (supplied with circuits of TX and PSU) brand new, boxed, £20.00.

PLUGS AND SOCKETS

TV PLUGS (metal type) 6 for 50p

TV SOCKETS (metal type) 50p

TV LINE CONNECTORS 5 for 50p

PL259 (PTFE) PLUGS 50p each or 5 for £2.25

SO239 (PTFE) SOCKETS 50p each or 5 for £2.25

25-WAY ISEP PLUGS and SOCKETS 40p set (1 plug + 1 skt). Plugs and sockets sold separately at 25p each

CANNON Right-angled plugs XLR LNE1575p

DIN SPEAKER SKTS, 2-pin, 4 for 30p

STANDARD JACK PLUGS, 1/2in., 4 for 50p

ANDREWS 44AN FREE SKTS (N-TYPE) for FH4/50B or FHJ4/50B cable £1.00 each

SO239 BACK-TO-BACK SOCKETS £1.25 each

BNC INSULATED SOCKETS (single-hole type) 65p each

VALVES

QQV03/10 (ex equipment) 75p each

2C39A (ex equipment) £1.00 each

QQV02/6 (ex equipment) £1.00 each

4X250B (ex equipment) £2.10 each

4X250B (ex equipment) £1.50 each

DET-22 (ex equipment) 2 for £1.00

EF80 (new) 25p, EZ81 (new) 25p

ECC81 (new) 30p, ECC83 (new) 30p

HIGH-QUALITY SPEAKERS

8 3/4in. X 6in. elliptical, 2in. deep, 4 ohms, inverse magnet, rated up to 10Watts, £1.50 each, or 2 for £2.75 (quantity discount available).

TERMS OF BUSINESS: CASH WITH ORDER. ALL PRICES INCLUDE POST & PACKING (UK ONLY). EXPORT ENQUIRIES WELCOME. PLEASE ADD 8% VAT. MINIMUM ORDER £1

CALLERS WELCOME BY APPOINTMENT
PLEASE ENCLOSE STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

ELECTROLYTIC CAPACITORS

AXIAL LEAD AND SINGLE ENDED	Price
MFD 6.3V 10V 16V 25V 35V 50V	
22 30p	40p
33 - 30p	35p 40p 45p
47 - -	40p 45p -
100 35p	40p - 45p 60p -
220 40p	40p - 50p 75p -
330 40p	45p 60p 75p 95p
470 45p	60p - 95p - -
1000 - -	95p - - -
3300 95p	95p - - -

TRADE ENQUIRIES WELCOME FOR QUANTITY

MAINS TRANSFORMERS

240V in. voltages quoted approx. RMS.

TYPE 10/2 10-0-10V at 2A, £1.50

TYPE 125BS Approx. 125V at 30mA, 65p

TYPE 27203 400V at 10mA, 200V at 5mA, 6.3V at 400mA, £1.25

TYPE 18/8 18V at 8A, £4.50 each

TYPE 16/6 16V at 6A, 4.5V at 100mA, £4.00

TYPE 28/4 28V at 4A, 12.5V at 500mA, £4.00

TYPE 129 400V at 20mA, 200V at 10mA, 6.3V at 500mA, £1.25

TYPE 70462 250-0-250V, 50-0-50V, 6.3V, £1.75

RADIO SPARES 500-WATT AUTO TRANSFORMER, 100/110/150/200/220/240/250V tapped input and output, step up or step down facility, ex new equip, £6.00

MAINS ISOLATING TRANSFORMER, 375VA, tapped primary, 240V output, new, £6.00.

MAINS ISOLATING TRANSFORMER, (ex equip), in metal cases, totally enclosed, tapped mains input, 110-240V etc., output 240V at 3A + 12V at 0.5A, £11.00.

AS ABOVE, output 240V at 12A + 12V at 3A + 22V at 2.5A, £27.50, carriage £2.

ELECTRONIC IGNITION FOR YOUR CAR!

Cut petrol costs by up to 15%. Install Electronic Ignition in your car in minutes. Reduces petrol consumption, increases overall performance. Prolongs contact-breaker and spark-plug life. Makes starting so much easier. Each unit (British manufacture) tested and guaranteed for 2 years/50,000 miles. IMPORTANT: STATE POSITIVE EARTH or NEGATIVE EARTH when ordering. £11.80 + VAT (94p). Post paid.

MISCELLANEOUS MAGNETIC DEVICES PROGRAMMERS, contain 9 microswitches with 9 adjustable drums for period switching (needs slow-motion motor to drive drum) many switching applications £1.00 each.

IIT HIGH-GRADE ELECTROLYTICS, 6800 mfd at 25V, screw terminals, complete with capacitor clip for vertical mounting, 50p each (quantity discount available).

MULTICORE CABLE, 1/4" dia. PVC covered, in 22ft. lengths with plug and socket fitted, 24 core stranded + 1 screened + 1 twin screened (ideal mobile control lead) £2.10 each.

TWIN HEAVY DUTY CABLE, PVC covered, 50/0.25mm, 15p per metre, or £10.20 per 100 metre reel.

CURLY LEADS, 4-core telephone-type 18in. closed, approx. 5ft. extended, 2 for 20p.

STUD RECTIFIERS, BYX42/300R, 300V at 10A, 30p each or 4 for £1.00

TRANSISTOR HEATSINKS to take 2 X T018 transistors, screw in clamps. Block size 1in. X 1/2in. X 1/2in. with 2 holes for mounting, 3 for 50p

PYE RADIO-TELEPHONE EQUIPMENT

Cambridge, Westminster, Motofone, Europa series. Send s.a.e. for full details, stating requirements, frequency, channel spacing, etc.

fibre optic suppliers

MARE'S TAIL Decorative Display. 22" dia. 7,000+ Fibres £10.00
FIBROFLEX SIZE 1 440 Strand Flexible Glass Light Conduit. 1.14mm Active Dia., Black Sheath. 10m £3.00; 100m £21.00
FIBROFLEX SIZE 4 1,760 Strand £1.50 per metre; 10m £12.00
CROFON 1610 Flexible 64 Strand Plastic Light Conduit. Active Dia. 1.8mm. O.D. 3.3mm. £1.20 per m.; 10m £3.00
PLASTIC OPTICAL MONOFIBRE Flexible Light Guide Dia. 10, 20, 40, 60 thou. FP10 100m £2.00. FP20 (0.5mm) 100m £4.00. FP40 10m £2.20; 100m £14.00. FP60 10m £4.00; 100m £30.00
OPTIKIT 103 2m CROFON 1610 + 5m each FP20, FP40, FP60 £4.70
OPTIKIT L6 6 Convex Glass Lenses Dia. 7/14/21/26/47/51mm £2.50
Optikits RR5 Five Retro-Reflectors for Optical/Infra-Red beam systems. Dias. 22/36/44/83mm + 150mm Strip. £2.00
ULTRASONIC TRANSDUCERS Sensitive 40kHz Tx/Rx pair £3.50
CIRCULAR POLARISERS Reduce glare on all types of instrument. RED/AMBER/GREEN or NEUTRAL. 50mm sq. 70p; 75mm sq. £1.40
OPTOELECTRONICS LIGHT SOURCES & DETECTORS
 MV54 2mm Red LED 20p. MLED500 T092 Red LED 20p.
 XC209-Red (3mm) 20p. XC209-Y. XC209-G (Amber, Green) 30p.
 MLED92 Infra Red Emitter 30p. MLS203 Photo-Thyristor £1.20.
 2N5777 High Sensitivity Photo-Darlington 25V 50p.
 MRD150 2mm High Speed Photo-Transistor (4 uS) 40V. 70p.
 Please add 8% VAT to prices. SAE please for short form/data.
FIBRE OPTIC SUPPLIERS (WW), 2 LOUDOUN ROAD MEWS, LONDON NW8 0DN 4544

EXPRESS

Prototype Printed Circuits
 Fastest in London Area
 Also medium production runs, call-offs, etc.
**Electronic & Mechanical
 Sub-Assembly Co. Ltd.**
 Highfield House, West Kingsdown,
 Nr. Sevenoaks, Kent.
 Tel: West Kingsdown 2344 [40]

zer088

Build a mixer to your own spec. using our easy to wire
AUDIO MODULES
 For full details contact Richard Brown at Zero 88, 115 Hatfield Road, St. Albans, Herts, AL1 4JS Tel. 63727

59

for sale

40kW Transmitters Collins (USA) FRT-22

4-27 MHz, CW (A1) and teletype (F1), suitable for SSB (A3J) with external exciter. Built-in crystal oscillator and frequency synthesizer, 10 autotune channels. Power requirements 230V 50/60 Hz (3 ph), automatic voltage regulation.

Volume ca. 480 cu. ft., weight ca. 12,600 lb. There are two identical sets available. Transmitters are used and need overhaul. Several tubes and vacuum capacitors must be replaced, minor parts missing.

Price: DM 8,000 per set; DM 14,000 for two sets, ex-stock Munich, in seaworthy packing with complete technical documentation.

DR. HANS BÜRKLIN
 8 München 2, Schillerstr. 40 (FRG) [4552]

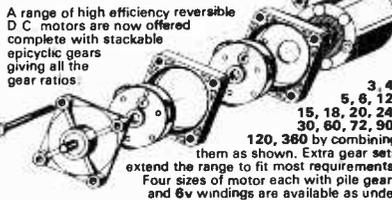
TELEPHONE EXCHANGE Cordless PABX No. 4 Automatic

Telephone & Electric Co. Limited.
 Installed 1961. Addition 1967.

300 Extensions 2 Manual Boards
 28 Exchange Lines 4 Keycaller Units
 2 Private Wires

Contact:
 Mr. E. Strachan,
 Site Electrical Engineer,
 Rolls-Royce & Associates Limited,
 Raynesway, Derby.
 Tel: Derby 61461 [4527]

MARX-LÜDER STACKABLE EPICYCLIC GEARED ELECTRIC MOTORS



A range of high efficiency reversible D.C. motors are now offered complete with stackable epicyclic gears giving all the gear ratios.

3, 4, 5, 6, 12, 15, 18, 20, 24, 30, 60, 72, 90, 120, 360 by combining them as shown. Extra gear sets extend the range to fit most requirements. Four sizes of motor each with pile gears and 6v windings are available as under

EM136P 1 1/2 watts; 5000rpm; size 24x24x74mm £5.70
 Max. gearbox torque 2kg.cm
 EM136P/1 Spare gear set with 3, 4, 5, 6 ratios 1.70
 EM141P 8 watts; 5000rpm; size 35x35x109mm £6.45
 Max. gearbox torque 5kg.cm
 EM141P/1 Spare gear set with 3, 4, 5, 6 ratios 1.90
 EM145P 20 watts; 7000rpm; size 52x52x180mm £8.25
 Max. gearbox torque 10kg.cm
 EM146P 30 watts; 4000rpm; size 52x52x200mm 10.20
 Max. gearbox torque 10kg.cm

SPECIAL OFFER
 "Gearbox pack". All items above 30.00

MOTORS without gearboxes
 EM1310 8 watts; 20g.cm; 8000rpm; 017mm 4.05
 EM136 1.2 watts; 40g.cm; 5000rpm; 021mm 3.80
 EM139 4.2 watts; 160g.cm; 5000rpm; 030mm 3.60
 EM141 8 watts; 320g.cm; 4500rpm; 030mm 4.20

SPECIAL OFFER
 "Motorpack". All motors above 14.00

Suggested applications. Laboratory equipment, stirrers, pump drives, servo systems, positioning of aeriels dampers, doors, power for models trains, boats, drills, cutting wheels etc. SAE for DATA SHEETS

"Motivator" Curtain Cord Controllers
 A few of these new units have just become available. Ultra slim design, e.g. size 40x185x185mm. Screws flat on wall behind curtains without showing. Can be connected directly to existing corded curtains. Incorporates internal auto limit switches and power supply. May be operated remotely by 3-way switch (supplied).
 Motivator Model B with 2 year battery pack. Kit 18.00
 Fully assembled and tested as above 24.00
 Motivator Model M with mains power supply. Kit 22.00
 Fully assembled and tested as above 30.00
 Additional information gladly supplied on request. All prices are inclusive in U.K. only.

**MAIL ORDER ONLY FROM
 AID-US PRODUCTS**
 Dept. WW5, 8 Hillview Rd., Pinner
 HA5 4PA, Middlesex [4579]

SURPLUS BARGAINS

EASTER LINE ANGUS
 chart recorders, model A601R
 500-0-500u.a. f.s.d. 110v AC,
 as new with manual. £35.00
 (carr. £1).
 Kent Chart recorders single point £20.
 multipoint £30 (£1.50).
 A.E.I. 4-stage sequential transistorised
 electronic timer, many applications, inc
 3 channel auto-light flasher (750 watts
 240v). Circuits provided for fully inter-
 rupted and dim/bright flashing. Modification
 instructions and mains transformer. £4.50
 only (50p).
 Printed circuit Kits. £1.25 (30p).
 Instant Heat Soldering Irons, 240v 100 watt
 £2.65 (30p).
 Veedor root 4 digit resettable counters 115v
 AC £1.25 (10p).
 AMPEX VIDIO Tape 2" x 1670'. New £9
 (50p).
 Ferric Chloride 25p lb (20p). 10 lbs for
 £2.50 (45p).
 TELEPRINTER PAPERS and TAPES, 8 1/2"
 wide, 3-ply carbon, buff manilla 60p (35p),
 ditto 7-ply NCR, no carbon required £1
 (35p). TAPES, 1/2", white £2 per 8 rolls (65p).
 1" buff £2 per 10 rolls (65p). 1" tape suit
 Friden, etc. £2 per 7 rolls (65p).
 B & R VHF change over coaxial relays 50v
 DC operating coil 2 1/4" x 2 1/4" x 2 1/4" £1.25
 (15p).
 35 watt Mains transformer outputs 2, 3, 6,
 20, 24, 27, 30, £1.25 (25p).
 All prices plus (p&p) total plus VAT 8%.
 Large S.A.E. for list.
CASEY BROS., 235 Boundary Rd, St Helens,
 Lancs.

SALE OF SURPLUS RADIO EQUIPMENT

1—Marconi Type 210c VDF Equipment
 2—Pye Handi Cambridge VHF Portable RX/
 PX
 3—Pye Bantam VHF TX/PX
 3—Pye Battery Charger Type BCI
 Quotations invited—addressed to:—
Supplies Officer,
 59, Portland Road,
 Luton, LU4 8AU.
 Further details available from Telecommunica-
 tions Officer, Telephone number Luton 36061
 ext. 28. [4572]

PM ELECTRONIC SERVICES CRYSTALS FOR PROFESSIONAL AND AMATEUR USE

We can supply crystals to most commercial specifications, with an express service for that urgent order. For the amateur we carry a large stock of the more popular frequencies, backed by a quick service for those "Specials". Please send SAE for details or telephone between 4.30-7 p.m. and ask for Mr. Norcliffe.

**7A, ARROWE PARK ROAD, WIRRAL,
 MERSEYSIDE L49 0UB.**
 Tel: 051-677 8918 (until 7 p.m.) [58]

PARTRIDGE ELECTRONICS

**MANUFACTURERS OF AUDIO MIXER SYSTEMS
 NEW PEAK READING
 * VU METER SYSTEMS**
 Which gives the advantages normally only associated with PPM systems at much lower cost.
**REF. W.W.,
 21/25, Hart Road, Benfleet, Essex.**
 (Established 23 years) [43]

WE SELL CONSTRUCTION PLANS

Phonevision, Television Camera, Police Radar Detector, Voice typewriter, Scrambler, Answering machine, Wireless quarter mlke. Plans: \$7.50 each.

COURSES

Detective-Electr. \$36.50. Security-Electr. \$43.50. Telephone Eng. \$59.
OVER 750 ITEMS
 Ask for Catalogue—Airmailed \$0.75
T. STRIK,
 Postbox 618, Rotterdam, Holland. [44]

MICRO ELECTRONIC TRANSMITTER



Receive on a
VHF RADIO
 The smallest Transmitter available in the UK.
 Only 2" x 1". Can pick up and transmit minute sounds and voices. Range 500 yards plus. Can be worn round the neck, held in the hand, or operated in a drawer. Works almost anywhere, uses PP3 battery (very long life). Completely self-contained, transistorised printed circuit. Used the world over. Fully guaranteed. Latest model now dispatched.
 Transmitter £15.50
 If required, suitable Radio for receiving transmissions £13.25
 P. & P. 45p. MAIL ORDER AND COD Welcome.
Mulhall Electronics, (WW)
 Ardglass, Co. Down, UK. BT30 7SF.
 Tel: 039-684 461. [4575]

AUDIO FUNCTION GENERATOR

1 Hz to 100 KHz in 5 ranges.
 SINE, SQUARE & TRIANGLE OUTPUTS.
 FM Modulation/Sweep INPUT.
 PRICE £19.78 plus V.A.T., excl. batteries.
APOLLO ELECTRONICS
 96 MILL LANE, LONDON, NW6 1NQ [4535]
 Tel: 01-794 8328

CRYSTALS

Fast delivery of prototypes and production runs.
INCLUDING :
 Statek LF crystals in TO5 package
 Buckman LF, clock, and mobile radio crystals
 Astro Filter crystals
 Jan General purpose crystals
Interface Quartz Devices Limited,
 29 Market Street, Crewkerne, Somerset.
 Tel : (046031) 2578 Telex: 46283 [57]

C AND G EXAMS

Make sure you succeed with an ICS home study course for C and G Electrical Installation Work & Technicians Radio/TV/Electronics Technicians. Telecomm Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers.

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:
INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept 734, Intertext House, London SW8 4UJ.
Or Phone 01-622 9911 (all hours). [4391]

ARTICLES WANTED

TOP PRICES PAID

for semiconductor and component redundant or excess inventories

P.R.S. ELECTRONICS

126 Headstone Road
Harrow, Middlesex
Tel: 01-965 2243

[34]

TAPE RECORDING ETC.

RECORDS MADE TO ORDER

DEMO DISCS
MASTERS FOR
RECORD COMPANIES

VINYLLITE
PRESSINGS

Single discs, 1-20. Mono or Stereo, delivery 4 days from your tapes. Quantity runs 25 to 1,000 records PRESSED IN VINYLLITE IN OUR OWN PLANT. Delivery 3-4 weeks. Sleeves/Labels. Finest quality NEUMANN STEREO/Mono Lathes. We cut for many Studios UK/OVERSEAS. SAE list.

DEROY RECORDS
PO Box 3, Hawk Street, Carnforth, Lancs.
Tel. 2273

[82]

BUSINESS OPPORTUNITIES

Hair Transplant

For free brochure, clip this ad. and send to:

Room 6
HAIR TRANSPLANT
INTERNATIONAL
502 Eccleshall Road, Sheffield
[4224]

CAPACITY AVAILABLE

WANTED SURPLUS

★ FACTORIES CLEARED ★

MACK'S ELECTRONICS
283 EDGWARE ROAD
LONDON WV 1BB
Tel: 01-262 8614

[4014]

ARTICLES FOR SALE

cont.

ECONOMISE ON SEMICONDUCTORS

All prices include VAT

★ Lower 741C prices 100 + 24p

★ Plastic 3 terminal Regulators

★ Low Price CMOS

★ Low price DIL sockets

	1+	10+	25+
709C Op Amp + data 8 pin DIL	34	32	30
723C Reg. + data 14 pin DIL	65	63	59
741C Op Amp + data 8 pin DIL	30	28	26
748C Op Amp + data 8 pin DIL	39	37	35
NE555 Timer + data 8 pin DIL	65	62	59
CA3046 Array 14 pin DIL	76	73	69
TDA1405 Reg. 5V 650mA	100	92	85
TDA1412 Reg. 12V 500mA	100	92	85
TDA1415 Reg. 15V 450mA	100	92	85
BC107, 108, 109	10	9.5	9
BC182, 184	11	10.5	10
BC212, 214	12	11.5	11
HP Red LED 1/2"	18	16	15
HP Red LED 0.2"	19	17	16
DIL Sockets, low profile	8 pin 11 14 pin 12 16 pin 13	10 11 12	9 10 11

TTL Mixed prices		
	1+	10+
7400	17	18
7402	17	18
7403	17	18
7404	18	17
7405	18	17
7410	17	16
7413	38	34
7420	17	16
7442	70	66
7447	90	85
7473	38	36
7474	35	33
7476	38	36
7486	30	28
7490	55	52
7492	55	52
7493	55	52
74121	44	42

BC109C	11	BZX88C-	11	1N914	5
BC177	18	3V3-15V	11	1N4001	5
BC178	18	2N3702	12	1N4002	5
BF244	24	2N3704	12	1N4004	7
BF244B	27	2N3708	10	1N4148	5
BFY51	17	2N3055	48		

CMOS Mixed Prices		
	1+	25+
4000	27	25
4001	27	25
4002	27	25
4007	27	25
4011	27	25
4012	27	25
4013	60	54
4015	150	140
4023	27	25
4025	27	25
4027	90	82
4030	63	57

AY-5-1224 Digital Clock IC, 12 or 24hr. 7 segment or BCD outputs, drives LED Minित्रon. LED displays. Simple interfacing. 16 pin DIL. IC + data + circuits £4.65. HP 5082-7740 0.3" digits £2.00. IC + 4 0.3" digits £12. IC + 4 0.3" digits + transistors + transformer £14.00

TBA810AS 7W Audio Amp. Thermal protection + data + circuit £1.20

TCA940 10W Audio Amp. Thermal protection, current limit + data + circuit £2.60

Carbon film High Stability 1/4W 5% resistors 10 ohm-2m2 1p ea., 10 9p, 100 80p same value.

By return service. Prices include VAT. P & P 8p (UK) overseas at cost. All items new TI, Motorola, Mullard, SGS etc. SAE lists, enquiries. Data sheets 4p. Colleges etc. supplied.

SILICON SEMICONDUCTOR SERVICES

41 Dunstable Road, Caddington, Luton LU1 4AL

**Scholarship Awarded by
The Institution of Electrical Engineers**

The Council of the Institution of Electrical Engineers will consider for award this year Undergraduate and Postgraduate Scholarships with a maximum value of £600 per annum.

The closing date for the receipt of applications is 1st May, 1975 and late applications cannot be considered.

Full particulars of the conditions governing the award of these Scholarships may be obtained from:

The Director, Qualifications Department, The Institution of Electrical Engineers, Savoy Place, London WC2R 0BL. [4573]

Sub-Miniature Mains Transformers

SCN-0-240v/12v-0-12v. 50 mVA max. 28mm W, 20mm H, 26mm D.

90p each inc. VAT, p. & p. Orders 50 or over, 10% discount. C.W.O.

Phono Leads

Phono Plug to Phono Plug. Single Screened Grey Cable. Length 2 yards. Min. 5 for 90p inc. VAT, p. & p. C.W.O. (Single sockets available with above. 5p each inc. VAT.)

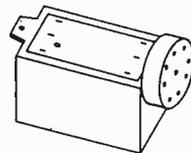
OR Call at our retail shop, open every day except Sunday.

LINWAY ELECTRONICS

843 Uxbridge Road, Hayes End,
Mddx. UB4 8HZ

4580

MINIATURE FM/VHF TRANSMITTER



KIT REQUIRING FIVE SIMPLE SOLDERED CONNECTIONS. SIZE 2" x 1" x 1". RANGE UP TO 500 YARDS.

COMPLETE WITH MICROPHONE AND BATTERY.

EXPORT ENQUIRIES WELCOME. OUR PRICE COMPLETE £6.75

Return post delivery. Not licensable in U.K. S.A.E. for further details: EES, THE AIRPORT, EXETER.

CARBON FILM RESISTORS—E12 SERIES

High Stab. 1W OR 1/2W 5%. 1p, 75p/100, £3-50/1000 (22Ω-1MΩ).

RESISTOR KITS 22Ω-1MΩ E12 SERIES
10E12 KIT 10 of each value (Total of 570) 1/2W, £3-45;
1/2W £3-85; 25E12 KIT 25 of each value (Total of 1425) 1/2W, £8-35; 1/2W, £8-45.

EQUIPMENT SALE

Regulated power supply modules. New in original packing. ATC 24V/2A, £10. Fenlow ± 15V/1A, with F/Panel, £12-50. NGM Vacuum Meters PRU3 (Used) £15. Marconi D-A Converters TF2402, £20. Code Converter TF2403, £20. Limits indicator TF2404, £20. HAAKE Const Temp. Water Circulators type F-Junior (± 0.10) Used, £50. Transformers 50V/30A £20. 7.5KV/0.015A, £7. Honeywell Chart Recorders £50. Solartron VF252 Precision Millivoltmeter £35. Solartron CA512 V.S.W.R. Indicators £25. 400V, 250mA Bench Power Supplies £15. Hatfield Ins. PUM1/16 400 cycle Generators £30. Multhead 2PH. Dec. Oac., £30. Many other items available. Please add £1 carriage and 8% VAT.

METAL FILM KITS ALSO AVAILABLE.

CATALOGUE No. 3 (Approx. 2000 Parts) 20p. C.W.O. P. & P. 10p on orders under £5. Overseas at cost.

B.H. COMPONENT FACTORS LTD
Dept. WW, 61 Cheddington Road, PITSTONE,
Nr. Leighton Buzzard, Beds. LU7 9AQ.
Cheddington (0296) 668446 [32]

EX-COMPUTER STABILISED POWER SUPPLIES

RECONDITIONED, TESTED AND GUARANTEED

Ripple <10mV. Over-voltage protection 120-130v. 50 c/s input. Stepdown transformer to suit about £3.

Post & Packing £1-70

5-6v. 8A. £12 5-6v. 16A. £16
5-6v. 12A. £14

PAPST FANS 4 1/4 x 4 1/2 in. 100 cfm. 240v. 50/60 Hz. £3-50 (30p).

PAPST FANS 6in. dia. x 2 1/2 in. deep. Type 7576 £5-00 (30p)

LIGHT DIMMERS 250w £2.60 (13p)

TRANSISTORS p & p 10p
BC107/8/9 BC147/8/9 BC157/8/9 all 9p
BF180 25p BF182/3 40p BF184 17p BC167 13p BFW10 55p BF336 35p 741 8 DIL 30p 2N3771 £1-10, 2N3441 50p, BD131 40p NE555 67p.

ELECTROLYTICS

30,000µ 25v, 68,000µ 16v, 15,000µ 30v 65p (20p) 5,000µ 35v., 40p (12p) 4,700µ 63v., 60p (12p) 2,000µ 50v., plus clip 35p (8p) 2,200µ 63v., 35p (8p)

EX-COMPUTER PC PANELS 2x4in.

25 boards for £1 (30p).

QH Bulbs, 12v. 55w. 50p (7p)
150 mixed HI-STABS. 60p (11p)
250 Mixed Resistors. 60p (13p)
250 Mixed Capacitors. 60p (11p)
200Si Planar Diodes. 50p (8p)
Microswitches. 8 for 50p (10p)
Min. Glass Neons. 8 for 50p (7p)
2N3055 EQUIV. 4 for £1 (10p)

SMALL ELECTROLYTICS

2.2µ 10/16v., 10µ 35v., 50µ 40v., 100µ 40v., 100µ 6v., 150µ 10v., 64µ 10v. 12 for 45p (6p)

PRESETS 100mW PIHER

220, 470, 4k7, 10k, 100k 12 for 50p (6p)

Postage and packing shown in brackets

Please add 8% VAT to TOTAL

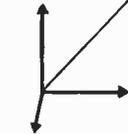
KEYTRONICS

Mail Order only.

44 EARLS COURT ROAD, LONDON, W.8
01-478 8499

QUARTZ CRYSTAL UNITS from

- 1.0-80.0 MHZ
- FAST DELIVERY
- HIGH STABILITY
- TO DEF 5271-A



TEL. HYTHE 848961
STD CODE 0703

WRITE FOR LEAFLET AT-1

McKNIGHT CRYSTAL Co.
HARDLEY INDUSTRIAL ESTATE, HYTHE, SOUTHAMPTON SO4 8ZY.

J. LINSLEY-HOOD

New Phase Locked Loop F.M. TUNER (As per Wireless World Annual).

Basic kit of parts

*£29.95 (tax £2.40)

Available in pack

form as follows:

Pack 1. Res. and capacitors £3.00 2. Semi conductors and IC's £6.25 3. Tuner head £5.50 4. P.C. boards and drawings £1.50 5. Chassis and tuning mechanism £5.00 6. Ceramic filters £1.50 7. Teak finish sleeve £3.00 8. Meter and muting module £2.50 9. Regulated power supply £5.00 10. Stereo decoder. Ready made £7.50 11. Push button and trimmer pack £2.50 (*Excludes packs No. 8, 10 and 11.) Tax extra.

TELERADIO ELECTRONICS

325 Fore Street, Edmonton, London N9 OPE. 01-807 3719.

Closed Thursdays

S.A.E. for further details of above and other Linsley-Hood superior low distortion designs.

Housing problems?

West Hyde will have a case to meet your needs. Check now. Ring

WEST HYDE

WEST HYDE DEVELOPMENTS LIMITED

Ryefield Crescent, Northwood Hills, Northwood, Middx. HA8 1NN.
Tel. Northwood 24941/26732. Telex: 923231

CONTIL MOD-2
MOD-3, SAMOS
BRIGHTCASE
AMTRON, MINOS
ENVIRONMENTAL
HEAVY DUTY CASES

WW—136 FOR FURTHER DETAILS

EXPRESS

PRINTED CIRCUITS—ROLLER TINNING—GOLDPLATING—FLEXIBLE FILMS. ETC.

Electronic & Mechanical Sub-Assembly Co. Ltd
Highfield House, West Kingsdown Nr. Sevenoaks, Kent
Tel: West Kingsdown 2344

SINTEL

Data and circuits supplied with orders, or available separately (4p stamp each).

NSN33-12" 3 Digit LED Readout—only 55p/digit! . . . £1.65
Economy DL704-3" LED 7 segment display . . . Only 95p
MK5020N Alarm Clock IC £5.60
PCB's now available for clocks, drivers and displays
CT7001 + 4 DL704 only £10.80; CT7001 + DL704 . £12.70
Soldercon IC socket pins 300 pins for £1-50
(Instructions supplied) 1000 pins for £4-00
—send s.a.e. for sample
ADD VAT @ 8%—Add 10p p&p for orders under £2
SINTEL 53c ASTON STREET, OXFORD Tel: 0865 43203

WE PURCHASE ALL FORMS OF ELECTRONIC EQUIPMENT AND COMPONENTS, ETC.

SPOT CASH

CHILTMead LTD.
7, 9, 11 Arthur Road, Reading, Berks. Tel: 582 605

SOWTER TRANSFORMERS

FOR SOUND RECORDING AND REPRODUCING EQUIPMENT
We are suppliers to many well-known companies, studios and broadcasting authorities and were established in 1941. Early deliveries. Competitive prices. Large or small quantities. See us quote.
E. A. SOWTER LTD.
Transformer Manufacturers and Designers
7 Dedham Place, Fore Street, Ipswich IP4 1JP
Telephone 0473 52794

EXCLUSIVE OFFERS

WORLD-WIDE RANGE NEVER BEFORE OFFERED

COMPLETE TRANSPORTABLE H.F. COMMUNICATIONS CENTRE housed in Air Conditioned TRAILER fitted two COLLINS KWT-6 500W S.S.B. Transmitter-Receiver and one COLLINS Receiver all fully tuneable 2 to 30 m/c/s digital readout synthesised frequency control, with line amplifiers and inputs, operating position and remote control facilities and ancillary equipment. Power input 115V or 230V A.C. Full details on application.

PHILCO HC-150 POINT-TO-POINT STRIP RADIO HF RECEIVERS 2/30 m/c/s. Ten fully tuneable channels to 0-5 kes with synthesisers. Single and diversity reception on ISB, DSB, SSB with 4 sub-bands to each channel. Full details and prices on application.

HIGHEST QUALITY 19" RACK MOUNTING CABINETS & RACKS

Our Height Ref. in inches	Width in inches	Depth in inches	Rack Panel Space in ins.	Price	
CD 69	21	13	68	£10-00	
CL 30	60	36	42	£12-50	
CR 69	30	20	—	£24-00	
DM 70	20	28	138	£21-00	
FA 85	22	36	160	£22-00	
FC 52	25	22	47	£17-00	
FD 40	22	24	72	£14-00	
FG 11	19	18	10	£11-00	
FH 15	21	17	11	£12-00	
FJ 15	21	15	12	£12-00	
FN 70	24	20	68	£17-00	
FL 84	22	17	80	£21-00	
LI 6	11	21	17	9	£15-00
LI 7	18	20	12	14	£15-00
LL 8	10	20	10	9	£15-00
LL 9	17	21	17	14	£15-00

Also Consoles, twin and multi-way Cabinets.

Our Height Ref. in inches	Channel Depth in inches	Rack Panel Space	Base	Price
RF 85	3	79	15	£11-00
RG 57	2	51	14	£9-00

Full details of all above on request.

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements we can probably help—all enquiries answered.

- * M.V.R. Videodisc LP Players P.U.R.
- * Tektronix 619 Oscilloscopes 1 GMC P.U.R.
- * Ferrerograph Series 4 Recorders £45-00
- * Airmac 701 Sig. Generators 30 k/c/s/30 m/c/s £30-00
- * Airmac 702 Sig. Generators 30 cyc/30 k/c/s £23-00
- * CF 381 Test Beta Freq. Response £140-00
- * Rustak Chart Recorders 1-8-1 m/a (New) £30-00
- * URA 8 Teletprinter Converters £25-00
- * Portable Mains Battery Floodlights £24-00
- * 400 channel Pulse Height Spectrum Analyzers P.U.R.
- * Airmac 245 L.F. 150 watt Oscillators £30-00
- * Solartron 5/25000 cyc. Oscillators £24-00
- * Southern Inst. 1500 F.M. Meters £24-00
- * Belling Lee T.V. Relay Equipment P.U.R.
- * Addo 5/8 track Tape PUNCHES £48-00
- * Tally 5/8 track Tape Readers £48-00
- * 80 column Card Hand PUNCHES £40-00
- * Auto Electric Carillon Chimes £250-00
- * 10 foot Triangular Lattice Mast Sections 6 inch sides £12-00
- * Ditto 15 foot with 15 inch sides £28-00
- * Casella Assmann Electric Hygrometers £34-00
- * Racal RA63 SSB Adapters (New) £70-00
- * Ampex Audio Stereo Tape Machines £250-00
- * Astrodatsa 5190 Time Code Generators £60-00
- * Geotek 4983 Helio Amplifiers £15-00
- * 19" Chrome trims 1 1/2" to 15" from £0-25
- * DG7/5 CRT's 2 1/2" £3-00
- * 3AZP/31 CRT's 1 1/2" £8-00
- * GGC-3 Lightweight Teletprinter £35-00
- * FX-1 Portable Teletprinter Receivers £85-00
- * Telet pe 28, 3-speed tape printers £35-00
- * 54" dia. Meteorological Balloons £2-50
- * Laboratory Radio Interference Filters £2-50

We have a varied assortment of industrial and professional Cathode Ray Tubes available. List on request.

FREE

40-page list of over 1,000 different items in stock available—keep one by you.

INSTRUMENTATION-TAPE RECORDER-REPRODUCERS

AMPEX

FR-600 and FR-100 1" and 1 1/4" 14 and 7 tracks 4 speeds Transistorised Also 1 1/2" 2 track 6 speeds

MINCOM

CMP-100 1 1/2" 1" 7 tracks 6 speeds

E.M.I.

BTR-1 Several other smaller decks. Full details on request.

Prices of above are from £100 to £400.

COMPUTER HARDWARE

- * CARD READER 80 col. 600 c.p.m.
- * PRINTER, High speed 1000 lines p.m.
- * TAPE READER, High speed 5/8 track 800 c.p.m.

Prices on Application

PLEASE ADD V.A.T. TO ABOVE

P. HARRIS
ORGANFORD-DORSET

BH16 6ER
BOURNEMOUTH-765051

BROADFIELDS & MAYCO DISPOSALS

21 Lodge Lane, N. Finchley, London, N12 8JG.

Telephone:

01-445 0749 01-445 2713 01-958 7624

MAY WE ASSIST YOU TO DISPOSE OF YOUR SURPLUS AND REDUNDANT STOCKS.

We will call anywhere in the British Isles, and pay SPOT CASH for Electronic Components and Equipment.

SANDOWN
Practical Wireless, October, November, December 1974
State of the Art STEREO FM TUNER
Typical Performance—Limiting voltage 0.5µV
Sensitivity—30dB quieting mono 15µV, 50dB stereo 12µV
Basic Stereo Module Kit £26.85. INTERESTED?
S. A. E. for further details to:-
FW ELECTRONICS, 40 TUDENHAM ROAD, IPSWICH, SUFFOLK IP4 2SL. Mail Order Only

STEREO DISC AMP

FOR BROADCASTING AND DISC MONITORING

Mains in. Balanced lines out. Excellent distortion and LF performance. MEETS IBA SPECIFICATION £95.00.

10-OUTLET DISTRIBUTION AMP

One balanced input—10 isolated balanced outputs
GENERAL STUDIO WORK ★ FEEDING MULTIPLE SLAVE PA AMPLIFIERS ★ DRIVING FOLDBACK HEADPHONES
Meets IBA signal path specification. Complete boxed unit £34.00. Set of parts less case and all XLR connectors £55.00.

PEAK PROGRAM METERS TO BS4297

also 200KHz version for high speed copying.

Drive circuit. 35 x 80mm. for 1mA L.H. zero meter to BBC ED1477. Gold 8-way edge con supplied.
Complete kit £12.00 Built and aligned £17.00
ERNEST TURNER PPM meters. scalings 1/7 OR-22/+4. Type 642. 71 x 56mm £12.60; 643. 102 x 79mm £15.00.
Twin movement. scale 86 x 54mm £37.00.



PUBLIC ADDRESS: SOUND REINFORCEMENT
In any public-address system where the microphones and loudspeakers are in the same vicinity acoustic feedback (howl-round) occurs if the amplification exceeds a critical value. By shifting the audio spectrum fed to the speakers by a few Hertz the tendency to howling at room resonance frequencies is destroyed and an increase in gain of 6-8dB is possible before the onset of feedback.

SHIFTERS IN BOXES with overload LED, shift/bypass switch. 8S4491 mains connector and housed in strong diecast boxes finished in attractive durable blue acrylic. Jack or XLR audio connectors.
Type A B C
Input impedance 200kOhm 200kOhm 10kOhm BALANCED
Output impedance 2k 20 or 600 ohm 20 or 600 ohm BAL
PRICE £58.00 £68.00 £94.00

SHIFTER CIRCUIT BOARDS FOR WW July 1973 article
Complete kit and board £24.00 Including p.s.u. and DESIGNER
Board built and aligned £31.00 mains transformer APPROVED

SPECTRUM SHIFTER: variable shifts, 0.1-1000Hz. for weird special effects and phasing. Ring for leaflets.

SURREY ELECTRONICS
The Forge, Lucks Green, Cranleigh,
Surrey GU6 7BG. (STD 04866) 5997
CASH WITH ORDER. less 5% UK post free. add VAT

INTERNATIONAL TRANSISTOR SELECTOR

Over 10,000 USA, EURO., JAP., BRITISH TRANSISTORS, ELECTRICAL, MECHANICAL SPECIFICATIONS, MANUFACTURERS AND AVAILABLE SUBSTITUTES
by T. D. Towers, M.B.E. Price £3.15

1975 EDITION
THE RADIO AMATEUR'S HANDBOOK
by A.R.R.L. Price £3.50

VIDEOTAPE RECORDING THEORY AND PRACTICE
by J. F. Robinson Price £4.80

OPERATIONAL AMPLIFIERS Design & Application
by Barr Brown Price £4.50

DIGITAL ELECTRONIC CIRCUITS AND SYSTEMS
by N. M. Morris Price £2.50

COLOUR TV with Particular Ref to PAL SYSTEM
by G. N. Patchett Price £5.15
★ PRICE INCLUDES POSTAGE ★

THE MODERN BOOK CO.
BRITAIN'S LARGEST STOCKIST
of British and American Technical Books
19-21 PRAED STREET,
LONDON, W2 1NP
Phone 723 4185
Closed Sat. 1 p.m.

Wilmslow Audio

THE firm for speakers!



- Baker Group 25, 3, 8 or 15 ohm £7.75
- Baker Group 35, 3, 8 or 15 ohm £8.50
- Baker Deluxe, 8 or 15 ohm £10.75
- Baker Major, 3, 8 or 15 ohm £8.00
- Baker Regent, 8 or 15 ohm £7.75
- Baker Superb, 8 or 15 ohm £14.50
- Celestion HF 1300 Mk II £6.95
- Celestion MH 1000 horn, 8 or 15 ohm £10.95
- EMI 13 x 8 £2.25
- EMI 13 x 8, 150 d/c, 8 ohm £2.50
- EMI 13 x 8, 450 t/w, 8 ohm £3.75
- EMI 13 x 8, 350, 8 or 15 ohm £8.25
- EMI 13 x 8, 20 watt bass 8 ohm £6.60
- EMI 8 x 5, 10 watt d/c, roll/s 4 or 8 ohm £2.50
- ELAC 59RM109 15 ohm, 59RM114 8 ohm £2.80
- ELAC 6 1/2" d/c, roll/s 8 ohm £3.50
- Fane Crescendo 12A or 8, 8 or 15 ohm £29.00
- Fane Crescendo 15, 8 or 15 ohm £36.00
- Fane Crescendo 18, 8 or 15 ohm £51.95
- Fane 701 Horn £35.00
- Fane 801T 8" d/c, roll/s 8 ohm £7.00
- Goodmans 8P 8 or 15 ohm £5.00
- Goodmans 10P 8 or 15 ohm £5.30
- Goodmans 12P 8 or 15 ohm £12.95
- Goodmans 12P-D 8 or 15 ohm £16.75
- Goodmans 12P-G 8 or 15 ohm £15.75
- Goodmans Audiom 100 8 or 15 ohm £12.00
- Goodmans Axtent 100 8 ohm £7.25
- Goodmans Axiom 402 8 or 15 ohm £17.25
- Goodmans Twin Axiom 8" 8 or 15 ohm £8.25
- Goodmans Twin Axiom 10" 8 or 15 ohm £9.00
- Kef T27 £5.25
- Kef B110 £7.25
- Kef B139 £14.25
- Kef T15 £6.00
- Kef DN8 £2.00
- Kef DN12 £4.95
- Kef DN13 £3.30
- Richard Allan CG8T 8 ohm £6.35
- STC4001G Super Tweeter £6.19
- Wharfedale Super 10 RS/DD £12.95
- Castle Super 8 RS/DD £8.95
- Tannoy 10" HPD £57.00
- Tannoy 12" HPD £59.00
- Tannoy 15" HPD £75.00
- Radford 8D25 £14.75
- Radford MD9 £8.95
- Radford HD3 £6.75
- Radford FN12 £8.95
- Baker Major Module each £10.75
- Goodmans DIN 20 (4 ohm) each £9.75
- Goodmans Mezzo Twinkit pair £45.00
- Helme XLK25 pair £22.00
- Helme XLK30 pair £14.95
- Helme XLK50 pair £39.95
- Kef kit I each £20.95
- Kef kit III each £36.75
- Peerless 20/2 each £14.95
- Peerless 30/2 each £20.95
- Peerless 20/3 each £22.95
- Peerless 50/4 each £34.95
- Peerless 3/15 each £15.00
- Richard Allan Twinkit each £8.95
- Richard Allan Triple 8 each £13.75
- Richard Allan Triple 12 each £19.95
- Richard Allan Super 12 each £23.75
- Wharfedale Linton 2 kit pair £19.25
- Wharfedale Glendale 3 kit pair £34.50
- Wharfedale Dovedale 3 kit pair £52.50

PRICES INCLUDE VAT

Cabinets for PA and HiFi, wadding, Vynair etc.
Send stamp for free booklet "Choosing a Speaker"
FREE with orders over £7—HiFi Loudspeaker Enclosures Book
All units are guaranteed new and perfect
Prompt despatch

Carriage: Speakers 38p each, tweeters and cross-overs 20p each, kits 75p each (£1.50 pair)

WILMSLOW AUDIO

Dept. WW

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire SK9 1HF. Discount HiFi, PA etc: 10 Swan Street, Wilmslow. Radio, HiFi, TV: Swift of Wilmslow, 5 Swan Street, Wilmslow. Tel: (Loudspeakers) Wilmslow 29599, (HiFi etc.) Wilmslow 26213

WW—063 FOR FURTHER DETAILS

PRECISION POLYCARBONATE CAPACITORS

All High Stability—Extremely Low Leakage

440V AC (±10%)	50p	63V Range	±1%	±2%	±5%
0.1µF (1 1/2" x 1 1/2")	50p	0.47µF	50p	46p	36p
0.22µF (1 1/2" x 1 1/2")	50p	1.0µF	80p	56p	46p
0.25µF (1 1/2" x 1 1/2")	62p	2.2µF	80p	65p	55p
0.47µF (1 1/2" x 1 1/2")	71p	4.7µF	£1.80	£1.05	85p
0.5µF (1 1/2" x 1 1/2")	76p	6.8µF	£1.64	£1.29	£1.09
0.68µF (2" x 1")	80p	10.0µF	£2.00	£1.60	£1.40
1.0µF (2" x 1")	81p	15.0µF	£2.75	£2.15	£1.90
2.0µF (2" x 1")	£1.22				

TANTALUM BEAD CAPACITORS—Values available: 0.1, 0.22, 0.47, 1.0, 2.2, 4.7, 6.8µF at 15V/25V or 35V; 10.0µF at 16V/20V or 25V; 22.0µF at 6V/10V or 16V; 33.0µF at 6V or 10V; 47.0µF at 3V or 6V; 100.0µF at 3V. ALL at 10p each, 10 for 85p, 50 for 24.

TRANSISTORS

BC183/183L	11p	BFY50	20p
BC107/8/9	8p	BC184/184L	12p
BC114	12p	BC212/212L	14p
BC147/8/9	10p	BC547/558A	12p
BC163/7/8	12p	BF194	12p
BC182/182L	11p	BF196/197	13p
		2N3055	60p

POPULAR DIODES—1N914 6p, 8 for 45p, 18 for 90p, 1N916 8p, 6 for 45p, 14 for 90p; 1844 6p, 11 for 50p, 24 for £1.00; 1N4148 6p, 6 for 27p, 12 for 45p; 1N4001 5p; 002 6p; 003 6p; 004 7p; 005 7p; 006 8p; 007 8p.
LOW PRICE ZENER DIODES—400mW, Tol. ±5% at 5mA. Values available: 3V, 3.3V, 3.6V, 4.7V, 5.1V, 6.5V, 6.2V, 6.8V, 7.5V, 8.2V, 9.1V, 10V, 11V, 12V, 13V, 13.5V, 15V, 16V, 18V, 20V, 22V, 24V, 27V, 30V, 33V. All at 7p each, 6 for 38p, 14 for 84p. SPECIAL OFFER: 100 Zeners for 45.50.

RESISTORS—High stability, low noise carbon film 5%. 1/4W at 40°C, 1/4W at 70°C. E12 series only—from 2.2Ω to 2.2MΩ. ALL at 1p each, 8p for 10 of any one value, 70p for 100 of any one value. SPECIAL PACK: 10 of each value 2.2Ω to 2.2MΩ (730 resistors) 45.

SILICON PLASTIC RECTIFIERS—1.5 amp, brand new wire ended D027; 100 P.I.V. 7p (4 for 28p) 400 P.I.V. 8p (4 for 30p).

BRIDGE RECTIFIERS—2 1/2 amp, 200V 40p; 350V 45p; 600V 55p.

SUBMINIATURE VERTICAL PRESETS—0-1W only. ALL at 6p each; 50Ω, 100Ω, 220Ω, 470Ω, 680Ω, 1kΩ, 2.2kΩ, 4.7kΩ, 6.8kΩ, 10kΩ, 15kΩ, 22kΩ, 47kΩ, 68kΩ; 100kΩ, 250kΩ, 680kΩ, 1MΩ, 2.5MΩ, 5MΩ.

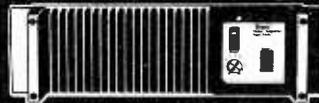
PLEASE ADD 10p POST AND PACKING ON ALL ORDERS BELOW £5. ALL EXPORT ORDERS ADD COST OF SEA/AIRMAIL.

PLEASE ADD 8% V.A.T. TO ORDERS.
Send S.A.E. for lists of additional ex-stock items.
Wholesale price lists available to bona fide companies.

MARCO TRADING (Dept. DII)
The Old School, Edstaston, Nr. Wem, Shropshire
Tel. Whixall (Shropshire) (STD 094872) 464/5
(Proprs.: Minicoast Trading Ltd.)



'SERIES 7' — Studio Monitor Version
One of the world's finest Amplifiers.



GRAMPIAN REPRODUCERS LIMITED

Hanworth Trading Estate, Feltham, Middlesex.

Telephone: 01-894 9141.

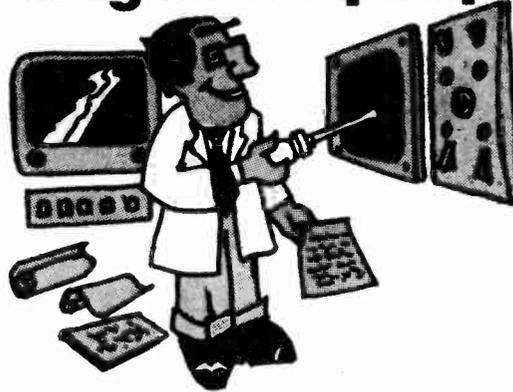


THE QUARTZ CRYSTAL CO. LTD.

Q.C.C. WORKS, WELLINGTON CRESCENT,
NEW MALDEN, SURREY. 01-942-0334 & 2988

ANY MAKE-UP OR COPY QUERIES CONTACT
JOHN GIBBON
01-261 8353

We enjoy solving other people's problems!



Jasmin take a slightly different approach to their customers and they are proud of the rapport they attain with them. Research and development staff are always available to offer advice on technical issues. This in turn means that Jasmin are able to offer a unique service if you have problems in the following spheres

- Complex automatic text and evaluation apparatus.
- Digitalized video and Ceefax/Oracle display equipment.
- Mini computer orientated systems.
- Specialist contract engineering.

Jasmin ELECTRONICS LIMITED

BOSTON HOUSE, ABBEY PARK ROAD, LEICESTER LE4 5AN
TELEPHONE: 0533-58128/9 TELEX: 341581

ARISTOCRATS IN CONTROL

WW-144 FOR FURTHER DETAILS

New models CALCULATOR ICs from THURLBY Lower prices

Increasing demand for the XE series high performance calculator chips has resulted in increases in scale allowing us to offer even better value for money.

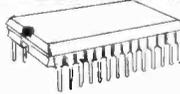
Thurlby Electronics offer you the opportunity to build yourself an advanced electronic calculator at amazingly low cost using one of the XE series MOS single chip calculator I.C's.

Every IC is brand new, tested and guaranteed. It comes complete with full data, circuit diagrams and wiring details covering the use of different types of displays, describing how to construct both

very simple and more elaborate keyboards, and explaining the operation of the calculator - both in normal calculations and in more complex operations.

XE303 Calculator IC

New XE303 series with memory and % 5 functions, +, -, x, ÷ with automatic constant facility on all 4 plus live % key. Full performance memory, store-recall-exchange, or automatic accumulating. Full 8 digits with floating decimal point and algebraic logic. Built-in clock generator, single power supply. Direct segment drive, suppression of non-significant zeros.



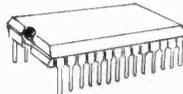
£3.25 +VAT

Full money back guarantee. Cash with order.

Postage and packing 20p per order. Please add 8% VAT to total order value.

XE202 Calculator IC

XE202 series 4 function and constant Full 8 digits with floating decimal point and algebraic logic. Powerful keyed constant facility on all 4 functions. Enormous exponent range: 10⁻²⁰ to 10⁺⁷⁹. Single strobe line facilitates very simple keyboard construction. Direct segment drive, suppression of non-significant zeros.



£2.25 +VAT

To Thurlby Electronics
Church Farm House,
Church End, Over,
Cams. CB4 5NH

Please supply _____

for which I enclose cash/cheque+PO

for £ _____ including VAT & postage

Name _____
Address _____

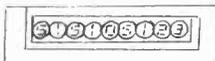
Display driving interface chips

TK9 9 digit suitable for XE 303 £0.95 + VAT
7105 8 digit suitable for XE 202 £0.75 + VAT



Special magnified LED displays

9 digit suitable for use with XE303 series £3.75 +VAT
8 digit suitable for use with XE202 series £3.25 +VAT



LOW FREQUENCY ANALYSER

50Hz-50KHz
ASSEMBLY AND INSTRUCTION
INFORMATION S.A.E.

PRICE **£27** p&p 75p

Board, modules and all
components (excluding
P.U.).

V.A.T. at 8%

CHILTMEAD LTD

7-9 ARTHUR ROAD, READING, BERKS. (rear Tech. College). Tel. Reading 582605

100MHz SCOPE TUBES

MULLARD D13-450GH-03. P31 PHOSPHOR.
INTERNAL GRATICULE-6CM X 10CM RECT-
ANGULAR. Y SENSITIVITY 3V PER CM X 11V
PER CM. SINGLE GUN. DISTRIBUTED Y PLATES,
TRACER ROTATE COILS.

BRAND NEW BOXED. £30 each.
CARRIAGE £2.

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 80-100

PAGE		PAGE		PAGE	
Action Video	41	Harris Electronics (London) Ltd.	13, 18	Quality Electronics Ltd.	17
Aero Electronics Ltd.	17, 20	Harris, P.	101	Quartz Crystal Co. Ltd.	102
Ambientacoustics	31	Hart Electronics	48		
Ancom Ltd.	10	Hayden Laboratories Ltd.	22		
Anders Electronics Ltd.	4	Heath (Gloucester) Ltd.	2		
Arrow-Hart (Europe)	31	Hengstler G.B. Ltd.	Readers' Card	Radford Audio Ltd.	14
Aspen Electronics Ltd.	28	Henry's Radio Ltd.	19	Radio Shop, The	52
A.S.P. Ltd.	70	H.H. Electronics	59	Radio T.V. Components	62
A. & S. T.V. Components	57	Hi-Fidelity '75'	77	Rank Audio Visual	40
		Hi-Fi Designs	45	R.E.W. Audio Visual Co.	42
		Hitachi-Shibaden (U.K.) Ltd.	40	Rola Celestion Ltd.	32
				R.S.T. Valves Ltd.	56
Barrie Electronics Ltd.	53				
Bell & Howell Ltd.	39	Icon Design	17		
Bentley Acoustic Corp. Ltd.	69	I.L.P. (Electronics) Ltd.	68	Sanyo Marubeni (U.K.) Ltd.	43
Bi-Pak Semiconductors	60, 61	Industrial Sub Assembly Ltd.	27	Samsons (Electronics) Ltd.	70
Bi-Pre Pak Ltd.	68	Industrial Tape Applications Ltd.	19	Scientronics	57
Bias Electronics Ltd.	27	Integrex Ltd.	72	Semicron Indexes Ltd.	13
B.H. Components Factors Ltd.	78	I.T.F.-L.E.C.S.	9	Scott, James Electronic Eng. Ltd.	12
Broadfields & Mayco Disposals	101	I.T.T. Instrument Services	15	Siemens Ltd.	24
Bull, J. Electrical Ltd.	69			Service Trading Co.	71
		Jackson Bros. (London) Ltd.	32	Servo & Electronic Sales Ltd.	66
		Jasmin Electronics Ltd.	103	S.G.S. Ates U.K. Ltd.	25
Cambridge Audio Ltd.	29	J.E.F. Electronics	101	Shelton Instruments Ltd.	17
Cambridge Learning	3	J.H. Associates Ltd.	79	Shure Electronics Ltd.	5, 23, 35
Carston Electronics	73			Sinclair Radionics Ltd.	38
Catronics	53			Sintel	101
Cerutti, S.A. & Cie.	77	K.E.F. Electronics Ltd.	7	S.J. System Designs	52
Chiltmead Ltd.	22, 67, 101, 104	Keytronics Ltd.	101	Sowater, E. A., Ltd.	101
Chromasonic Electronics Ltd.	51			Sugden, J. E., & Co. Ltd.	20
Colomor (Electronics) Ltd.	63			Surrey Electronics	102
Computer Sales & Services	78				
Concorde Instrument Co.	52	Lasky's	54, 55		
Crichton, J.	48	Levell Electronics Ltd.	1	Technomatic Ltd.	79
Crofton Electronics	31	Lynx Electronics	48	Tequipment Products (Tektronix U.K.) Ltd.	34
C.T. Electronics Ltd.	76			Teleradio Special Products	101
		Macfarlane, W. & B.	58	Teletape Video, The London Cassette Centre	41
		Macinnes Labs Ltd.	30	Teonex Ltd.	6
Dixons Technical CCTV Ltd.	17	Maplin Electronic Supplies	65	Thurby Electronics	103
Drake Transformers Ltd.	10	Marco Trading Co.	102	Trampus Electronics	46
		Marconi Instruments Ltd.	cover ii	Trec Consultants Ltd.	40
		Marshall, A., & Sons (London) Ltd.	58		
East Cornwall Components	50	McKnight Crystal Co.	101		
Eddystone Radio Ltd.	21	McLennan Eng. Ltd.	16	United-Carr Supplies	37
Electronic Brokers Ltd.	74, 75	Mills, W.	57		
Electronic Mech. Sub Assembly Co. Ltd.	101	Milward, G. F.	64	Valradio Ltd.	20
Electrovalue	53	Modern Book Co.	102	Vero Electronics	18
Elektor Publications Ltd.	22	Multicore Solders Ltd.	cover iv	Vortexion Ltd.	cover iii
E.M.I. Telecommunications	36				
Eurotype	27	Naim Audio Ltd.	26		
		Newnes Butterworths	50		
				Wayne, Kerr, The, Co. Ltd.	8
Farnell Instruments	28	Ocii Optical Coatings Ltd.	12	West Hyde Developments Ltd.	101
Ferrograph, The, Co. Ltd.	14			Whiteley Electrical Radio Co. Ltd.	20
Fi-Comp Electronics	56			Wilkinson, L. (Croydon) Ltd.	57
Future Film Development Ltd.	52	P. & B. Electronics Ltd.	76	Wilmslow Audio	102
F.W. Electronics	101	Patrick & Kinne	66	Wireless World (3 in 1)	49
Fylde Electronic Labs. Ltd.	79	Phoenix Electronics (Portsmouth) Ltd.	26	Wireless World Annual	30
		Physical & Elec. Labs. Ltd.	56		
		Powertran Electronics	46, 47		
Gardners Transformers Ltd.	13	Precision Petite Ltd.	77		
Gramplan Reproducers Ltd.	102	Prosser Scientific Insts.	28	Z. & I. Aero Services Ltd.	16, 72
Greenwood Electronics Ltd.	11	Pye Unicam	26	Zettler GmbH	19

Printed in Great Britain by Hazells Offset Ltd., Leigh Road, Slough, Bucks., and Published by the Proprietors L.P.C. ELECTRICAL-ELECTRONIC PRESS LTD., Dorset House, Stamford St., London, SE1 9LU telephone 01-261 8000. *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 Distributors Inc. 156 West 15th Street, New York, N.Y. 10011. 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.

SYSTEM 2000

VORTEXION

A new range of sound equipment from **Vortexion**, **System 2000** has been designed by our engineers to combine the aesthetics of design in the domestic equipment field with the near flexibility of a modular system. Like all our equipment **Vortexion System 2000** is built to last.

No matter what your sound problem, whether hotel or local pop group, ask our Design Consultants how it can be solved with **System 2000**.



VORTEXION

Vortexion Ltd., 257-263 The Broadway, Wimbledon, SW19 1SF
Telephone: 01-542 2814 and 01-542 6242/3/4
Telegrams: "Vortexion London SW19"

Ersin Multicore- the international solder

Ersin Multicore 5-Core Solder

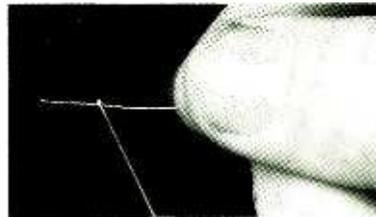
The proved superiority of ERSIN Multicore Solder for over thirty years is due to many factors. We have specialised throughout this period in the manufacture of cored solders. Consequently our research and manufacturing staff have been able to devote all their energies to the development of Multicore Solders. All alloys are of highest purity, carefully formulated and checked.

Our unsurpassed ERSIN flux is rigorously tested before and after it is incorporated in the solder wire. Our five separate cores of flux ensure flux continuity, leave only an ultra-thin layer of solder separating flux from work for instant wetting and provide a more accurate ratio of flux to solder. It is therefore possible to

use less solder and obtain greater reliability.

Our Quality Control at all stages of manufacture is guaranteed and recorded by the batch number on every reel.

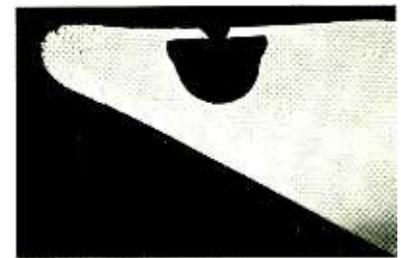
Needle fine gauges



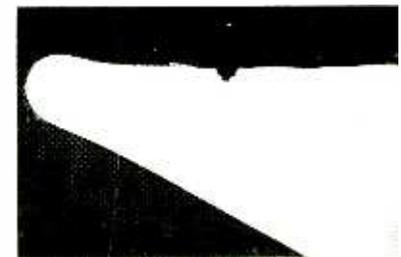
In addition to our standard range of wire diameters (10-22 swg: 3.2-0.7 mm) supplied on 2½ kg and ½ kg reels we also mass-produce needle-fine gauges (24-34 swg: 0.56-0.23 mm) on 250 g reels for microminiature soldering applications—still with 5 Cores of flux.

Savbit Solder

One of our most popular special ERSIN Multicore Solder alloys is SAVBIT alloy. Compared with ordinary tin/lead solders it dramatically reduces the erosion of soldering iron bits, copper wires and printed circuit conductors. It also saves costs and increases reliability. SAVBIT alloy containing 5-Cores ERSIN 362 flux has received special Ministry approval—under DTD. 900/4535 for Military applications.



Sectioned iron-plated bit, after 40.000 simulated operations using 60/40 Solder.



Sectioned iron-plated bit, after 40.000 simulated operations using SAVBIT Solder.

ALLOY

Composition (nominal major elements)	Grade	Melting Temperature		Specification
		Solidus °C	Liquidus °C	
50/33/17 Sn/Pb/Cd	TLC	145	145	DIN 1707
62/36/2 Sn/Pb/Ag	LMP	179	179	DIN 1707
62/35.7/2/0.3 Sn/Pb/Ag/Sb	Sn62	179	179	QQ-S-57 1E
63/36.7/0.3 Sn/Pb/Sb	Sn63	183	183	QQ-S-57 1E
60/40 Sn/Pb	K	183	188	B.S. 219
60/39.7/0.3Sn/Pb/5b	Sn60	183	188	QQ-S-57 1E
50/50 Sn/Pb	F	183	212	B.S.219
50/49.7/0.3 Sn/Pb/Sb	Sn50	183	212	QQ-S-57 1E
50/48.5/1.5 Sn/Pb/Cu	Savbit 1	183	215	DTD 900/4535 DIN 1707
45/55 Sn/Pb	R	183	224	B.S.219
40/60 Sn/Pb	G	183	234	B.S.219
40/59.7/0.3 Sn/Pb/Sb	Sn40	183	234	QQ-S-57 1E
30/70 Sn/Pb	J	183	255	B.S.219
20/80 Sn/Pb	V	183	275	B.S.219
15/85 Sn/Pb	—	225	290	—
Pure Tin	P.T.	232	232	B.S.3252
95/5 Sn/Sb	95A	236	243	B.S.219
5/93.5/1.5 Sn/Pb/Ag	H.M.P.	296	301	B.S.219



For full information on these and a Selector Guide to other MULTICORE products please write on your Company's letterhead direct to:

Multicore Solders Limited, Maylands Avenue, Hemel Hempstead, Hertfordshire HP2 7EP.
Tel: Hemel Hempstead 3636 Telex: 82363