

wireless world

FEBRUARY 1980 50p

Australia A\$ 2.00
Canada \$ 3.15
Denmark Kr. 17.00
Germany Dm. 5.00
Greece Dr. 87.00
Holland Dfl. 5.75
Italy L. 1900
Norway Kr. 17.25
Singapore M\$ 4.50
Spain Ptas. 140.00
U.S.A. \$ 2.50

Microwave intruder alarm
Multiphonic organ
Townsman aerial

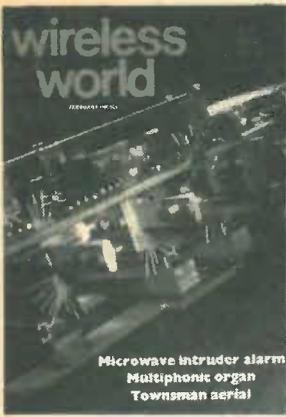


You can see what you're doing

Telequipment's versatile CT71 Curve Tracer is the answer to your semiconductor testing problems. Insert two transistors into the test fixture, set the easy-to-use controls and you can make immediate comparison of characteristics at the flick of a switch. Display collector currents from 5nA to 200mA per division, and base or collector volts 0.1V to 100V/division. Test all types of transistors, FET's, diodes, thyristors and triacs easily, safely and accurately with the Telequipment CT71. Put it to the test, ask for a demonstration or our 36 page catalogue. It's quite free.

TELEQUIPMENT 

Tektronix UK Ltd., PO Box 69, Coldharbour Lane, Harpenden, Herts. AL5 4UP.
Tel: Harpenden 63141.



Front cover shows thyristor stack with heat sinks, made by Pinnacle Electronics Ltd. Photographer Paul Brierley.

IN OUR NEXT ISSUE

Pulse-induction metal detector incorporates method of eliminating magnetic viscous effects

Electronic security lock uses m.n.o.s. non-volatile devices to give a four-digit combination which is invulnerable to power cuts

Acoustic measurement without the use of anechoic conditions is described

Current issue price 50p, back issue (if available) £1.00, at Retail and Trade Counter, Paris Garden, London SE1. Available on microfilm: please contact editor.

By post, current issue 79p, back issues (if available) £1.00, order and payments to Room CP34, Dorset House, London SE1 9LU.

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

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

Telegrams / Telex: Wiworld Bispres 25137 BISPRS G. Cables Ethaworld, London SE1.

Subscription rates: 1 year £9.00 UK and \$31 outside UK.

Student rates: 1 year, £4.00 UK and \$15.50 outside UK.

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

Subscriptions: Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. Telephone 0444 59188. Please notify a change of address.

USA mailing agents: Expeditors of the Printed Word Ltd, 527 Madison Avenue, Suite 1217, New York, NY 10022. 2nd-class postage paid at New York.

© IPC Business Press Ltd, 1980
ISSN 0043 6062

wireless world

ELECTRONICS / TELEVISION / RADIO / AUDIO

FEBRUARY 1980 Vol 86 No 1530

33 Status symbols

34 **Microwave intruder detector** — 1
by K. Holford

39 **Circuit analysis by small computer**
by A. S. Beasley

41 **Adaptable-anatomy a.t.e.** 54 **Literature received** 81 **Books received**

42 World of amateur radio

43 **More on the scientific computer** — 2
by J. H. Adams

46 New frequency allocations

49 **Multiphonic synthesizer organ**
by J. H. Asbery

51 **What's so natural about e?**
by J. C. Finlay

55 **Letters to the editor**
Loop aerials Scientific computer
Perceiving direction in surround sound

58 **News of the month**
Twelve more London radio stations Meteosat 1
Automatic car telephones

62 **Circuit ideas**
Radio control encoder Fuse tester
Reverberation amplifier

67 **Adapter unit for spectrum analyser**
by R. C. V. Macario

70 **Novatexts: two-transistor astables**
by P. Williams

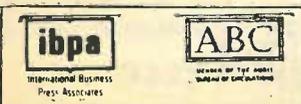
72 **Townsmen aerial**
by B. J. P. Howlett

77 **Clock timer**
by R. D. Clemow and T. C. Carden

82 **Electronic focusing**
by D. Di Mario

84 New products

86 Sidebands



THINK OF A SHAPE



S 500D — dual channel
up to 500W / RMS per
channel DC-20 KHZ

Whatever it is, the **H||H** S' range of power amplifiers will handle it

The **H||H** S' range is designed to handle heavy industrial usage in the fields of vibrator driving, variable frequency power supplies and servo motor systems.

S 500D

Dual Channel

19" rack mount 3½" high
500w r.m.s. into 2.5 ohms per channel
900w r.m.s. in bridge mode
DC-20 KHZ at full power
0.005% harmonic distortion (typical) at
300w r.m.s. into 4 ohms at 1 KHZ
3KW dissipation from in-built force cooled
dissipators

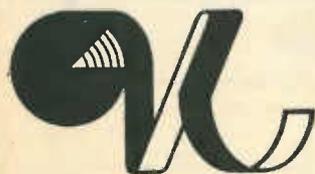
S 250D

Single Channel

19" rack mount 3½" high
500w r.m.s. into 2.5 ohms
Retro-convertible to dual channel
DC-20 KHZ at full power
Full short and open circuit protection
Drives totally reactive loads with no
adverse effects

A complete range of matching transformers and peripheral equipment for closed loop, constant current and voltage use are available.

Alternative input and output termination to order. Rack case for bench use built to specifications. For complete data write or call.

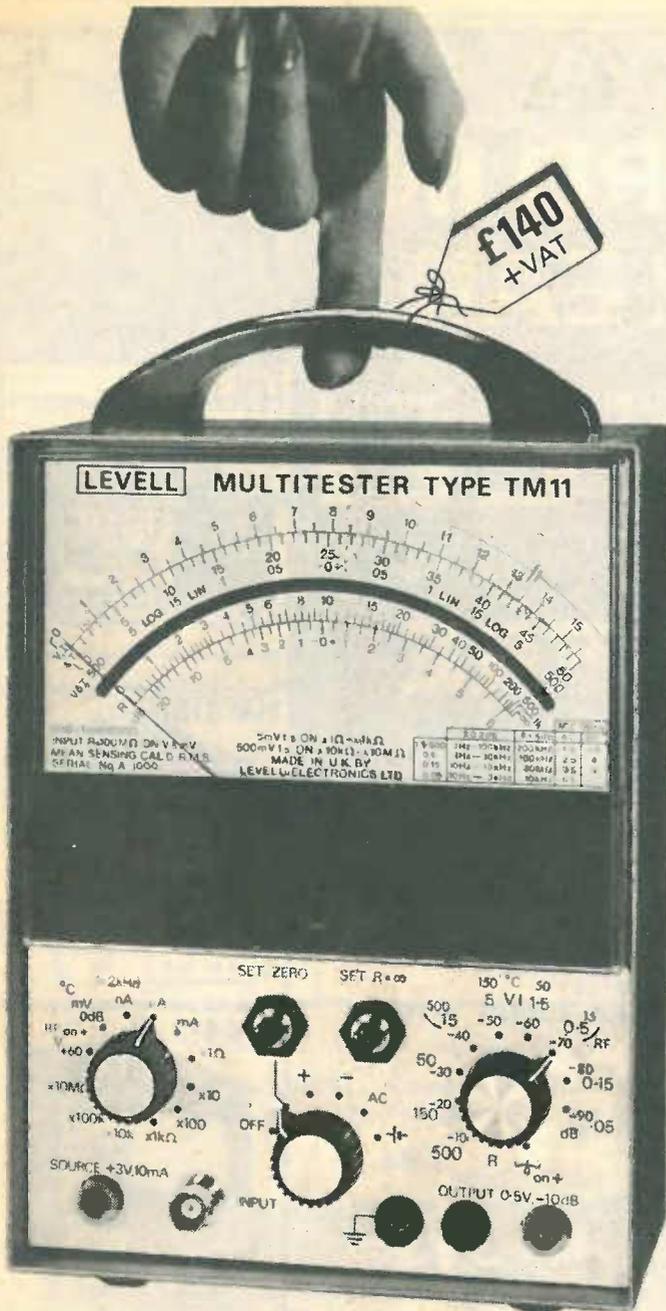


Kirkham Electronics

MILL HALL, MILL LANE, PULHAM MARKET, DISS, NORFOLK IP21 4XL
DIVISION OF K.R.S. LIMITED
TELEPHONE (037 976) 639/594

FRANCHISED COMMERCIAL AND INDUSTRIAL AGENTS FOR **H||H** ELEC-

WW — 01 FOR FURTHER DETAILS



VERSATILE
ELECTRONIC
MULTITESTER

120 BASIC RANGES

- AC V, I & dB : 50 μ V/500V fsd, 50pA/500mA fsd, -90dB/+50dB mid scale. Acc. \pm 1.5% fsd above 500 μ V & 500pA. Response 3Hz/200kHz above 500 μ V and 500nA. Input R = 100M Ω on volts.
- DC V, I & NULL : 150 μ V/500V fsd, 150pA/500mA fsd, polarity reversible. Acc. \pm 1.5% fsd above 500 μ V & 500pA. Input R = 100M Ω on volts. 5 Null ranges have centre zero lin/log scale covering \pm 4 decades.
- RESISTANCE : 0.2 Ω /10G Ω in 7 ranges, polarity reversible. Low test voltage for solid state circuits.
- LEAKAGE at 3V : Uses 3V source with current ranges to test capacitors, diodes and resistance up to 100G Ω .
- VOLT DROP at 10mA : Uses 10mA source with voltage ranges to test diodes, LED's and resistance down to 10m Ω .

30 OPTIONAL RANGES

- RF VOLTS : 0.5V/500V fsd, 10kHz/1GHz, using RF Probe. Price £28 + VAT.
- HIGH VOLTS : 1.5kV/50kV fsd, AC/DC, using HV Probe. Price £21 + VAT.
- HIGH CURRENT : 1.5A/50A fsd, AC/DC, using Current Shunt. Price £19 + VAT.
- TEMPERATURE : -150 $^{\circ}$ C/+500 $^{\circ}$ C fsd in 7 ranges using Temperature Probe. Price £46 + VAT.

The instrument operates from a 9 volt battery, life 1000 hrs., or, AC mains when optional Power Supply Unit is fitted. Size is 240mm x 150mm x 80mm. Weight is 1.75 kg. Meter scale length is 140mm. Leather case is available at £18 + VAT.

LEVELLE ELECTRONICS LTD.

MOXON STREET, BARNET, HERTS., ENGLAND, EN5 5SD.
TEL: 01-449 5028/440 8686
WW — 016 FOR FURTHER DETAILS



A WORD IN YOUR EAR HAMEG oscilloscopes ARE HERE

Hameg the name for quality, performance and value in OSCILLOSCOPES. Advanced design optimising the use of both integrated circuits and discrete components ensures reliability.

Just a glance at the specification chart will make you want to know more.

HM 307	Single Trace DC-10 MHz , 5 mV/cm Plus built in Component Tester	£149
HM 312	Dual Trace DC-20 MHz , 5 mV/cm Sweep Speeds 40 ns - 0.2s/cm 8 x 10 cm Display	£250
HM 412	Dual Trace DC-20 MHz , 2mV/cm Sweep Speeds 40 ns - 2 s/cm and Sweep Delay	£350
HM 512	Dual Trace DC-50 MHz , 5 mV/cm Sweep Speeds 20 ns - 5 s/cm plus Sweep Delay	£580
HM 812	Dual Trace DC - 50 MHz , 5 mV/cm 20 ns - 5 s/cm, Sweep Delay and Storage	£1325

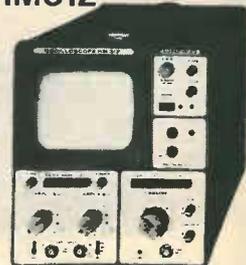
We may be a new name to you, but each instrument is backed by over 21 years experience in oscilloscopes.

Distributed by
Electronic Brokers
49/53 Pancras Road
London NW1 2QB
Tel. 01-837 7781

HM307



HM312



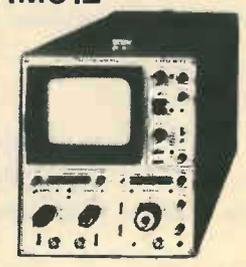
HM412



HM512



HM812



All prices UK list exc. VAT.

MICROCHIPS AT MICRO PRICES

Compare our prices before you buy elsewhere

MEMORIES	
2102 Static RAM	80p
2114 Low power high speed 300NS	4.00
4116 Dynamic RAM	5.95
5101 1K CMOS RAM. Low power	3.95
Low power	3.95
EPROMS	
1702A	3.75
2708	5.95
2716 Single 5V supply	19.95
UART	
AY-5-1013A	2.98
CHARACTER GENERATOR	
RO-3-2513 UC	4.50
FLOPPY DISK CONTROLLER	
FD 1771 Single Density IBM Compatible	17.95
FD 1791 Dual Density IBM Compatible	34.95
SUPPORT DEVICES	
MC14412VL	7.97

7 WATT AUDIO AMP KIT

Small, Single hybrid IC and components fit on a 2"x3" board (included). Runs on 12 VDC. Great for any project that needs an inexpensive amp. Less than 3% THD @ 5 watts. Compatible with SE-01 sound kit. £4.50 plus 50p P&P and VAT.

DISPLAY LEDs AT LOWEST PRICES

FND 500 75p

INTERSIL CHIPS ARE DOWN

Due to bulk purchase, we are able to offer unbeatable prices on INTERSIL chips. Compare our prices and see how much you save.

ICL7106CPL	6.75
ICL7107CPL	6.95
ICL8038CCPD	2.95

LINEAR ICs

NE555N-8 Timer	18p
NE555N-14 Dual Timer	50p
UA723CN Voltage Regulator	33p

POWER CONVERTER MT56WS

Now you can operate 115/120 Volts American equipment from 240 Volts. This converter has outlets for American type 2 or 3 pin plugs. Rated 20VA. **Only £8.95**

From T.1.: **TL490 BAR/DOT DRIVER IC.** Drives 10 LEDs with adjustable analog steps. Units are cascadable up to 10 (100 steps). Drives LEDs directly. Great for **voltage, current or audio displays.** Similar in features to LM3914 with specs and circuit notes. **ONLY £1.75 NEW!**



FAIRCHILD RED LED LAMPS

#FLV5057 Medium Size Clear Case RED EMITTING. These are not retested off-spec. units as sold by some of our competitors. These are factory prime, first quality, new units.

VERY LIMITED STOCK!!
 8p EACH 100 OFF
 6p EACH 1,000 OFF
 5p EACH 2,000 OFF



INTERSIL UNIVERSAL TIMER/COUNTER EVALUATION KIT ICM7226A EV/KIT

8 digits 5 Function 4 range to 10MHz with 0.1Hz res. time interval and period to 10 seconds with 0.1 microsecond res. units up to 10 million and ratio. A breadboarding area is provided for user to add his own input conditioning circuitry or prescalers and digital outputs are available as multiplexed as well as being displayed. Complete kit **ONLY £39.50 + VAT**

SE 01 Sound Effects Kit

The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new Texas Instruments **SN 76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3 1/4" x 3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains,** or almost an infinite number of other sounds. The unit has a multiple of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100mW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.) **COMPLETE KIT ONLY £12.50 P&P 50p + VAT**



THE MOST VERSATILE LIQUID CRYSTAL DISPLAY

1.24 25+100+ LCD106 6.45 5.50 5.25

5" Field effect LCD display featuring 3 1/2 digits, colon, plus/minus sign, 3 decimal points and "LO BAT" indicator. Ideal for DMMs, DPMs, digital thermometers, AM/FM radio readouts. Just look at the features. Ultra low power consumption, high contrast ratio, wide viewing angle, rapid response, proven sealing techniques, superior MTBF, reflective aluminium foil. Over 300,000 already sold! Perfect interface for Intersil 7106 40 Pin DIL.

Ordering information: For orders under £50 add 50p p.&p. Add 15% VAT to total. All items are subject to prior sale and therefore subject to availability. Prices are subject to change without notice. Quantity discounts are available for OEMs and dealers. Send SAE for details.

All orders to:

4 Meeting Street Appledore, Nr. Bideford North Devon EX39 1RY
 Telex 8953084

WW - 043 FOR FURTHER DETAILS

WHEN QUALITY COUNTS... Count on OPTOELECTRONICS USA for State-of-the-Art top quality Frequency Counters at Pace Setting prices.

MODEL 8010

NEW
 9 DIGITS 10Hz to 1 GHz
 ONLY £295 + VAT

(Complete with built-in Nicads)



- Range 10Hz to 1GHz
- 1 ppm TCXO
- 9 digits red LED 0.4"
- Black Anodized Aluminium Case - Providing RF Shielding
- Input Sensitivity Control
- 8 Gate times
- NBS traceable Calibration
- 10 MHz time base
- External time base input
- HiZ and 50 ohm inputs
- Full year guarantee
- AC/DC NiCad battery portable operation
- Compact size: 3"H x 7 1/4"W x 6 1/2"D weight approx. 2 lbs.

MODEL 7010

NEW
 9 DIGITS 10Hz to 600 MHz
 ONLY £99 + VAT

(Complete with built-in Nicads)



- Range 10Hz to 600MHz
- 9 red 0.4 LED digits
- NBS Calibration traceability
- Black Anodized Aluminium Case
- 3 Gate times - LED indicator
- 1 ppm TCXO
- 10 MHz time base
- Optional external clock input £15 + VAT
- 1 Megohm and 50 ohm inputs
- AC/DC or Nicad rechargeable battery operation
- Full year guarantee
- Comprehensive manual
- Miniature size - weight 1 lb.

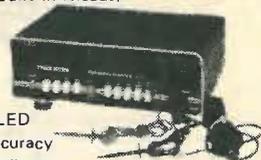
BRIEF SPECIFICATIONS

Model	Range	LED Digits	SENSITIVITY 50 OHM INPUT	HI-Z INPUT	GATE TIMES	RESOLUTION	TCXO TIME BASE	EXT. CLOCK INPUT
7010	600 MHz	9	5-20 mV	10-30 mV	1-10 mV	12 MHz; 60 MHz; Max. Pres. 20°-40°C; 1 Hz; 10 Hz; 600 MHz; 1 ppm	10 MHz	Yes Option ET5
8010	1 GHz	9	1-10 mV	5-20 mV	10-35 mV	1 Hz; 10 Hz; 1 GHz; 1 ppm	10 MHz	Yes Std.

MODEL TRMS 5000

NEW
 4 1/2 DIGIT TRUE RMS
 MULTIMETER/THERMOMETER
 ONLY £190 + VAT

(Complete with built-in Nicads)



- 4 1/2 digit 0.5 LED
- 0.04% DC Accuracy
- True RMS reading
- Precision °C/°F Thermometer
- 10 Amp range
- AC/DC or portable operation
- Test leads and temp. probe included
- Anodized Aluminium Case - 3 1/4"H x 7 1/4"W x 6 1/4"D - 2 lbs.
- High - Low ohm measurements
- Full year guarantee
- Input impedance 10 Megohm shunted by less than 80 pF.

BRIEF SPECIFICATIONS

DC VOLTAGE		AC VOLTAGE		
Range	Accuracy	Range	Accuracy	Accuracy
2V	0.05%	45Hz-10 kHz	±0.25%	10 kHz-40 kHz
20V	0.04%	20V	±0.5%	35%
200V	0.04%	200V	±0.5%	1%
1000V	0.04%	1000V	±0.5%	2%

RESISTANCE		Accuracy	
Range	Accuracy	High Ohms	Low Ohms
2K ohm	±0.5%	±10%	±10%
20K ohm	±0.5%	±10%	±10%
200K ohm	±0.5%	±10%	±10%
2 megohm	±1%	±15%	±15%
20 megohm	±3%	±3%	±3%

DC AND TRMS AC CURRENT		Accuracy	
Range	DC	45Hz-10 kHz	10 kHz-40 kHz
2 mA	0.5%	1%	1.5%
20 mA	0.5%	1%	1.5%
200mA	0.5%	1%	1.5%
2000mA	0.5%	1%	1.5%
10 Amp	0.5%	1%	1.5%

TEMPERATURE		Accuracy	
Range	Celsius	Fahrenheit	Resolution
-50.00° to +150.00°	±0.1°	±0.1°	0.1°
	±0.2°	±0.2°	0.2°



Sole UK Distributors: **Order yours from us.**
Maclin-Zand Electronics Ltd. 38 Mount Pleasant, London WC1X 0AP. Tel: 01-837 1165/01-278 7369 Telex:8953084 Maclin G.
 Also available from retail shops: Audio Electronics, 301 Edgware Road, London W.2. Tel: 01-724 3564
 Z & I Aero Services, 85 Tottenham Court Road, London W.1. Tel: 01-580 8403

WW-044 FOR FURTHER DETAILS

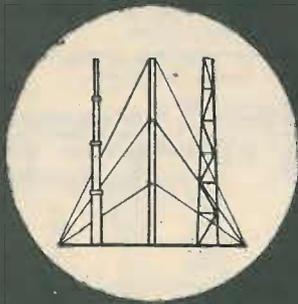


Hilomast Ltd

HILOMAST SYSTEMS



PNEUMATIC TELESCOPIC MASTS



HILOMAST LIMITED
THE STREET HEYBRIDGE — MALDON
ESSEX CM9 7NB ENGLAND
Tel. MALDON (0621) 56480
TELEX NO. 995855

WW — 007 FOR FURTHER DETAILS

The NEW P3 from PRECISION PETITE for the man in a hurry...

A new addition to
a great range of
precision tools.



*Fits snugly
in the hand.*

£17.55
inc. VAT

with
UNIVERSAL CHUCK

With the famous P1 and P2 drills now firmly established, Precision Petite have now produced the P3 hand drill with UNIVERSAL CHUCK so that all the accessories associated with the P1 & 2 can be quickly interchanged without changing the chuck. This will save considerably on the time factor where absolute accuracy is not highly essential. Employs the same motor and has the same characteristics as the P2 drill without removeable head, and fits the S2 Drill Stand. Send for details of this reliable and robust new drill and accessories now and save yourself those valuable moments. *SAE please.*

See it at CRAFT IN ACTION EXHIBITION
Royal Agricultural New Hall
Nov. 13-16 inc.



S2 DRILL STAND
will accept P1, P2
and P3 drills.
£17.96
inc. VAT

*Ask for accessories
leaflet*



Sole UK Distributors

PRECISION PETITE LTD

119a HIGH STREET TEDDINGTON MIDDLESEX TW11 8HG
TEL: 01-977 0878

WW — 008 FOR FURTHER DETAILS

Quantum Electronics

NEW PRODUCTS — NEW PRODUCTS

Our product range for the 80s is outlined below but it is impossible to cover everything in such a small space. For detailed information and a price list send a large S.A.E. or a dollar bill.

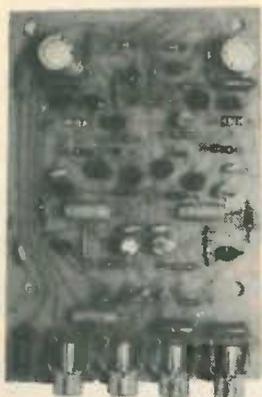
PRE-AMP & POWER AMP KITS



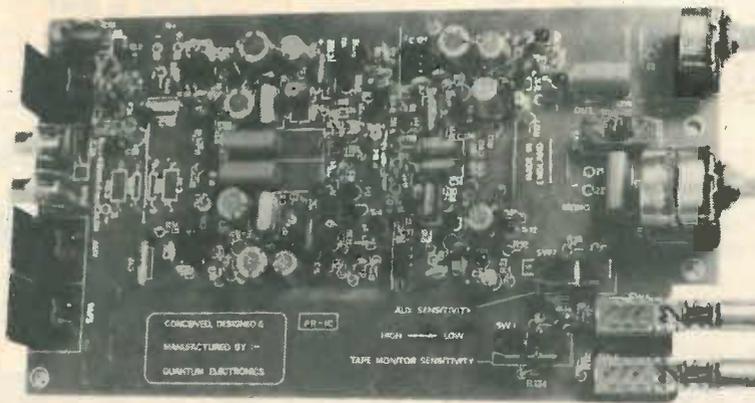
The pre-amp is now available in kit form in versions to suit any cartridge and consists of the module C1 (below) and the hardware kit HK1. No soldering is involved and assembly takes about 20 mins. There are six power amp kits, four mono and two stereo, from 45 to 260W to satisfy virtually every requirement. They use ready-built and tested p.c. boards to achieve an ease of construction similar to module based kits at lower cost. There are also mains supply kits to enable independent use of the pre-amp, which is normally powered via our power amp. Similar equipment is also available ready-built from us or via our dealers.

C1 + HK1	£68.70	P2 (stereo 45W per channel) kit	£87.28
C1mc + HK1	£70.95	P4 (stereo 110W per channel) kit	£109.42

MOVING-COIL & PRE-AMP MODULES



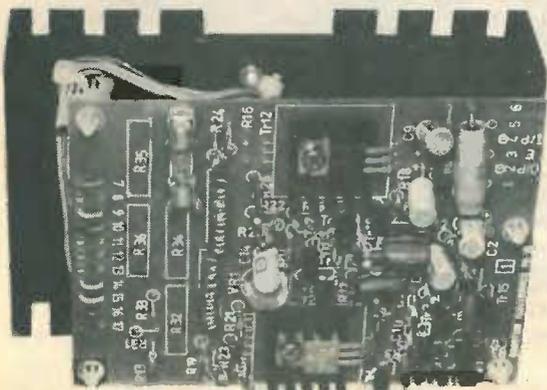
MC1



C1 (C1mc)

Previously restricted to trade and export, the C1 pre-amp module is now available separately in 3 versions to match any cartridge. It has unbeatable specifications, caters for disc, auxiliary and 2 or 3 head tape machines and requires only a rough supply of ± 18 to 35V d.c. The new moving coil pre-pre-amp achieves low thd, high overload, good r.f. rejection and good noise performance without resorting to the expensive multiple transistor design. Only tantalum capacitors and metal oxide resistors are used in the signal path and it can be powered either via the C1 or by a battery. Hardware kits are available to build both types and they are also available ready-built.

MC1 Module: **£22.25** C1 Module: **£49.50** C1mc: **£51.75**



POWER AMP MODULES AND SUPPLIES

The power amp modules are now also available to retail customers in a variety of powers and formats up to 260W r.m.s. They use the same high performance circuitry as the kits above, giving t.h.d. below .01% at 1kHz, but are capable of sustained high level use with excellent reliability. There are power supplies for use with any one or two of these modules, all of which use toroidal transformers, also available separately. The module illustrated is a medium duty 150W r.m.s. type, the M1508, which requires the MS3 supply.

M1508: **£35.79** MS3: **£26.28**

Exports: We can deal efficiently with orders to any country. Please write with your specific requirements for a quote by return. All equipment can be wired for 110V mains.

1A STAMFORD STREET, LEICESTER. Tel. 546198

OX DISCO, BOX 123 CLAYMONT, DE 19703, U.S.A. Tel. 1-302-798-7932

MINIC TELEPRODUTOR, BOX 12035, S-750 12, UPPSALA 12, SWEDEN

L.A.B. (A.P.S.), VANDKUNSTEN 4, DK 1467, COPENHAGEN, DENMARK

LOWE ELECTRONICS LTD.

119 CAVENDISH ROAD, MATLOCK, DERBYSHIRE.
TEL. 0629 2430 OR 2817. TELEX 377482 LOWLEC G



CS1577 130mm DUAL TRACE TRIGGERED SWEEP OSCILLOSCOPE

£480 + VAT

PRICE INCLUDES TWO X10
FULL BANDWIDTH PROBES

- * 130 mm mesh PDA
- * DC - 30 MHz
- * 2 mV sensitivity
- * Signal delay
- * Auto level triggering
- * Display modes CH1, CH2, DUAL ADD, X-Y
- * Single shot with variable hold off

SPECIFICATION

Bandwidth: DC - 30 MHz (3 dB) 40 MHz (6 dB)

Sensitivity: 2 mV/cm - 10V/cm

Input R.C.: 1 M ohm 22 pF

Risetime: 11.7 nS

Overshoot: less than 3%

Sweep time: 100 nS/cm - 0.5S/cm

Linearity: better than 3%

Calibrator: 1 KHz 100 mV square wave

Trigger bandwidth: DC - 40 MHz

Trace rotation: Electrical

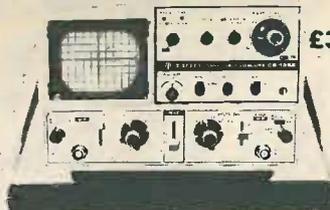
Phosphor: P31

Power: AC 100 / 120 // 220/240V 50/60 Hz 40W

Dimensions: 260mm x 190mm x 375mm

Weight: 10 Kg

CS1352 DUAL TRACE 15 MHz/2mV PORTABLE



£350 + VAT

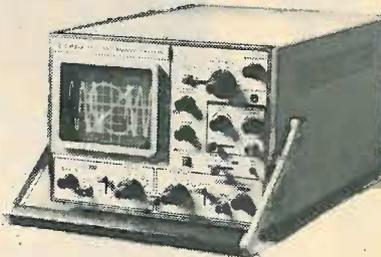
The CS1352 oscilloscope offers you not only dual trace, 15MHz bandwidth operation at sensitivities down to 2mV/cm but also use from 100-240 Vac mains and portable operation using the optional rechargeable battery pack. Automatic charging is carried out when the CS1352 is plugged into a mains supply. Now you can have top performance both on the bench and out in the field — and at an affordable price.



CS1575 DUAL TRACE 4 FUNCTION

The CS1575 is a unique tool for the audio engineer. It features the normal facility of dual trace display with sensitivity to 1 mV/cm but not only can it display the input signals on two channels, it can **simultaneously** display the phase angle between them and measure the phase angle referenced to a zero phase calibration display. In addition to these unique features, you also have independent triggering from each channel to give stable displays even with widely differing input frequencies.

Absolutely indispensable to the professional audio engineer, the CS1575 is now in use all over the world. See it in action or send for complete details.



£278 + VAT

**TRIO
OSCILLOSCOPES**

The Trio range of oscilloscopes offer top quality at moderate cost. The brief specifications show the performance features which have made these oscilloscopes firm favourites in all parts of the world, with bandwidths to 30 MHz and sensitivities down to 1mV/cm on 130 mm screens. Prices are very realistic and we try to ensure that delivery is ex-stock at all times — quite a change these days.

FOR FULL DETAILS ON THESE AND OTHER MODELS, CONTACT THE SOLE AGENTS, LOWE ELECTRONICS.

WW — 033 FOR FURTHER DETAILS

The King of Valves



Genuine Gold Lion valves — hand built, utilising advanced pumping techniques and individually tested to a tight specification — are your answer to the high quality sound demands made by musicians and listeners alike.

Gold Lion KT77's and KT88's covering 30-200 watts, are now available from M-OV along with data and distribution details. Find out all about the King of Quality — from M-OV.

™ Trade Mark of M-OV Audio Valves.

M-OV
A MEMBER OF THE GEC GROUP

S&C

5711

THE M-O VALVE CO. LTD., HAMMERSMITH, LONDON, ENGLAND, W6 7PE.
TELEPHONE 01-603 3431 TELEX 23435. GRAMS THERMIONIC LONDON.

WW — 011 FOR FURTHER DETAILS

Dual output power supplies



Now you can get on-card dual output power supplies from Vero Systems — in five versions:

- DUAL 5 Volts
- DUAL 12 Volts
- DUAL 15 Volts
- MIXED 5 and 12 Volts
- MIXED 5 and 15 Volts

The cards are designed to Eurocard standard size (100 x 160mm) to fit straight into your card or case frame.

Each supply is fully regulated with over voltage over current and thermal protection. Input voltage is 110/120/220/230/240 volts AC and both outputs are fully isolated from each other but may be connected to give different power rail configurations.

The cards are supplied fully tested each one complete with 64-way indirect connector plug, card handle and connection chart.

ORDER CODE	FUNCTION	PRICE
89-2665G	DUAL 5V	£32.43
89-2671K	DUAL 12V	£38.50
89-2703B	DUAL 15V	£38.50
89-9017B	DUAL 5-12V	£38.50
89-9018H	DUAL 5-15V	£38.50

VERO SYSTEMS

VERO SYSTEMS (ELECTRONIC) LTD

362 Spring Rd. Southampton Hants. SO9 5QJ Tel: (0703) 440611 Telex: 477164

WW — 024 FOR FURTHER DETAILS

UK BID FOR YOUR WIRE FRAME MONITOR CHASSIS ORDERS

It's
KGM
the Euro-source
you've been
hoping for!

The alternative source that's near to hand . . . KGM. A video production line with high volume capability, here in Europe. Ready to meet your orders for open frame monitor chassis that neatly replace those long-range imports you're using currently. Same mounting, same international-standard connections. But one big, competitive advantage . . .

We're so much nearer, with the stocks, fast production response, spares and service you could only expect from a home based source. KGM prices are highly competitive too, especially on big orders. We can prove that with a quote, but how about product performance? . . .

The specifications you want... bright, clear CRT data display, with superior resolution. The quality you get from years of video experience. Your popular screen sizes, in any phosphor colour. Latest miniaturised pcb construction of course, in an open chassis that allows screen tilt and mounting variations to fit your package.

So if you buy video display this way . . . call KGM now. See how keen we are to win your next order.

KGM ELECTRONICS LIMITED
Clock Tower Road, Isleworth, Middlesex TW7 6DU, England.
Telephone: 01-568 0151. Telex: 934120

KGM **ELECTRONICS**
LIMITED

Hall Electric Limited International Semiconductor Distributor



Haltron

Germanium Transistors



Haltron

Silicon Transistors



Haltron

Integrated Circuits



Haltron

Zener Diodes



Haltron

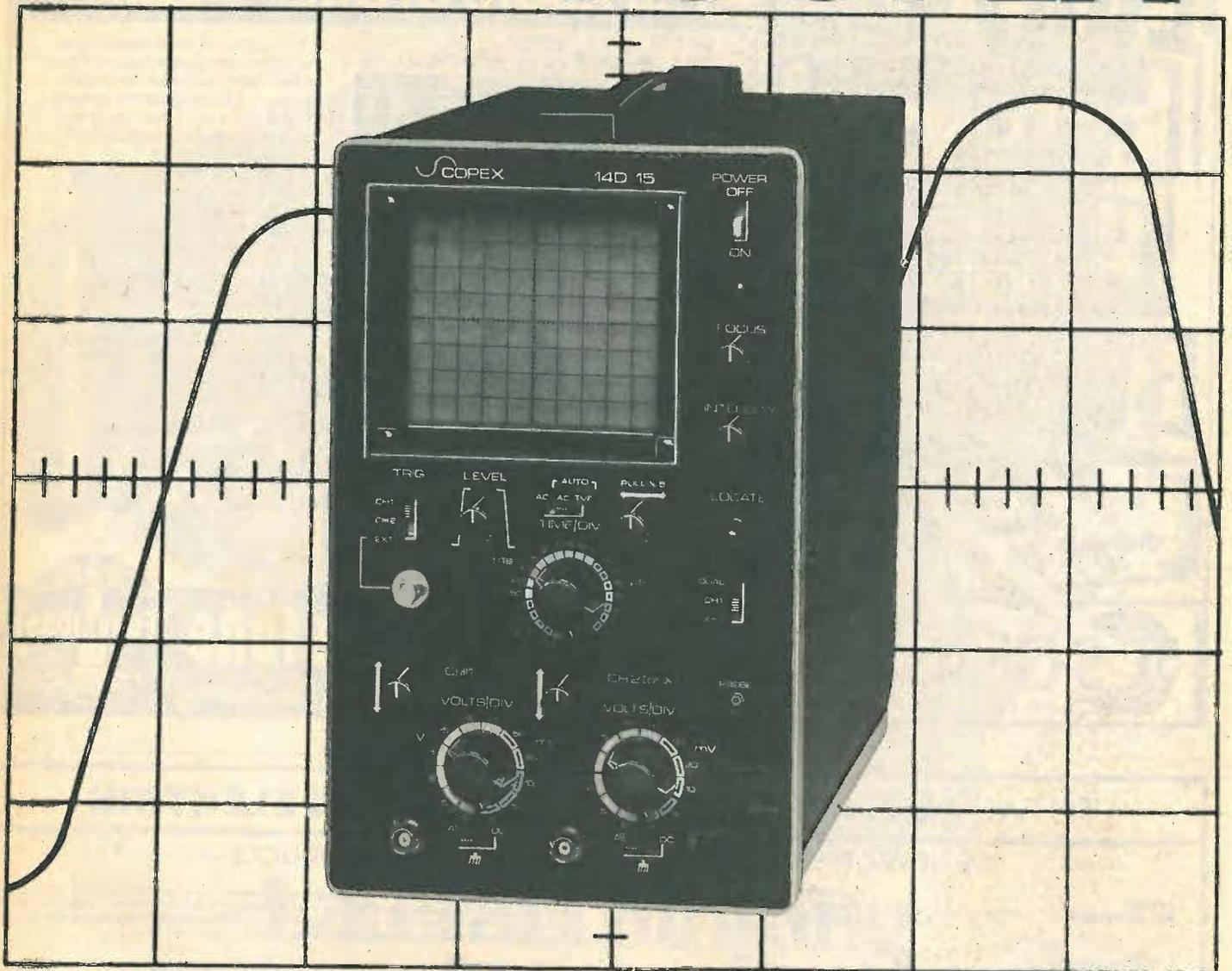
Rectifier Diodes

Hall Electric,
International
Semiconductor specialists
and World's largest
independent
Tube distributor

Electron House, Cray Avenue, Orpington, Kent BR5 3QJ Telephone: Orpington 27099. Telex: 896141 Cralec G

WW - 042 FOR FURTHER DETAILS

TRUST SCOPEX



The 14D-15 is the very latest addition to the Scopex range of brilliantly engineered, easy to use oscilloscopes.

Here's what it offers:-

- Large screen 10 cm x 8 cm
- Triggers on channels 1 and 2
- 2 mV – 10V/DIV sensitivity
- 3% accuracy – a Scopex speciality
- DC-15 MHz bandwidth over the entire screen
- Probe test output
- Wide time base range
- Switched mode power supply

Plus a host of well thought-out additional facilities, free delivery in the UK mainland and a very good price of £280 plus VAT.

Trust Scopex to get it right.

 **SCOPEX**

Pixmore Avenue, Letchworth,
Herts. SG6 1JJ.
Telephone: 04626 72771.

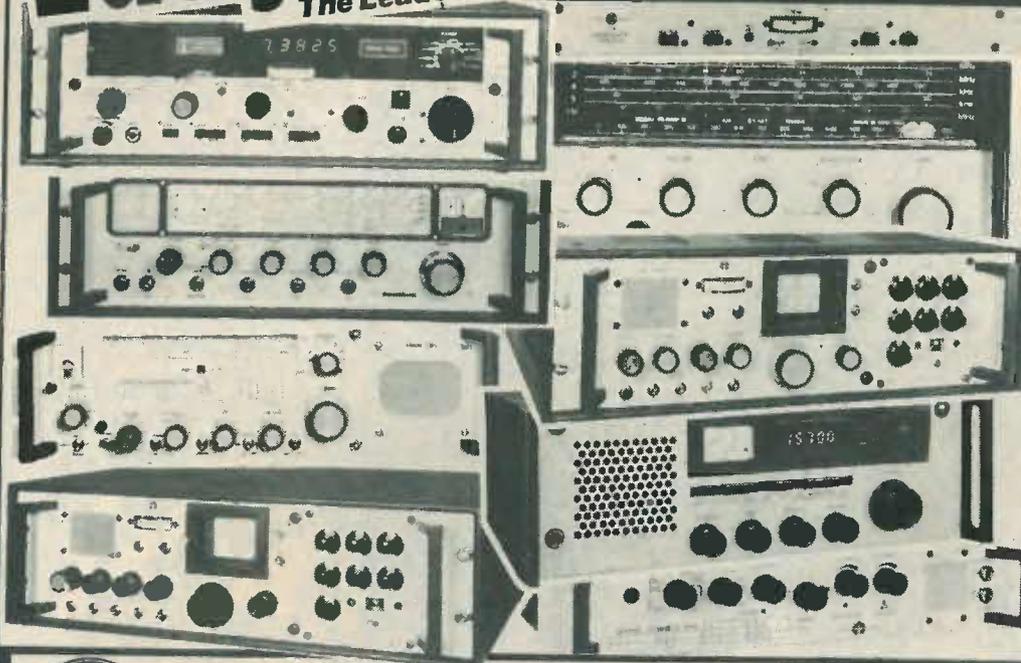
WW-052 FOR FURTHER DETAILS

Eddystone

The Leaders in Short Wave

at SONIC SOUND AUDIO BRITAIN'S No. 1 AUDIO STORE

SOLE U.K. RETAIL
DISTRIBUTORS
FOR EDDYSTONE



Sonic Sound, the premier home entertainment store have now added yet another big name in the field of sound equipment to further enhance their prestige in London's centre of the audio/visual and Hi-Fi field in Tottenham Court Road.

Eddystone, at the top of the tree since short wave began, have now appointed Sonic Sound Audio as sole retail distributors in the United Kingdom

Anyone even contemplating purchasing short wave equipment, be they looking for the best possible available for their Embassy, press department or home use, should visit or contact Sonic where they will be able to view and listen to the most comprehensive range of the latest short wave equipment on the market today.

Listen and choose in comfort at Britain's most up-to-date air conditioned sound demonstration studios. Full ranges of Hi-Fi, Video equipment, In-car and portables, etc., from all leading manufacturers; B & O, Sanyo, Sony, Hitachi, Pioneer, J.V.C.



THE COMMUNICATION CENTRE

SONIC SOUND AUDIO

248-256 TOTTENHAM COURT ROAD LONDON W1 TEL: 01-637 1908

Eddystone

A Marconi Group Company.



WW — 034 FOR FURTHER DETAILS

TOTAL AMPLIFICATION FROM CRIMSON ELEKTRIK

WE NOW OFFER THE WIDEST RANGE OF SOUND PRODUCTS —

STEREO PRE-AMPLIFIER



POWER AMPLIFIER MODULE



CPR 1 — THE ADVANCED PRE-AMPLIFIER. The best pre-amplifier in the U.K. The superiority of the CPR 1 is probably the disc stage. The overload margin is a superb 40dB, this together with the high slewing rate ensures clean top, even with high output cartridges tracking heavily modulated records. Common-mode distortion is eliminated by an unusual design. R.I.A.A. is accurate to 1dB; signal to noise ratio is 70dB relative to 3.5mV; distortion <.005% at 30dB overload 20kHz.

Following this stage is the flat gain/balance stage to bring tape, tuner, etc. up to power amp. signal levels. Signal to noise ratio 86dB; slew-rate 3V/μS; T.H.D. 20Hz—20kHz <.008% at any level.

F.E.T. muting. No controls are fitted. There is no provision for tone controls. CPR 1 size is 138x80x20mm. Supply to be ± 15 volts.

MC 1 — PRE-AMPLIFIER. Suitable for nearly all moving-coil cartridges. Sensitivity 70/170μV switchable on the p.c.b. This module brings signals from the now popular low output moving-coil cartridges up to 3.5mV (typical signal required by most pre-amp disc inputs). Can be powered from a 9V battery or from our REG 1 regulator board.

XO2:XO3 — ACTIVE CROSSOVERS. XO2 — two way, XO3 — three way. Slope 24dB/octave. Crossover points set to order within 10%.

REG 1 — POWER SUPPLY. The regulator module, REG 1 provides 15.0-15v to power the CPR 1 and MC 1. It can be used with any of our power amp supplies or our small transformer TR 6. The power amp kit will accommodate it.

POWER AMPLIFIERS. It would be pointless to list in so small a space the number of recording studios, educational and government establishments, etc., who have been using CRIMSON amps satisfactorily for quite some time. We have a reputation for the highest quality at the lowest prices. The power amp is available in five types, they all have the same specification. T.H.D. typically .01% any power 1kHz 8 ohms. T.I.D. insignificant, slew rate limit 25V/μS; signal to noise ratio 110dB; frequency response 10Hz-35kHz — 3dB; stability unconditional, protection drives any load safely; sensitivity 775mV (250mV or 100mV on request), size 120 x 80-25mm.

POWER SUPPLIES. We produce suitable power supplies which use our superb TOROIDAL transformers only 50mm high with a 120-240 primary and single bolt fixing (includes capacitors/bridge rectifier).

POWER AMPLIFIER KIT. The kit includes all metalwork, heatsinks and hardware to house any two of our power amp modules plus a power supply. It is contemporarily styled and its quality is consistent with that of our other products. Comprehensive instructions and full back-up services enable a novice to build it with confidence in a few hours.

PRE-AMP KIT

This includes all metalwork, pots, knobs, etc., to make a complete pre-amp with the CPR 1(S) module and the MC 1(S) module if required.



POWER AMPLIFIER MODULES

CE 608 60W/8 ohms 35-0-35v	£19.52
CE 1004 100W/4 ohms 35-0-35v	£23.02
CE 1008 100W/8 ohms 45-0-45v	£25.96
CE 1704 170W/4 ohms 45-0-45v	£31.00
CE 1708 170W/8 ohms 60-0-60v	£33.97

TOROIDAL POWER SUPPLIES

CPS1 for 2xCE 608 or 1xCE 1004	£18.56
CPS2 for 2xCE 1004 or 2x4xCE 608	£18.80
CPS3 for 2xCE 1008 or 1xCE 1704	£19.75
CPS4 for 1xCE 1008	£17.12
CPS5 for 1xCE 1708	£24.15
CPS6 for 2xCE 1704 or 2xCE 1708	£25.53

HEATSINKS

Light duty, 50mm, 2 C/W	£1.44
Medium power, 100mm, 1-4 C/W	£2.35
Disc group, 150mm, 1-1 C/W	£3.04
Fan, 80mm, slate 120 or 240v	£19.70
Fan mounted on two drilled 100mm heatsinks 2x4 C/W, 65 max. with two 170W modules	£31.05

THERMAL CUT-OFF, 70°C

	£1.54
--	-------

POWER AMP KIT £35.03

PRE-AMPS

These are available in two versions — one uses standard components, and the other (the S), uses M0 resistors where necessary and tantalum capacitors.

CPR 1	£31.65
MC 1	£21.28
CPR 1S	£40.87
MC 1S	£33.17

ACTIVE CROSSOVERS

XO2	£15.16
XO3	£23.58

POWER SUPPLY

REG1	£6.90	TR6	£1.97
------	-------	-----	-------

PRE-AMP KIT £38.07

BRIDGE DRIVER, BD1

Obtain up to 340W using 2x170W amps and this module.

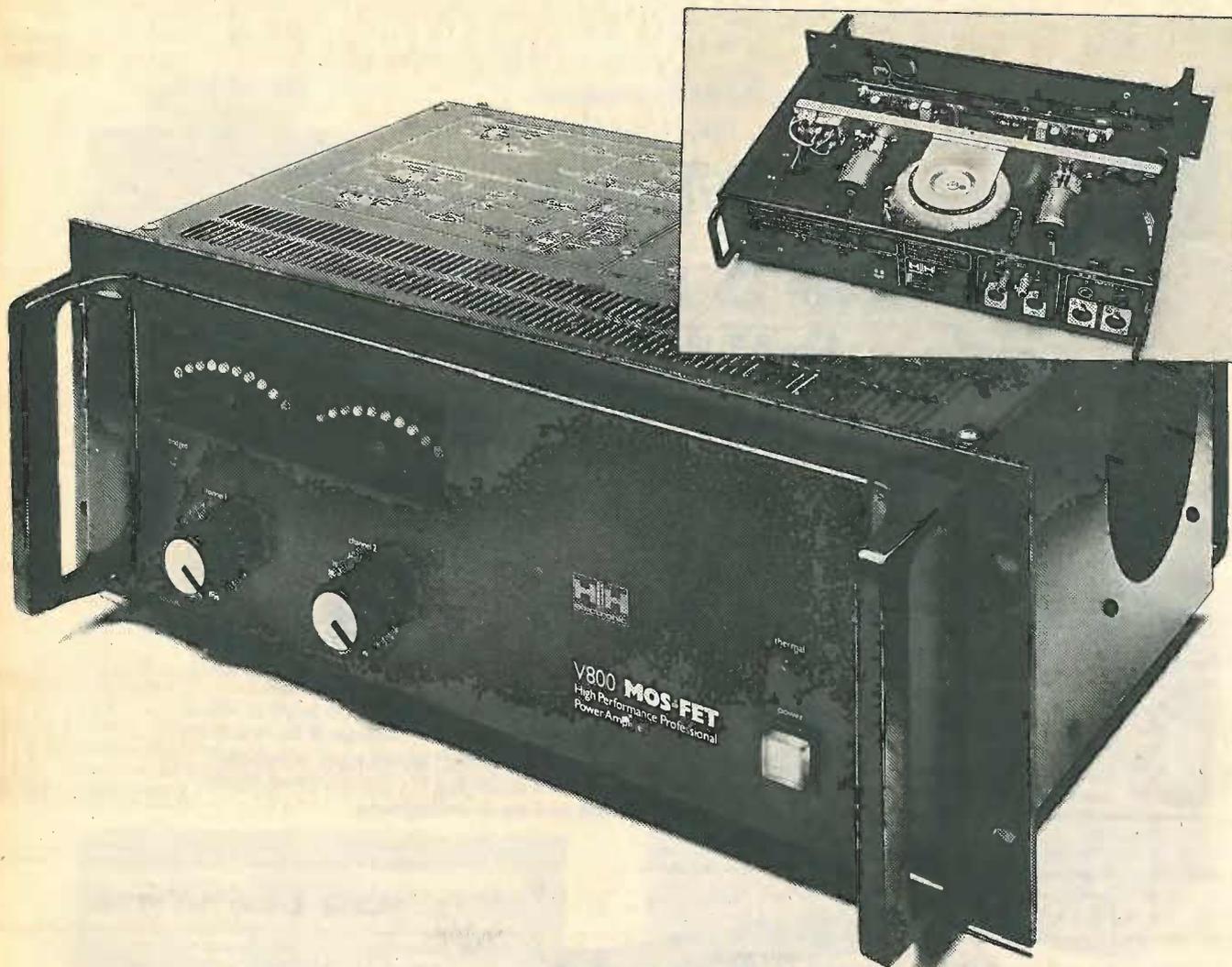
BD1	£5.75
-----	-------

CRIMSON ELEKTRIK

1A STAMFORD STREET, LEICESTER LE1 6NL. Tel. (0533) 553508
U.K. — Please allow up to 21 days for delivery

All prices shown are UK only and include VAT and post. COD 90p extra. £100 limit. Export is no problem, please write for specific quote. Send large SAE or 3 International Reply Coupons for detailed information. Distributors: Down Hi-Fi & Video Centre, 66 Abbey Street, Bangor, N. Ireland. Badger Sound Services Ltd., 46 Wood Street, Lytham St. Annes, Lancashire FY8 1QG.

WW — 037 FOR FURTHER DETAILS



Lateral Thinking

"The perfect definitive power amplifier should run absolutely stable and completely undistorted across a full frequency range up to the highest power level with total dependability," we said. Our resolve was to make that ideal a reality.

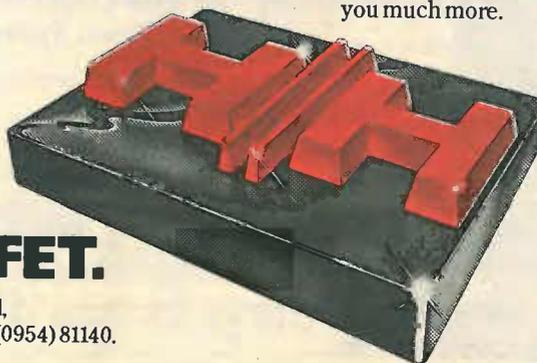
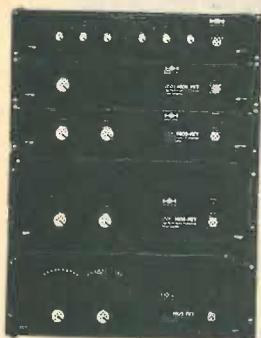
Thus, our boffins at Cambridge donned their thinking caps and with typical panache sliced across convention with a radical new solution: MOS-FET technology.

And the result? No thermal runaway. No secondary breakdown. Simpler circuits. Fewer components. Therefore, greater reliability under tough conditions. Whatever your application; variable frequency power supplies, servo motor

systems, vibrator driving, or superior audio installations, our new MOS-FET amplifiers will deliver perfect waveforms right up to 50kHz at full power.

Now this technology is available to you, in 19" rackmount format with models from 150 to 800 Watts... and upwards in multiples, using the X300 frequency dividing network.

So if you're thinking that our thinking was along the right lines, then drop us a line yourself and we'll tell you much more.



Graduate to the 80's. MOS-FET.

HH Electronic, Dept. A5, Viking Way, Bar Hill,
Cambridge CB3 8EL. Telephone: Crafts Hill (0954) 81140.
Telex: 817515 HH Elec G.

fact:
**the Pro Master™ sound
 system is not an evolution...
 it's a full-blown**

REVOLUTION!



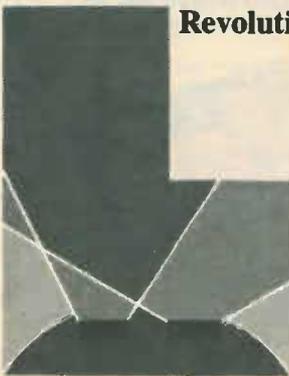
The PRO MASTER modular sound system ushers in a new generation of sound system versatility, reliability, and quality for today's entertainers, musicians, and speakers — for use in settings as diverse as intimate clubs, lounges, large auditoriums, churches, and schools. Its multitude of performance-proven features is the result of sophisticated computer design techniques, advanced materials, and countless hours of personal consultation with performers and sound technicians.

Revolutionary New Console

Finally! The best of *both* worlds. A console so easy to use that it won't overwhelm the beginning group, yet with the advanced features and capabilities required by experienced professional performers—such as pre-fader monitor mixing, effects and/or built-in reverb, with their own tone controls, LED clipping indicators with attenuators on each input, and full patching facilities for every system component. Super power: *twin 200-watt solid-state power amplifiers!* Doubles as a stereo recording console for groups that want to "lay down a few tracks" without paying for studio time, or can be used as an ultra-sophisticated keyboard mixer with power. Unitized ARMO-DUR™ structural foam combination case and chassis makes it more durable than steel. Ultra-light: only 47 pounds.

Revolutionary: Variable Dispersion Sound System

Advanced new variable dispersion high-frequency horn system projects your sound — everywhere in the house, giving you a choice of 60° long-throw, or 120° wide-angle dispersion with the twist of a knob. Tailors the sound to the room — even L-shaped rooms.



Revolutionary New Loudspeaker

Every extra ounce — every unnecessary cubic inch — has been computer designed OUT of the PRO MASTER loudspeaker. Modern materials and moulding techniques accommodate a high-performance 15-inch woofer and a high-frequency horn and compression driver in a startlingly small, efficient enclosure. Less than 28 inches high, 23 inches wide, 16 inches deep. Weighs an easy-to-handle 58 pounds. Yet, the power handling capacity is a remarkable 150 watts, and the frequency response is 50 to 15 kHz.

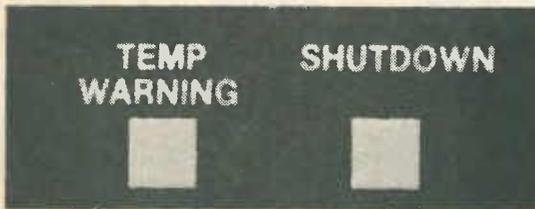


**Replaces All this Equipment...
And Does More!**

The impressive array at left includes a mixing console, two graphic equalizers, a pair of 200-watt power amps, a monitor mixer and an octave analyzer. The PRO MASTER gives you all these capabilities — plus features that you can't find in any other console, at any price: Unique FEEDBACK FINDER™ circuit, exclusive PATCH BLOCK™ patch panel, wide-range LED peak output and input clipping indicators. Plus pre-fader monitor send controls, LED power amp overload, temperature warning and shutdown indicators, 0 to 30 dB input attenuators, full stereo features, simultaneous effects and reverb on each channel. What's more, you have Hi-Z and Lo-Z balanced transformer-coupled mic inputs on all six mic channels, (can handle 12 mics simultaneously), plus two additional auxiliary input channels for adding synthesizers, tape players, tuners, sub mixers or any other high level output components. And each Lo-Z input features built-in simplex powering for condenser microphones.

Revolutionary: LED Status Indicators

Alerts you to developing trouble *before* it gets serious! You have time to correct the problem before it interrupts the performance. Temperature warning LED warns you if amplifier is overheating. Shutdown LED indicates power amplifier and speaker protection system activation. Only the power amplifiers are shut down until the internal cooling fan lowers the temperature.



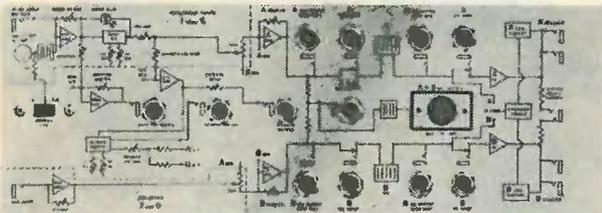
LED peak indicators virtually make VU meters obsolete. They respond to short transients that wouldn't budge a needle, and cover 42 dB without range switching. PA overload LEDs light at full power and also warn you of distortion-causing problems such as bad speaker cables or too many speakers.



**Revolutionary: FEEDBACK FINDER™ /
Equalizer**

Controls feedback — the number one enemy of a successful performance. FEEDBACK FINDER visually indicates the troublesome frequencies for precise adjustment of the twin 10-band equalizers. Enables you to equalize for maximum gain on the house and/or monitor system. Nothing else like it!

Revolutionary: PATCH BLOCK™ Patch Panel



The back panel is a unique combination block diagram and patch panel with 12 patching jacks located at appropriate points on the block diagram. For the beginner who is taking his act on the road for the first time, the PRO MASTER works "as is," with no special connections. But with the PATCH BLOCK, the professional can create a wide variety of setups and add auxiliary equipment without makeshift connections. And you can change setups at a moment's notice without confusion. Simplicity and versatility, the PRO MASTER has them both!

Hear the Revolutionary New Sound!



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

WW — 017 FOR FURTHER DETAILS

Top value test equipment from TANDY

LCD DIGITAL MULTIMETER.

Low-cost hand held digital multimeter with a full 3½ digit LCD display. 0.5% basic accuracy, auto polarity operation. 10 MΩm DC input impedance. Reading to ± 1999.

Scales:
DC volts: 1mV to 1000V (1% ± 1 digit accurate).
AC volts: 1mV to 500V (1% ± 2 digits accurate).
DC current: 1μA to 200mA (1% ± 1 digit accurate).
Resistance: 10Ωm to 20 MΩms (1.5% ± 1 digit accurate).
Power source: 9V battery or AC with optional adaptor.
Size: 155 x 75 x 30 mm. • 22-198

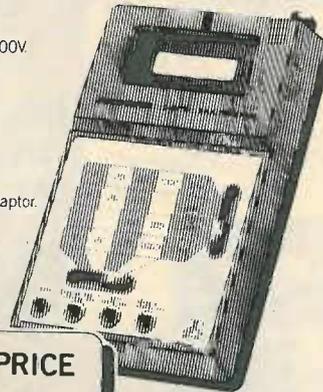


PRICE
53.19

LOW-COST LCD MULTIMETER COMPONENTS AND PARTS

A portable, compact sized multimeter with a full 3½ digit LCD display. Auto polarity operation, low battery indicator. 10 MΩm Input impedance.

Scales:
DC volts: 2 20 200 1000V.
AC volts: 200 500V.
DC current: 2 20 200mA.
Resistance: 2 20 200 2000 KOHM.
Power source: 9V battery or AC adaptor.
Size: 37 x 85 x 130 mm. 22-197



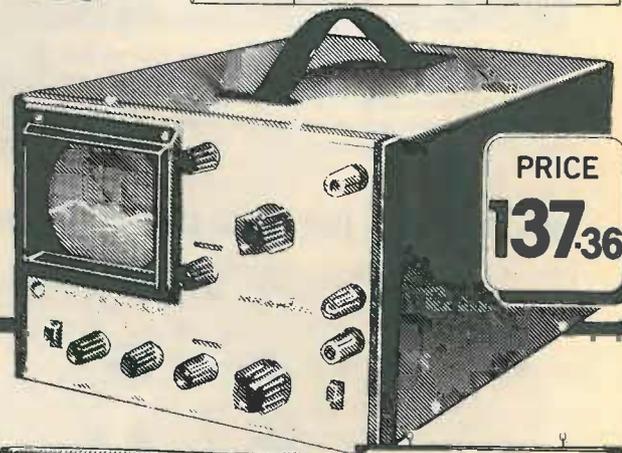
PRICE
39.93

CAT. No.	DESCRIPTION	PRICE
276-032	LED	4 for 69p
276-033	LED	2 for 48p
276-034	LED	2 for 59p
276-142	Infra-Red Emitter Detector Pair	£1.37
277-1003	12V DC Automotive Digital Clock Module	£17.52
276-9110	6 pin edge connector for 277-1003	40p
276-1373	Power Transistor Mounting Hardware	50p
276-1363	TO 220 Heat Sink	60p
276-1364	TO 3 Heat Sink	81p

AC/DC 8 MHz OSCILLOSCOPE

A new approved 8MHz version of last years' winner! The advance design features of this oscilloscope make it an absolute essential for industrial uses on production lines, in laboratories and schools. Ideal for radio and TV servicing, audio testing, etc.

Specifications:
Horizontal axis: Deflection sensitivity better than 250mV/DIV. **Vertical axis:** Deflection sensitivity better than 10mV/DIV (1DIV 6mm). **Bandwidth:** 0.8MHz. **Input impedance:** 1MΩm parallel capacitance 35pF. **Time base:** Sweep range: 10Hz - 100kHz (4 ranges). **Synchronization:** Internal () **Size:** 200 x 155 x 300 mm. **Supply:** 220 240 50Hz. 22-9501.



PRICE
137.36

You save because we design, manufacture, sell and service. Tandy have over 7,000 stores and dealerships worldwide. Over 2,500 products are made

specifically for or by Tandy at 16 factories around the world. The quality of our products has been achieved by over 60 years of continuous technological advancement.

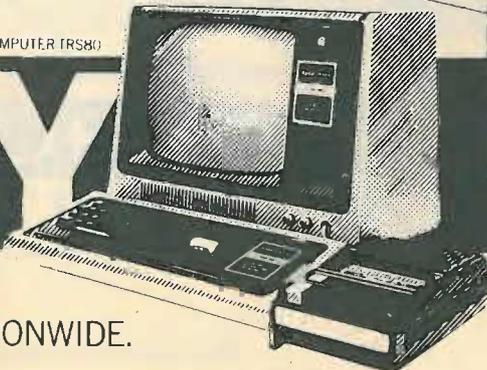
KNOWN AS RADIO SHACK IN THE U.S.A. MAKERS OF THE WORLD'S BIGGEST SELLING MICROCOMPUTER (TRS80)

TANDY

The largest electronics retailer in the world.

Offers subject to availability. Instant credit available in most cases.

OVER 170 STORES AND DEALERSHIPS NATIONWIDE.



TANDY
DEALER

Most items also available at Tandy Dealers. Look for this sign in your area.



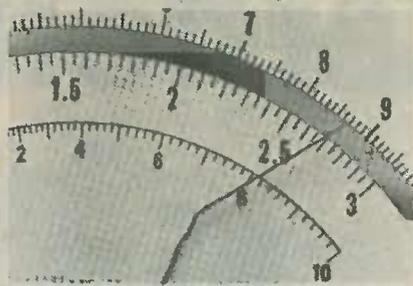
Access, Barclaycard and Frustrcard welcome.

WW - 039 FOR FURTHER DETAILS

Finally, you can have all the advantages of DMMs and none of the disadvantages of analogues for about the same price.

Our new 169 is a tough, lightweight, battery-powered digital multimeter for use in the field or on the bench. It is a 3½-digit, full 5-function DMM with respectable .25% DC accuracy.

Its low-parts-count, high-efficiency design keeps power consumption to a minimum for longer component life and fewer failures. MTBF is 20,000 hrs. or about 10 years.



Is this the end for Analogue meters?

only one calibration adjustment a year is required. That adds up to a cost-of-ownership no other competitive DMM can touch. For example, the 169 needs only one battery change per year at a cost of about £1.50.

When you factor in features like function and range annunciation right on the display, auto-zero, auto polarity, 60% larger display than other DMMs and the easy-to-read, colour coded front panel, we think you'll get the point. No analogue meter or DMM can match the price/performance of the new 169. It costs £99 (plus VAT)

For information on the 169 or any Keithley DMM call (0734) 861287
Telex: 847047

Ex stock

WW—062 FOR FURTHER DETAILS

All 5 functions are fully protected – 1400V peak on DCV and ACV, 300V on Ω , 2A (250V) on DCA and ACA. The fuse is externally accessible for quick replacement. Extensive vibration stress-testing assures the 169 will stand up to all the mechanical shock and abuse normally associated with tough applications.

Cost-conscious ease of maintenance is so thoroughly designed into the 169 that

KEITHLEY

Keithley Instruments Ltd.
1, Boulton Road
GB-Reading, Berkshire RG2 0NL
UNITED KINGDOM
(0734) 861287 Telex: (851) 847047

Keithley Instruments GmbH
Heiglhofstrasse 5
D-8000 München 70
(089) 714-40-65
Telex: 521 21 60

Keithley Instruments SARL
44, Rue Anatole France
F-91121 Palaiseau Cedex
01-014-22-06.
Telex: (842) 204188



Carston Electronics

specialists in
second user test and
measuring instruments

**AS
NEW**

**EX STOCK
DELIVERY**

Oscilloscopes

TEKTRONIX 465

DC-100MHz Dual Trace 5mV-5V/Div
0.05 μ s-0.5s/Div Delayed T/B XY DC 4MHz

£1200

TEKTRONIX 475A

DC-250MHz Dual Trace 5mV-5V/Div
0.01 μ s-0.5s/Div Delayed T/B XY DC 3MHz

£1950

**THESE INSTRUMENTS SOLD
WITH ONE YEAR FULL
GUARANTEE**

	Prices from £
Acoustic	
BRUEL & KJAER	
2203 Precision sound level meter	400
1613 Octave filter set couples directly to 2203 & 2204	250
CEL	
112 LEQ meter digital readout	450
Amplifiers	
MICRO MOVEMENTS	
M1270 DC Amplifier 15mV-150V 2 and 10 channel rack systems available	50
Attenuators	
STC	
74600 3 decade units. 0-100dB atten. in steps of 0.1dB 75 Ω impedance	25
Bridges	
CINTEL	
277 Measures iron core inductances 0.01H-1000H (with a Q value not less than 2)	130
DAWE	
210B Decade Capacitance box 0.1 μ F-1mF 0.1 μ F step	20
MARCONI	
TF1313 Measures C/L/R with an accuracy better than $\pm 0.25\%$	425
TF1245 'Q' meter. Freq. range 1kHz-300MHz using external osc.	350
WAYNE KERR	
B221. Plus low impedance adaptor	225
Q221. Measures L/C/R	450
B641. Measures L/C/R/G Accuracy of 0.1%	230
Q801. Y parameter test set. Plus transistor adaptor unit	230
Cable Test Equipment	
MARCONI	
TF2333 Transmission Test set	575
HEWLETT PACKARD	
3556A. For psophometric measurements from 20 Hz-20kHz. 0.1mV-30V input level	475
NEC	
TTS-37B. Noise, level and VU measurement. Sensitivity 180dBm up to +20dBm	275
STC	
74216A Noise Generator CCITT	240
74261A Psophometer CCITT	475
WANDEL U. GOLTERMANN	
DLM-1. Send/receive system for measuring phase jitter random noise and frequency shift on data transmission lines	1500
LDS-2. 200Hz-600kHz sender for measuring group delay and attenuation variations	3250
LDEF-2. Filters for DLM unit	250
Counter Timers	
HEWLETT PACKARD	
5300A/5303B DC-520 MHz 6 digits	210
MARCONI	
TF2414A DC-40MHz 7 digits	120
RACAL	
835. DC-15 MHz 6 digits	100
Time interval/Period/Ratio	250
9024 10 Hz-600 MHz 7 + 1 digits	100
9835 DC-15 MHz 6 digits	100
9837 DC-80 MHz 6 digits	130

More second user bargains

Distortion Systems

RADFORD	
DMS2 10 Hz-100 KHz meter	160
LD02 10 Hz-100 KHz Oscillator	160
Function Generators	
ADVANCE	
J4. 10 Hz-100 kHz. 10 V r.m.s. output Sine/Square Wave	175
PHILIPS	
PM5127. 0.1 Hz-1 MHz. Sine/Square/Triangular/Pulse outputs. External sweep facility 30Vp. p max output	325
Logic Analysers	
HEWLETT PACKARD	
1601L Logic state analyser 12 channel display	250
Mains Monitors	
AMPROBE	
LAV3X. Mains voltage recorder	30
RUSTRAK	
288 + CT Clamp-on AC recording ammeter	70
Microwave Equipment	
FLANN	
FMI. Piston Attenuator 3.5-12 GHz. Attenuation up to 120 dB	120
Modulation Meters	
AIRMEC	
2101-300 MHz. AM/FM	150
4093-1500 MHz. AM/FM	295
MARCONI	
TF2300A 1-1000 MHz. AM/FM	450
Oscilloscopes	
ADVANCE	
OS1000A DC-20 MHz. dual trace	310
COSSOR	
110/111 DC-20 MHz. dual trace	325
110/112 DC-1MHz. differential	275
CDU 150. DC-35 MHz. dual trace 5mV sensitivity, delayed timebase	350
DYNAMCO	
D7100. DC-30 MHz. 2 channel delayed timebase. Sensitivity 10 mV	375
PHILIPS	
PM3226. DC-15 MHz. dual trace. 2mV sensitivity	325
PM3233. DC-10 MHz. true dual beam 2mV sensitivity	425
PM3410. DC-1GHz. Sampling oscilloscope	950
PM3210 DC-25 MHz. dual trace	250

Prices from £

SOLARTRON

CD1400 DC-15 MHz. dual trace. Sensitivity 10 mV/cm	160
TEKTRONIX	
535A/1A1. DC-15 MHz. dual trace 5mV sensitivity. Delayed timebase 556/1A1. True dual beam. DC-50 MHz. Can display 2 separate signals at different sweep rates. Includes trolley	250
545A/1A1. DC-30 MHz. dual trace. Delayed timebase	700
585A/82. DC-80 MHz. dual trace 10 mV sensitivity	275
547/1A1. DC-50 MHz. dual trace DTB	525
547/1A4. DC-50 MHz. four trace DTB	625
TELEQUIPMENT	
D53. DC-15 MHz. dual trace 10mV sensitivity	225
D53A. DC-25 MHz. dual trace. 10mV sensitivity with C-2 plug-in DC-15 MHz. with JD plug-in D34 DC-15 MHz. dual trace Batt/Mains Portable	250
Oscilloscope Plug-ins	450
TEKTRONIX	
Type R. Transistor R.T. tester. Pulse rate 120 pulses/sec. R.T. Less than 5 μ s	100
Type L. DC-20 MHz. 5mV sensitivity fast rise time amplifier	30
Type G. Differential amplifier. 100:1 CMR DC-20 MHz. 50 mV sensitivity Plug-ins for 500 series	50
1A1 dual trace Plug-in DC-50 MHz	225
1A2 dual trace Plug-in DC-50 MHz	180
1A4 four trace Plug-in DC-50 MHz	375
1A5 Differential Plug-in	175
Z Differential Plug-in	140
81 Adaptor Plug-in 1A Series to 580 Series	75
Oscilloscopes (storage)	
TEKTRONIX	
549/1A1. DC-30 MHz. 5mV sensitivity. Dual trace. Storage scope. Writing speed: 5cm/ μ s with enhancement. Includes trolley	675
564/3A74/3B4. DC-2MHz, four channel. 20 mV sensitivity. Writing speed up to 500 cm/ms	650
564B/3A6/2B67. DC-10 MHz. dual trace 10mV sensitivity, split screen storage oscilloscope	750

Prices from £

Power Meters

MARCONI SAUNDERS	
6460 10MHz-40GHz (Depending on Head)	300
6420 10MHz-12.4GHz 10mw	75
6421 10MHz-12.4GHz 100mw	75
6422 10MHz-12.4GHz 1mw	50
6428 26.5-40GHz 10mw	50
Power Supplies	
APT	
TCU250. 0-50V, 0-2A. Current limit	40
KSM	
MV801. 0-60V, 1A. Constant voltage or current	40
ROBAND	
T101. 50V, 1A. Variable	15
SOLARTRON	
As 751. 50V, 1A. Variable	15
STARTRONIC	
117, 20V, 0.5A. Variable twin	30
TRYGON	
0-20V, 3A. Current limit	45
Pulse Generators	
DB ELECTRONICS	
150. I.C. pulse generator	50
EH RESEARCH	
120D. 100 Hz-10 MHz 20V/50 Ω	100
RT 1ns	100
122. 1 KHz-200 MHz 5V/50 Ω	220
RT 12ns	220
139(L). 10Hz-50 MHz 10V/50 Ω	175
RT 5ns	175
1221. Timing Unit 6 Channel 0-10 MHz 5V/50 Ω RT 8ns	50
G710. 5V/50 Ω 30 Hz-50 MHz RT 5ns	100
132AL. 50V/50 Ω 5 Hz-3 MHz	175
RT 12ns	175
PHILIPS	
PM5705. 0.1 Hz-10 MHz. Typical RT 6ns Output 1-15V	225
Records and Signal Conditioning Equipment	
BRUNO WOELKE	
ME102B. Wow and flutter meter	75
ME102C. Wow and flutter meter	90
FERROGRAPH	
RTS2. Recorder test set, Wow and flutter etc.	375
HEWLETT PACKARD	
680M, 5 inch. Stripchart Single Pen 5mV-120V I/P 20cm/min 2.5 cm/Hr	295

Prices from £

RACAL

Store 4. Uses 1/4 inch magnetic tape. Will record 4 F.M. channels. Operates at 7 different speeds. **1950**

SOUTHERN INSTRUMENTS

10-100. 6 channel U.V. 5-1000 mm/sec	250
M1330. 10 channel U.V. 5-2500 mm/sec	325
Selection of Galvanometers available at £15.00 each.	

YOKOGAWA

3046. 10 inch Chart Single Pen. 0.5 mV-100 V I/P2. 60cm/min and/hr	350
3047. 2 Pen Version of 3046	425

Signal Sources and Generators

ADVANCE	
63B. FM/AM 5-200 MHz	130
HEWLETT PACKARD	
200CD. 5Hz-600kHz O/P 10V RMS	75
8693/100. 3.7-8.3 GHz 5mW sweeper plug-in	525
608E. 10-480 MHz AM	410
618C. 3.8-7.6 GHz FM	1600
MARCONI	
TF791. FM Deviation Meter 4-1024 MHz	95
TF801/D1. 10-470 MHz AM. FM.	255
TF995A/2. 1.5-220 MHz AM. FM.	350
TF995B/5. 2-220 MHz AM. FM.	475
TF2005A. Two tone 20 Hz-20 KHz	200

PHILIPS

PM5326. 100 kHz-125 MHz. Digital display of frequency. AM. FM. Sweep facility for I.F. measurements	525
PM6456. FM Stereo generator. RF output 100 MHz	175

ROHDE & SCHWARZ

SWOB 11. 0.5-1200 MHz. 50 Ω	850
------------------------------------	-----

TEXSCAN

9900. 10-300 MHz. Sweep generator with CRT display	525
--	-----

Spectrum Analysers

NELSON ROSS	
011. DC-20 kHz. 80dB dynamic range. Dispersion: 100 Hz-6 kHz	350
022. DC-100 kHz. Dynamic range 60dB fits into various 500 series CRO's	350
TEKTRONIX	
3L5. Plug-in unit fits into various 500B series CRO's. 50 Hz-1 MHz. Greater than 60dB dynamic range	475
1L20. Plug-in fits various 500 series CRO's 10 MHz-4.2 GHz. 40dB dynamic range	1000

Vibration

DAWE	
1461. CV(M) Portable Vibration Analyser Kit	350

Voltmeters-Analogue

BRADLEY	
CT471C. AC/DC/ Ω /current multimeter and RF	75
HEWLETT PACKARD	
427A. AC/DC/ Ω multimeter	275
3406A. 10 kHz-1.2 GHz	345
LINSTEAD	
M2B. DC/AC 10 Hz-500 kHz	25

MARCONI

TF2603. AC voltmeter to 1.5 GHz	300
---------------------------------	-----

Voltmeters-Digital

FARNELL	
DM131B. 1999 FSD AC/DC/ Ω /Current/Temperature	85
SOLARTRON	
LM1420.2. 2300 FSD DC only 0.05%	75
LM1420.2BA. 2300 FSD AC True RMS/DC	110
A200. 19999 FSD DC only	160
A203. 19999 FSD AC/DC/ Ω . Sensitivity: (1 μ V DC, 10 μ V AC, 100m Ω resistance)	300
A205. 19999 FSD AC/DC/ Ω	300
A243. 119999 FSD AC/DC/ Ω . Sensitivity: (1 μ V DC, 10 μ V AC, 10m Ω resistance)	325
7045. 19999 Auto AC/DC/ Ω	250
7050. 99999 Auto AC/DC/ Ω	350

Wave Analysers

HEWLETT PACKARD	
302A. 20 Hz-50 kHz 75dB range	375
WAYNE KERR	
A321 20 Hz-20 KHz Sens 75dB	125



Carston

Carston Electronics Limited
Shirley House, 27 Camden Road, London NW1 9NR. Telex: 23920

Contact David Kennedy or Noel Jennings **01-267 5311/2**

Redundant Test Equipment

Why not turn your under-utilized test equipment into cash? Ring us and we'll make you an offer.

VAT charged at Standard Rate

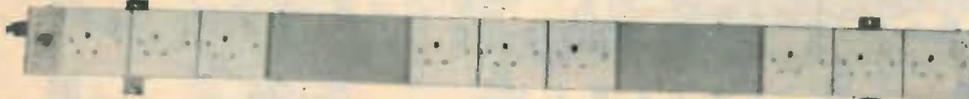
OLSON PORTABLE MAINS DISTRIBUTION



**New!
Slim Jim**

Dim. 1 3/4" x 2 1/2" x 18 3/4"
£12.15. PP 85p + VAT

19" Rack Mounting Type 13A/4SW/R £16.80. P&P £1 + VAT.



Instant Trunking System for Wall or Bench Mounting

NEW! 10 sockets switched in sloping box



Type 13A/10SW £27.50. P&P £1.85 + VAT



COMPLETE WITH 6FT. CABLE AND
13-AMP FUSED PLUG.



4 sockets 13A	£12.75
6 sockets 13A	£15.00
4 sockets 13A switched	£14.45
6 sockets 13A switched	£16.75
+ Post £1 + VAT	

ALL DISTRIBUTION PANELS ARE FITTED WITH MK SOCKETS & PLUG
Send for details of complete range

EPROM ERASER



Low cost ultra violet eprom erasing
lamp will erase up to 12 chips at
one time.

PRICE £95.00 + VAT

TR6 — 6 sockets switched £21.50

TR9 — 9 sockets switched £25.50
Plus P&P £2 + VAT

MAINS ISOLATING UNIT

The Olson mains isolating unit is an essential bench item for safety when testing and repairing mains-operated equipment. The isolating transformer has an earthed screen and is rated 250VA.



£38 + P&P £2 + VAT

OLSON ELECTRONICS LTD., FACTORY NO. 8, 5-7 LONG ST., LONDON E2 8HJ
TEL. 01-739 2343

WW — 019 FOR FURTHER DETAILS

MONOLITH QUALITY REEL TO REEL & CASSETTE TAPE HEADS + MECHANISMS



C2000

REMOTE OPERATION TAPE
TRANSPORT MECHANISM
FOR DIGITAL OR AUDIO.

THIS BRITISH MADE CASSETTE
TRANSPORT HAS GIVEN
INDUSTRY A GREAT COST
SAVINGS OVER
COMPARABLE FOREIGN
IMPORTS AND IS NOW BEING
MADE GENERALLY AVAILABLE.

CAN BE SUPPLIED WITH TAPE FAIL/
END DETECTION, SEARCH, AND FAST
ERASE. SOLENOID CONTROL PROVIDES
FULLY REMOTE OPERATION.

WRITE NOW FOR FULL DETAILS
BASIC PRICE £60.30 INC. VAT.

POPULAR UNIVERSAL CASSETTE TAPE HEADS

B12-01 Mono Playback.....	£1.89	C42RPH04 Stereo GLASS FERRITE R/P....	£11.60
B12-02 Mono Record/Playback.....	£4.02	C42RPS18 Stereo TWIN GAP R+P.....	£25.21
B24-01 Stereo Playback.....	£3.30	E12-09 Mono/stereo erase.....	£ 1.85
B24-02 Stereo Record/Plbk.....	£6.66	B22-02 Twin 1/2 track R/P.....	£ 5.97
B24-07 Stereo R/P, (Dolby Stm).....	£7.87	C44RPH03 Quad 1/4 track R/P.....	£13.17
C42RPH20 Stereo SENDUST R/P....	£9.28	C44RP2ESD1 Quad 1/4 track combined R/P + Erase.....	£26.45
C42RP1ESD1 Stereo combined R/P + Erase.....	£10.93	C22ESD2 Twin half track erase.....	£ 4.72

SEND FOR OUR FULL CATALOGUE 25p.

MONOLITH

THE MONOLITH ELECTRONICS CO. LTD.
1/7 CHURCH ST., CREWKERNE, SOMERSET, ENGLAND. (0460) 74321

PLEASE ENCLOSE
30p P&P WITH
ORDER

ALL PRICES
INCLUDE VAT

Audio Modules

Build your system or make add-ons with SESCOM audio modules.

MIC-4
Low Impedance
Microphone Pre-amp

LA-3
Line Amplifier Transformer
Balanced 600 ohm output

PS-3
Power Supply
24 volts DC
regulated 120/240
VAC input

Pre-amps
Balanced low impedance for microphone, high impedance general purpose, RIAA Phono, NAB tape (1%, 3%, 7 1/2, 15 ips).

Equalizers
Active (bass, mid-range, treble) high pass filter, low pass filter.

Other Modules
Line amp, power amp, compressor, sine wave oscillator, plug-in power supply.

Accessories
Sheet metal, sockets, slide pots.
Low distortion < .1%, low noise, bi-fet op-amps, high slew rate, single supply (9-36 volts DC), plug-in.



"Quality
Engineered
Sound
Products"

SESCOM, INC.
P.O. Box 590,
12931 Budlong Ave.,
Gardena, CA 90247 U.S.A.
(213) 770-3510, (800) 421-1828,
TWX (910) 346-7023

SEND FOR YOUR FREE COPY
OF OUR NEW CATALOG

We also manufacture
audio transformers,
snakes, direct boxes
and mic-splitters.

WW — 087 FOR FURTHER DETAILS

NEW UNBEATABLE 1980 PRICES NOW! EXPLORER/85

**Professional Computer Kit
FEATURES INTEL 8085 CPU
WITH ON BOARD S-100 EXPANSION**

FLEXIBILITY: Real flexibility at LAST. The EXPLORER/85 features the Intel 8085 cpu 100% compatible with all 8080A and 8085 software. Runs at 3MHz. Mother Board (Level A) with 2, S-100 pads expandable to 6 (Level C).

MEMORY

- 2K Monitor ROM
- 4K WORKSPACE/USER RAM
- 1K Video RAM
- 8K Microsoft BASIC in ROM or Cassette.

NEW S100BD
16K Dynamic RAM Kits £139 + VAT
Expandable to 64K on one board
Extra 16K kits at £88.95 + VAT

INTERFACES

STANDALONE FULL ASC11 Keyboard Terminal, 32/64 characters per 16 lines
Cassette interface (with motor control and cassette-File structure)
RS-232/20Ma Loop, 4, 8bit: 1, 6 bit I/O ports, programmable 14bit binary counter/timer.
Direct interface for any S-100 Board.
FULL Buffering decoding for S-100n Bus pads, wait state generator for slow memory.
Each stage has separate 5v 1A regulator for improved isolation and freedom from cross talk.
P.S.U. requirements: 8v, 6.3v AC.
Runs with North Star controller and Floppies/CPM.
EXPLORER/85 is expandable to meet your own requirements with easy to obtain S-100 peripherals.
EXPLORER/85 can be purchased in individual levels, kit form or wired and tested. OR as a package deal as above.



£275 + VAT
Microsoft BASIC on Cassette

- 16K £376 + VAT
- 32K £459 + VAT
- 48K £540 + VAT
- 64K £625 + VAT

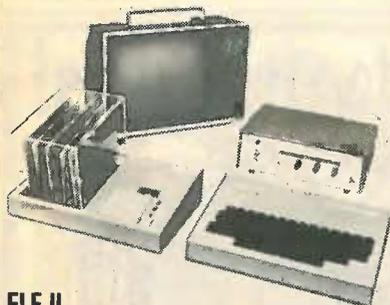
£295 + VAT
Microsoft BASIC in ROM

AVAILABLE NOW!

WE ARE KILLING INFLATION WITH

ELF II

THE TRIED AND TESTED
MICROCOMPUTER
SYSTEM
THAT EXPANDS
TO MEET
YOUR NEEDS



Computer Kit
**STARTS AT
£59.95
+ VAT**

**ELF II
BOARD WITH VIDEO OUTPUT
FEATURING THE RCA COSMAC 1802 cpu**

STOP reading about computers and get your "hands on" an ELF II and Tom Pitman's short course. ELF II demonstrates all the 91 commands which an RCA 1802 can execute, and the short course speedily instructs you how to use them.

ELF II's VIDEO OUTPUT makes it unique among computers selling at such a modest price. The expanded ELF II is perfect for engineers, business, industry, scientific and educational purposes.

NEWTRONICS KEYBOARD TERMINAL AT £114.20 + VAT

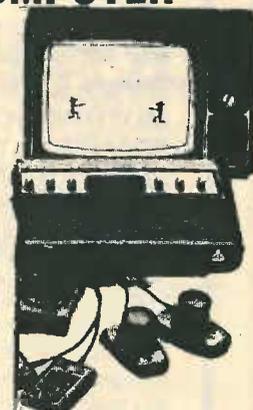
The Newtronics Keyboard Terminal is a low cost stand alone Video Terminal that operates quietly and maintenance free. It will allow you to display on a monitor 16 lines of 64 characters or 16 lines of 32 characters on a modified TV (RF Modulator required). The characters can be any of the 96 ASC II alphanumeric and any of the 32 special characters, in addition to upper/lower case capability, it has scroll-up features and full X-Y cursor control. All that is required from your microcomputer is 300 baud RS232-C or 20ma loop serial data plus a power source of 8v DC and 6.3v AC. The steel cabinet is finished in IBM Blue-Black. And if that is not enough the price is only **£114.20 + VAT** as a kit, or **£144.20 + VAT** assembled and tested. Plus £2 P&P (Monitor not included.).

THE ATARI VIDEO COMPUTER SYSTEM £138 + VAT

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program™ cartridges!

Cartridges now available. All at **£13.90** each + VAT
Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score, Space War, Sky Diver, Air Sea Battle Codebreaker, Miniature Golf
Extra Paddle Controllers — **£14.90** + VAT
Keyboard Controllers — **£18.90** + VAT

**RACAL AP12, C12 TAPES: 10 for £4.50 + VAT
NOW AVAILABLE 8K FULL BASIC FOR ELF II
NEWSOFT GAMES FOR ELF II. 4 for £5 + VAT.**



SEND SAE FOR COMPREHENSIVE BROCHURE

Please add VAT to all prices (except manuals). P&P £2. Please make cheques and postal orders payable to **NETRONICS** or phone your order quoting **BARCLAYCARD, ACCESS** number.

We are now open for demonstrations and Sales, Monday-Saturday, 9.30 a.m.-6.30 p.m. Near Highgate Underground, on main A1 into London.

**NEW ADDRESS: NEWTRONICS
Bigger
Premises
255 ARCHWAY ROAD
LONDON N6 5BS**

New Phone No. 01-348 3325

DEPT. WW

ELF II EXPANSION KITS

	Ex VAT
* Power Supply (6.3v AC) for ELF II	£5.00
* ELF II Deluxe Steel Cabinet (IBM Blue)	£19.75
* Giant Board Kit System/Monitor, Interface to cassette, RS232, TTY, etc.	£25.50
* 4K Static RAM board kits (requires expansion power supply)	£57.50
* Expansion power supply (required when adding 4K RAMs)	£19.00
* ASC11 Keyboard Kits 96 printable characters, etc.	£39.95
* ASC11 D/lux steel cab (IBM Blue)	£12.75
* Kluge prototype board (build your own circuits)	£11.00
* 86 pin Gold plated connectors, each	£3.75
* ELF Light pen writes/draws on TV screens	£6.00
* Video graphics board 32/64 characters by 16 lines on TV/monitor screens	£61.50
* ELF II Tiny basic on cassette	£9.75
* ELF-Bug/monitor powerful systems monitor/editor	£9.75
* T. Pitmans short course in programming manual (nil VAT)	£3.00
* T. Pitman short course on tiny basic manual (nil VAT)	£3.00
* RCA 1802 users manual (nil VAT)	£3.00
* On cassette Text Editor, Assembler, Disassembler (each)	£12.75

ELF II BOARD SPECIFICATION

* RCA 1802 8-bit microprocessor with 256 byte RAM expandable to 64K bytes
* RCA 1861 video IC to display program on TV screen via the RF Modulator
Single Board with Professional hex keyboard — fully decoded to eliminate the waste of memory for keyboard decoding circuits
Load, run and memory protect switches
16 Registers
Interrupt, DMA and ALU
Stable crystal clock
Built in power regulator
5 slot plug in expansion bus (less connectors)

**You'll do better at Martin Associates
we guarantee it!**

sales hire repair



- ANALYSERS**
- AIRMEC 248A Wave Analyser 5-300MHz £150.00
 - DYMAR 771 A.F. Wave Analyser 20Hz-50KHz £200.00
 - TEKTRONIX IL20 Spectrum Analyser 10MHz-4.2GHz £1500.00
 - WAYNE KERR A.321 Wave Analyser 20Hz-20KHz £100.00
 - RADIOMETER FRA2D Wave Analyser 20Hz-16KHz £250.00
- ATTENUATORS**
- HEWLETT-PACKARD 355C Attenuator 0-12dB 1dB steps DC-1GHz 50 ohms £95.00
 - PHILCO Attenuator 30dB 50 ohms 100W £30.00
- BRIDGES**
- GENERAL RADIO 1607A Transfer Function & Immittance Bridge £350.00
 - MARCONI 2701 In-Situ Universal Bridge £300.00
 - WAYNE KERR B.221A Universal Bridge 0.1% £225.00
 - WAYNE KERR B.224 Universal Bridge 0.1% £600.00
 - WAYNE KERR B.521 Universal Bridge 1% £65.00
 - WAYNE KERR B.641 Universal Bridge 0.1% £500.00
- COUNTERS**
- HEWLETT-PACKARD 5260A Frequency Divider 0.3-12.4GHz £450.00
 - HEWLETT-PACKARD 5253B Frequency Converter 50MHz-500MHz £250.00
 - MARCONI TF.1417 7 Digit 10MHz c/w 500MHz Converter £175.00

- METERS**
- RACAL 301A R.F. Millivoltmeter 100Hz-900MHz £175.00
 - AIRMEC 319 UHF Wattmeter 10-300mW 1MHz-1.4GHz £90.00
 - AVO Precision Avometer £160.00
 - DYMAR 711 Microvoltmeter 50KHz-850MHz £150.00
 - DYMAR 761 Noise Factor Meter £90.00
 - HEWLETT-PACKARD 400H Millivoltmeter £150.00
 - MARCONI 791D Carrier Deviation Meter 4MHz-1024MHz £175.00
 - MARCONI TF.1020A/1 R.F. Power Meter 250MHz 50 ohms 50/100W £100.00
 - MARCONI TF.1152 R.F. Power Meter 0-25W 75 ohms £65.00
 - MARCONI TF.1245/1247 'Q' Meter + Oscillator 20MHz-300MHz £500.00
 - MARCONI TF.2600 Valve Voltmeter £130.00
 - MARCONI TF.2604 Electronic Voltmeter £100.00
 - RADIOMETER BKF.6 20Hz-200KHz Distortion Meter £250.00
- OSCILLOSCOPES**
- HEWLETT-PACKARD 130C X-Y-T DC-500KHz 200uV/cm £200.00
 - SCOPEX 1S-10A DC-10MHz Single Beam re-chargeable batteries, NEW £245.00
 - SCOPEX 4D-10B DC-10MHz Dual Beam 10mV/cm, NEW £210.00
 - SCOPEX 4D-25 DC-25MHz Dual Beam 10mV/cm, NEW £360.00
 - TEKTRONIX 545B + CA Plug in, DC-24MHz £350.00
 - TEKTRONIX 545B + 1A1 Plug in, DC-33MHz £400.00
 - TEKTRONIX 564 STORAGE Plug in, 3S76 and 3T77A £500.00
 - TEKTRONIX 535A DC-15MHz, Mainframe only £190.00
- SIGNAL SOURCES**
- AIRMEC 365A VHF AM/FM 1-320MHz 52-75 ohms £600.00
 - HEWLETT-PACKARD 608D 10-420MHz £350.00
 - HEWLETT-PACKARD 608F 10-455MHz, 50 ohms £450.00
 - HEWLETT-PACKARD 8011A Pulse Generator 0.1Hz-20MHz £400.00
 - HEWLETT-PACKARD 200CD 5Hz-600KHz, 600 ohms £150.00
 - GENERAL RADIO I215C 50-250MHz Oscillator Unit £75.00
 - MARCONI TF.144H/4 10KHz-72MHz AM Generator £470.00
 - MARCONI TF.995A/3/S 1.5MHz-220MHz AM/FM £370.00
 - MARCONI TF.1066B/6 10MHz-470MHz AM/FM £500.00
 - MARCONI TF.1099 Sweep to 24MHz £175.00
 - MAXSON M.1241 UHF Wide Band Power Oscillator 2500MHz £400.00
 - MUIRHEAD D-650-B 1-111, 100Hz o/p 126V £130.00
 - MUIRHEAD D-850-A 2 Phase Oscillator 0.01Hz-11.2KHz £200.00
 - MICROPOWER 223 1.12.4GHz Sweep Generator £650.00
 - R & S SWF Sweep Generator 5-225MHz £185.00
 - R & S SWH Sweep Generator 5-12MHz £195.00
- RECORDERS**
- B & K 2305 Level Recorder £800.00
 - HEWLETT-PACKARD 2D X-Y-T recorder £400.00
 - ADVANCE — BRUSH 260 6 Channel £1200.00
 - BELL & HOWELL 5-124 U/V Recorder 17 Channel 6 Galvos £600.00
 - HEWLETT-PACKARD 320R 2 Channel Recorder £150.00
- MISCELLANEOUS**
- AVO TT 537 Transistor/Diode Tester £75.00
 - AVO ALD270-6BR Analogue Limit Detector £100.00
 - BARNETT Dead Weight Pressure Gauge Tester, c/w Weights & 2 Gauges £250.00
 - R & S SWOB 1 Polyskop 0.5-400MHz 50 ohms £450.00
 - PYELING 1000lb. Vibrator/Amplifier £500.00



MARTIN ASSOCIATES
34 Crown Street
Reading
(Berks. RG1 2SE)
Tel. Reading (0734) 51074

WW — 055 FOR FURTHER DETAILS



**0.1% DISTORTION
WIDE BANDWIDTH
PROTECTED O/P TRANSISTORS
FULL LOAD LINE PROTECTION
NO EXTERNAL COMPONENTS
ONLY FIVE PINS TO CONNECT**



A division of J.L.P. ELECTRONICS LTD., GRAHAM BELL HOUSE, ROPER CLOSE, CANTERBURY, KENT, CT2 7EP (0227) 54778 : Telex 965780

SIMPLY AHEAD - and staying there!

O.E.M. PLATE POWER AMPLIFIERS

MADE IN ENGLAND

I.L.P. offer for prompt delivery, a range of O.E.M. Plate Power Amplifiers in three useful output ratings. These units are typical of I.L.P. design and manufacture — encapsulated circuitry, rugged construction, just five pin connections, trouble-free mounting, no output capacitor or other external components to be added, and operation from split line power source. **PRICES ARE KEENLY COMPETITIVE, QUALITY AND MANUFACTURE OF THE HIGHEST POSSIBLE STANDARDS.** Modules can also be manufactured to customer's own design.

UNIT PRICE FOR	100 +	250 +	500 +	1000 +	2500 +	5000 +
HY 120P 60W rms 8Ω	£10.30	£9.37	£8.51	£7.74	£7.04	£6.40
HY 200P 120W rms 8Ω	£13.18	£11.98	£10.89	£9.90	£9.00	£8.18
HY 400P 200W rms 4Ω	£19.26	£17.51	£15.92	£14.47	£13.16	£11.96

Sizes—

HYP 120P and HY 200P
HY 400P

116 x 50 x 23mm
116 x 75 x 23mm

WW—059 FOR FURTHER DETAILS

PORTABLE PRECISION

A RANGE OF 3½ DIGIT LCD MULTI-METERS OFFERING HIGH PRECISION AND EXTENDED BATTERY LIFE. ALL TYPES FEATURE FIVE FUNCTION OPERATION (AC AND DC VOLTS, AC AND DC CURRENT, RESISTANCE) WITH ABILITY TO CHECK DIODES. 0.5" LCD DISPLAY WITH 'BATTERY LOW' WARNING. AUTO-POLARITY, AUTO-ZERO. FULL PROTECTION AGAINST TRANSIENTS AND OVERLOADS WITH ABILITY TO WITHSTAND MAINS ON ANY RANGE. RUGGED ABS CASES AND A COMPREHENSIVE 1-YEAR WARRANTY.

The LMM-200 is a compact handheld multimeter with 0.5% basic accuracy and 15 different ranges. It measures AC/DC voltage from 0.1mV to 500V, AC/DC current from 0.1µA to 2 Amps and resistance from 0.1Ω to 2MΩ. 200 hour battery life.

The LMM-2001 is an identical instrument but with a 0.1% basic accuracy.

The LMM-100 is suitable for field or bench use. It has a basic accuracy of 0.1% and 25 different ranges. It measures AC/DC voltage from 0.1mV to 1KV, AC/DC current from 0.1µA to 2 Amps and resistance from 0.1Ω to 20MΩ. Battery life is over 2,000 hours. It also features a unique 'digital hold' facility and adjustable carrying handle.

Lascar Electronics Ltd., Unit 1, Thomasin Road, Basildon, Essex.
Telephone No: Basildon (0268) 727383.



FROM
£34.95
+VAT

	£	P & P	VAT	TOTAL
LMM-200	34.95	1.00	5.39	41.34
LMM-2001	44.95	1.00	6.89	52.84
LMM-100	69.95	1.50	10.72	82.17
TEST LEADS	1.95	0.25	0.33	2.53

To: Lascar Electronics, Unit 1, Thomasin Road, Basildon, Essex.

Please send me Data

LMM-100 £82.17 LMM-200 £41.34 LMM-2001 £52.84 TEST LEADS £2.53

Name _____

Address _____

Tel. No. _____

I enclose cheque/P.O. value _____

WW — 071 FOR FURTHER DETAILS

QUARTZ CRYSTALS

made to
your spec. **FAST!**

MOD & CAA APPROVED

AEL

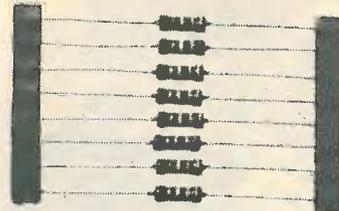
AEL CRYSTALS LTD

GATWICK HOUSE HORLEY SURREY ENGLAND RH6 9SU
Telephone: Horley (02934) 5353 Telex: 87116 (Aerocon Horley)
Cables: Aerocon Telex Horley

WW—061 FOR FURTHER DETAILS

carbon film RESISTORS

PRICES REDUCED. SEND FOR DETAILS NOW



Z & I

AERO SERVICES LTD.

42-44A-46 Westbourne Grove
London W2 5SF
Tel. 01-727 5641 Telex 261306

WW — 032 FOR FURTHER DETAILS

REDAN TV TUBES

with EDICRON ELECTRON ASSEMBLIES

- Monochrome or colour
- Standard, quick heat, delta or inline
- Wide range of neck sizes and heater ratings
- Predictable in use and performance

- High tolerance on insert procedure
- High conversion rate on ageing
- Long service life
- Neck glass, tube bases, equipment and accessories also supplied

For full details contact :

EDICRON LTD.

Redan House, 1 Redan Place, London W2 4SA.
Tel: 01-221 4717 Telex: 265531 Edicrn G

WW—063 FOR FURTHER DETAILS

WILMSLOW AUDIO

The firm for Speakers

HI-FI DRIVE UNITS



Audax HD12 9D25	£7.65
Audax HD13D34H	£12.75
Audax HP11P25EBC	£6.65
Audax HP20B25H4	£13.25
Audax HD24S45C	£20.50
Baker Superb	£25.00
Castle Super 8RS/DD	£12.65
Chartwell CEA205 8" bass, matched pairs only 8 ohm (pair)	£61.25
Coles 4001	£7.65
Coles 3000	£7.65
Celestion HF 1300 II	£8.45
Celestion HF 2000	£10.25
Dalesford D10 tweeter	£8.45
Dalesford D30/110 5in	£11.25
Dalesford D50/153 6½in	£12.25
Dalesford D50/200 8in	£12.25
Dalesford D70/250 10in	£22.25
Dalesford ABR 10in	£10.25
Dalesford D100/310 12in	£35.75
Decca London horn	£57.25
Decca DK30 horn	£43.75
Decca CO/1000/8	£10.25
EMI 14A/770 14in x 9in 8 ohm	£19.50
EMI 8in x 5in d/c, 10 watt, 4 ohm	£4.05
EMI Type 350 4 ohm	£9.45
Isophon KK8/8	£8.15
Isophone KK10/8	£8.45
Jordan Watts Module	£20.40
Jordan Watts HF kit	£9.15
Jordan 50mm unit	£23.00
Jordan CB crossover (pair)	£23.00
Jordan Mono crossover (pair)	£23.00
Kef T27	£9.45
Kef B110	£12.00
Kef B200	£13.25
Kef B139	£27.00
Kef DN13	£5.40
Kef DN 12	£8.65
Kef DN 22 (pair)	£40.85
Lowther PM6	£51.00
Lowther PM7	£88.45
Peerless KO10DT	£10.50
Peerless DT10HFC	£10.50
Peerless KO40MRP	£12.25
Radford BD25 II	T.B.A.
Radford MD9	T.B.A.
Radford MD6	T.B.A.
Radford FN8/FN831	T.B.A.
Richard Allan DT20	£8.95
Richard Allan DT30	£9.45
Richard Allan CG8T	£11.25
Richard Allan CG12T Super	£25.30
Richard Allan LP8B	£11.75
Richard Allan HP8B	£17.60
Richard Allan HP128	£28.40
Seas H107	£8.95
Shackman Electrostatic, c/w polar network and crossover (pair)	£130
Tannoy DC386 15in	£178.90
Tannoy DC296 10in	£107.35

PA GROUP & DISCO UNITS



Baker Group 35	£15.45
Baker Group 50/12	£23.45
Baker Group 50/15	£35.15
Celestion Powercell 12/150	£56.50
Celestion Powercell 15/250	£69.25
Celestion G12/50 Twin cone	£15.95
Celestion G12/80 Cambric edge	£20.25
Celestion G12/80 Twin cone	£19.75
Celestion G12/125 Cambric edge	£35.10
Celestion G15/100 Cambric edge	£31.95
Celestion G15/100 Twin cone	£32.25
Celestion G18/200	£53.25
Celestion MH1000	£15.95
Fane Pop 40	£12.50
Fane Pop 50H	£13.80
Fane Pop 75	£19.70
Fane Pop 65	£21.25
Fane Pop 80	£25.50
Fane Pop 100	£41.80
Fane Guitar 80L	£26.10
Fane Guitar 80B	£27.15
Fane Disco 80	£27.15
Fane PA80	£26.10
Fane Bass 85	£34.00
Fane Crescendo 12E	£57.50
Fane Crescendo 15E	£74.50
Fane Crescendo 18E	£94.75
Fane J44	£6.90
Fane J104	£13.75
Fane J73	£9.75
Fane HPX1/HPX/2	£3.45
Fane HPX3A	£5.60
Fane HPX3B	£4.55
Goodmans 8PA	£5.05
Goodmans 12P	£21.00
Goodmans 12PD	£23.95
Goodmans 12PG	£23.65
Goodmans 18P	£48.45
Goodmans Hifax 50HX	£21.85
Motorola Piezo horn 3½in	£8.50
Motorola Piezo horn 2inx6in	£12.25
Richard Allan HD8T	£17.00
Richard Allan HD10T	£18.50
Richard HD12T	£24.45
Richard Allan HD15	£43.40
Richard Allan Atlas 15in	£85.15
Richard Allan Atlas 18in	£110.75

WILMSLOW AUDIO



KITS FOR MAGAZINE DESIGNS etc.
KITS FOR MAGAZINE DESIGNS
Kits include drive units, crossovers, BAF/long fibre wool, etc. for a pair of speakers. Carriage £3.75

Practical Hi-Fi and Audio PRO9-TI (Rogers) Felt panels for PRO9-TL £6.72 plus £1.60 carriage £138
Hi-Fi Answers Monitor (Rogers) £146
Hi Fi News State of the Art (Atkinson) £182

Hi Fi News Miniline (Atkinson) £48 (carriage £2.66)
Hi Fi for Pleasure Compact Monitor (Colloms) £115 (carriage £5.25)

Popular Hi-Fi Mini Monitor (Colloms) £74

Popular Hi Fi Round Sound (Stephens) including complete cabinet kit £71
Popular Hi-Fi (Jordan) £93 plus (carriage £2.66)

Practical Hi-Fi & Audio BSC3 (Rogers) £65
Practical Hi-Fi & Audio Monitor (Giles) £155

Practical Hi-Fi & Audio Triangle (Giles) £99
Practical Hi-Fi & Audio Mini Triangle (Giles) £108

Wireless World Transmission Line (Bailey) KEF £122
Wireless World Transmission Line (Bailey) RADFORD £184

Hi-Fi News Tabor (Jones) with J4 bass units £60
Hi-Fi News Tabor (Jones) with H4 bass units £66

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

Smart badges free with all above kits (to give that professional touch to your DIY speakers!). Send 50p for up to 6 reprints/construction details of above designs.

SPEAKER KITS



PRICES PER PAIR—
CARRIAGE £2.66

Dalesford System 1	£54
Dalesford System 2	£57
Dalesford System 3	£104
Dalesford System 4	£110
Dalesford System 5	£142
Dalesford System 6	£95
Eagle SK210	£17.60
Eagle SK215	£32.60
Eagle SK320	£40.80
Eagle SK325	£68.50
Eagle SK335	£93.00
Goodmans DIN 20 4 ohm (special offer)	£27.60
LS3/5A equivalent kit	£71
Lowther PM6 kit	£105.30
Lowther PM6 Mk 1kit	£110.40
Lowther PM7 kit	£176.85
Peerless 1070	£124.70
Peerless 1120	£142.10
Peerless 2050	£51.10
Peerless 2060	£67.40
Radford Studio 90 kit	£184
Radford Monitor 180 kit	£218
Radford Studio 270 kit	£350
Radford Studio 360 kit	£440
Ram Kit 50 (makes RAM 100)	£71.50
Richard Allan Tango Twin kit	£49.00
Richard Allan Maramba kit	£69.00
Richard Allan Charisma kit	£101.20
Richard Super Triple kit	£81.70
Richard Allan RA8 kit	£52.65
Richard Allan RA82 kit	£83.30
Richard Allan RA82L kit	£89.90
Seas 223	£40.85
Seas 253	£63.10
Seas 403	£76.60
Seas 603	£122.60
Wharfedale Denton XP2 kit	£31.45
Wharfedale Shelton XP2 kit	£40.40
Wharfedale Linton XP2 kit	£56.20
Wharfedale Glendale XP2 kit	£69.00

CARRIAGE & INSURANCE	
Tweeters & Crossovers	50p each
Speakers 4"-6½"	80p each
Speakers 10"-12"	£1.00 each
Speakers 12", 13" x 8", 14" x 9"	£1.75 each
Speakers 15"	£2.75 each
Speakers 18"	£4.00 each
Speaker kits	£1.75 each
Mag. design kits	£3.00 pair
	£3.75 pair

Everything in stock for the speaker constructor!
BAF, Long Fibre Wool, Foam, Crossovers, Felt Panels, Components, etc.
Large selection of grille fabrics. (Send 18p in stamps for grille fabric samples).

PRICES CORRECT AT 18.6.79

ALL PRICES INCLUDE VAT @ 15%

Send 30p stamp for free 38 page catalogue 'Choosing a Speaker'

Telephone Speakers, Mail Order and Export 0625 529599

Hi-Fi: (Swift of Wilmslow) 0625 526213.

Lightning service on telephoned credit card orders!

SWIFT
OF WILMSLOW
The firm for Hi-Fi
5 Swan Street,
Wilmslow, Cheshire.

WILMSLOW
AUDIO
The firm for Speakers

Swan Works, Bank Square,
Wilmslow, Cheshire.

NEW FROM BARMECO

Introducing a new 3-element H.F. Tribanda with proven performance and reliability

THE WORLD RANGER TRIBANDER

Designed, engineered and manufactured in the U.K. Use of high quality materials ensures high electrical stability under all weather conditions with exceptional mechanical rigidity and strength. All traps are high grade P.T.F.E. formers with insulated windings.



SPECIFICATION:

Frequency	10, 15 & 20 metres
Impedance	52 ohms
R.F. Power (max.)	1 kW (AM) 2 kW (PEP)
VSWR (at resonance)	Less than 2.0:1
Forward gain	Up to 8.0 dB
Front-to-back ratio	25 dB
Mast diameter	31.75mm to 41.30mm
Wind survival	80 mph
Turning radius	14' 10"
Longest element	26' 0"
Boom length	12' 0"
Net weight	21 lbs.

Price: **£145.00** complete with Balun, plus carriage @ £3.50. High quality 50 ohm coaxial cable available @ 50p per metre. Balun available separately @ £12.50 each. All items subject to current VAT

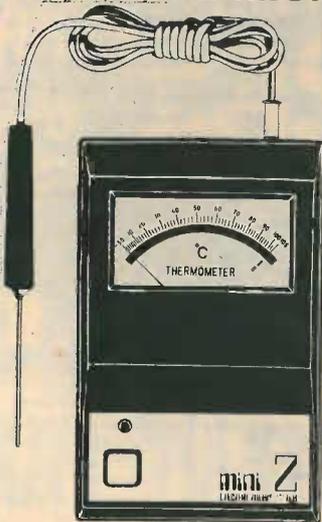
COMING SOON: A range of HF Monobanders and a 2 metre base station vertical

Orders to:

BARNET METAL & CAR CO. LTD.
Tewin Road, Welwyn Garden City, Herts.
Telephone: Welwyn Garden 24327. Telex: 28125. Cable: BARMECO

WW — 006 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 with carrying case, Probe and internal 1½ volt standard size battery.
Model "Mini-Z 1" measures from -40° C to + 70° C. Price £30.00
Model "Mini-Z 2" measures from -5° C to + 105° C. Price £30.00
Model "Mini-Z Hi" measures from + 100° C to 500° C. Price £33.00
(VAT 15% EXTRA)

Write for further details to

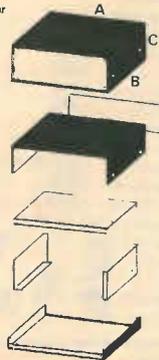
HARRIS ELECTRONICS (LONDON)
138 GRAY'S INN ROAD, LONDON, WC1X 8AX
(Phone 01-837 7937)

WW — 027 FOR FURTHER DETAILS

TMEC 19 Rose Lane, Biggleswade, Beds.

Mail Order and correspondence only.
Trade enquiries welcome
CALLERS STRICTLY BY APPOINTMENT

NEW CASES RACK MOUNTING or FREE STANDING



Cover & Base: Steel/Black PVC Embossed Laminate: 22g(0.7mm).
Front Panel: Aluminium: REF 17U 16g(1.5mm); REF 19U 12g(2.5mm).
Back Panel: Aluminium: 16g(1.5mm).
Internal Chassis Plate: Steel: 18g(1.5mm).
Internal End Brackets: Steel: 20g(1.0mm).

Front & Rear apertures: Dimm. A: less 1.5" (38mm)
Dimm. C: less 0.63" (16mm)
Dimm. B: less 0.75" (19mm)

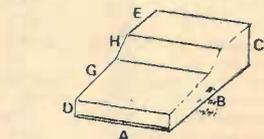
	NOMINAL OUTSIDE DIMENSIONS					
	inch		mm			
19R2	19.25	9.75	3.75	489	247	98
19R3	19.25	9.75	6.50	489	247	140
19R4	19.25	9.75	7.25	489	247	184
19R5	19.25	9.75	9.00	489	247	227
17U2	17.50	9.75	3.38	444	247	86
17U3	17.50	9.75	5.13	444	247	130
17U4	17.50	9.75	6.88	444	247	175
17U5	17.50	9.75	8.63	444	247	219

17UXP + 17U Box with 19R Front Panel for rack mounting.

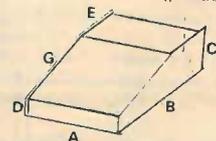


NEW CONSOLES for KEYBOARDS or SLIDER CONTROLS

Type DS=Double Slope.



Type SS=Single Slope.



All Aluminium, 2-piece, Desk Consoles: Top: 16g(1.5mm).
Base: 14g(2.0mm).

Self colour, untreated.
4 screw fixing, underneath into threaded bushes.
Larger sizes will accept TRITON and NASCOM and will take
a 4" high, power-supply, transformer.
Ventilate on slots in base and rear panel.

	NOMINAL OUTSIDE DIMENSIONS						
	inch		mm				
	DS6	DS12	DS15	SS8	SS13	SS17	
A	6	13	15.5	6	12	15.5	
B	8	13	17	8	13	17	
C	3	4	4.25	3	4	4.25	
D	1	1	1.75	2	2.5	2.5	
E	2	4	10	3.25	6	8	
G	5	7.5	5.63	5	7.5	8.5	
H	1.5	2	2				

TYPE	DS6	DS12	DS15	SS8	SS13	SS17	19R2	19R3	19R4	19R5	17U2	17U3	17U4	17U5	17UXP2	17UXP3	17UXP4	17UXP5
PRICE £	4.50	11.00	15.00	5.00	9.50	13.50	14.24	15.54	16.78	17.44	14.04	14.80	15.44	16.00	14.44	15.45	16.24	17.00
VAT £	0.97	1.05	2.29	0.75	1.42	2.02	2.14	2.32	2.52	2.62	2.11	2.22	2.32	2.40	2.17	2.32	2.44	2.56
TOTAL	7.47	12.05	17.29	5.75	10.92	15.52	16.38	17.87	19.30	20.06	16.15	17.02	17.76	18.40	16.61	17.77	18.68	19.56

CARRIAGE U.K. INCLUDED.

TERMS C.W.O.

S.A.E. for Details.

EUROPEAN AGENTS REQUIRED.

WW — 047 FOR FURTHER DETAILS

CASED INVERTERS

Assembled in attractive instrument cases with carrying handles.

Squarewave output or filtered DC input: 12v or 24v types. Frequency: 50Hz ± 5%. AC output 240v or 110v types off load. Panel voltage meter indicator. Reverse polarity, protection. DC and AC circuitry fused. Mains output via 13A type slot. 2 year guarantee.

SD/1-8"×6"×6" 150 watts	£42.00
SD/2-8"×6"×6" 200 watts	£54.00
SD/3-10"×6"×6" 300 watts	£67.00
SD/4-10"×6"×6" 400 watts	£78.00
SD/5-10"×8"×6" 500 watts	£100.00
SD/6-10"×8"×6" 600 watts	£115.00
SD/7-12"×8"×6" 800 watts	£135.00
SD/8-12"×8"×6" 1000 watts	£160.00

Filtered output 18% extra

SINEWAVE INVERTERS

A new range of units designed to power equipment requiring a smooth waveform. Assembled in tough instrument cases with carrying handles.

DC input: 12v or 24v types (± 2v). AC output: 240v or 110v types on load. Frequency 50Hz ± 3% typical. Panel meter indicates voltage output. Reverse polarity input protection. Separate driver oscillator circuit. Fully fused DC and AC circuits. 2 year guarantee.

DD/1-100 watts 8"×6"×6"	£100.00
DD/2-150 watts 8"×6"×6"	£140.00
DD/3-200 watts 8"×6"×6"	£180.00
DD/4-300 watts 8"×6"×6"	£250.00
DD/5-400 watts 8"×6"×6"	£300.00

SPECIAL CONVERTERS

In response to customers' requests we have included this range.

All units are assembled in tough ABS cases approx 4"×4"×2".

TT/1-12v DC in/24v DC 40w out	£19.00
TT/2-12v DC in/48v DC 40w out	£19.00
TT/3-24v DC in/48v DC 40w out	£19.00
TT/4-24v DC in/12v DC 40w out	£19.00
TT/5-6v DC in/12v DC 20w out	£17.00

Terms of Business:

Carriage U.K. inclusive in prices. Overseas charged at cost F.O.B. Cheque, P.O., cash with orders. Official orders welcome but priority given to cash customers. Cased, etc. sizes subject to alteration. Delivery: some goods ex-stock, others up to 28 days average. Quantity discounts with pleasure.

INVERTERS ARE OUR BUSINESS

DC TO DC CONVERTERS

Simple but effective low cost range of converters.

Assembled on small aluminium sheets with no frilly extras.

Combined driver/output transformer.

Input protected to act as free floating to any polarity, output via Ply leads.

S/1-4v DC in/9v 500 ma	£14.00
S/2-4v DC in/12v 500 ma	£14.00
S/3-4v DC in/15v 500 ma	£14.00
S/4-4v DC in/18v 500 ma	£14.00
S/5-4v DC in/24v 500 ma	£14.00
S/6-6v DC in/9v 500 ma	£14.00
S/7-6v DC in/12v 500 ma	£14.00
S/8-6v DC in/18v 500 ma	£14.00
S/9-6v DC in/24v 500 ma	£14.00
S/10-6v DC in/30v 500 ma	£14.00
S/11-6v DC in/40v 500 ma	£14.00
S/12-6v DC in/50v 300 ma	£14.00
S/13-9v DC in/12v 500 ma	£14.00
S/14-9v DC in/18v 500 ma	£14.00
S/15-9v DC in/24v 500 ma	£14.00
S/16-9v DC in/30v 500 ma	£14.00
S/17-9v DC in/40v 500 ma	£14.00
S/18-12v DC in/24v 500 ma	£14.00
S/19-12v DC in/30v 500 ma	£14.00
S/20-12v DC in/40v 500 ma	£14.00
S/21-12v DC in/50v 300 ma	£14.00
S/22-12v DC in/50v 750 ma	£16.00
S/23-12v DC in/60v 300 ma	£14.00
S/24-12v DC in/60v 750 ma	£16.00
S/25-12v DC in/70v 300 ma	£14.00
S/26-12v DC in/70v 750 ma	£16.00
S/27-12v DC in/80v 300 ma	£14.00
S/28-12v DC in/80v 750 ma	£16.00
S/29-12v DC in/90v 300 ma	£14.00
S/30-12v DC in/100v 300 ma	£16.00

AUTO/MAINS INVERTER UNITS

These units maintain a source of AC mains power throughout any interruptions in the domestic supply. Assembled in smart instrument cases the units incorporate a built-in inverter, battery charger and full automatic switching circuits. Mains input required 220/240v AC. Mains output direct 220/240v AC. Inverter output 220/240v AC. O/F. Frequency 50Hz ± 4%. 2 year guarantee.

Inverter smoothed square wave out. Panel voltage meter indicator. AC output via 13A type socket. DC & AC circuits fused.

AM/1-10"×5"×4", 100 watts	£49.00
AM/2-10"×5"×4", 150 watts	£65.00
AM/3-10"×5"×4", 200 watts	£78.00
AM/4-12"×6"×5", 300 watts	£100.00
AM/5-12"×6"×5", 400 watts	£115.00
AM/6-12"×6"×5", 500 watts	£130.00
AM/7-12"×6"×6", 600 watts	£148.00
AM/8-12"×6"×6", 800 watts	£170.00
AM/9-14"×8"×8", 1,000 watts	£200.00

State input required. 12v DC or 24v DC.

INVERTER PANELS

A range of simple aluminium sheet assembled units without any frilly extras, inputs and outputs by polarity coloured leads. 20w to 100w models use a combined driver/output transformer.

PA/1-6v DC in/240v AC 20w	£15.00
PA/2-6v DC in/240v AC 40w	£18.00
PA/3-12v DC in/240v AC 20w	£15.00
PA/4-12v DC in/240v AC 50w	£18.00
PA/5-12v DC in/240v AC 100w	£22.00
PA/6-12v DC in/240v AC 150w	£30.00
PA/7-24v DC in/240v AC 20w	£16.00
PA/8-24v DC in/240v AC 50w	£19.00
PA/9-24v DC in/240v AC 100w	£24.00

All units are approx 4"×3".

Square waveform. 50Hz or 60Hz type ± 6%. AC output voltages are off load.

ELONHURST LIMITED

104A BRACKENBURY ROAD, LONDON, W.6
Telex: 8954665. GITS G ELECT.

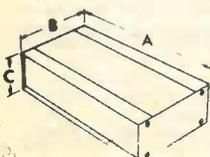
TEL: 01-748 5778



CASE SYSTEMS "CLASSIC" RANGE OF CASES

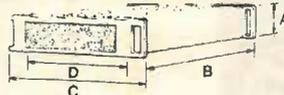
All cases designed and manufactured by Case Systems

Although the cases are designed as a low-cost case, they are well finished and truly look expensive. This effect is enhanced by the proportion of anodised aluminium, to shiny black leather textured top and bottom plates. Such features as these panels slotting into the front and rear extrusions and into milled grooves in the side plates, keeping them completely flat, increases the impression of a costly case.

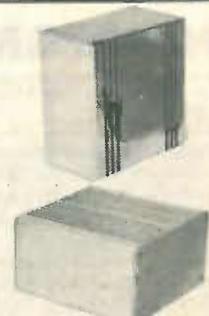


All prices plus V.A.T. 15%

Case Type	A	B	C	Price
A	8.50"	5"	2.50"	£8.00
B	12"	5"	2.50"	£9.50
D	17"	5"	2.50"	£11.75
C	8.50"	9"	3.50"	£10.50
E	12"	9"	3.50"	£11.75
F	17"	9"	3.50"	£12.50
G	8.50"	9"	5.25"	£13.50
H	12"	9"	5.25"	£14.20
J	17"	9"	5.25"	£14.90



Case Type	A	B	C	D	Price
101	3.50"	9.25"	11.25"	9"	£13.45
102	3.50"	12"	11.25"	9"	£14.85
103	3.50"	17"	11.25"	9"	£15.50



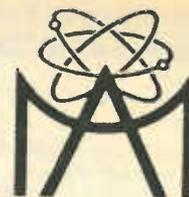
HEAT SINK BOX

This is an all alloy extrusion ribbed for heat dissipation. Anodised natural satin. Front size 2" × 3.50".

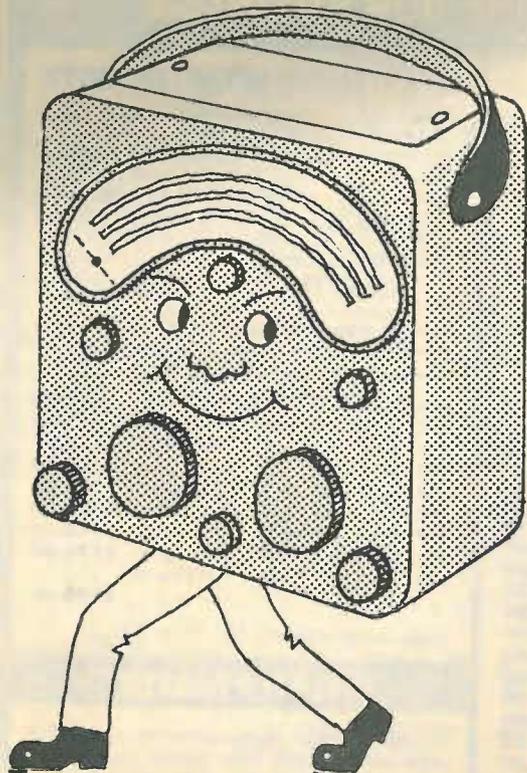
Length	Price
3.95	£2.95
5.95	£3.95
7.95	£4.95

All Case System cases are available with Discounts 5 off—10%, 10—12%, 25—15%, 50—20%, 100—25%. Prices include p. & p. U.K. Terms c.w.o. S.A.E. for details: 20 HUNT LANE, CHADDERTON, LANCASHIRE, ENGLAND TEL: 061-652 1580

MARTIN ASSOCIATES (ELECTRONICS) LTD.



LET US PUT A SMILE
ON YOUR AVO
AT A FIXED PRICE

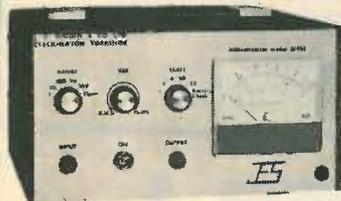


PRICES INCLUDE CLEANING, CALIBRATION, TOTAL LABOUR CHARGES FOR REPAIR WORK.
THE PRICE DOES NOT INCLUDE THE REPLACEMENT OF COMPONENTS, MOVEMENTS OR CASES.

MARTIN ASSOCIATES (ELECTRONICS) LTD., 34, CROWN STREET, READING. BERKS.
TELEPHONE: READING (0734) 595853/51074

WW-056 FOR FURTHER DETAILS

J E S AUDIO INSTRUMENTATION



Illustrated the Si 451 Millivoltmeter — pk-pk or RMS calibration with variable control for relative measurements. 50 calibrated ranges. **£78.00.**

Si452 **£63.00**
Distortion Measuring Unit
15 Hz — 20 KHz — .01%

*Si453 **£78.00**
Low distortion Oscillator,
Sine—Square—RIAA

PRICES plus VAT

J. E. SUGOEN & CO. LTD. Tel. Cleckheaton (0274) 872501
GARR STREET, CLECKHEATON, W. YORKS BD19 5LA

WW-071 FOR FURTHER DETAILS

TRANSISTOR TESTER
DATEST 2

NPN
READY
PNP

Si PNP PNP SCR
TEST IDENTICALLY
TRIAC — LAMPS OFF

OFF
ON

TEST CURRENTS LOW HIGH

At last...

A REALLY RELIABLE IN CIRCUIT TRANSISTOR TESTER THAT WORKS!

Previous Testers have been too easily fooled by low shunt impedances resulting in false alarms on perfectly sound transistors. Designed for fast IN-CIRCUIT testing the new DATONG DATEST 2 tests transistors, FETs, SCRs and Triacs even when shunted by resistors as low as 20 ohms!

Automatic NPN/PNP indication, foolproof three-LED display, and unique test probes allow a very high rate of testing even by unskilled users. Very competitive price includes probes and the DATEST 2 is available from stock. Full data sheet free on request. **ONLY £45 COMPLETE + 15% VAT.**
Total Price £51.75 inc. VAT & P&P.

DATONG ELECTRONICS LIMITED
Spence Mills, Mill Lane, Bramley
Leeds LS13 3HE
Telephone: Pudsey (0532) 552461

WW — 022 FOR FURTHER DETAILS

Monogram 1980

NEW PRODUCTS

700 watts — £350*

INTRODUCTION OFFER ONLY

* Normal List £550

Amplifier Modules

POWER AMPLIFIERS

250watts -- £105 350watts --- £125

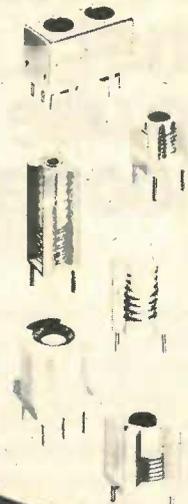


Send Cheques/Money Orders to - A4 SAE / \$1 Bill for Literature
MONOGRAM PROFESSIONAL AUDIO, 281 Balmoral Drive, Hayes, Middx. ENGLAND TEL 01-573-1566 10·0 AM - 8·30 PM

WW — 030 FOR FURTHER DETAILS

TOKO MAKE THE WORLD'S BEST RANGES OF COILS.

It seems a long time since TOKO first revolutionized the coil manufacturing business with their unique ranges of miniature RF and IF coils. Many imitators have come - and gone - in the meantime, but none have managed to equal TOKO's consistent quality, and skill in innovative coil design. However, perhaps TOKO's supremacy in designing and supplying these types of wound component has tended to overshadow the other product areas of TOKO's manufacturing capability. So the rest of this advertisement is devoted to semiconductors, ceramic and mechanical filters, and their new low cost ceramic resonator to replace the costly quartz crystal in many MPU and ultrasonic systems. And don't forget - not only do we offer you some exciting and innovative products in print - the supply is carefully maintained at all times through the only stockist/distributor of signal frequency processing coils in the UK.



SEMICONDUCTORS

Wide capacity range tuning diodes: KV1210 and KV1220 series
A unique range of matched dual and triple diodes, possessing tuning capacity ranges in excess of 15:1 (1.9v, or 1.25v series.) The diodes are supplied in either a single package, or in a snap-apart package, where each anode and cathode is separately available, and circuit layout flexibility is unrestricted. The two basic series are for either 9v or 25v maximum bias, with a maximum matching deviation of only 2% over the entire bias range.

Electrical characteristics		Each diode - 9v series (25 volt series)			units		conditions	
Item	Symbol	min	typ	max	V dc	IR = 10uA	VR 15v (25v)	VR = 1v, f = 1MHz
Reverse voltage	V _{BR}	20 (30)			nA			f = 1MHz
Leakage	I _R			100	pF			VR 1v, f = 1MHz
Capacitance	C _{1v}	440 (510)	500 (620)		pF			VR 13v, f = 1MHz
Capacity ratio	C _{1v-9v} C _{1v-25v}	15 (20)	17 (22)					
Q (both series)		200			ppm/°C			
Temp. Coeff.	TC _Q		500 (130)					



SIL package
Snap-apart package(s)

Ordering information:	
Structure	9v 25v
3 SIL	1210 1220
2 SIL	1211 1221
3 s/a	1215 1225
2 s/a	1216 1226

SIL : Single in line
s/a : Snap apart
Prefix all types "KV"



The TOKO range of ICs is based largely on custom applications in radio/audio, calculator, printer and allied applications. Custom designs in all major technologies are available, and the standard list includes:
AM/FM complete radio and IF amplifier devices KB4402 (CA3089E), KB4420 (HA1137), KB4400 (MC1310), KB4419 (AM/FM portable radio IC), KB4420 (HiFi AM tuner IC), KB4436 (FM noise blanker IC), KB4423 (Noise blanker IC), KB4437 (Pilot cancel stereo decoder IC), KB4438 (Muting HiFi audio preamp - two channel)
Clock LSI : The MK50366/50372 direct drive multifunction clock/timer ICs for LED or Fluorescent displays.
Driver arrays for gas discharge/fluorescent displays, gas ignition drivers etc.

FILTERS

TOKO's new CF5H series of FM IF filters have been designed for excellent thermal and long term stability in applications such as communications and car radio. Three basic bandwidths are available to suit various standards. Spurious responses in the 8-12MHz region are typically below 50dB down.
10ff : 60p 100 off: 36p each

TOKO's CFM2 series of AM mechanical filters are available in the range 200-600kHz. The mechanical design ensures low spurious response, and excellent stability when compared to cheap ceramic filter alternatives. With the appropriate input/output matching transformers, a shape factor of better than 3:1 is possible. Stock types are centered on 455kHz versions.
10ff : 65p 100off: 45p

Coil block filters:
TOKO expertise in coil design is reflected in the wide range of very high specification, low cost filter blocks for radio and audio. Several standard ranges have evolved for use in 19/38kHz stereo pilot tone notching, and other custom requirements may be readily met from the standard range of tuneable inductances in the 1-50mH range held by AMBIT.

Examples from stock types:
19/38kHz mono filter 1 off £1.00
100 off £0.65
6 pole FM linear phase filter 1 off £2.45
100 off £1.36

CHOKES

TOKO's range of fixed inductors is based on three main styles (as illustrated). Between them, a range covering 1uH to 120mH in E24 series is available, with other values available to special order. (Subject to min order quantity.) The rigid pins are suitable for all types of automatic insertion, and are spaced on 5mm centres. Prices are unbeatable compared to other types of choke:

Type	1-49	50-99	100-499
7BA	16p	9.5p	7.2p
8RB	19p	16p	12p
10RB	33p	27p	21p

7BA covers 1uH to 1mH
8RB covers 100uH to 36mH
10RB covers 1mH to 120mH
(Tuneable signal chokes are also available in this range)

DIGITAL FREQUENCY TUNING SYSTEMS

In keeping with TOKO's policy of being prepared for all the latest advances in radio technology - Ambit have been carrying out extensive work on evaluating the new digital frequency synthesiser systems from the major manufacturers. Hardware for evaluation is available now. Mullard's uniquely versatile LN123/4 system for professional communications of all types, the low cost 'RTS' serial data controlled system for up to around 200MHz in consumer and amateur radio applications. National Semiconductor's DS8906 AM/FM synthesiser using a single IC for prescaler/serial programmable counter/phase detector. Hitachi's dedicated AM/FM/SW car radio MPU controlled system. OKI electric's solution with on board RAM station recall. Fairchild's versatile FEX2500 system for radio/TV. Plessey's various offerings for professional, commercial and industrial applications. Plus any others that are made available to us for general release in the meantime.

And as well as the synthesiser hardware, there are various radio systems to use as building blocks. And as you might have come to expect from Ambit, the radios are just as technology conscious as the rest of the system. Not simply an afterthought in the shape of MPU specialists idea of a wireless to hang on the end of 'his baby'. The synthesiser driven units include both bandswitched versions of fully DC operated LW/MW/FM receivers, FM only, AM only - and a new continuously tuned 5kHz to 30MHz system with switched bandwidth IFs and most of the features you would expect to find on systems costing ten or twenty times more. Plus, of course, VHF tuners ranging from 30MHz to 220MHz in our standard PIN agc 4 and 6 circuit variants. In other words, a total package approach to radio in the eighties - from one source. As well as the synthesiser systems, Digital Frequency Readouts are already available with either Fluorescent, LED or LCD. All the standard IF offsets for AM/FM, plus the new DF44 with the addition of 10.7MHz and 2MHz offsets in the SW

range. 100Hz AM resolution, 4mA consumption at 5v, 10kHz VHF resolution. In other words, something that covers nearly all applications and requirements up to 200MHz (or 399.99MHz with the appropriate prescaler). Next time you are thinking about any form of radio system, either consumer, communications or any associated aspect - remember that TOKO coils are available ex-stock from Ambit, or to custom specifications. A full range of chokes from one microhenry to 120 millihenries, with tuneable versions with as much as 40% tuning range. To complement this range, Ambit also offer various crystal and ceramic filters to communications standards, a wide range of semiconductor, including JFET, MOSFET signal amplifiers. (40673/3SK51 - 100+ 33p). 100W power MOS devices, varicaps of all sorts, plus most other semiconductor requirements for your system. (Plessey 1600 series now in stock.)

TOKO UK Ltd., Ward Royal Parade, Alma Road, Windsor, Berkshire TLX.848095 TOKO G
Exclusively stocked and distributed in the UK by
AMBIT INTERNATIONAL, 2 Gresham Road, Brentwood, Essex. tel (0277) 227050/216029

WWW - 076 FOR FURTHER DETAILS

“Where can I get a Universal Bridge that's good enough for the labs, simple to use and tough enough for the shop floor and doesn't cost a fortune?”

“Here”—AVO's Universal Bridge B150 Mk. 3 gives you measurement of resistance, capacitance, inductance accurate to 1%, can be used anywhere, it's battery powered. And anyone can use it, connections are simple and readings easy to take—with no calculations thanks to the mechanical in-line digital display and interlocking units selector.

The B150 Mk. 3—for use in production, quality control, development labs—even at goods inwards. Tough metal cabinet, and the AVO guarantee of reliability, serviceability and accuracy, all at a price that's a pleasant surprise. From good distributors everywhere.

Ring us for the name of your nearest stockist or for fuller details of AVO's Universal Bridge B150 Mk. 3.



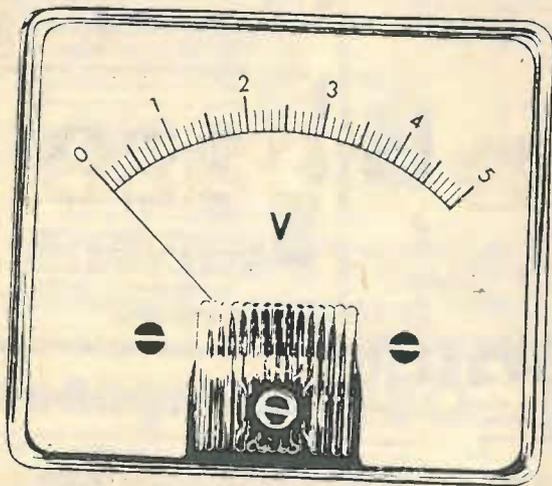
Avo Limited, Archcliffe Road,
Dover, Kent. CT17 9EN.
Tel: 0304 202620 Telex: 96283.

Thorn Measurement & Components Division



WW — 058 FOR FURTHER DETAILS

METER PROBLEMS?



137 Standard Ranges in a variety of sizes and stylings available for 10-14 days delivery. Other Ranges and special scales can be made to order.

Full Information from:

HARRIS ELECTRONICS (London)

138 GRAYS INN ROAD, W.C.1 Phone: 01/837/7937

WW—049 FOR FURTHER DETAILS

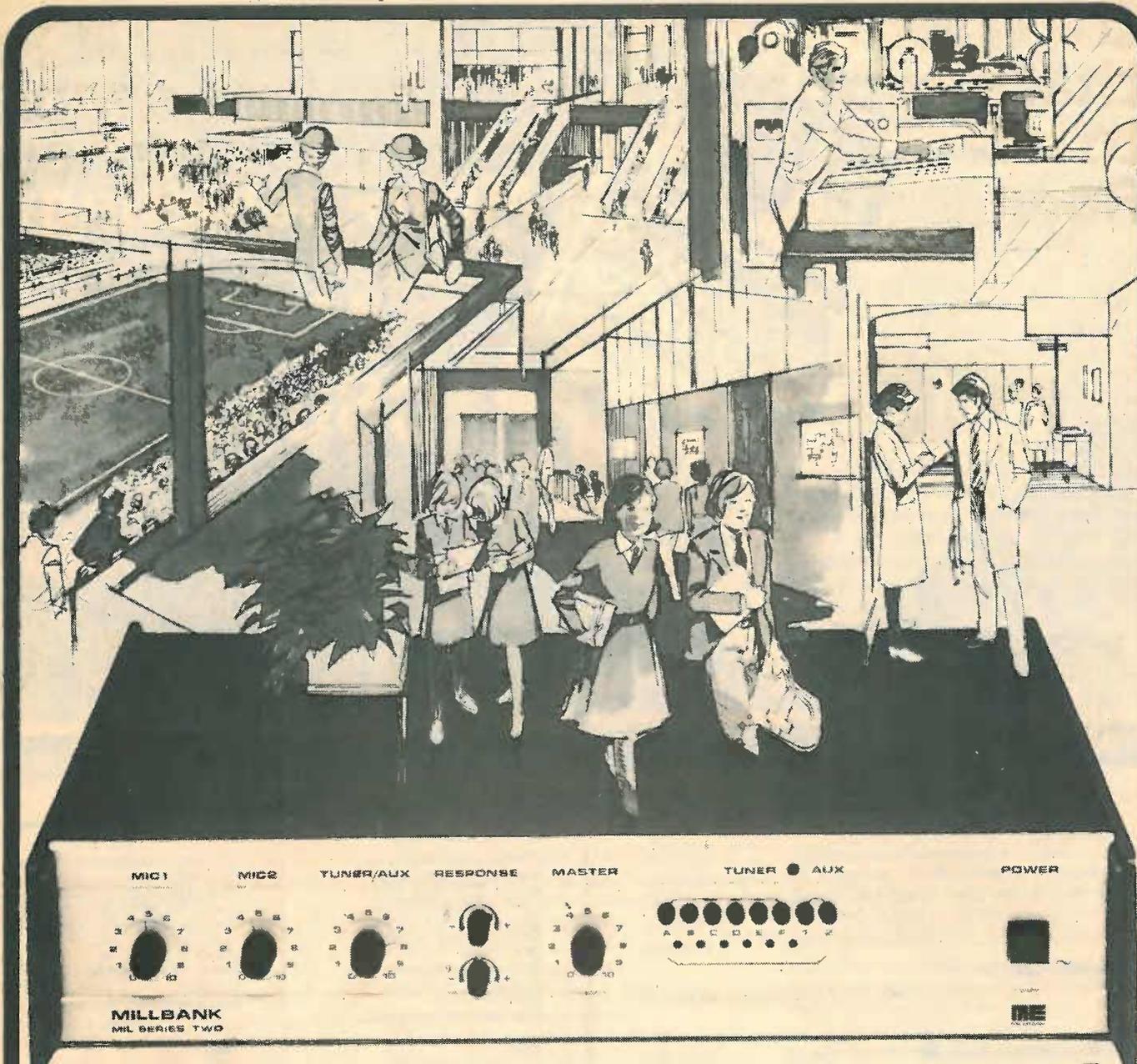
TAKE A DAY OFF

R & D Effort,
Production Holdups,
Machine down time
etc. by securing
your copy of the
VEROSPEED
fully priced
catalogue of stocked
components from

VEROSPEED

Barton Park Industrial Estate,
Eastleigh, Hampshire SO5 5RR
Tel: (0703) 618525

WW — 023 FOR FURTHER DETAILS



Your attention please!

MIL series amplifiers are designed and priced for installations in a wide range of applications including churches, schools, restaurants, factories, shops and offices.

Each amplifier is available with input facilities for microphones and music sources; six programme push button AM tuners or FM

tuners and preannouncement chimes are available options.

One model incorporates automatic switching to a battery supply in the event of a power failure.

Such a versatile system can confidently satisfy your exact requirements.

Please tick as required.

For further information on this product

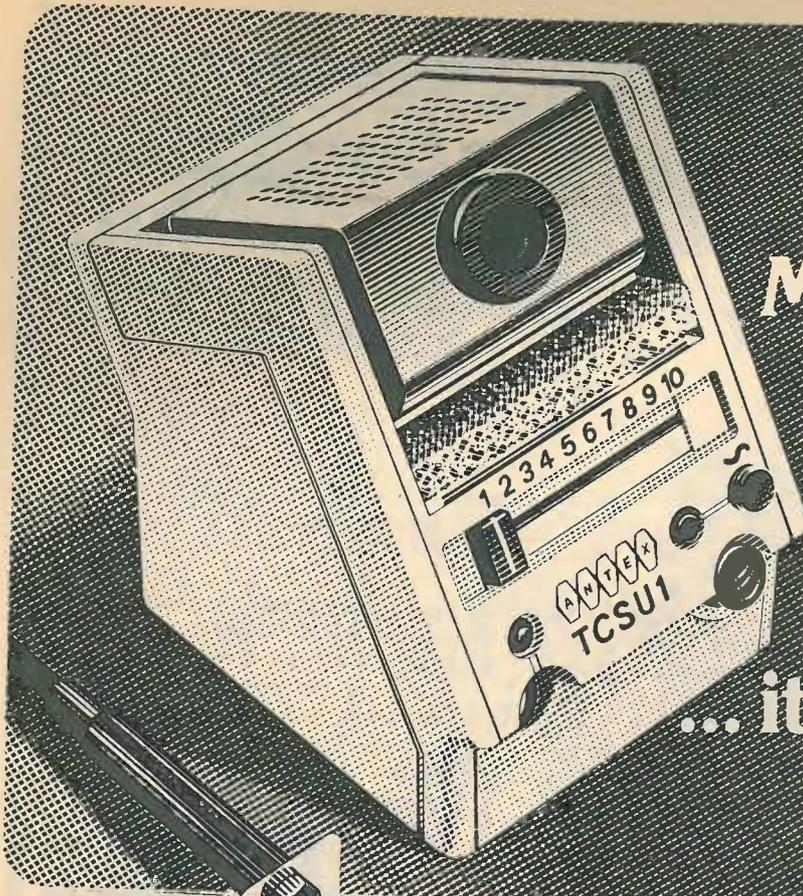
Complete range of sound equipment



Name _____

Position _____

Attach this coupon to your letter heading and send to:
MILLBANK ELECTRONICS GROUP LIMITED, MARKETING SERVICES UNIT,
P.O. BOX 33, UCKFIELD, SUSSEX. ENGLAND.



Micro-soldering!

ANTEX
TCSU1 & CTC

... its the perfect kit

Model TCSU1

Micro-Soldering Station

Accurate pin point temperature control between 65° and 400°C. Heating element and sensor built in tip of the iron for fast response. Interchangeable slide-on bits from 4.7 mm (3/16") down to 0.5mm. Zero voltage switching, no spikes. No magnetic field, no leakage. Supplied with miniature CTC (35-40watt) iron or XTC (50watt). TCSU1 soldering station with XTC or CTC iron £36 (6.44). Nett to industry.



Model CTC - 24 volts Priced at £9.75 (1.87)



Model XTC - 24 volts Priced at £9.75 (1.87)

Model CX 17watts - 230 volts



A miniature iron with the element enclosed first in a ceramic shaft, then in stainless steel. Virtually leak-free. Only 7 1/2" long. Fitted with a 3/32" bit. £4.20 (.98)
Range of 5 other bits available from 1/4" down to 3/64".
Also available for 24volts.



Spare element Model CX230E

Model X25 25 watts - 230 volts



A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation. Fitted with 1/8" bit and priced at £4.20 (.98)
Range of 4 other bits available.
Also available in 24volts.



Spare element Model X25/240E

Model SK3 Kit

Model SK4 Kit



Contains both the model CX230 soldering iron and the stand ST3. Priced at £5.70 (1.49)
It makes an excellent present for the radio amateur or hobbyist.



With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at £5.70 (1.49)

Model SK1

Model MLX 12volts

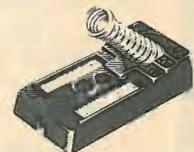
ST3 Stand.



This kit contains a 15 watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet, 'How to Solder'. Priced at £5.95 (1.53)

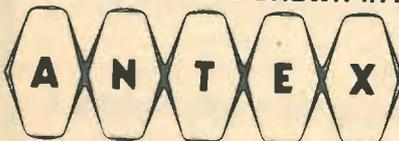


The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips. Packed in a strong plastic envelope it can be left in a car, a boat or a caravan ready for soldering in the field. Price £4.55 (1.14)



A strong chromium plated, steel spring screwed into a plastic base of high grade insulating material provides a safe and handy receptacle for all ANTEX models soldering irons. Priced at £1.50 (.57)

* VAT + P&P as shown in brackets ()



Stocked by many wholesalers and retailers or direct from us if you are desperate.

Please send me the Antex colour brochure I enclose cheque/P.O./Giro No.258 1000

Name

Address

Antex Ltd, Freeport, Plymouth PL1 1BR Tel. 0752 67377

WWW FEB

WW - 068 FOR FURTHER DETAILS



wireless world

Status symbols

Editor:

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

Deputy Editor:

 PHILIP DARRINGTON
 Phone 01-261 8435

Technical Editor:

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

Projects Editor:

 MIKE SAGIN
 Phone: 01-261 8429

News Editor:

 RAY ASHMORE, B.Sc., G8KYY
 Phone 01-261 8043

Communications Editor:

 TED PARRATT, B.A.
 Phone 01-261 8620

Drawing Office Manager:

ROGER GOODMAN

Technical Illustrator:

BETTY PALMER

Production & Design:

ALAN KERR

Advertisement Controller:

G. BENTON ROWELL

Advertisement Manager:

 BOB NIBBS, A.C.I.I.
 Phone 01-261 8622

DAVID DISLEY

Phone 01-261 8037

BARRY LEARY

Phone 01-261 8515

Classified Manager:

 BRIAN DURRANT
 Phone 01-261 8508 or 01-261 8423

NEIL McDONNELL

 (Classified Advertisements)
 Phone 01-261 8508

JOHN GIBBON (Make-up and copy)

Phone 01-261 8353

Publishing Director:

GORDON HENDERSON

There has lately been a great deal of talk, reaching a focus in *The Times* correspondence columns, on the titles that workers in our industry should grace themselves with. Considerable thought has clearly been expended on the suggestions correspondents have made; the intention is evidently to differentiate between 'engineers', who sit at desks, lost in thought, and 'craftsmen/technicians' who dwell in workshops, doing the bidding of engineers. Blame is heaped on the daily press for referring to ignoble creatures who man picket lines as engineers, as in "Engineers demand 30%", when the feeling is that they should be called 'engineering workers' or in some way dissociated from those who use their mental, instead of their manual skills. The man who repairs television sets for a living ought, it is said, to be called a technician, not an engineer.

Notions of social status, abstract except insofar as salaries are concerned, are at the root of the debate. A tenet of the status-seeker is that the more imposing his work-title, the higher the esteem in which he is held by the community: refuse-disposal operatives find it more acceptable to consult a turf accountant than to lay a bet with a bookie. The improbability of such a ploy ought, by now, to be apparent to any observer of mores.

If engineers (for lack of a better word) in electronics are not accorded by society the intangible quality of status they seek, it is more likely to be due to the value society attaches to their work than to the names they are given.

The results of the work are seen to be in entertainment, which is taken for granted, and in industrial and military

systems, which are not understood: put another way, the benefits are thought to be either trivial or necessary, but remote. An engineer's store of experience and knowledge is irrelevant because, unlike a doctor or accountant, he does not, visibly at least, affect their lives in any serious way.

Distinction between technician and engineer always used to be indicated by the label 'design engineer' for the originator, and if the others wanted to call themselves engineers, no-one worried: the differential was preserved.

Low standing of engineers is not of great concern to the community. Where it is of consequence is inside a company or organization, where management is too often the preserve of accountants or sales people, or even individuals who have no training in either engineering or administration. Engineers' salaries do not compare well with those of managers who are often their educational inferiors, simply because engineers are not allowed into positions in which they can influence the direction of a company. If the control of engineers continues to be left to those who are untrained in engineering, then the dismal performance of this country in manufacturing will not improve. This is the vital reason for demanding a greater status, not a self-congratulatory assumption of grand titles.

If the recommendations contained in the Finiston Report are adopted, the engineering profession will not be short of status, and it will be hard-won. The prospect of losing one's registration through complacency should lead to a level of competence not seen in any other profession.

Microwave intruder detector — 1

Design with good interference rejection and noise monitoring

by K. Holford, C.Eng., Philips Research Laboratories

This design provides a simple but effective circuit which uses a cycle counting scheme to prevent the alarm being triggered by short movements or pulses. The circuit has excellent interference rejecting properties. A noise monitoring circuit is described in part 2 so that the alarm can be set up easily and reliably in terms of a low false-alarm probability.

A simple novel design of stabilizer allows the nominal 12V supply to have one volt or more of ripple before the basic noise level is disturbed.

This design is suitable for the Mullard CL8960 microwave module, a complete microwave front-end containing both the microwave generator (Gunn diode) and a mixer diode to produce the audio Doppler beat signal in response to radial movement. It requires a power supply of about 7.0 volts d.c. at about 150mA. The module has Home Office approval and has featured in a previous Wireless World design¹ in 1977. That paper and reference² provide useful background to movement detection by microwaves.

The present design is the result of considerable experience over the years in small radar design and has laid emphasis on false-alarm immunity, reliability and simplicity, and the use of a single nominal 12 volt supply for the complete microwave intruder detector (MID). The lowest usable supply voltage is important to preserve standby battery life. The circuit shows 11 volts although this can be reduced to ten by careful choice of component source and circuit settings, and to 9.5V by selection.

The great advantage of the MID, apart from its apparent ease of installation, is its constant vigilance. It can be set to sound an alarm for five minutes and then turn off if there is no further movement. This contrasts with a door-and-window switch system which, in simple installations, is likely to be out of action if disturbed. It may be silenced to await the owner's return.

However, both the design of the MID and its installation must be carried out with knowledge of the likely causes of false alarm. This can be simplified, and reliability improved to the point which makes it a very popular device, by providing an interference monitoring circuit that indicates when the alarm has an unreliable setting. Super sen-

sitive MIDs are more likely to false alarm than less sensitive ones. Even those MIDs having good circuit design should be adjusted for a sensitivity which is no more than that necessary to ensure intruder detection. It is the setting of this sensitivity and the monitoring of the safety factor once it is set that is the key to a reliable installation. Some manufacturers "burn in" their alarms for long periods to ensure they are reliable, but this is lost if there is serious unsuspected movement in the vicinity of the MID installation. Part 2 describes a false alarm circuit for monitoring this kind of event.

False alarms attributable to the MID itself, particularly when set for a high sensitivity, can be due to amplified thermal noise, such as 1/f semiconductor noise, to vibration, or simply an interference on the power supply leads which gets into the signal circuits. The MID should contain protection against both power supply pulses and signals caused by external short transient movements.

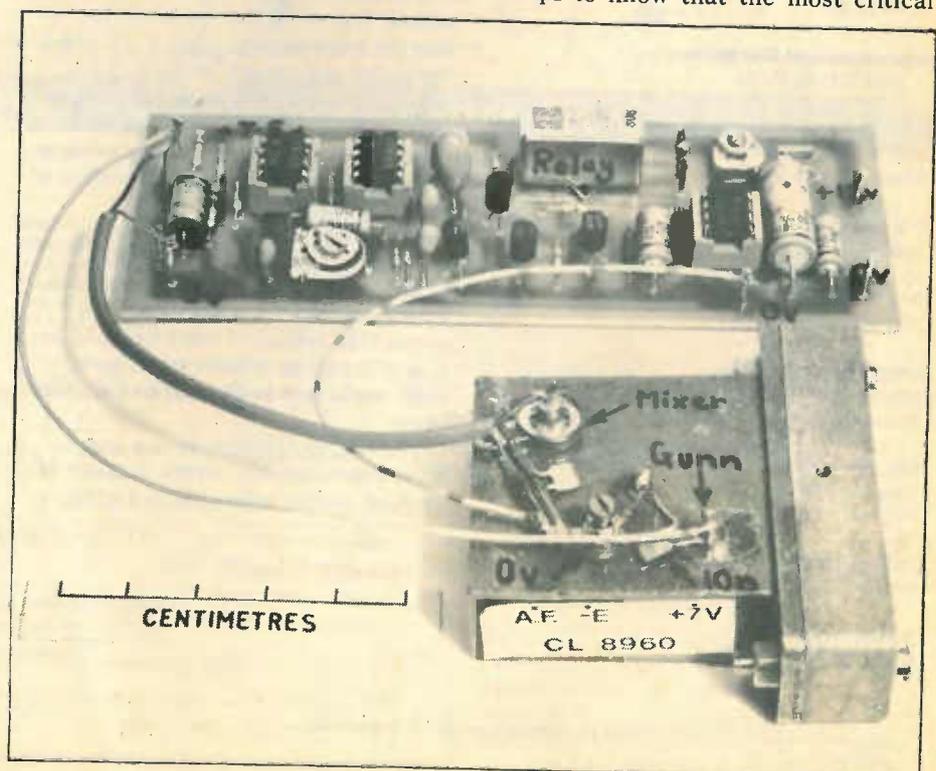
Setting-up procedure for this intruder alarm circuit (given in part 2) can be simplified using an additional indication circuit that also monitors noise level and indicates when safety margin is reduced.

False alarm due to causes external to the MID can include those due to nearby equipment with an internal cooling fan and an aperture through which the radiation can pass and then return with a Doppler (movement) shift. In fact just an amplitude modulation of the reflection is sufficient.² The gas in fluorescent lamps, when switched on, ionizes to become a fluctuating reflector which can easily cause an alarm. Other causes include pedestrian movement outside windows close to the alarm. Microwave radiation can pass through glass, albeit with a considerable attenuation, as well as through dry plasterboard. Do you keep pigeons in your loft as well as a pig in the bath?

Most industrial MIDs use a light-emitting diode to show when it is detecting movement during setting up.

None, to my knowledge, provide one to show that the noise, including that due to spurious movement, is too high for reliability at the chosen sensitivity setting in the particular environment in which the MID must work. This is covered in part 2.

The starting point for an alarm design must be the power supply, its noise and outside ripple rejection properties. It helps to know that the most critical



aspect of this is going to be the provision of the supply to the Gunn diode. Any ripple on this and the microwave power will be modulated and in turn will result in this ripple appearing at the mixer output. This is caused by the microwave power used for the mixing which affects the direct voltage across the mixer. If this is not satisfactory the rest of the design is suspect. The mixer output signals are in any case caused by an amplitude modulation of the mixer power when the return signal, shifted by the Doppler difference, is added to the local signal used for mixing.² This return signal is many orders of magnitude less than that used for mixing and hence the modulation of microwave power due to the power supply has to be extremely small. Ultimately, the radar sensitivity is limited by the mixer noise and the design should therefore aim not to artificially increase this.

In the past Gunn power supplies have not received the attention in the literature that they deserve; neither have manufacturers of microwave modules volunteered information on the sensitivity to ripple. A need exists for this to be included in the data. The ripple output from the mixer will depend first on the ripple on the Gunn supply and also on the amount of microwave power being used for mixing and the operating condition of the mixer. For instance, if a low level mixer is being used, such as in the Mullard CL8960, there will be supplementary direct current bias used to enhance sensitivity. But a mixer using about 0.5mW or more of power will often just have a 1kΩ resistor across the mixer to cause a current flow. Figure 1 shows these two types together with the resistors.

Ripple factor is defined here as the ratio of ripple voltage from the mixer to that across the Gunn diode. The microwave power used for mixing in the CL8960 is only about 0.02mW but will increase with a small reflector in front of the module so that ripple factor may be measured for other mixing powers. Such powers can occur if the module front is covered and sometimes intentionally by means of a 3mm screw or so placed in the front shroud, see Fig. 10 (part 2), and used to optimize signal-to-noise ratio with a particular amplifier or circuit design.*

The actual microwave power in use is evident by the change in direct voltage when the microwave signal is turned on. Thus setting up instructions can specify the type of bias circuit used and the direct voltage that should be expected. (Special anti-static precautions are needed during measurement to avoid mixer damage, given later.)

*The intended optimum mixer power will occur naturally if the module is bolted to a 160x430mm aperture in a 1/16in thick metal plate, such as the side of a box, and the other side of the aperture is fitted with the shroud shown in Fig. 10 which comes with it.

Table 1. Ripple transfer factor measured for microwave modules

Mixer	CL8960	CL8960	CL18960	CL8960	In-line module
Ripple factor	0	0.016	0.025	0.06	0.08
Direct voltage (V)	0.300*	0.26	0.00	-0.4	-0.2

* Zero microwave power

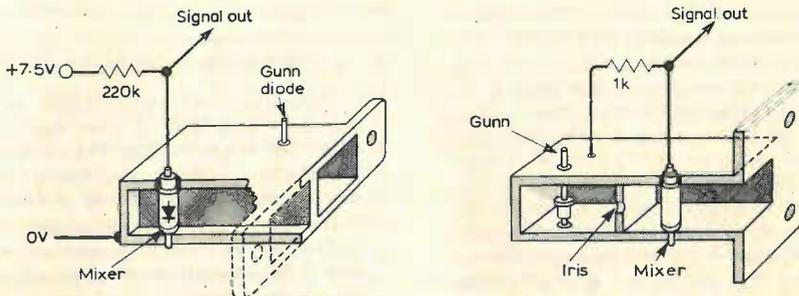


Fig. 1. Microwave part of the design is contained in Mullard CL8960 module (left). Direct current bias is not needed for in-line module, available shortly.

Gunn diode power supplies

Integrated circuit regulators in general have not reached the performance required for Gunn supplies. At least, they are not generally being released against a suitable specification. Typical is the 7808 from the 7800 series. This has an 8V output and is suitable for use with a 7.5 volt diode*. The guaranteed minimum ripple rejection is 56dB and the data shows a supply of 14 volts. This rejection is not even enough for a typical CL8960. When tested with a 150mA output a 66dB rejection at 14V became 63dB at 12 volts. Noise output of 13µV r.m.s. was acceptable but several times higher than a circuit made from discrete components.

Common practice in providing Gunn supplies is to use a zener diode to set the voltage and follow this with an emitter-follower to provide the power. In the circuit of Fig. 2 the current bias for the zener diode is derived from the supply but decoupled as much as is practical bearing in mind possible problems due to electrolytic leakage current. The 47µF capacitor across the zener diode reduces noise but only contributes to the decoupling above about 100Hz.

* This design is based on the use of 7.5 volts, as this improves low temperature reliability. Pressure for the lowest possible working voltage has caused a 7.0V release specification. Also more recent work has improved the Gunn diode. If 7.0 volt working is essential it can be used.

The 1000µF capacitor has a typical impedance at 100Hz of 2 ohms (no maximum quoted) at 0°C and the zener diode 20 ohms, so that the ripple rejection to the voltage across the zener is $2200/2 \times 1000/20 \times 20 = 5500$ or 94dB (ignoring impedance change). Note that the splitting of the chain increased decoupling by about 30dB. This 94dB is much more than can be achieved with an output transistor when this is delivering 150mA as can be seen from Table 2.

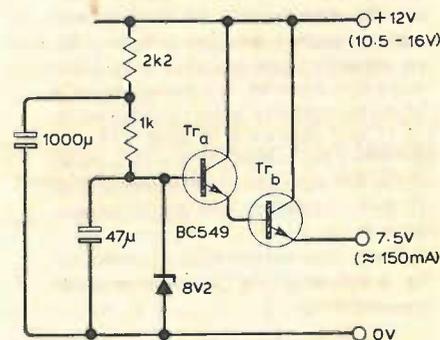


Fig. 2.

Table 2. Ripple rejection with circuit of Fig. 2.

Transistor type	BD139	BD139 BD135	BDX77	BFY52	BFX85
Rejection (dB)	97	55	61	52	52
Output noise (µV, rms)	0	1	2	2	2
Load current (mA)	0	150	150	150	150
No. of samples	3	3	3	3	3

The ripple rejection was found to degrade by 2dB when the supply voltage was reduced to 2.5 volts above the zener voltage.

Improved circuit

The output transistor is the limiting factor and if, as seems likely, better types will not be made available, some form of feedback must be devised using a suitable op-amp. Ideally the performance will approach that of the op-amp alone. One such attempt is shown in Fig. 3.

This circuit will achieve 100dB rejection although even 83dB is adequate. The ability of the circuit to reject ripple and tolerate a low supply voltage depends on the current output taken from the i.c. and, not least, who made it. The maximum current required for a CL8960 is 166mA and the minimum current gain of BD135 is 40. Thus the i.c. output current can be up to 4mA. The circuit was tested with what turned out to be a high gain transistor having a base current of only 1.2mA, so an extra 3.5mA was taken to see the effect. Results are shown in Table 3.

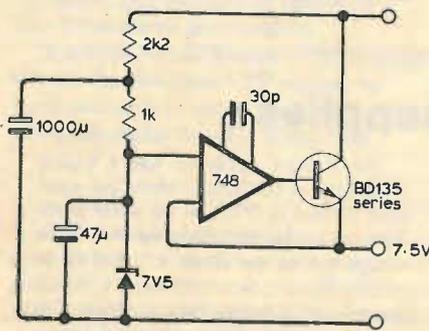


Fig. 3.

The advantage of the 748 over the 741 is that the 30pF capacitor can be increased if a loop stability problem is experienced. A 741 of different manufacture did oscillate when the extra 3.5mA load was applied, although with the 748 the capacitor could be reduced to 10pF before this occurred. The manufacturer is the most important factor in choosing an i.c. In this instance a National 748 outperformed five samples of a more expensive LM308 equivalent from manufacturer (2), both in rejection and minimum working voltage.

Finally a two emitter-follower version of Fig. 4 is shown in Fig. 5 with some more measurements.

Table 3. Use of op-amp as shown in Fig. 3 improves ripple rejection.

IC type	Noise output	No. of samples	Minimum rejection	Minimum V _s as shown	Minimum V _s for 83dB +3.5mA
748 ¹	2µV	10	101dB	9.53V	9.7V
748 ²	2µV	20	103dB	10.23V	11.0V

1 National Semiconductor, 2 other well-known make

Measurements were made at a frequency of 200Hz to avoid hum problems but at least 100dB was measured over the band 10Hz to 1kHz. The fact that this is greater than the 94dB of the bias chain is a reflection of capacitor tolerance.

The minimum voltage working was only 0.1V lower if 30dB rejection was specified and this ripple breakthrough can easily be seen on an oscilloscope. This can be used as a rough check.

From these figures you can see that a poor i.c. would show advantage in using another emitter-follower with an end-of-spread CL 8960 and BD135, due to the reduced current load which would require less voltage. With a BC547 as the second

transistor the minimum voltage fell from 11.0V to 10.5V but with a good i.c. it rose from 9.7V to 10.0V, due to the higher output direct voltage required for the extra transistor over-riding the low-current improvement. These voltages and those above assume an exact 7.5V zener diode. With a 5% tolerance another 0.4V must be added.

The circuit of Fig. 3 can be simplified by noting that the i.c. output voltage is above that of the zener diode by the V_{be} of the transistor; see for instance the circuit of Fig. 4. Also by using 1kΩ plus 22kΩ preset series resistance between F and B, the voltage may be set accurately using a 6.8V zener.

Table 4. Rejection by fig. 4 circuit with 12 volt supply was also over 100dB.

IC type	Noise output	No. of samples	Minimum rejection	Minimum V _s for 83 dB rejection as shown	Minimum V _s for 83 dB +3.5mA
748 ¹	2.5µV	10	>100dB	9.53V	9.76V
748 ²	2.5µV	20	>100dB	10.23V	10.83V

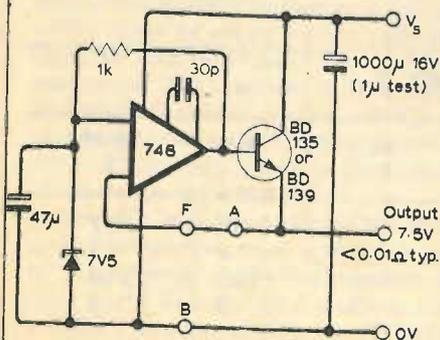
1 National Semiconductor, 2 other well-known make

Table 5. Two-transistor version for higher currents or poor i.c.s

IC type	Noise output	No. of samples	Rejection ½ 12V supply	Supply min. for 83dB
748 ¹	3.5µV	10	100dB	10.07V
748 ²	3.5µV	20	99dB	10.62V

1 National Semiconductor, 2 other.

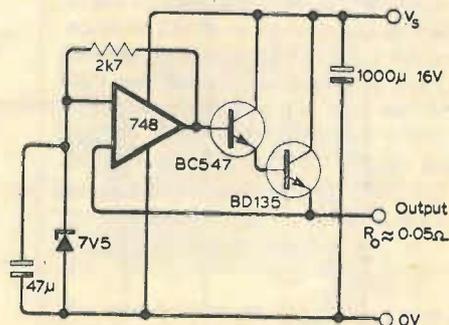
Fig. 4.



From the previous results it seems fair to expect that the circuit of Fig. 4 could be put into production with a minimum working voltage of 10.5V and a ripple rejection of 83dB, provided the i.c. manufacturer is selected with care, and even better if BD135s are available with h_{FE} minimum of 80. A considerable percentage of the products will work satisfactorily down to a supply voltage of 10V.

Measurements were made with a zener diode selected for an accurate 7.5V voltage. Any higher voltage requires the supply minimum to be raised by the difference. But also, the use of the 7.0V specified in the CL8960 data would allow a reduction of 0.5 volts. Thus a 10.5 volt minimum could be met, even with a poor i.c.

Fig. 5.



Note: 784 requires 30pF compensation capacitor.

Ripple transfer factor for the two modules is shown in Table 1. In both cases the mixer used was the Mullard BAV46 which is a typical type for this application. The CL8960 bias shown uses fewer components than in the data sheet. The direct voltage working point should be chosen for best noise figure. With a 42µA bias current and the circuit to be described this is about half the non-microwave bias. For a 300mV diode, a variation from 90 to 270mV causes a 1.5dB worsening of noise figure and some 6dB sensitivity loss at the extremes.

Measurements show that a factor of about 0.02 should be used for design with the CL8960 and the more stringent 0.08 or more for the in-line design. The aim here will be for a 0.1 design so as to allow for future microwave module development.

If the noise from the module is naturally 5µV and the design aim is to hold the noise increase to just 1dB, the ripple contribution on its own must be not more than about 2.5µV. If it contributed 5µV the overall noise would degrade by 3dB.

The rejection required of the power supply is therefore 83dB for 2.5µV r.m.s. from 1V pk-pk with ripple factor of 0.1. Even a typical CL8960 is going to require 69dB if ripple factor is 0.02.

The 83dB minimum ripple rejection factor is achieved (see "Gunn power supplies") so as to allow 1V pk-pk on the intruder alarm supply for a module with a ripple factor of 0.1. As a typical CL 8960 has a factor of 0.02 it could tolerate 5V pk-pk ripple, although due to the voltage swing the minimum supply voltage of 10.5V would need to be increased to about 13V.

It might be thought that battery supplies would not need ripple rejection. However, this ignores practical points like switching-on and switching-off surges with long leads, possible bad connections due to corrosion and

trickle charging from mains derived supplies. Thus a 1V pk-pk ripple rejection is very useful.

Doppler amplifier design had an aim of about 90dB gain and also an adequate ripple rejection. Ripple may be present due to the signals originating from outside the power supply, or caused by the power supply itself, or generated by the amplifier drawing signal current from the power supply and its associated impedance. Feeding back a voltage due to an inadequate ripple rejection can lead to an unstable amplifier. The nature of this problem is illustrated in Fig. 6. Currents I_a and I_b supply the amplifiers but contain components at the signal frequency. These in turn generate voltages via the finite output impedance of the power supply. A low impedance supply eases the problem, as do lightly loaded amplifiers which do not generate large signal currents. After this the amplifier should be designed for a good rejection factor.

A suitable amplifier circuit is shown

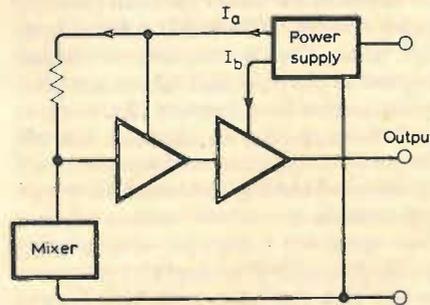


Fig. 6. Ripple may be due to signals originating from sources internal or external to the power supply. Currents shown can generate voltages through the output impedance of power supply, hence the need for a low impedance supply and lightly-loaded amplifiers.

Fig. 7. Beat frequency amplifier with mixer bias current supply was designed to tolerate supply impedance of more than five ohms.

in Fig. 7. It was designed to tolerate a supply impedance of more than 5 ohms which is much higher than needed for a stabilized supply, but often a good design does not look very different from a poor one at first sight. The main point is not to inject signals from the supply via the networks which supply amplifier bias. The Gunn power supply can be used to power the amplifier and as this has a very low output impedance of about 0.05 ohms this will greatly help the design. For instance, some of the decoupling of the input bias chain can be omitted.

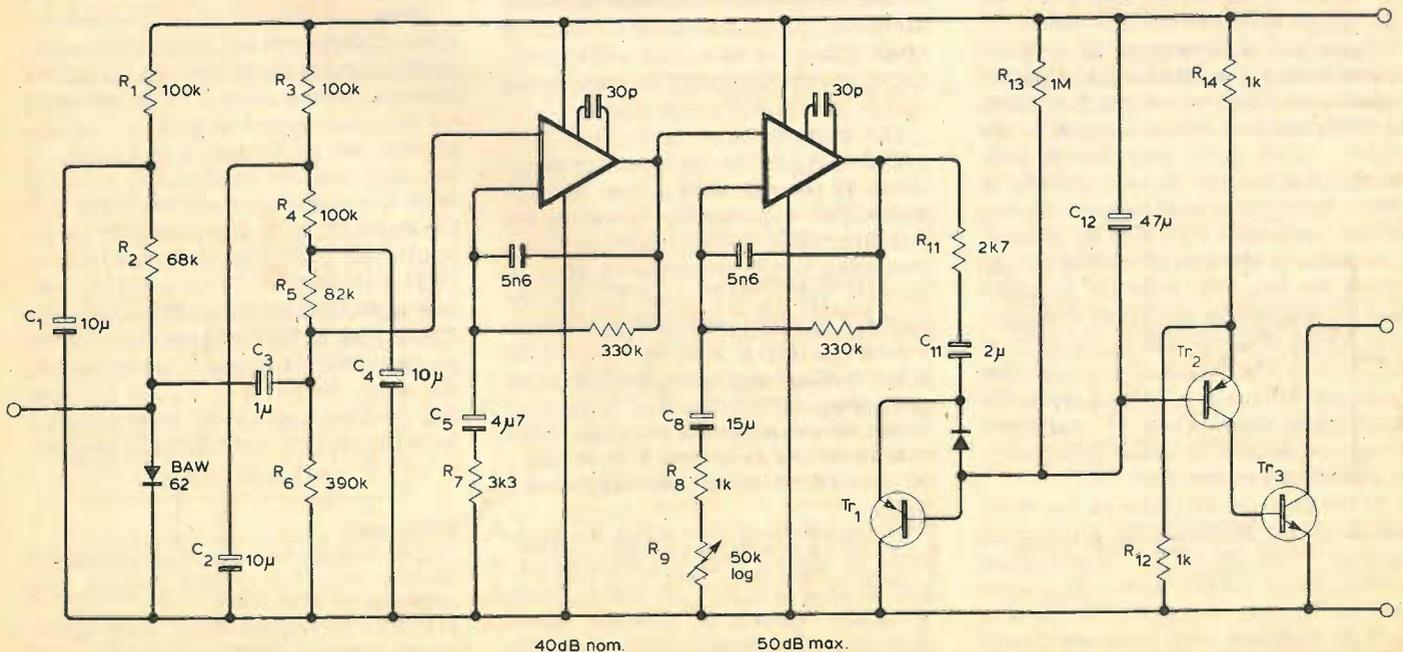
Starting at the left hand side the resistor chain R_1 and R_2 provides well-decoupled current bias for the mixer, the diode being merely for protection against the input charging up when the mixer is absent which carries the risk of mixer damage when it is re-connected. Even without microwave bias the mixer voltage is only 0.3V which is below diode conduction with the 43µA direct current bias.

The second resistor chain biases the op-amps to the best point for a symmetrically-clipped sinewave output on overdrive. With the use of the Gunn power supply capacitors C_1 and C_2 can be omitted.

The first op-amp has a voltage gain of 100 and the second 300, a total of 90dB ignoring impedance differences. Gain of the second can be reduced 50 times with R_9 . Because radar range varies as the fourth power of power gain, this is equivalent to a range change of seven times. For a lower range of sensitivity the first op-amp 330kΩ resistor can be reduced.

The second op-amp is directly connected to the first and the circuit is both very economical in the use of components and has good ripple rejection properties. No economy is sacrificed in performance.

The amplitude-response of the amplifier is suitable for an MID. The low frequency cut-off is controlled by C_5



and C_8 . The input capacitor plays little part as it was chosen large for low noise reasons. At maximum gain C_5 and C_8 and their associated resistors cause the response to be -3dB at 11Hz which corresponds to a radial velocity of 15.8mm/s or 0.6in/s , assuming the UK MID frequency of 10.687GHz . Range will be roughly proportional to velocity below this due to the 12dB per octave response of the two time constants. With reduced gain R_9 will reduce the fall-off of the second time constant and response will fall with speed more slowly.

The ability of the radar to reject faster-than-walking-speed targets is also controlled by two time constants, those of the capacitor across each op-amp feedback resistor. With 5.6nF capacitance across 330kohm the -3dB point per stage is at 86Hz or 1.25m/s (1.5ft/s or 2.8mile/h). Range will be half at twice this velocity and decrease inversely proportional to velocity thereafter.

Amplifier noise was measured with both a mixer connected and a 1kohm substitute. At the time the amplifier had only one third of the size of feedback capacitors and an upper response of approximately 240Hz . Noise voltage equivalent input for the resistor varied from 0.3 to $0.6\mu\text{V}$ r.m.s. depending on which of ten i.c.s was used, as measured by the usual averaging "r.m.s." meter. On an oscilloscope the larger figure corresponded to $4.4\mu\text{V}$ pk-pk equivalent. This is well below that expected from the microwave module and makes the exact value inimportant.

Amplifier gain required can be seen from the $5\mu\text{V}$ r.m.s. expected noise input and the 2V pk-pk output from the op-amps which will cause a build-up to an alarm level in the circuit which follows the op-amps. This is 103dB and so 90dB offers a reasonable safety factor. The threshold at which the circuit following the op-amps just begins to work is 1.5V pk-pk.

Fluorescent lights can interfere with the operation of an MID and the use in the presence of these must be avoided unless a circuit is fitted with rejection capabilities. The ionized gas fluctuates at 100Hz and can induce a signal in the radar. With just one lamp predominating this may be substantially at 100Hz but with several lamps a strong 200Hz component may also be present. The phase of the signal relative to the mains can also vary over the full 360° due to differences in target distance. The design of a suitable comb filter is not within the scope of this article. Low-pass filters are only marginally acceptable, even when of multipole design, because of the loss of response to all but slow movement.

In the past the MID design has paid far too little attention to protection against being set off by interference pulses, even single ones, let alone several. To some extent this is due to a lack of designers with both electronic

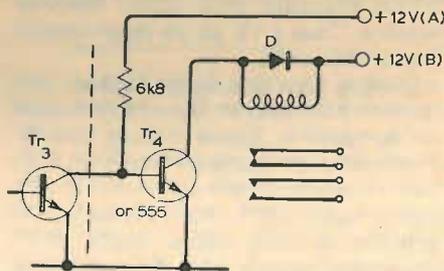


Fig. 8. Normal practice is to have a relay energized so that power failure can be indicated. For a high security area a 555 timer (fed by Tr_4 or with Tr_3 collector connected to pin 2) could be arranged to short a relay hold-off after a short interval.

For use with a 555, (A) connects to 0V, the diode is omitted, Tr_4 collector becomes pin 3, and its base connects to pin 2.

circuit design experience and microwave engineering experience.

Radar wavelength at 10.687GHz is 28mm and one beat frequency cycle is produced by the mixer for each 14mm of radial movement toward or away from the radar. Thus a counting or similar process is possible and hence a circuit which requires a certain distance of movement before an alarm is set off. This is not complete proof against much shorter oscillating movements which can wobble the vector² and produce a beat signal but it does provide valuable protection against multiple interference pulses of a few at a time and against single short infrequent movements. A memory can be provided to defeat an approach in a series of short movements and the proportioning of the memory time versus degree of protection provided is a matter for design consideration.

In the circuit shown the capacitor C_{11} is used as a bucket to charge C_{12} with one bucket of charge per cycle. Thus the radial movement distance required to charge C_{12} to about half the supply voltage and so set off the alarm by causing Tr_2 to conduct, is determined by the ratio C_{11}/C_{12} . A single movement of about 600mm or 24 inches will trip the circuit shown. Capacitor C_{11} loses some charge voltage due to the diodes.

The memory time constant is controlled by R_{13} across the capacitor and is about 47 seconds with a low leakage electrolytic — preferably tantalum for stability. Thus 37% of any previous movement is still remembered after 47 seconds. Values of C_{12} and R_{13} may be altered if required, provided electrolytic leakage-current is paid due regard. In practice any changes are unlikely to be more than three times. For instance 9 inches of movement is probably good enough for the most critical user and a 50 second memory will take some beating.

Transistor Tr_1 is a bootstrap arrangement to ensure that the charge per bucket does not fall off appreciably when C_{12} charges up. With the alarm detecting an intruder and a 7.5 volt

amplifier supply the output of the op-amp will usually be at least 4V pk-pk.

In use the output transistor Tr_3 is intended to short the base-emitter junction of a relay transistor, such as in Fig. 8. It is normal with alarms to have the relay energized when the circuit is working and no alarm condition so that power failure is indicated. Transistor Tr_3 will sink several mA and is very conservatively used at 2mA . It could be ten with little risk.

Alternatively, Tr_4 could operate a 555 timer, or itself be a 555 timer in which case the base connection shown would be pin 2. The 555 appears to have a built-in diode suitable for relay driving, although this is not stated in the data. The use of a five minute alarm which expires if there is no further movement is a useful feature for avoiding a noise complaint and leaves the system ready to detect the next disturbance. For a high security area the 555 would be arranged to short a relay hold-off control as in Fig. 8. Thus an alarm is given if wires are cut.

Both the amplifier on its own and complete with the microwave module were tested for power supply ripple rejection. The amplifier at that time used smaller feedback capacitors and had an upper -3dB point per stage of 240Hz . Thus ripple rejection will be generally better above 100Hz than the figures shown.

Table 6. Typical ripple rejection for Fig. 7 and module

Ripple frequency (Hz)	10	50	100	500
Rejection with 12V supply (mV pk-pk)	55	55	70	500
Rejection with 7.4V supply (mV pk-pk)	36	36	45	500

These are typical rather than worst-case ripple figures but not too important as the use of a stabilizer with only 30dB rejection would allow a 1V pk-pk ripple on the stabilizer input. Thus, as expected, the performance is limited by the less tolerant microwave circuits. With the microwave module fitted and the stabilizer to be described a 1V pk-pk ripple over the frequency range 10Hz to 1kHz had no effect with a supply voltage of 10.5V . Also with a 12V supply the ripple had to be increased above 5V pk-pk before the ripple could be seen in the noise. Removal of C_1 and C_2 from Fig. 7 when the circuit was powered from the Gunn supply did not alter this.

To be continued

References

1. M. W. Hosking, Microwave intruder alarm. *Wireless World* vol. 83 1977, July pp. and August pp.
2. Holford K. Doppler Radar With Sense, *Wireless World* vol. 78 1972, pp. 535-9.

Circuit analysis by small computer

Tedious though flexible matrix technique lends itself to computer calculation

by A. S. Beasley, B.Sc., McMichael Ltd.

As the price of desktop computers falls, they are coming to be regarded as another piece of lab equipment, along with oscilloscopes and analysers. Using such machines designs may be checked and components "tweaked" for optimum performance, without any danger of damaging expensive components.

This article shows the principles of computer circuit analysis; a second shows how a Commodore Pet can be used to "bread-board" circuits ranging from micro to audio frequencies. As desktop machines become more common this approach must look increasingly attractive to professional users in industry and education, as well as to non-professionals.

Many textbooks deal with linear two-port analysis; because of their familiarity I shall use them as an introduction to a far more powerful multi-port technique.

Consider the two-port network of Fig. 1. Choose any two of V_1, V_2, I_1, I_2 ,

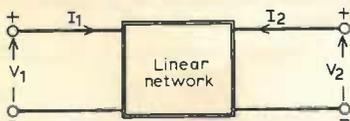


Fig. 1

as independent variables and the remaining two as the dependent variables. Choosing the voltages as the independent variables and assuming linearity, write

$$I_1 = y_{11}V_1 + y_{12}V_2$$

$$I_2 = y_{21}V_1 + y_{22}V_2$$

or in matrix form

$$\begin{pmatrix} I_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix}$$

where the y-parameters have the dimensions of admittance, the reciprocal of impedance. Figure 2 gives the y-

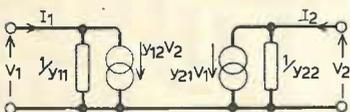


Fig. 2

parameter equivalent circuit of any linear two-port network and Table 1 gives the gain and impedance properties

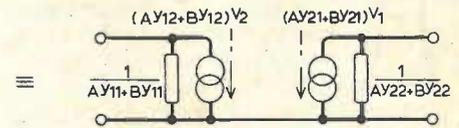
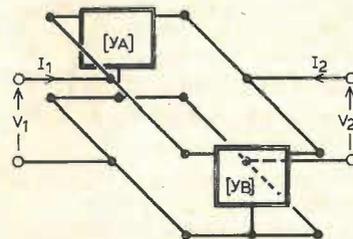


Fig. 3

terminated in a load admittance Y_L and driven from a source of admittance Y_S .

Consider paralleling two different two ports, as in Fig. 3. It is immediately obvious from the equivalent circuit representation that the overall two-port network (formed by the combination of networks A and B) has the following y-parameters

$$y_{11} = AY_{11} + BY_{11} \quad y_{21} = AY_{21} + BY_{21}$$

$$y_{12} = AY_{12} + BY_{12} \quad y_{22} = AY_{22} + BY_{22}$$

The overall y-parameters are simply the sum of the parts. It is this property of the admittance representation that we shall now generalize: the property of adding small matrices to describe the whole circuit, i.e. $[y] = [y_A] + [y_B]$

Indefinite admittance matrix

The indefinite admittance matrix or YF matrix relates the total current at any node in the circuit to the voltages at the nodes, where voltages are referenced from some node external to the circuit. This is best illustrated by an

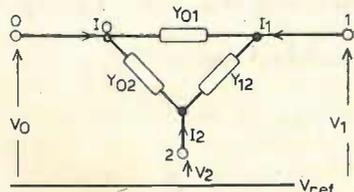


Fig. 4

where Y_{01}, Y_{02}, Y_{12} are admittances.

example; consider Fig. 4. You can see that

$$I_0 = (Y_{01} + Y_{02})V_0 - Y_{01}V_1 - Y_{02}V_2$$

$$I_1 = -Y_{01}V_0 + (Y_{01} + Y_{12})V_1 - Y_{12}V_2$$

$$I_2 = -Y_{02}V_0 - Y_{12}V_1 + (Y_{02} + Y_{12})V_2$$

or in matrix form

$$\begin{pmatrix} I_0 \\ I_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} Y_{01} + Y_{02} & -Y_{01} & -Y_{02} \\ -Y_{01} & Y_{01} + Y_{12} & -Y_{12} \\ Y_{02} & -Y_{12} & Y_{02} + Y_{12} \end{pmatrix} \begin{pmatrix} V_0 \\ V_1 \\ V_2 \end{pmatrix}$$

Notice that the YF matrix exhibits a great deal of symmetry. It may be

Table 1

$$Z_{in} = \frac{y_{22} + Y_L}{D_y + y_{11}Y_L} \quad A_v = \frac{V_2}{V_1} = \frac{-y_{21}}{y_{22} + Y_L}$$

$$Z_{out} = \frac{y_{11} + Y_s}{D_y + y_{22}Y_s} \quad A_i = \frac{I_2}{I_1} = \frac{y_{21}Y_L}{D_y + y_{11}Y_L}$$

where $D_y = y_{11}y_{22} - y_{12}y_{21}$

shown rigorously* that for any passive circuit

- Y_{nn} is the sum of all admittances connected to node n
- Y_{nm} is minus the sum of all admittances connecting the n to the m node
- the sum of any row or column is zero (this applies to active circuits as well as it derives from conservation of charge)
- $Y_{nm} = Y_{mn}$

These four properties of the YF matrix allow any passive network to have its YF matrix written down by inspection. These same properties also allow a computer to create the YF matrix with great ease; only the nodes that components lie between and their value need be known.

The technique in summary

For passive networks rote application of the four rules produces the YF matrix. For active networks use Table 2 to find the YF matrix. For a network with active and passive components simply add the individual YF matrices obtained by considering the passive and active components on their own. YF matrix may be reduced to a simple two-port network and then application of Table 1 gives the impedances and gains of the network.

Reduction of the YF matrix

The way to extract information from the YF matrix concerning impedances and gains (as for the two-port network) is to note that the currents in the YF representation give the total current flowing into a particular node. By Kirchhoff's Law we know that this is zero for all internal nodes, i.e. nodes not connected to the input or output of the network.

To demonstrate by means of an example, see Fig. 5. You can see that

$$\begin{pmatrix} I_0 \\ I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} Y_{01} + Y_{02} + Y_{03} & -Y_{01} & -Y_{02} & -Y_{03} \\ -Y_{01} & Y_{01} + Y_{12} + Y_{13} & -Y_{12} & -Y_{13} \\ -Y_{02} & -Y_{12} & Y_{02} + Y_{23} + Y_{12} & -Y_{23} \\ -Y_{03} & -Y_{13} & -Y_{23} & Y_{03} + Y_{13} + Y_{23} \end{pmatrix} \begin{pmatrix} V_0 \\ V_1 \\ V_2 \\ V_3 \end{pmatrix}$$

Because $I_3 = 0$ eliminate V_3 by putting

$$V_3 = (Y_{03}V_0 + Y_{13}V_1 + Y_{23}V_2) / \Sigma$$

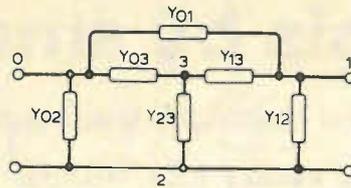
where $\Sigma = Y_{03} + Y_{13} + Y_{23}$

For a two-port network measure voltage from node 2 (i.e. $V_2 = 0$). Substituting these relationships into the YF matrix:

$$\begin{pmatrix} I_0 \\ I_1 \end{pmatrix} = \begin{pmatrix} Y_{02} + Y_{01} + Y_{03} - Y_{03}^2 / \Sigma & -(Y_{01} + Y_{03} \cdot Y_{13} / \Sigma) \\ -(Y_{01} + Y_{13} \cdot Y_{03} / \Sigma) & Y_{01} + Y_{12} + Y_{13} - Y_{13}^2 / \Sigma \end{pmatrix} \begin{pmatrix} V_0 \\ V_1 \end{pmatrix}$$

So by equating all internal currents to zero we have found the two-port y-parameters, and using Table 1 we deduce the impedances and gains of the network.

Fig. 5



where Y_{01} etc. are admittances.

YF matrix for active components

Consider the transistor in Fig. 6. From the data sheet we can quickly discover its common-emitter y-parameters, which relate the currents into the base and collector to the voltages applied (referenced from the emitter). Now even for active components conservation of charge is obeyed so by rule three the YF matrix for the transistor is

$$\begin{pmatrix} y_{ie} & y_{re} & -(y_{ie} + y_{re}) \\ y_{fe} & y_{oe} & -(y_{fe} + y_{oe}) \\ -(y_{ie} + y_{fe}) & -(y_{re} + y_{oe}) & \Sigma \end{pmatrix}$$

where $\Sigma = y_{ie} + y_{re} + y_{fe} + y_{oe}$

Table 2 gives the YF matrices for other common two-port networks.

YF matrix for active and passive components

Now that YF matrices of active and passive networks can be created the "parallel networks add y-parameters" rule can be used, which carries over the more general YF matrix. The following example illustrates the techniques we can now use.

It is because this technique is so flexible, handling any configuration of components, yet is a rote procedure with straightforward though tedious calculation, that it is ideally suited to the computer.

A second article will outline a program based on the YF matrix and discuss modelling techniques.

*High Frequency Amplifiers by R. S. Carson. Wiley Interscience.

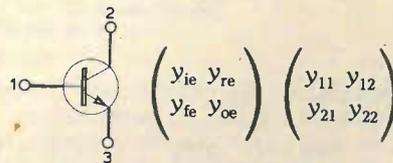
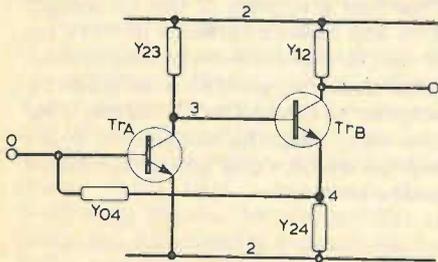


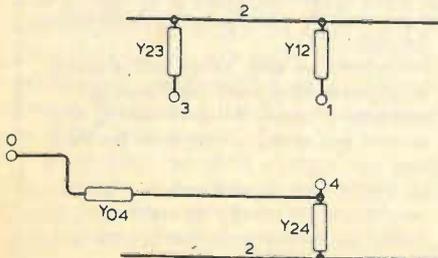
Fig. 6

Example

To analyse



represent the circuit as a paralleling of



$$YF_1 = \begin{pmatrix} Y_{04} & 0 & 0 & 0 & -Y_{04} \\ 0 & Y_{12} & -Y_{12} & 0 & 0 \\ 0 & -Y_{12} & \Sigma_1 & -Y_{23} & -Y_{24} \\ -Y_{04} & 0 & Y_{24} & 0 & Y_{04} + Y_{24} \end{pmatrix}$$

where $\Sigma = Y_{12} + Y_{23} + Y_{24}$

and

$$YF_2 = \begin{pmatrix} A y_{ie} & 0 & -(A y_{ie} + A y_{re}) & A y_{re} & 0 \\ 0 & 0 & 0 & 0 & 0 \\ -(A y_{ie} + A y_{re}) & 0 & \Sigma_A & -(A y_{re} + A y_{fe}) & 0 \\ A y_{re} & 0 & -(A y_{fe} + A y_{oe}) & A y_{oe} & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

where $\Sigma_A = A y_{ie} + A y_{re} + A y_{oe} + A y_{fe}$

$$YF_3 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & B y_{oe} & 0 & B y_{fe} & -(B y_{oe} + B y_{fe}) \\ 0 & 0 & 0 & 0 & 0 \\ 0 & B y_{fe} & 0 & B y_{ie} & -(B y_{re} + B y_{ie}) \\ 0 & -(B y_{ie} + B y_{oe}) & 0 & -(B y_{fe} + B y_{ie}) & \Sigma_B \end{pmatrix}$$

where $\Sigma_B = B y_{ie} + B y_{re} + B y_{oe} + B y_{fe}$

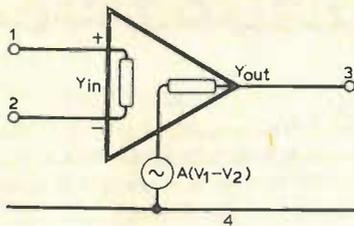
The overall YF matrix is then

$$YF = YF_1 + YF_2 + YF_3$$

The tedious but simple calculations to reduce the YF matrix are best left to a computer; these calculations will yield the impedances and gains of the circuit.

Table 2
Op-amp

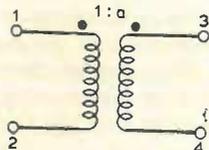
$$\begin{pmatrix} Y_{in} & -Y_{in} & 0 & 0 \\ -Y_{in} & Y_{in} & 0 & 0 \\ -A \cdot Y_{out} & A \cdot Y_{out} & Y_{out} & -Y_{out} \\ A \cdot Y_{out} & -A \cdot Y_{out} & -Y_{out} & Y_{out} \end{pmatrix}$$



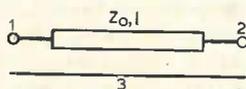
Ideal transformer

$$\begin{pmatrix} a^2Y & -a^2Y & -aY & aY \\ -a^2Y & a^2Y & aY & -aY \\ -aY & aY & Y & -Y \\ aY & -aY & -Y & Y \end{pmatrix}$$

where $Y = 1.5 \times 10^4$



Transmission line



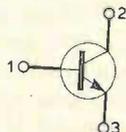
Line impedance Z_0 length l at a frequency where $h = 2\pi/\lambda$

$$\begin{pmatrix} \frac{1}{jZ_0 \sinh l} + \frac{j \tan(hl/2)}{Z_0} & \frac{-1}{jZ_0 \sinh l} & \frac{-j \tan(hl/2)}{Z_0} \\ \frac{-1}{jZ_0 \sinh l} & \frac{1}{jZ_0 \sinh l} + \frac{j \tan(hl/2)}{Z_0} & \frac{-j \tan(hl/2)}{Z_0} \\ \frac{-j \tan(hl/2)}{Z_0} & \frac{-j \tan(hl/2)}{Z_0} & \frac{2j \tan(hl/2)}{Z_0} \end{pmatrix}$$

given y_e parameters

$$YF = \begin{pmatrix} y_{ie} & y_{re} & -(y_{ie} + y_{re}) \\ y_{fe} & y_{oe} & -(y_{fe} + y_{oe}) \\ -y_{ie} - y_{fe} & -y_{re} - y_{oe} & \Sigma \end{pmatrix}$$

where $\Sigma = y_{ie} + y_{re} + y_{fe} + y_{oe}$



Adaptable anatomy for a.t.e.

A new form of integrated automatic test equipment, the GRADUATE, unveiled by its maker, Marconi Space and Defence Systems at the recent Brighton a.t.e. conference, offers the central advantages of "virtual instrumentation" and "reconfigurability." Although it will have to live down a laboured cap and gown presentation (it forms the "T" in the name whenever a mention occurs in the technical literature headings), the facilities lurking behind these two terms are quite real.

"Virtual instrumentation" involves dispensing with conventional test instruments, using instead software-combined modules, with the intention of simplifying measurement and readout, and adapting easily to different test requirements. Checks are made by the a.t.e. circuits and the results fed to the central v.d.u., which also displays simulated front panel controls, the instrument being simulated depending upon the way in which the a.t.e. has been "configured" by the software. A set of functional modules carries out the work and comprises three main sections, i.f., r.f., and digital. These modules are inserted into a kernel composed of four shelves, each of which has eight injection mouldings capable of holding one double or two single modules. Matching connections are provided at each module for service inputs, permitting any module to be inserted anywhere in a kernel.

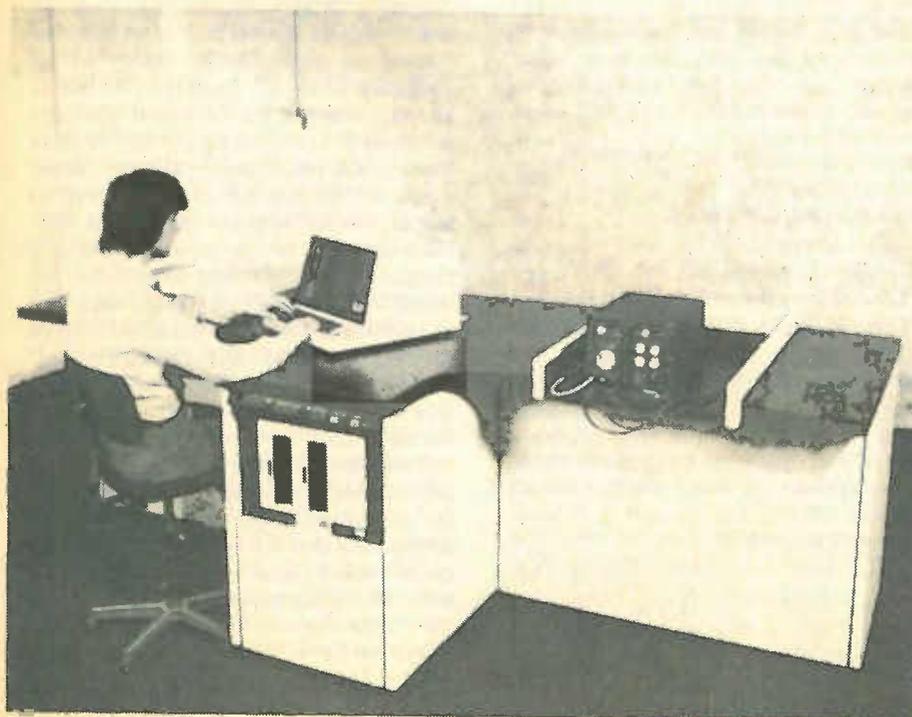
The central controller is a 24-bit word processor using bit-slice technology with a fixed microcode in p.r.o.m. and an extension e.p.r.o.m. for controller firmware development. The main memory is expandable in 32K word steps up to 1M word, and standard peripherals are a v.d.u. and keyboard, dual floppy-disc drive, line printer for program development and strip printer for test results.

Part of the control process is a calibration facility, deviations of each module from its "standard" performance being stored in p.r.o.m. within the module at the time of calibration. This means that close-limit accuracy in the modules themselves is made unimportant and, assuming that the characteristics of each module are stable, their stimulus outputs and measured inputs can be automatically corrected using the stored data.

A self-test facility provides for individual modules and integral p.c.bs to be tested using resident programs, and a self-test module permits on-line validation checks to be carried out during normal testing, ensuring that any failure is not incorrectly attributed to the equipment.

Module isolation is effected using a 25kHz, three-phase power distribution system. This is transformer-coupled and rectified on the interface power assembly board contained in each module. One ribbon cable is used to distribute the supply to each module and another carries analogue signals between them. For high frequency and fastedge signals the performance of the ribbon highway becomes inadequate and appropriate functional modules therefore have separate front panel connectors. A high-frequency, three-switch design is available, working into the microwave region.

Physically, the GRADUATE is made up by combining up to four kernels and four 19in racks, the layout being determined by the table top. In this way it can be tailored to satisfy particular constraints of space or can be laid out in a different shape to cater for expansion, relocation or change of function.



WORLD OF AMATEUR RADIO

WARC and the amateurs

The ending, early in December, of the World Administrative Radio Conference at Geneva has left both professional and amateur communications with the major problem of sorting out exactly how they will fare when the new international table of frequency allocations comes progressively into use over the years ahead. The problem, as some of us foresaw, is that a divided and highly political conference has added such a proliferation of "footnotes" to the regulations that it has almost destroyed any remaining coherence of the frequency table, and indeed some observers go so far as to suggest that it has left world spectrum management virtually in tatters. There are also now many "resolutions" not directly reflected in the frequency table.

However, at least by comparison with some other services, radio amateurs in Region 1 (and also radio astronomers) have emerged without having suffered any immediately obvious major calamities, indeed with a few useful gains, though nobody is prepared to admit being pleased with the results until the impact of various footnotes has been more fully evaluated. Certainly it is clear that all amateurs have every reason to be grateful to the International Amateur Radio Union, the R.S.G.B. and a number of the other national societies for their long-term efforts to promote better international understanding of the value of this hobby in both developed and developing countries.

The three new h.f. bands reached the international table: 10.100 to 10.150MHz (about 29.6 metres); 18.068 to 18.168MHz (16.5 metres); and 24.890 to 24.990MHz (12 metres). It will, of course, be several years before these become available to amateurs (possibly 10.1MHz will be the first to be transferred to the amateur service). The availability of amateur allocations at 7, 10, 14, 18, 21, 24 and 28MHz should prove a useful incentive for further ionospheric research as well as making long-distance operation possible at most times of the day or night, throughout most of the sunspot cycle. However the allocations are only 50 or 100kHz wide and this will call for a high degree of self-discipline to avoid the worst effects of over-crowding, particularly if the bands are open for all modes of transmission. A small "Top Band" allocation (1810 to 1850kHz) is now back in the International Table from which it vanished in 1947, with the "footnote" that permits U.K. operation between 1800 to 2000kHz remaining attached to the table. In fact U.K. amateurs do not appear to have lost any

h.f. or v.h.f. frequencies, though it is too early to say whether or not operation on some bands will be adversely affected by the many new footnotes.

According to returning delegates and observers, one of the many surprises of WARC was the very disappointing attitude shown towards amateur radio by the Japanese delegation, despite that country's domination of the world market for amateur radio equipment. Amateurs are also hoping that the active role taken at Geneva by the Chinese delegation may mean less use of 7MHz amateur frequencies by broadcasting stations in that country — and possibly licensing of amateurs there. There is also a sense of relief that the new h.f. allocation for international broadcasting above 13.6MHz is unlikely to extend beyond 13.8MHz instead of the proposed 14.0MHz and this gives rise to the hope that a "cordon sanitaire" will be maintained between the megawatt and the amateur 14MHz band.

From all quarters

North American amateurs on 50MHz continued to be received in Europe daily throughout November and it seems likely that this month will prove to have been the peak period of Solar Cycle 22. Even low-power stations were received with excellent signal-to-noise ratios, usually around 1400GMT. On November 18th, Angus McKenzie, G30SS could still copy signals from VE1ASJ near St. John, New Brunswick, Canada when that station progressively reduced power from 0.6W to about 10mW! While most of the 50MHz openings were to the East Coast of Canada and the USA, on some days excellent signals were received from stations from Texas, California and even Mexico City.

The original 144MHz London repeater GB3LO at Crystal Palace has been extensively modified and re-installed in readiness for the change to the planned new four-repeater coverage of London and for which it will become GB3SL (R2) with GB3NL at Enfield on R7; GB3WL on R1 at Hillingdon (all these three repeaters being run by the UK FM Group (London); and GB3EL on R0 at Havering. Some at least of these should be in operation by the time these notes appear. A new u.h.f. (70cm) repeater, GB3SK, has opened at Folkestone on channel RB6.

RACE (radio amateur club de l'espace), a group of French amateurs mostly working at scientific research establishments, is aiming to build equipment for a French amateur satellite.

According to observations made by Ron Ham at Storrington, Sussex, sporadic E reception of signals between 40 and 80MHz occurred on 48 days between May 19 and August 21, 1979 compared with 69 days in 1978 and 37 days in 1977, once again emphasising that there appears to be no direct connection between solar activity and the seasonal Sporadic E conditions.

There have been many different versions of how amateurs acquired their not-always-appreciated sobriquet "ham". According to a story in "Worldradio", it began in 1911, and a station operated by three young members of the Harvard Wireless Club: Albert Hyman, Bob Almy and Reggy Murray. In the period before official licences were issued in the USA, they used a self-assigned call sign formed from the initial letters of their surnames, HAM. Subsequently Albert Hyman was asked to appear before the US Congressional committee where his arguments against imposing licence fees on American amateur stations, such as HAM, attracted nationwide publicity. It is a plausible story, but there have been other accounts suggesting that like "73" (best regards) it all started much earlier, in the days of land-line telegraphists.

In brief

An American amateur, Mike Vestal, W0YZS last year became the first amateur to "Work All States" on the 430MHz (70-cm) band ... The 1980 R.S.G.B. National VHF Convention is to be held at the "Winning Post." Twickenham, Middlesex on March 8 ... Forthcoming 7MHz contests organised by the R.S.G.B. comprise a telephony contest on February 2-3 and c.w. on February 23-24 ... Decisions taken at WARC, Geneva may make it possible for Class B licensees to use the 70MHz band ... A long-range planning committee of the A.R.R.L. is attempting to identify "the opportunities and the obstacles that lie ahead and what the League should be doing to prepare for them" ... P. Balestrini, G3BPT was due to be installed as the 46th president of the R.S.G.B. in the course of an evening cruise on board the motor vessel "Mayflower Garden" on the River Thames on January 12th ... American amateurs are concerned at the very high failure rate of candidates sitting examinations for "Advanced Class" licences and have pointed out that the official FCC "study guide" often bears little relationship with the questions asked as a result of the updating of study guide and examination to different timetables.

PAT HAWKER; G3VA

More on the scientific computer — 2

An improved monitor

By J. H. Adams, M.Sc.

Since publication of the scientific computer, correspondents have suggested several features to improve the performance. This new monitor incorporates many of those features and includes a general expansion of the facilities available in BURP, including the routines for graph plotting. By restructuring the interpreter four extra functions, described in table 7, have been fitted into the three original e.p.r.o.ms. The demonstration programs have been removed, but these could be stored on tape, and the Creed 75 teleprinter interface has been replaced by a standard 110 baud ASR/KSR interface. The KSR machine is now cheaper and is fairly standard whereas the 75 may have different speeds and encoding as I suspect some readers have found to their cost.

Hardware modifications

Connections for the two extra keys are shown in Fig 3. The interface for the teleprinter is essentially a latch as in the original design, but this must be connected to D_0 instead of D_7 . Most teleprinters contain an interface card for a 20mA loop or an RS-232 link. For a current loop, the second circuit drives the printer quite satisfactorily.

Firmware modifications

Changes to the firmware are detailed in tables 8 and 9. Primarily, space has been made in the first e.p.r.o.m. for three of the subroutines originally in the second which deal with instruction entry and condition testing of the MM57109. This has been achieved by using a simpler and shorter teleprinter interface, eliminating the subroutine at 034E, and trimming the low level monitor so that it ends at 024E. This has left space in the second e.p.r.o.m. for a new subroutine 051D which extends the old 04E6, now 047C, and together they can recognise and deal with the new facilities. Because these routines are quite complex, a disassembled listing of each is given in table 10.

The third r.o.m. is slightly briefer because checks for ends of lines, present in virtually all of the statement handling routines, are replaced by 051D. The command MOD (08BE) has been changed so that PRINTs buried in multi-statement lines are also changed to WRITEs. CALLs have been re-addressed to suit the first two r.o.ms and CALL 042E has been replaced by the single RST byte CF (see 0008). In the

original r.o.m., after going through the sequence of recognition checks for encoded commands or, later, first words of statements, the interpreter returns to the command state or ignores the rest of the line respectively, if it cannot find a match or the generated code within the firmware.

This is particularly useful for dealing with REM because, being unrecognised, such lines are ignored as explained last month. A major change in the modified r.o.m. provides jumps to 1C00 (at 0975) for commands, to 1C60 (at 0AD7) for new statements and to ID00 (at 0BDE) for new functions. As a result REM has disappeared but the apostrophe has the same effect and retains the facility for remarks.

0993 is an example of where 051D is used solely to jump spaces between the

line number and the first word of the statement. Therefore, it is the point to which 051D transfers execution after coming across an ! in the text being interpreted. 097F pops off the stack, increments and pushes back the C register which is used as the line register store and then looks for and executes that new line. Thus, it is the point to which 051D transfers control after finding a ' or 8DH number in the text. Because the computer scans the text for line numbers whether they exist or not, the lines in a program should be as close together as possible (say every other line) for the fastest program execution. Using multiple statements avoids this problem to some extent and can therefore reduce the execution time of some programs, particularly simple ones, by up to 20%.

Table 7. Additional facilities for the new monitor.

INT (0B64)	Outputs the number in the 57109 to 1E00 — F and tests the exponent sign. If negative, the whole number is written to zero, if positive, the lower mantissa exponent is drawn and used to calculate (OB72-8) where blanking should start. If the exponent is not less the 09 (OB80-B), blanking is carried out. The number stack in the 57109 is then collapsed by one to remove the old value (OB97) and the new value is entered into the 57109 by a jump to 050F at OB9A.
FRAC (0BA1)	Outputs the number and tests as in INT. If the exponent sign is negative, execution jumps to OB96 (0BA5) and effectively does nothing. For positive exponents a similar sum involving the lower mantissa exponent digit is performed and a jump is made back to OB79 in the INT routine (0BAE).
RND (0BB4)	029F is called which loads the refresh register into A, converts it to a three digit decimal integer and enters it into the 57109 (this subroutine runs straight into 02AD). A pseudo-random delay (0BB8-A) based on the current v.d.u. printing position is then called so that a second call of 029F will generate a second number from the Z80 refresh register which is only tenuously linked to the first. These numbers, now in the Y and X registers of the 57109, are combined through the sequence of instructions at 0BBE to give $X = 128X + Y / 16383$, i.e. a reasonably random number between 0 and 1. Note that as this uses two of the 57109 stack registers, no more than two other variables must be present in the 57109 when RND is used.
ABS (0BD3)	This simply uses the number cruncher test instruction 12 to test for a negative number in the X register. The result of this test governs whether the instruction to change sign, OC, is executed.

Table 8. Alterations to the first r.o.m.

024F was 03CE	0263 was 0260	0282 was 058A
02AD was 024E	02C7 was 0446	0326 was 0317
0345 was 0336	0367 was 0729	0374 was 0372
0395 was 0393	03A1 was 039F	03AB was 03A9
03C6 was 03C4	03D1 was 0260	

029F	Generates a 7-bit pseudo-random number and inputs it to the 57109.
02D1	Converts the computer 6-bit ASCII to true ASCII and prints it.
02D9	Prints a space.
02DE	Prints carriage return and line feed.
02E8	Prints the contents of register A.
02F0	Prints (A) as a two character hexadecimal byte.
0317	Prints CR, LF, the contents of HL in hexadecimal and a space

Using the new facilities

In low level the first feature to be noted is that READY does not disappear when a command is typed in nor does the first letter appear at the beginning of the second v.d.u. line. This is because the same algorithm is now used for both high and low level word recognition. Clashes produced in the changeover explain the changes of COR to MOD and PROM to PROG. To leave LOAD, the space key is now used instead of @. The main change which affects both levels is that the interrupt-and-reset, which occurred whenever any key was depressed, has been omitted because control can be regained by using RESET. The "arrow" keys now revert to standard keys, RESET enters the low level and Control A (depressing A and the control key simultaneously) enters the high level. The delete key to the right of] can be used to delete complete bytes by one depression per byte. Although this will cause the formatting to go out of true during the LOAD, the grouping by four is maintained and on pressing the space bar at the end of the load the format will be restored.

When loading programs in high level

language, another character Control E is used to signify the end of LOADING or ADDING. This allows the colon, which was previously used for this purpose, to be included in printed messages etc. without terminating the current operation. Ensuring correct format of the input has been eased by a cursor, although with the original monitors few

problems will be encountered if a space is typed when in doubt. The DEL key backsteps and clears the last v.d.u. character and also backsteps HL. Corrections are, therefore, easily typed in, but mistaken returns and line numbers cannot be corrected in this way because

Fig. 3. Modifications to the keyboard and teleprinter interface.

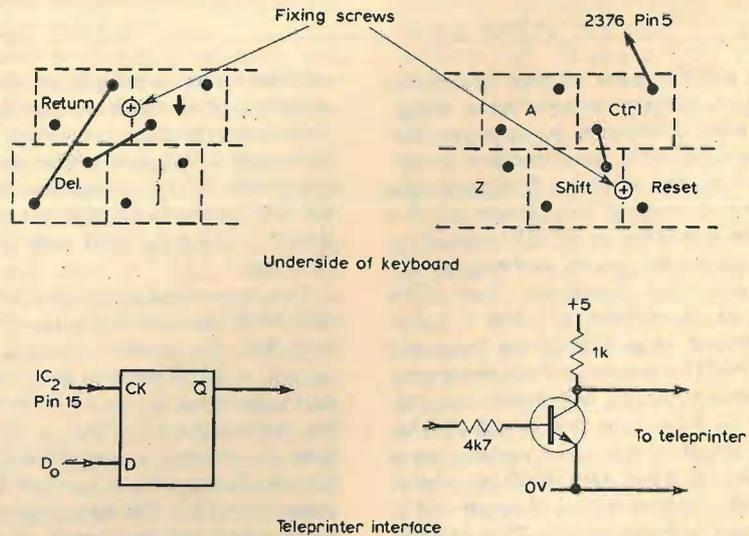


Table 9. Firmware changes.

0400	Old 04D4 running straight into 040D
040D	Old 0460
0467	Old 04BA
047C	Old 04E6, 04FA-E is added to this so that when a code of less than 0B is drawn from the look-up table at the end of the r.o.m., execution jumps to 0B60. These new codes are for ABS, FRAC, INT, RND and any others which are not simple MM57109 operations and will thus require some Z80 software.
051D	Jumps spaces and then returns on bytes less than 1B and greater or equal to 2A (except for 8D). Thus, for letters, operators and spaces, this routine will just jump spaces and return with HL pointing to the first non space, i.e. 051D is a supplement to 047C. If the byte found lies between 1A and 2A it will, after: (a) "(052D) transfer text up to the next" onto the v.d.u. and then jump back to the start of the subroutine to deal with whatever follows. (b)) (053B) collapse the stack and return. (c) ((0542) call 051D to jump spaces and then 047C to execute the text within the parentheses until the call of 051D finds a). As this) will have been found during the calling of 051D at 0546 and as (indicates that the original call of 051D is no longer required, i.e. the bracketed term has been computed, detection of) drops the stack pointer past the return address the call at 0546 so that a return is made to the original point in the interpreter from where 051D was called. After dealing with an expression in parentheses, the computed result is left in the X register of the 57109 and the SCII for), 29, is left in register A. If the interpreter has not yet recognised the byte it must now be at the end of the statement. Before looking for a ! ' or 8DH, two types of statement need special attention. 1FE1 is used in the third r.o.m. (0999) to store the code generated from the first word of the line. If it is 33 (i.e. a WRITE statement), execution shifts from 0554 to 056B. WRITE lines are similar to print types except that the material to be displayed is fed to locations from 1D80 rather than to the v.d.u. 056B sets an FF at the end of the block used and then resets DE to 1D80 and outputs the characters up to FF on the teleprinter. After restoring AF and DE it returns to 0563. If the line is a LET (code 2C) the variable to which the computed value is to be assigned is drawn from its store (1FE2) and the contents of the 57109 X register are fed to it. After dealing with these two special cases, checking of the original byte continues (0560). The remaining possibilities will transfer control rather than return from the subroutine and so the pointer is moved down the stack, losing the previously stored return address and then, after: (d) ! (0563) execution passes to 0993. (e) 8DH ' or anything else, passes execution to 097F. 8D is the code for return and indicates the end of a line. ' signifies that the rest of the line is a remark which the interpreter will also want to treat as the end of a line. Jumps text and then calls 051D and, when required (i.e. letters, operators or digits), 047C as well. Calls 051D as above.
0582-4	Old 0714.
0589	Old 0714.
0594	Old 0714.
05A9	Unchanged.
0736	Unchanged.
074A	Modified 074A.
075A	Old 076D.
0773	Used in the above two to cover common parts and thus save space.
0789	Used in INT and FRAC.
07A2	Unchanged.
07AC	Unchanged.
07B7	Unchanged.
07D6	Look-up table which now includes codes for new functions (07DA/DC/E3/E9).

they involve internal operations by the interpreter rather than the byte by byte storage which takes place during lines. The critical formatting points are LET lines where the variable following let must be followed immediately by the equal sign, and IF lines where, when a variable precedes the comparison sign, there must be a space in between.

A program in table II demonstrates the uses of the new facilities. Lines 3 and 4 show the new REM and in this case they are complete lines on their own. Remarks may be appended to any "active" line just preceded by an apostrophe. Line 5 shows printed text in an INPUT line. The input variable X is against the " to save r/w.m. space but again, spacing is not critical. In line 7, two spaces are left between step and 1 without any effect on the interpreting of the line. Note that the expression in parenthesis is spaced exactly as in a LET statement. Line 9 demonstrates the compounding of two LET type statements (with the LET omitted) by the use of an exclamation mark. The statement following ! is typed immediately after the !, again to conserve r/w.m. space. Line 11 is "If K is a whole number and if Z is also a whole number, then print half of K plus A to two decimal figures and then half of the positive difference between K and A". This line illustrates the need for a space between the variable and the greater than, equals or less than sign. A space is required because, under the original interpreter, this had to be a variable but it can now be a variable, number or function in parenthesis and therefore has to be distinguishable. A closing parenthesis has no other meaning and does not need the space, i.e. IF (X SIN I -) = Q print....

The text following an IF comparison can be any other permitted statement including another IF as shown in the example program. Therefore, the old form IF X=0 THEN I25 will be IF X =0 GO 125. It might seem that the freedom to place statements end to end on the same line will reduce all programs to one line in length (note that a line is not determined by the length of a v.d.u. line and may consist of any number of characters). However, this is not so because whenever a statement has to be entered as the result of a jump, or it initiates a specific jump, the statement must either start or end a program line respectively. This means that the first instruction in a FOR loop must be at the beginning of a line because further through the execution a NEXT will try to jump back to it. Similarly, the statement after the complete IF term must be on a new line because IF is basically "perform the operation specified after the conditional test if the latter is true or jump to the next line".

By similar reasoning, GOSUB and GO should be at the end of lines, as should RETURN and END. The lines to which GOSUB and GO refer should start with the statement to which the jump was directed.

While encoding the new functions by algorithm, several clashes occurred with already assigned codes and this provided an opportunity to re-encode the two log. functions into a more standard format, i.e. CLG for a common log and LOG for log. to the base e. The radian to degree conversions have

also been changed by dropping the first letter, i.e. TD for a conversion to degrees and TR for one to radians.

The author is offering a set of three p.r.o.ms programmed with the new monitor firmware for £30. Alternatively, existing p.r.o.ms can be reprogrammed for £6.50 (both plus 35p post and packing). 5 The Close, Radlett, Hertfordshire.

Table 10. Disassembled subroutines.

047C LD A,(HL)	04D9 EX AF AF'	051D INC HL
047D INC HL	04DA LD A,20	051E LD A,(HL)
047E LD C,0F	04DC CP (HL)	051F CP 20
0480 CP 20	04DD JRVZ 03 04E2	0521 JRZ FA 051D
0482 JRZ FB 047C	04DF EX AF AF'	0523 CP 1B
0484 CP 1B	04E0 JR 2E 0510	0525 RET C
0486 JRC 51 04D9	04E2 DEC HL	0526 CP 8D
0488 CP 30	04E3 CALL 0715	0528 JRZ 03 052D
048A JFVC 17 04A3	04E6 CP 20	052A CP 2A
048C CP 2D	04E8 JFVC 02 04EC	052C RET 'C
048E JRVZ 03 0493	04EA ADD 20	052D CP 22
0490 CP (HL)	04EC CP 50	052F JRVZ 0A 053B
0491 JRC 0C 049F	04EE JRC 02 04F2	0531 INC HL
0493 ADD 0D	04F0 SUB 10	0532 LD A,(HL)
0495 AND A	04F2 ADD B4	0533 CP 22
0496 JP PE049D	04F4 PUSH BC	0535 JRZ E6 051D
0499 OR 09	04F5 LD C,A	0537 LD (DE),A
049B AND FB	04F6 LD B,07	0538 INC DE
049D RST 1	04F8 LD A,(BC)	0539 JR F6 0531
049E RET	04F9 POP BC	053B CP 29
049F LD C,0C	04FA CP 0B	053D JRVZ 03 0542
04A1 LD A,(HL)	04FC JP C 0B60	053F INC SP
04A2 INC HL	04FF CP 80	0540 INC SP
04A3 EX AF AF'	0501 JRC 05 0508	0541 RET
04A4 PUSH DE	0503 EX AF AF'	0542 CP 28
04A5 EX DE,HL	0504 LD A,20	0544 JRVZ 08 054E
04A6 LD HL,1E00	0506 RST 1	0546 CALL 051D
04A9 LD B,0F	0507 EX AF AF'	0549 CALL 047C
04AB CALL 05A0	0508 AND 3F	054C JR F3 0546
04AE LD L,09	050A RST 1	054E PUSH AF
04B0 LD (HL),C	050B RET	054F LD A,(1FE1)
04B1 LD L,00	050C DEC DE	0552 CP 33
04B3 EX AF AF'	050D EX DE,HL	0554 JRZ 15 056B
04B4 AND 0F	050E POP DE	0556 CP 2C
04B6 CP 0E	050F XOR A	0558 JRVZ 06 0560
04B8 JRVZ 02 04BC	0510 PUSH HL	055A LD A,(1FE2)
04BA LD A,0A	0511 CALL 07AC	055D CALL 040D
04BC LD (HL),A	0514 LD B,10	0560 POP AF
04BD LD A,(DE)	0516 LD A,(HL)	0561 INC SP
04BE INC HL	0517 INC HL	0562 INC SP
04BF INC DE	0518 RST 1	0563 CP 21
04C0 CP 28	0519 DJVZ FB 0516	0565 JP Z 0993
04C2 JFVC F0 04B4	051B POP HL	0568 JP 097F
04C4 CP 20	051C RET	056B LD A,FF
04C6 JRZ 44 050C		056D LD (DE),A
04C8 LD L,0A		056E LD E,80
04CA LD (HL),0B		0570 LD A,(DE)
04CC INC HL		0571 CP FF
04CD LD A,(DE)		0573 JRZ 08 057D
04CE INC DE		0575 AND 3F
04CF CP 2D		0577 CALL 02D1
04D1 JRVZ E1 04B4		057A INC DE
04D3 LD (HL),0C		057B JR F3 0570
04D5 INC HL		057D POP AF
04D6 LD A,(HL)		057E POP DE
04D7 JR DB 04B4		057F POP DE
		0580 JR E1 0563

Table 11. Demonstration programs.

```

003 'THIS PROGRAM, PUBLISHED IN PART 4, TOOK 19 LIVES BEFORE. NOW...
005 PRINT "THIS PROGRAM USES NEWTONS METHOD FOR SOLVING"
007 INPUT "F = F(X). ENTER AN INITIAL VALUE NOW "Q IERASE
009 X=Q IGO SUB 25
011 G=F'IX=X 1.00001 * IGO SUB 25
013 TOP !IF (G ABS )<0.00001 PRINT "SOLUTION ="Q6 IEND
015 Q=1 F G / 1 - REC 0.00001 * - Q * IPRINT Q8 IGO 9
025 F=X LOG X 3 * + 10.3074 -
027 RETURN
    
```

0073

```

003 'THIS PROGRAM COMPUTES PAIRS OF NUMBERS WHICH, WHEN
004 'SQUARED AND SUBTRACTED, GIVE THE INPUT NUMBER
005 INPUT "INPUT NUMBER IN QUESTION "X
007 FOR A=1 STEP 1 UNTIL (X ROOT 1 + )
009 K=X A / IZ=K A - 2 / ABS
011 IF K =(X INT ) IF Z =(Z INT ) PRINT (K A + 2 / )2 (K A - 2 / ABS )
013 NEXT A IGO 5
    
```

0026

New frequency allocations

WARC 79 decisions for radio services in Region 1

The list opposite gives frequency allocations to radio services decided at the World Administrative Radio Conference (WARC 79) held by the International Telecommunication Union at Geneva, 24 September to 6 December. It is taken from the revised Radio Regulations which will come into force on January 1982 and will replace the allocations made at the previous event of this kind held in Geneva in 1959 (see October 1979 issue, p.52, for background). Because of lack of space, and the interests and geographical distribution of our readers, the information presented here is no more than an extract from the international table of frequency allocations which will be part of the Regulations and in its present form runs to 174 pages and includes hundreds of footnotes, giving additions, qualifications, restrictions etc for particular countries. First, our list covers only ITU Region 1 (Europe, Africa, Middle East and Russia). Secondly, its upper limit is 10GHz whereas the WARC allocations in fact go up as far as 275GHz. Thirdly, all the footnotes have been omitted. Nevertheless, the list does give details of the main changes which are particularly important to radio services in the UK.

For example: as a result of a change in the long-wave band limits, Droitwich (Radio 4) frequency will eventually have to be moved to 198kHz; the BBC have obtained a medium-wave frequency for their Carfax traffic information service; international short-wave broadcasting has acquired overall an additional 780kHz, including an extra band; television Channel 1 (Crystal Palace and other stations) will be transferred from broadcasting to radio communication; land mobile radio may be moving into parts of television Band I and Band III by internal agreement within the UK (the 405-line television services in these bands probably will be closing down by 1985); v.h.f. radio broadcasting will eventually be extended up to 108MHz, though for a long time it will be sharing the top end of this band (104-108MHz) with communication services; at u.h.f. two 8MHz channels will eventually become available, perhaps for land mobile radio or television, between television Bands IV and V; and at the top end of the u.h.f. band there is more space for mobile services. However, it will take a good many years

for all these changes to be implemented and some will not occur till near the time of the next WARC, possibly in 2000AD.

In the lists, the code letters show the radio services to which the frequencies have been allocated, and these codes are explained in the key below. The terminology here is approximately the same as that used in the ITU frequency allocation document. In all cases the first code letter, to the immediate right of the frequency band, indicates a "primary" service (using ITU terminology) in the band, that is, a service which has equal rights with a "permitted" service but has prior choice of frequencies when frequency plans are made. The next code letter to the right could also indicate a primary service, but in some cases it could be a "permitted" service (which has rights equal to those of a primary service except that it gets the second choice in frequencies), or a "secondary" service (which must not cause interference to primary services and cannot claim protection from interference produced by them). To avoid complications in a short article, our list does not indicate the actual categories of service applying to the second and subsequent code letters, but in general a rough guide is that the order of categories when moving through the code letters from left to right is: primary, permitted, secondary.

The following notes highlight some of the changes which may be of interest to our readers.

Long waves

The limits of the l.w. broadcasting band (150-285kHz) have been moved downwards in frequency by 1.5kHz to 148.5-283.5kHz. This has been done to bring the band in line with medium waves in having its carrier frequencies at integral multiples of the 9kHz channel spacing, to avoid heterodyne interference and facilitate digital tuning of receivers using synthesizers. The 15 channels will be moved in three blocks of 5 channels, starting in 1986 with the lower limit and ending in 1990 with the upper limit. As a result the 200kHz Droitwich broadcasting frequency will be changed to 198kHz (9kHz × 22). Radio beacon frequencies for aircraft navigation within this range will be changed accordingly.

Medium waves

The band limits of the m.w. broadcasting band (525-1605kHz) have been adjusted upwards to 526.5-1606.5kHz to give the correct amounts of space for the sidebands at these limits — an adjustment that was not made at the 1974-75 regional l.f./m.f. broadcasting conference (January 1976 issue, p.42). Just below this the BBC have acquired a 7kHz band of 519.5 to 526.5kHz on a secondary basis for their experimental Carfax traffic information service.

Short waves

The short-wave broadcasters did not get the hoped-for increase of sixty per cent or more in spectrum space but did achieve an extra 780kHz overall, which amounts to 32.5% over the present allocation. They acquired a new band at 13.6-13.8MHz (21m), extended the 13m, 16m, 19m, 25m and 31m bands by amounts varying between 100kHz and

continued overleaf

Key to code letters in list

A	Amateur
AF	Aeronautical fixed
AM	Aeronautical mobile
AMS	Aeronautical mobile — satellite
AR	Aeronautical radionavigation
AS	Amateur satellite
B	Broadcasting
BS	Broadcasting — satellite
ES	Earth to space (satellite)
F	Fixed communications
HA	Hearing aids
ISM	Industrial, scientific, medical
LM	Land mobile
M	Mobile
MA	Meteorological aid
MBS	Mobile — satellite
MLS	Microwave landing system
MM	Maritime mobile
MMS	Maritime mobile — satellite
MR	Maritime radionavigation
MS	Meteorological — satellite
RA	Radio astronomy
RL	Radiolocation or radar
RN	Radionavigation
RNS	Radionavigation — satellite
S	Space research
SAT	Satellite (Earth exploration)
SE	Space to earth (satellite)
SF	Standard frequency
SFS	Standard frequency — satellite
SI	Satellite identification
TS	Time signal

Table of frequency allocations for Region 1

L.F. (kHz)	SERVICES				
9-14	RN	7.0-7.10	A, AS	40.02-40.98	F, M
14-19.95	F, MM	7.10-7.30	B	40.66-40.70	ISM
19.95-20.05	SF & TS	7.30-8.10	F, LM	40.98-41.015	F, M, S
20.05-70	F, MM	8.10-8.195	F, MM	41.015-47.00	F, M
70-72	RN	8.195-8.815	MM	47.0-68.0	B, LM
72-84	F, MM, RN	8.815-9.040	AM	68.0-74.80	F, M
84-86	RN	9.040-9.50	F	74.80-75.20	AR
86-90	F, MM, RN	9.50-9.90	B	75.20-87.50	F, M
90-110	RN	9.90-9.995	F	87.50-100.0	B, LM
110-112	F, MM, RN	9.995-10.003	SF, TS	100.0-108.0	B, F, M, LM
112-115	RN	10.003-10.005	SF, TS, S	108.00-117.975	AR
115-117.6	RN, F, MM	10.005-10.10	AM	117.975-136.00	AM
117.6-126	F, MM, RN	10.10-10.150	F, A	136.0-137.0	AM, F, M
126-129	RN	10.150-11.175	F, M	137.0-138.0	SE, MS, F, M
129-130	F, MM, RN	11.175-11.400	AM	138.0-143.60	AM, LM, MM
130-148.5	MM, F	11.40-11.650	F	143.60-143.65	AM, SE, LM, MM
148.5-255	B	11.650-12.050	B	143.65-144.00	AM, LM, MM
255-283.5	B, AR	12.050-12.230	F	144.0-146.0	A, AS
283.5-315	MR, AR	12.230-13.20	MM	146.0-149.9	F, M
		13.20-13.360	AM	149.9-150.05	RNS
		13.360-13.410	F, RA	150.05-153.0	F, M, RA
MF.		13.410-13.60	F, M	153.0-154.0	F, M, MA
315-325	AR, MR	13.553-13.567	ISM	154.0-156.7625	F, M
325-405	AR	13.60-13.80	B	156.7625-156.8375	MM (Distress)
405-415	RN	13.80-14.00	F, M	156.8375-174.00	F, M
415-435	AR, MM	14.00-14.250	A, AS	174.0-223.0	B, LM
435-495	MM, AR	14.250-14.350	A	223.0-230.0	B, F, M, LM
495-505	M (Distress)	14.350-14.990	F, M	230.0-267.0	F, M
505-526.5	MM, AR	14.990-15.005	SF, TS	267.0-272.0	F, M, SE
519.5-526.5	BBC Carfax	15.005-15.010	SF, TS, S	272.0-273.0	SE, F, M
526.5-1,606.5	B	15.010-15.10	AM	273.0-322.0	F, M
1,606.5-1,625	MM, F, LM	15.10-15.60	B		
1,625-1,635	RL	15.60-16.360	F	U.H.F.	
1,635-1,800	MM, F, LM	16.360-17.410	MM	322.0-328.6	F, M, RA
1,800-1,810	RL	17.410-17.550	F	328.6-335.4	AR
1,810-1,850	A	17.550-17.90	B	335.4-399.9	F, M
1,850-2,025	F, M	17.90-18.030	AM	399.9-400.05	RNS
2,025-2,045	F, M, MA	18.030-18.052	F	400.05-400.15	SFS
2,045-2,160	MM, F, LM	18.052-18.068	F, S	400.15-401.00	MA, MS, SE
2,160-2,170	RL	18.068-18.168	A, AS	401.0-402.0	MA, SE, ES, F, MS, M
2,170-2,173.5	MM	18.168-18.780	F	402.0-403.0	MA, ES, F, MS, M
2,173.5-2,190.5	M (Distress)	18.780-18.90	MM	403.0-406.0	MA, F, M
2,190.5-2,194	MM	18.90-19.680	F	406.0-406.1	ES
2,194-2,300	F, M	19.680-19.80	MM	406.1-410.0	F, M, RA
2,300-2,498	F, M, B	19.80-19.990	F	410.0-420.0	F, M
2,498-2,501	SF, TS	19.990-19.995	SF, TS, S	420.0-430.0	F, M, RL
2,501-2,502	SF, TS, S	19.995-20.010	SF, TS	430.0-440.0	A, RL
2,502-2,625	F, M	20.010-21.0	F, M	433.05-434.79	ISM
2,625-2,650	MM, MR	21.0-21.450	A, AS	440.0-450.0	F, M, RL
2,650-2,850	F, M	21.450-21.850	B	450.0-460.0	F, M
2,850-3,025	AM	21.850-21.870	F	460.0-470.0	F, M, SE
		21.870-21.924	AF	470.0-582.0	B
		21.924-22.000	AM	582.0-606.0	AR (UK only)
H.F. (MHz)		22.0-22.855	MM	606.0-790.0	B, BS
3.025-3.155	AM	22.855-23.000	F	790.0-862.0	F, B
3.155-3.195	HA	23.0-23.2	F, M	862.0-890.0	F, M, B
3.155-3.20	F, M	23.20-23.35	AF, AM	890.0-942.0	F, M, B, RL
3.20-3.40	F, M, B	23.35-24.00	F, M	942.0-960.0	F, M, B
3.40-3.50	AM	24.00-24.890	F, LM	960.0-1,215	AR
3.50-3.80	A, F, M	24.890-24.990	A, AS	(GHz)	
3.80-3.90	F, AM, LM	24.990-25.005	SF, TS	1.215-1.240	RL, SE
3.90-3.950	AM	25.005-25.010	SF, TS, S	1.240-1.260	RL, SE, A
3.950-4.0	F, B	25.010-25.070	F, M	1.260-1.30	RL, A
4.0-4.063	F, MM	25.070-25.210	MM	1.30-1.35	AR, RL
4.063-4.438	MM	25.210-25.550	F, M	1.35-1.40	F, M, RL
4.438-4.650	F, M	25.550-25.670	RA	1.40-1.427	SAT, RA, S
4.650-4.750	AM	25.670-26.100	B	1.427-1.429	ES, F, M
4.750-4.850	F, AM, LM, B	26.10-26.175	MM	1.429-1.525	F, M
4.850-4.995	F, LM, B	26.175-27.50	F, M	1.525-1.530	SE, F, SAT, M
4.995-5.003	SF, TS	26.957-27.283	ISM	1.530-1.535	SE, MMS, SAT, F, M
5.003-5.005	SF, TS, S	27.5-28.0	MA, F, M	1.535-1.544	MMS
5.005-5.060	F, B	28.0-29.7	A, AS	1.544-1.545	MBS
5.060-5.450	F, M	29.7-30.005	F, M	1.545-1.599	AMS
5.450-5.480	F, AM, LM			1.559-1.610	AR, RNS
5.480-5.730	AM			1.610-1.6265	AR, RA
5.730-5.950	F, LM	V.H.F.		1.6265-1.6455	MMS
5.950-6.200	B	30.005-30.010	SI, F, M, S	1.6455-1.6465	MBS
6.20-6.25	MM	30.01-37.5	F, M	1.6465-1.660	AMS
6.525-6.765	AM	37.5-38.25	F, M, RA	1.660-1.6605	AMS, RA
6.765-6.795	ISM	38.25-39.986	F, M	1.6605-1.6684	RA, S, F, M
6.765-7.0	F, LM	39.986-40.02	F, M, S		

1.6684-1.670	MA, F, M, RA
1.670-1.690	MA, F, MS, M
1.690-1.700	MA, MS, F, M
1.700-1.710	F, MS, M
1.710-2.290	F, M
2.290-2.300	F, S, M
2.300-2.450	F, A, M, RL
2.400-2.500	ISM
2.450-2.500	F, M, RL
2.500-2.655	F, M, BS
2.655-2.690	F, M, BS, SAT, RA, S
2.690-2.70	SAT, RA, S
2.70-2.90	AR, RL
2.90-3.100	RN, RL

S.H.F.

3.100-3.400	RL
3.40-3.60	F, SE, M, RL, A
3.60-4.20	F, SE, M
4.20-4.40	AR
4.40-4.50	F, M
4.50-4.80	F, SE, M
4.80-4.990	F, M, RA
4.990-5.000	F, M, RA, S
5.0-5.250	AR, MLS
5.250-5.255	RL, S
5.255-5.350	RL
5.350-5.460	AR
5.460-5.650	RN, RL, LM
5.650-5.725	RL, A, S
5.725-5.850	ES, RL, A
5.725-5.875	ISM
5.850-7.075	F, ES, M
7.075-7.250	F, M
7.250-7.450	F, SE, M
7.450-7.550	F, SE, MS, M
7.550-7.750	F, SE, M
7.750-7.900	F, M
7.900-8.025	F, ES, M
8.025-8.175	F, ES, M, SAT
8.175-8.215	F, ES, MS, M, SAT
8.215-8.400	F, ES, M, SAT
8.40-8.50	F, M, S
8.500-8.750	RL
8.750-8.850	RL, AR
8.850-9.000	RL, RN
9.0-9.2	AR
9.2-9.8	RL, RN
9.80-10.0	RL, F

200kHz (see list) but lost 70kHz from the lower end of the 11m band, which is now 25.67-26.1MHz. There was no change below 9MHz. These gains were obtained, initially against considerable opposition, at the expense of the fixed h.f. communication bands, which tend to alternate with the broadcasting services; but the fixed services will be offered replacement frequencies. The transfers will not start until 1984, but in any case it was decided that there will be a new conference for planning the h.f. broadcasting bands and this could take place in 1982 or 1983. The first part will establish the technical parameters, then, when everyone has digested the same basic data, the planning proper will start a year or more later. At WARC 79 nineteen delegations, including the UK's, "reserved their positions" on h.f. broadcasting, which means that, in the absence of an adequate plan, they do not intend to be bound by these decisions. They felt, for example, that not

enough spectrum was allocated in the 41m and 49m broadcasting bands.

The maritime mobile service has also gained some extra space at h.f., several of the higher bands being increased by 100kHz or more.

V.h.f. bands

The radio communication services gained some extra frequencies at v.h.f. in parts of the spectrum they have not been in before. For example, 41.015-47.0MHz will be exclusively for fixed and mobile communications. Hitherto in Britain 41-47MHz has been allocated to 405-line television broadcasting (Channel 1 of Band I) and in fact the BBC will be able to keep it on a primary basis till 1987 (and the French broadcasters till 1986). Furthermore, the land mobile service of 30 countries including the UK have been allocated 47.0-68MHz (the remainder of the UK tv Band I) on a permitted basis, leaving broadcasting as the primary occupant. When, however, 405-line television broadcasting is closed down, and in the absence of alternative broadcasting requirements, land mobile radio could be allowed to take over the whole band.

The land mobile service of the UK and 15 other countries has also obtained the band 174-223MHz on a permitted basis. Hitherto 174-216MHz has been occupied exclusively by television broadcasting (Band III for 405-line transmissions in the UK) and this service will continue to use it, and the extension to 223MHz, on a primary basis until 405-line tv is closed down. And land mobile radio in 19 countries including the UK will also be moving into an adjacent band 223-230MHz on a permitted basis. The primary occupant of this band will be broadcasting, while fixed and mobile communications are to use it on a secondary basis.

The land mobile and maritime mobile services have primary allocations in 29 countries, including the UK, throughout the band 138-144MHz.

However, mobile radio will be losing some spectrum in the region of 100MHz as v.h.f./f.m. sound broadcasting is extended upwards in frequency (January issue, p. 63). Broadcasting in fact will eventually become the primary service in a band 87.5-108MHz and has a common world-wide allocation from 100 to 108MHz (a decision forced mainly by the African countries) and the UK police and fire mobile radio at present using 97.6-102.1MHz will have to move by the end of 1989. Up to then they will remain on a permitted basis and there will probably be a phased withdrawal over the next ten years. Meanwhile fixed and mobile services will continue to use 100-104MHz on a primary basis until a new plan made by a regional broadcasting conference (possibly in 1983) comes into force. And 104-108MHz is allocated to mobile radio on a permitted basis till the end of 1995 and on a secondary basis thereafter. In the UK this 104-108MHz is at present used

for private mobile radio (e.g. the nationalized public services). Thus broadcasting and radio communication will be equally sharing 104-108MHz for probably the next twenty years. At the bottom end of the 87.5-108MHz band, the section 87.5-88MHz is also allocated on a permitted basis to the land mobile service in ten countries included the UK. A new conference entirely devoted to mobile radio is likely to be held in about 1982.

U.h.f. bands

Broadcasting will be the primary service in the band 470-790MHz and will share with fixed communications, also a primary service, from 790 to 862MHz. In the UK however, television Bands IV and V are at present separated by three 8MHz channels of the aeronautical navigation service, taking 582-606MHz. The channel at 582-590MHz will continue until the end of 1987 and the channel 598-606MHz until the end of 1994. Thus this aeronautical service will eventually be squeezed into one 8MHz channel at 590-598MHz and the other two could be used either for land mobile radio or television broadcasting. The top end of the u.h.f. band, 862-960MHz, has been opened up to mobile radio, which is something the UK delegation particularly wanted to achieve. In this 862-960MHz band the broadcasting service shown in the list applies only to certain countries in the African broadcasting area.

Amateur radio

The amateur radio service uses frequencies throughout the spectrum for conventional and satellite communication. For comments on the WARC 79 allocations, see *World of Amateur Radio* by Pat Hawker elsewhere in this issue.

We hope to deal with the allocations above 10GHz in a later issue. This is the part of the spectrum used by satellites, where some noteworthy changes have been made; for example the satellite allocation in the 10GHz region has been almost doubled and provision has been made for a mobile satellite service at 14GHz which would enable transportable earth stations to be taken to remote places for relaying television news and other events directly by satellite. Direct broadcasting from satellites to domestic rooftop aerials can now take place in the three bands: 11.7-12.5GHz (see January 1979 issue); 40-42.5GHz; and 84-86GHz. (The broadcasting satellite allocation in our list at 2.50-2.690GHz is limited to national and regional community reception systems.)

More detailed and complete information on the WARC 79 frequency allocations can be obtained from the Radio Regulatory Department, Home Office, Waterloo Bridge House, London SE1 8UA (tel: 01-275 3000). □

Multiphonic synthesizer organ

Improved circuit to eliminate 'thumps'

by J. H. Asbery, B.Sc.

The novel keyboard switching system described in an article in this journal in June, 1973, enabled six notes to be played simultaneously with the use of only six generators. One drawback to the original system was the production of 'clicks' and 'thumps' when keys were pressed and released: this new version uses the same switching arrangement, but an additional circuit to provide a smooth decay is included.

A multiphonic organ is one in which there are only as many generators as notes you wish to play at the same time, as distinct from one generator for every note on the keyboard, which is the case with a polyphonic organ. Two completely different types of multiphonic organ are in use.

The computer organ has a polyphonic generator system, producing a signal for each note on the keyboard, but only one basic waveshape. An electronic multiphonic switching system connects

this signal to one of a limited number of waveshape processing units when a key is pressed. There are typically 12 of these units, so that only 12 notes may sound at the same time. A computer organ with only 6 wave shape processing units would be an attractive proposition, if a significant reduction in cost could be achieved.

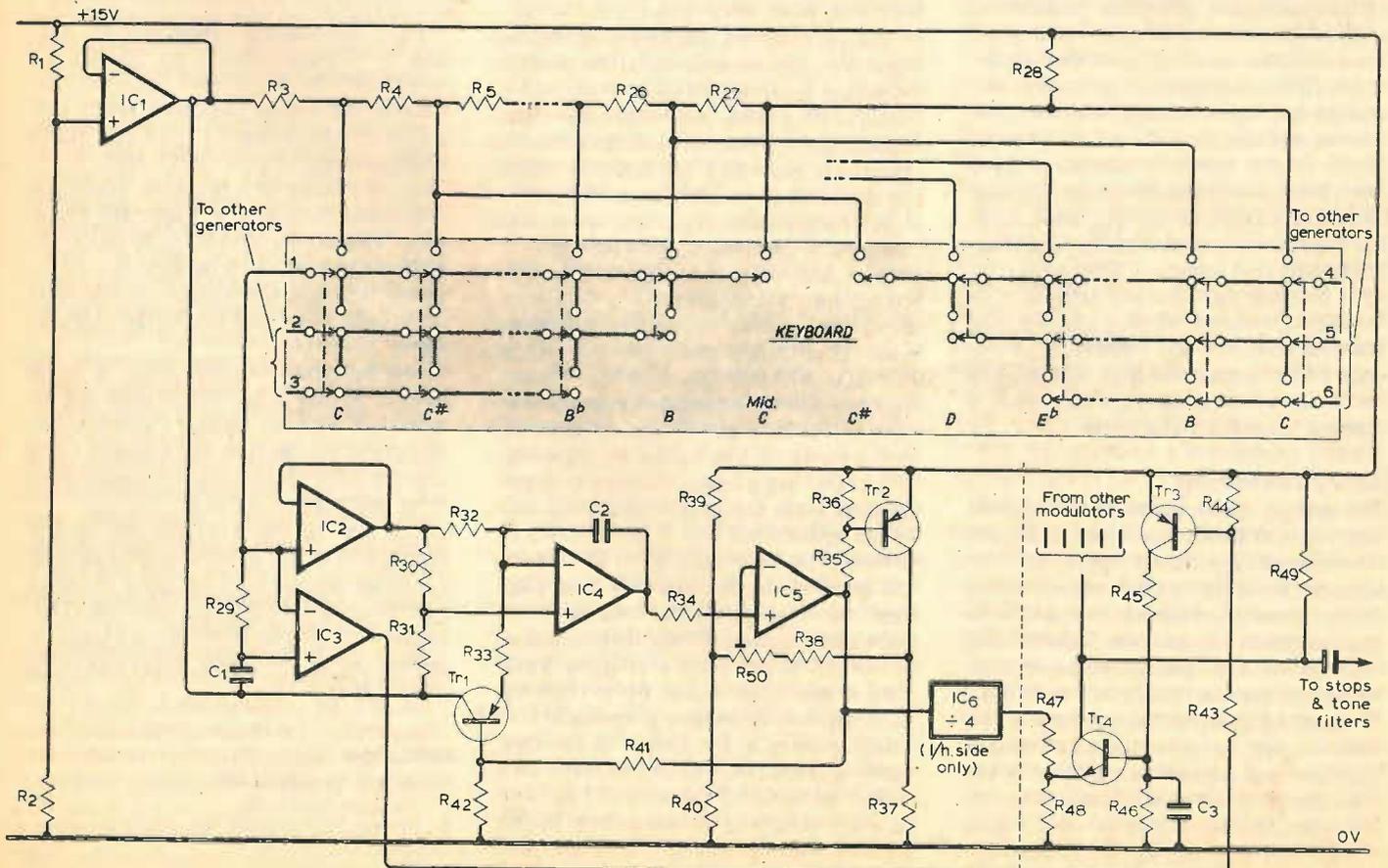
The second type¹ uses a mechanical keyboard changeover switching system and generators, in which the frequency is determined by the value of the resistor connected to it by the keyboard switching system. Whilst these organs are satisfactory for home use, they are subject to a fundamental limitation: when the hand is lifted from the keyboard the connection to the resistor is broken, so that the signal ceases abruptly. At higher volume levels, such as those required for church or theatre use,

this gives rise to objectional key clicks and thumps. The use of a reverberation unit mitigates this effect a little, but despite much work to find alternative means of reducing the clicks and thumps to an acceptable level, it appears that the only satisfactory and acceptable solution is to arrange for the sound to die away over a few cycles when the key is released.

Most synthesizers are monophonic, which is a severe limitation. There are a number of instruments in which a polyphonic generator system is used, the output waveform from the keyboard switching system being fed to a programmed, voltage-controlled filter, but the output from the keyboard switching system consists of a mixture of the different notes, so that it is not possible to process the signals individually by the usual synthesizer techniques.

By combining multiphonic techniques with synthesizer techniques, it is possible to overcome the limitation of the synthesizer, namely its monophonic

Fig. 1. Circuit of the multiphonic synthesizer organ



characteristic, by multiphonic techniques, and to overcome the limitation of inexpensive multiphonic organs by synthesizer techniques. The generators are voltage-controlled oscillators: it is therefore possible to store the switched voltage on a capacitor so that they will continue to oscillate at the correct frequency after the key has been released, and arrangements can be made to cause the sound to die away over a few cycles, completely eliminating click and thump. The waveform from each generator is available separately and unmixed for individual treatment and processing by existing synthesizer techniques.

Voltage-controlled oscillators

The requirements placed on voltage controlled oscillators for use in a multiphonic organ are more stringent than for a v.c.o. in a monophonic instrument. As there are more than one of these units, the cost and size become more significant and it is more important to minimize these. In a multiphonic instrument, the voltage for a given note is the same for all the v.c.os, so that high consistency between all the oscillators in the one instrument is essential.

The design of the ramp-type v.c.o. adopted, IC₄ and IC₅, is conventional except for the switching transistor Tr₁, which is used in a new way. When this design of v.c.o. is used with a switching transistor in conventional mode the transistor gives rise to a large variation between similar v.c.os: f.e.t.s. are sometimes used, but these are also subject to a wide tolerance spread. In conventional mode, the bottoming voltage of the transistor collector (transistor on) is of the order of 40 mV. Transistors are sometimes used in the reverse mode, in which the functions of collector and emitter are interchanged and the bottoming voltage is reduced to around 25mV. In the mode of operation used here, when the transistor is on, current flows from base to emitter and from base to collector in the same direction, rather like two separate diodes (except with much better characteristics). The bottoming voltage, that is the voltage between collector and emitter, is of the order of 2mV. As a result of this there is much better consistency between a number of similar v.c.o. units.

Decay switching

The second main problem of a multiphonic synthesizer is that it is not practical to provide two-pole, or two separate keyboard switching systems: the one system has therefore to perform two functions. It has to connect the v.c.o. to the voltage corresponding to the key pressed, and it provides an on/off control signal, for that generator, to control the modulation envelope sequence and any other signal processing sequence desired. The keyboard switching system connects the v.c.o. memory circuit, C₁, IC₂, to the correct

Components list

Integrated circuits			
1,2,3,4	741	21	26.7 1% metal film
5	709	22	28.0 1% metal film
6	74C93	23	30.1 1% metal film
(two 74C93s for three dividers)		24	31.6 1% metal film
		25	33.2 1% metal film
		26	35.3 1% metal film
		27	37.4 1% metal film
		28	165.0 1% metal film
		29	100k carbon film
		30	=R ₃₁ 2% metal film
		31	20k 20% metal film
		32	2×R ₃₃ 2% metal film
		33	7.7k 5% metal film
		34	10k carbon film
		35	10k carbon film
		36	1k carbon film
		37	1.2k 20% metal film
		38	=R ₄₀ 2% metal film
		40	33k 20% metal film
		41	2.2k 5% carbon film
		42	4.7k 5% carbon film
		43	100k 5% carbon film
		44	10k 5% carbon film
		45	220k 5% carbon film
		46	100k 5% carbon film
		47	100k 5% carbon film
		48	33k 5% carbon film
		49	3.3k 5% carbon film
		50	1k 20% pot

The product of R₃₃ and C₂ should be nominal plus or minus 1%.

We understand that Mr Asbery is prepared to supply components from 87, Oakington Manor Drive, Wembley, Middlesex.

voltage, enabling the oscillator to continue oscillating at the correct frequency after the note has been released. As the capacitor, C₁, holds the control voltage, there is no change of voltage and no signal available to initiate the decay sequence. If the capacitor, C₁, is omitted or much reduced, when the key is released the output voltage of IC₂ falls, providing a signal to initiate the decay sequence, but the frequency of the oscillator will be incorrect. In a monophonic synthesizer this problem is solved by a two pole switching system.

The solution adopted here is to interpose a resistor, R₂₉, between the switching system and the memory capacitor, C₁. IC₃ detects the direction of current flow through this resistor by detecting the polarity of the voltage across it. When the note is pressed the input current to the non-inverting input of IC₃ flows through R₂₉, so that the non-inverting input of IC₃ is more negative than the inverting input: the output is therefore low. When the key is released, the input current to the inverting input of IC₃ and the non-inverting input of IC₂ is derived from memory capacitor, C₁, and flows through R₂₉, and the inverting input of IC₃ becomes more negative than the non-inverting input, so that the output goes high. The output of IC₃ is the required control signal. When the key is released the output voltage of the memory, IC₂, falls by the sum of the voltages across R₂₉ in the one and off states. In the organ de-

scribed in this article the resulting change of frequency could not be detected by ear. However, if this slight frequency shift is not acceptable, correction can be made by mixing a small amount of the output of IC₃ with the output of IC₂.

The keyboard switching system is divided into two halves to minimize the work and cost and to reduce the range required from the v.c.os to two octaves. The left-hand oscillators are similar to the right-hand ones to ensure the required accuracy and avoid two sets of keyboard resistors. Two-stage, divide-by-2 units, to reduce the frequency by four are interposed between the output of the left-hand oscillators and the modulators or signal processing.

The keyboard resistors form a series system so that a low impedance can be provided without undue current consumption, and so that the value of each resistor only affects the frequency step from one note to the next.

The part of Fig. 1 to the left of the dotted line is the generator and on/off detector, which may be used to drive synthesizer circuits as desired. The circuit to the right of the dotted line is a simple organ envelope generator and modulator.

References

1. Multiphonic organ, J. H. Asbery. *Wireless World*, June 1973, p303.
2. 'Transistor organs for the amateur.' Alan Douglas

What's so natural about e?

2 — The relationship of Euler's number to logarithms

by John C. Finlay

In the previous article the author presented the first part of a popular study of Euler's number, the key to universal laws of change. Here he continues with his use of graphical methods to show the relationship of e to natural logarithms, after discussing the invention of logarithms by John Napier.

The more inquisitive type of schoolboy, who has just managed to conquer the technique of using logarithms to the base of 10 (thanks to Henry Briggs from Yorkshire, 1561-1630), leafs through his new book of tables and comes across another table of logarithms, variously described as natural, hyperbolic or (wrongly) as Napierian. However, on seeing the odd-looking figures and the cumbersome calculations required for numbers lying outside the range of 1 to 10 he promptly shuts the book and forgets about them. That word 'natural' is pushing itself forward again and no doubt you are thinking "I won't be caught the second time. It's obviously going to be natural and has something to do with 'e'." And so, of course, it is. The really remarkable fact about natural logarithms is that a system very close to them was originally published by the landed Scottish aristocrat, John Napier (or Neper), 1550-1617, as the first-known logarithms, and long before Euler revealed any of several series for e . Now the historical approach to the study of a science is often rewarding, at the very least in clothing it with some often welcome human interest, and at best presenting a logical sequence of development of ideas and terms on a leisurely time scale, which may offer some consolation to the student of today who is expected to take it all in within five minutes! I can offer no such neat justification for looking at the history of logarithms — it is unbelievably tortuous, certainly curious, mathematically revealing and utterly fascinating. Above all, the invention of logarithms was, uniquely in mathematics, an unheralded 'bolt from the blue' (as it was described at a tercentenary celebration in 1914^{10, 11}), owing nothing to any previous work.

Baron Napier, of Merchiston Castle, Edinburgh, had a major preoccupation, as a good Protestant in the dangerous times of the Spanish Armada, in lam-

basting Roman Catholicism and proving scientifically that the Pope was Antichrist. Fortunately, however, he took time off to try and help astronomers and navigators in their complicated calculations, a matter of growing importance in the expanding world that followed the explorations of the first Elizabethan age. In particular he wanted to reduce the labours of multiplication and division in frequently used trigonometrical formulas such as

$$\sin A \sin B = \frac{\cos(A-B) - \cos(A+B)}{2}$$

which you and I learned at school, and which was also well known in Napier's time.

Now suppose that, like Napier, you had no knowledge of the laws of indices and therefore no incentive to express numbers in that form, just what might you deduce from a comparison between these two sets of numbers:

1 2 3 4 5 6 (Arithmetic progression)
2 4 8 16 32 64 (Geometric progression)

(which we looked at earlier)? Obviously the first set is an A.P. because all the terms differ by the same value, namely unity, whereas the second is a G.P. since successive terms increase by the same multiplier, namely 2. You will then note that the G.P. is made up of multiples of 2 equal to the corresponding A.P. term, e.g. $16 = 2 \times 2 \times 2 \times 2$ (four 2s). Perhaps you have also spotted that any two terms in the G.P. multiplied together give another term somewhere in the list, e.g. $2 \times 4 = 8$ and $4 \times 16 = 64$. All this so far was well known before Napier's time. But now have another look at the A.P. terms corresponding to the last two examples:

$$\begin{array}{ll} \text{A.P. } 1+2=3 & \text{A.P. } 2+4=6 \\ \text{G.P. } 2 \times 4=8 & \text{G.P. } 4 \times 16=64 \end{array}$$

Isn't it self-evident where Napier received the inspiration that was to earn him the gratitude of a myriad workers doing their calculations in science, engineering and business?

To convert the multiplication of awkward numbers into the simpler process of addition and back again clearly requires many fine steps to be practical, and they must range in geometrical progression against their 'artificial numbers' (as Napier first termed them) in arithmetic progression.

Commonsense dictates that, without any precision aids to calculation, the geometric ratio should be as simple as possible, but what about the starting artificial number? Here the plot thickens, because this number was not 0, as you might expect, but 10^7 .

To see where this arose, we must recall that Napier's objective was to draw up a table of artificial numbers for dealing with the multiplication of sines, and the sine in his day was not the ratio as we understand it but simply the length of the side opposite the relevant angle in a right-angled triangle (it must surely astonish you to realize the sex-appeal of this half-chord, due to a translation error made over 800 years ago¹². *Sinus* in Latin means 'bosom' or 'curve', i.e. the cleavage!). Moreover the convenient idea of the decimal point for decimal fractions had not been used — it was in fact introduced by Napier when he was preparing his tables!

Tables of sines (as then defined) for various angles were commonly available, and to have the convenience of stating them in whole numbers a very high round number such as 10^7 was arbitrarily given to the hypotenuse of the corresponding right-angled triangle, thus allowing a 7-figure statement of the 'sine'. The *sinus totus* or 'whole sine' for 90° was then 10 000 000, for 21° was 3 583 679 (see Fig. 13) and for 0° was just 0. Napier used such figures in drawing up his tables, based upon a G.P. starting with 10 000 000 and taking off $1/10\,000\,000$ as an easily calculated fraction from this first term and every subsequent term. He kept going until he reached the hundredth term, which worked out at about 100 less than the first term, actually 9 999 900,000 495 0 (note his use of the decimal point!¹⁰).

He realised then that the gaps between the terms would eventually become very small, requiring millions of calculations between any two consecutive integers! Another approach was needed and Napier had a further inspiration, a geometrical model which provided not only the basis for his calculations but also a firm scale to which to peg them. Talking of pegs, let us note that by this time he had also invented the word 'logarithm' (to replace 'artificial number') from two well-known Latin words *logus*=ratio and *arithmos*=number. A logarithm was

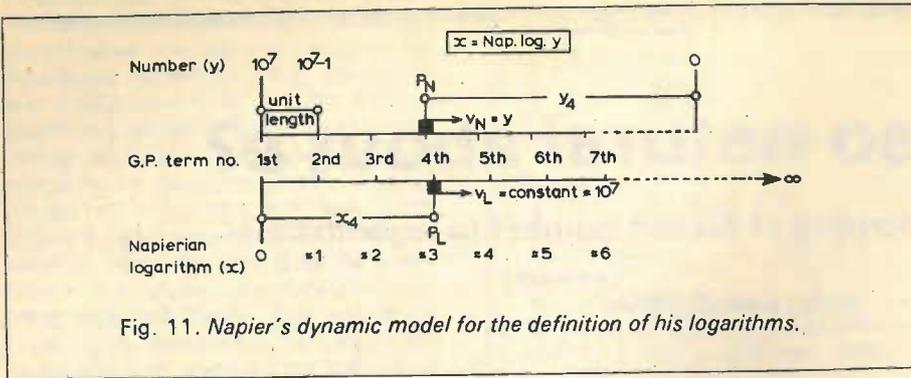


Fig. 11. Napier's dynamic model for the definition of his logarithms.

thus a 'ratio-number'. What a pity it was that the laws of indices were unknown to Napier! Not only would this have eased his self-imposed task, but it would have spared us yet another redundant mathematical word (logarithm = index = exponent = power!¹³).

The model was a dynamic one, visualizing the comparative motion of two points along two parallel lines (Fig. 11) to the same scale of distance. One point P_L , representing the logarithm, moves at steady velocity v_L along the lower line, which is of infinite length. The other point P_N , representing the number, moves along the upper line of 10^7 units long, and at a velocity v_N equal to its distance y from the far end of the line. At the starts, for the 1st term, both P_N and P_L move away at the same velocity, equal therefore to 10^7 units, but P_N steadily slows down as y diminishes and gradually falls behind P_L . Napier defined his logarithm as (Napierian) logarithm = x for the corresponding number y

as obtained from the model. So a zero logarithm implies a number of 10^7 and an increase in value of the logarithm corresponds to a decrease in the number. P_L also has to reach infinity before P_N arrives at the scale end at number zero.

Now consider the comparative positions of Napier's G.P. terms on the scales. The 2nd term, by definition, was $10^7 - 1$, and so the distance along the number scale from 1st to 2nd terms is 1 unit (on either scale) as marked. The corresponding logarithm for the 2nd term was estimated by Napier as 1.000 000 1, which for practical purposes on the diagram can be shown as approximately 1. This establishes the linear log. scale and the term markings at approximately 2 3 4 5 6 etc. Napier was also able to fill in on the number scale (in principle, anyway) the values he had already calculated for the first 100 terms. You will see straightaway that the terms will steadily crowd up on the number scale as P_N moves to the right (the degree of compression is exaggerated for effect in Fig. 11 for the few terms shown), and that you would need an infinite number of them to reach the zero number, as suggested by the lower scale rising to infinity.

Now suppose, as I suggested before, that you, like Napier, had no knowledge of the laws of indices, nor of the calculus

(the work of Newton and Leibniz was still to come). What else could you discover from his model which would help you to calculate just those logarithms that you wanted for particular numbers, instead of a thicket of largely useless G.P. terms? Well then, you might suddenly realize that by spanning equal lengths along the log. scale you could use the other favourite trick of the engineer and extrapolate your number values from those already found, skipping over a lot of unwanted ones. More generally, as Napier used¹⁰, for 4 numbers a b c d , if $a/b = c/d$, then $\log b - \log a = \log d - \log c$. He was thus able to extrapolate from one number whose logarithm he had already calculated to another whose logarithm was to be found, at least very closely, by matching up to a ratio already calculated.

His objective, remember, was to produce a table of logarithmic sines, recorded for every minute of angle from 0° to 90° alongside the sine values already published by Vieta (1579) and others¹⁰. He matched the sine values as nearly as possible to the numbers appearing in his series and used ratio methods to account for the small differences in the logarithms¹¹. The tables were laid out in complementary form, reading down the left-hand sides from 0° to 45° and up the right-hand sides from 45° to 90° , so that cosines and log. cosines were also obtained by reading right across the table. A central 'difference' column, recording the difference between the two adjacent columns of logarithms, also enabled log. tangents to be obtained¹⁰.

So, after some twenty years of complex calculations, Napier eventually and valiantly accomplished his purpose in easing the multiplication of sines (and other trigonometric functions). During this work he came to realize the broader application of his logarithms to multiplication in general, although taking such logarithms from his original tables was no easy matter if they had to be interpolated between the available figures (allocated of course to particular angles)¹⁵. The book, published in 1614 in Latin¹⁴, was an instant success, not only in Britain but throughout Europe as well (it included 90 pages of the tables and 57 pages of description of their uses).

Professor Henry Briggs (of London

and later Oxford Universities), the leading mathematician of the day, was so impressed that in 1615 he visited Napier at Merchiston to pay his respects and to discuss the system. This was a most famous and fruitful meeting, resulting in an agreed change of 0 to be the logarithm of 1 (which Napier had already been considering) and an appropriate power of 10 to be the logarithm of 10^7 , as being more convenient for general calculations using logarithms. This was the basis of ordinary or Briggsian logarithms. Napier died in 1617 and in the event Briggs chose the now familiar base of 10 for the new 14-place tables for numbers from 1 to 20 000 and 90 000 to 100 000 which he published in 1624¹⁶. Vlacq, a Dutch mathematician, filled in the gap and republished the Briggs figures in 1628¹⁰.

Now can we leave the history of logarithms here, enthralling though it may be to some^{17, 18, 19, 20, 21} and boring to others? If the latter think I seem to have been carried away by it, I have had a very definite goal - to answer the burning question of the difference between Napierian and natural logarithms, a matter fundamental to the understanding of 'e'. I am staggered to find that even many mathematicians do not recognize a difference (quotations would be invidious!), so it is no wonder that engineers are often confused. This is a classic example of the merit of going back to original sources for information. Also, above all, there is the fascinating question as to why Napier's logarithms, as the first-born, are related to e , of which he knew nothing.

Let's make a rough graph of the numbers (y) which Napier found in his series, plotted against the logarithms (x) which he allocated to them (Fig. 12).

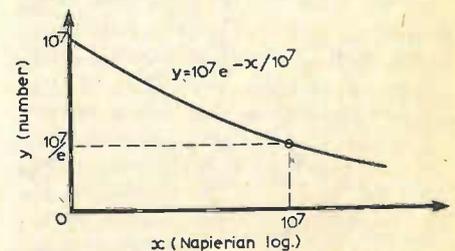


Fig. 12. Napier's series for calculating logarithms fits this curve.

He assigned 10^7 to a log. value of 0 and two or three points taken from his tables¹⁴ for logs. up to around 1.5×10^7 will do. Here are some typical values:

Angle	Sine (old form)	Log. sine (Napierian)
0°	0	∞
$12^\circ 53'$	2 229 666	15 007 330
$21^\circ 35'$	3 678 541	10 000 685
$37^\circ 20'$	6 064 511	5 001 310
90°	10 000 000	0

The curve looks suspiciously like an exponential of a^{-x} form (Fig. 7), especially as it dies away with a feather

finish to infinity on the log. scale. Perhaps it is of the e^{-x} form? To see this we can cheat a bit by looking forward to the useful curves of Fig. 17 (next part). Now examine the value of y for $x=10^7$. Napier quotes 3 678 541 for 10 000 685 respectively (which is as near as we can get without resorting to Napier's tortuous interpolation). Divide the second figure by the first on your ever-eager electronic calculator and what do you find? Yes - e again! ($1/e$ is of course 0.36788 to 5 figures). Fig. 12 is then of e^{-x} form (compare with Fig. 17) because when x , running right from zero, reaches the value of y at which the curve crossed the y axis (here 10^7), the value of y has fallen to $1/e$ of its crossing-over value. With a bit of careful comparison of the two figures you will see, I hope, that $y=e^{-x}$ in Fig. 17 has to become $y=10^7e^{-x/10^7}$ for Fig. 12

$$e^{x/10^7} = \frac{10^7}{y}$$

$$x/10^7 = \log_e 10^7/y$$

Thus Nap. $\log y = x = 10^7 \log_e 10^7/y =$
 $10^7 \log_{1/e} y/10^7$

(In case any of you with a knowledge of calculus, like our old P.M. friend, have been uneasily shuffling about during the last bit of trickery, you might like to read a very simple and elegant proof of the above results¹⁷. Whichever way you prove it, you can be proud of doing more than Napier could - he didn't understand negative indices!)

Now why should the numbers for Napier's logarithms have anything to do with e ? Well, of course, they were formed in a geometric series of reducing terms, falling in proportion to their value, similar but opposite to those in the strip-by-strip build-up of $y=e^{-x}$ (Fig. 8), so that we get the mirror-image curve e^{-x} (see Figs. 7 and 17). And what about the base of Napier's logarithms? The result $10^7 \log_{1/e} y/10^7$ shows that the Napierian base is $1/e$, as is also clear from the fitting of the y/x curve to e^{-x} . In contrast, for the e^x curve the logarithmic base is e . By common agreement this is termed the 'natural' logarithmic base, which it is then for the natural growth curve. On the other hand, Napier's base is a 'natural' (if you will forgive the confusion of meaning!) for the natural decay curve!

If I am allowed another brief reference to history,²¹ what we now call 'natural' logarithms first appeared accidentally as interpolating numbers in Edward Wright's 1618 translation (into English) of Napier's *Descriptio*. The first deliberate tables of 'New Logarithms', as he called them, were published for numbers 1 to 1000 in 1620 by John Speidell in London, being

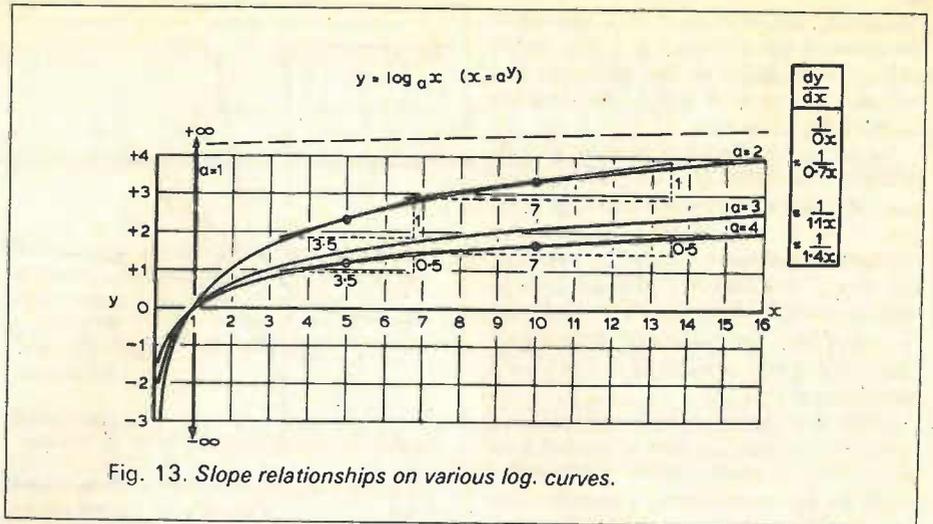


Fig. 13. Slope relationships on various log. curves.

natural logarithms without the decimal point. More than a century was to pass before the importance of natural logarithms was appreciated in analysis, including the work of Euler on negative and complex numbers (mentioned later). Johann Heinrich Lambert, an Alsatian, published the first such table in 1770.

To see how the value of e can be derived from natural logarithms as such, let's first consider the slopes of logarithm curves for exponential curves in general. Earlier we looked at exponential curves of the form $y=a^x$, but this time we'll interchange x and y to focus attention on the exponent as the dependent variable:

If $x=a^y$ then $y=\log_a x$ (from the definition of a logarithm).

Here are some calculated values of y for various values of x and a :

x	$1/8$	$1/4$	$1/3$	$1/2$	1	2	3	4	8	9	16
$\log_a x$ for $a=1$	-∞ to +∞										
$\log_a x$ for $a=2$	-3	-2		-1	0	1	2	3	4		
$\log_a x$ for $a=3$			-1		0		1			2	2.52
$\log_a x$ for $a=4$		-1			0			1			2

I have put in only the key values to keep the table uncluttered, and have plotted $y(=\log_a x)/x$ in Fig. 13. The vertical line for $a=1$ is a special and academic case (a 'limit'), having y at all values between $-\infty$ and $+\infty$ for $x=1$. This is the sole value of x for $a=1$ since 1 to any power (y) is always 1. You will observe that the slopes of the curves all diminish as x gets larger. Try to find what relationship they have to x by using the tangential ruler again at a couple of points, for convenience at $x=5$ and $x=10$:

For $a=2$ $x=5$ slope = $dy/dx = 1/3.5$ whereas at $x=10$ $1/7$
 This suggests that the slope is inversely

proportional to x , or $dy/dx \approx 1/0.7x$, and in fact this will check out against any further measurements you may care to make.

*Also for $a=4$ $x=5$ slope = $dy/dx = 0.5/3.5 = 1/7$
 and at $x=10$ $0.5/7$

Again the slope is inversely proportional to x , and in this case $dy/dx \approx 1/1.4x$. In the same way you can find out for $a=3$ that $dy/dx \approx 1/1.1x$.

It now strikes you that there must be a curve for some value of a between 2 and 3 for which $dy/dx = 1/x$. So let's interpolate again to find it by plotting $1/(x(dy/dx))$ against a as in Fig. 14. If you are beginning to feel that you've been here before, just look back at Fig. 6. The curve is the same, and all we've done is to exchange x and y ! Those approximate coefficients 0.7, 1.1 and 1.4 ring a bell or two, and if you turn Fig. 13

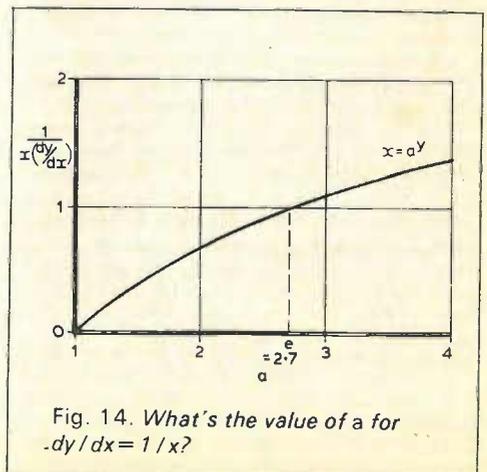


Fig. 14. What's the value of a for $dy/dx = 1/x$?

sideways and look at it in a mirror it becomes identical with Fig. 5. The point is hammered home in Fig. 15 where the curves for e^x and $\log_e x$ are shown against the same axes.

So, as well as finding another way to bring out the value of e , we have proved (no, after some ominous rumblings from the P.M. I had better substitute 'verified') that for e^x , $y = dy/dx$, and that for $\log_e x$, $1/x = dy/dx$. Those of you who aspire to the calculus will note that we have also obtained the differential coefficients with respect to x of $e^x (=e^x)$ and of $\log_e x (=1/x)$.

There is still one more graphical wile that we can use to find e , which you may think is even trickier than any I have so far mentioned. Consider the innocent-looking equation $y=1/x$ and draw up a table of values for it:

x	1	1.5	2	2.5	3
$1/x$	1	0.67	0.5	0.4	0.33

Now plot these out as in Fig. 16. Construct a square as shown, spanning unity on both axes. Its area is clearly unity. Now see if you can mark off an area *under the curve* also equal to that of the square. You can do this by using another traditional engineer's dodge of counting squares, in a number of vertical strips for convenience, adding narrow strips one by one, as required, from left to right. Obviously you're going to have to move further up the baseline than 2, but how far? Yes, you've guessed that it will be to e !

Why should this be so? The curve is called a rectangular hyperbola, which suggests there might be a link here

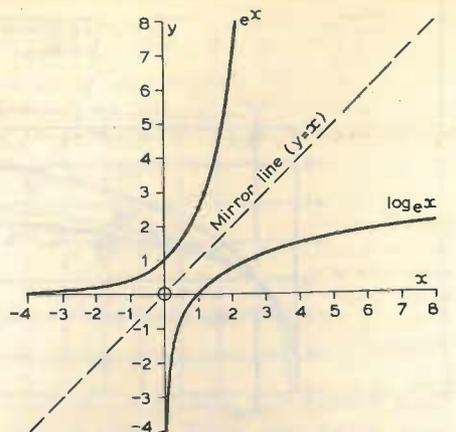


Fig. 15. The mirror image curves e^x and $\log_e x$.

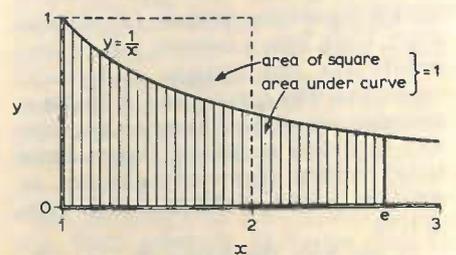


Fig. 16. Finding e from the area beneath a rectangular hyperbola.

between natural and hyperbolic logarithms. We can justify the method from what we have already discovered about such logarithms. Now we have shown that the slope of the curve for $y = \log_e x$ is always $1/x$. That is differentiation in the calculus, and the reverse process is integration or summing up,

meaning graphically that we must find the area under the y/x curve. If then we do this for the curve of $y=1/x$ between two particular values of x , we are reversing the action and will finish up with the difference between the two corresponding values of $\log_e x$. The area under the curve between values $x=1$ and $x=e$ is thus $\log_e e - \log_e 1 = 1 - 0 = 1$, as already discovered.

References

10. A. Hooper. *Makers of Mathematics*, Ch.V pp.169-193 (The invention of logarithms), Faber & Faber 1949.
11. ed. C. G. Knott. *Napier Tercentenary Volume*, pp.1-32 (Inaugural address by Lord Moulton: The invention of logarithms, its genesis and growth), Longmans, Green 1915.
12. Ref. 10, pp.127-132.
13. L. Hogben. *Mathematics in the Making*, p.177, Macdonald 1960.
14. J. Napero (or Napier). *Mirifici Logarithmorum Canonis Descriptio* (A description of the marvellous law of logarithms), Andrew Hart (Edinburgh) 1614.
15. Ref. 11, p.121 (G. A. Gibson: *Napier's logarithms and the change to Briggs's logarithms*).
16. H. Briggs. *Arithmetica Logarithmica*, William Jones (London) 1624.
17. Ref. 6, pp.242-6 (Logarithms).
18. D. E. Smith. *History of Mathematics Vol.II, Special Topics of Elementary Mathematics*, pp.513-523 (Logarithms), Ginn 1925.
19. ed. E. M. Horsbrugh. *Napier Tercentenary Celebration - Handbook of the Exhibition* pp.1-16 (G. A. Gibson: *Napier and the invention of logarithms*), Royal Society of Edinburgh 1914.
20. E. Kasner, J. Newman. *Mathematics and the Imagination*, pp.78-85 (e), republished Pelican 1968.
21. *Encyclopaedia Britannica*, Vol.14 p.304 (Origin of natural logarithms) 1959.

Literature Received

Leaflet on solid-state transient protectors is new from Unity Power Systems, offering complete technical information and application advice. Write to Unity Power Systems, Pembroke House, 44 Wellesley Road, Croydon, Surrey or circle WW 401

Reliability of the Intel 3636, 16k p.r.o.m. is assessed in a report recently released by the company. Copies are obtainable from Intel Corp (UK) Ltd, Dorcan House, Eldene Drive, Swindon, Wilts SN3 3TU WW 402

Wire-strippers and d.i.p.-socket inserters for high-volume production are described in two brochures, available from Automation Ltd, Marbaix House, Bessemer Road, Basingstoke, Hants RG21 3NT WW 403

Semiconductor Summary for 1979/1980, from ITT is now available giving the full range of information on all ITT devices, infra-red remote control, i.cs for entertainment, clock, car and musical instrument applications. ITT Semiconductors Ltd, Maidstone Road, Fooks Cray, Kent. WW 404

'Intelligent' tape transport, type 8800 from EMI, which incorporates microprocessor control and a built-in fault-diagnosis routine,

is illustrated in a brochure from SE Labs (EMI) Ltd, Data Products Division, Spar Road, Feltham, Middx TW140TD. WW 405

A new type of crystal cut, the thermal transient compensated (t.t.c.) is described in a paper and leaflet from Cathodeon Crystals Ltd, Linton, Cambridge CB1 6JU. WW 406

Brandenburg describe their range of static inverters, the 060 range, in a leaflet just produced. Copies can be obtained from Brandenburg Ltd, 939 London Road, Thornton Heath, Surrey CR4 6JE. WW 407

Work in universities on vibration and noise, funded by the Science Research Council, is reviewed by the SRC in a 47 page booklet, obtainable from SRC, PO Box 18, Swindon SN2 1ET. WW 408

Aspect is a new publication, by Vermason Ltd, on the subject of static - causes, problems and solutions. The two-page sheet is to be published three times a year. Hunter Bureau of Communications Ltd, Drayton House, Gordon Street, London WC1H 0AX. WW 409

A brochure on tungsten carbide drills and routers for printed-board production is

available from Dymet Alloys Ltd, Frimley Road, Camberley, Surrey GU15 2QC.

WW 410

The process of mechanical plating of small parts and its claimed advantages over electroplating are explained in a brochure, obtainable from Morlock Industries Ltd, Bridgnorth Road, Wombourne, Wolverhampton WV5 8AU. WW412

Brochure on the AXE digital telephone switching system is available from The Ericsson Group, Telefonaktiebolaget L.M. Ericsson, S-126 25 Stockholm, Sweden. WW413

Catalogue of small electronic components for the home constructor is obtainable at 30p from Ace Mailtronix Ltd, Tootal Street, Wakefield, West Yorkshire WF1 5JR.

Video production switchgears, an extended effects generator and an audio mixing switching unit made by Central Dynamics of Canada and handled by Pye are briefly described in leaflets from Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge, CB1 3JU. WW414

LETTERS TO THE EDITOR

LOOP AERIALS

A careful exploration of the medium and long wave broadcast bands leads to the conclusion that their neglect by many listeners is as much to do with poor receiver and aerial performance as with band congestion and interference. The r.f. selectivity of most portables and tuners is so poor that attaching a long wire aerial (as advised by Mr McLeod¹) simply makes second channel interference impossibly bad. However the resonant loop or the "H-field multiplier" described by Mr Schemel² overcomes the twin problems of insensitivity and poor r.f. selectivity, and with large well designed loops some astonishing results can be obtained with poor receivers. The price paid is that the aerial needs to be tuned independently of the receiver, or left tuned to a preferred station. Nevertheless this is an excellent way of widening the scope of listening experience.

Following experiments with a feeder-coupled loop (described in *Wireless World* many years ago³) a 2m x 1m six-turn m.w. tuned loop was set up and used either as an "H-field multiplier" with portable receivers or coupled with 300-ohm cable to the ferrite rod of an f.m./a.m. tuner. Favourable results obtained during winter months suggested that with some receivers even larger loops would be useful. Mr Schemel has shown that in view of inherent noise levels 1m² is the largest size necessary. However I find that the 8m x 4m single-turn outdoor loop now in use gives a better performance, probably because the very large signals help the a.g.c. of the receivers to deal better with fading. This aerial is coupled to the ferrite rod of the tuner by a few turns, 2cm in diameter, in series with the loop.

For long-wave reception a 2m x 2m 15-turn loop is used, situated in a loft and coupled by means of a single turn to 80-ohm cable. At the receiver end there is an 8cm diameter coil of about 25 turns, fixed to the side of the receiver case with tape. The receiver itself is of the Hong Kong transistor sort, which in fact cost less than the wire and cable used for the aerial.

A low-pass audio filter with a deep (-30dB) notch at 8kHz is in circuit throughout and is considered indispensable.

Finally a comment on the operation of the "H-field multiplier". I follow Mr Schemel's theory (p.51) up to the final paragraph where he mentions the conservation of energy, and says that the enhanced field, QH, is in phase quadrature with the incident field. This cannot be generally correct since the phase of the loop current passes rapidly from positive to negative (or vice versa) as the circuit is tuned through resonance. It seems better to suppose that the loop acts as a transformer, making the absorbed energy available at an impedance different from that of free space. If we regard the loop as parallel tuned, this impedance is very high, so that the ferrite rod of a receiver has only to be lightly coupled to the loop to absorb a useful proportion of the energy from it (see Mr Schemel's footnote, p.51). On the other hand a small coil in series with the loop makes the energy available at very low impedance. These are complementary points of view, the

former being more appropriate when the receiver is near the middle of a large loop, the latter when it is near one of the sides.

R. A. W. Hill
Glasgow College of Technology
Glasgow G4

References

1. McLeod, N. *Wireless World*, letters, November 1978.
2. Schemel, R. E. "The Loop Aerial Revived", *Wireless World*, July 1979, p.48-52.
3. Hill, R. A. W. *Wireless World*, letters, February 1953.

The author replies:

Mr Hill, like myself, is obviously a loop proponent, and I would only like to add some observations of my own to those in his letter.

Coupling a long wire into a modern radio may be unsatisfactory, quite apart from the reasons put forward in the original article, because transistor mixers are much more liable to overload than their valve counterparts. Both overload and the decreased r.f. selectivity have the effect of producing audible beats and cross modulation.

Separate tuning of the loop increases selectivity but only improves sensitivity when coupling to the first tuned circuit is insufficient. Since this useful technique may be tried by some readers, they are cautioned to avoid overcoupling. It would appear that Mr Hill's installation is undercoupled, since he observes that quite large loop areas give a noticeable improvement in reception; it could also be that the receiver is of very poor sensitivity, and I can confirm that a large tuned loop used in this way works wonders. Notwithstanding this, my own experience with a good receiver and a closely coupled untuned loop would indicate that an area of 1 m² is more than adequate.

Finally, Mr Hill observes that the phase of the loop field passes from 180° to 0° as the loop is tuned through resonance. This is indeed the case, and exactly at resonance the phase angle is 90° as stated in the article. Readers who constructed the field multiplier may have noted that the loop can almost suppress the signal rather than boost it at a critical tuning point. This occurs when the out-of-phase component of the loop field almost cancels the incident.

R. E. Schemel

THE INTELLIGENT PLUG

I was interested in the article "The intelligent plug" in the December issue. In your warning note you refer to p.m.e. and I hope you will not mind if I mention that this stands for protective multiple earthing.

Where the electricity supply authority has applied this method of earthing to its distribution system, the consumer will have been offered an earth terminal which is, in fact, a connection to the neutral of the electricity supply system. The injection of a carrier frequency between the neutral and earth on the consumer's installation will effectively be short-circuited at the incoming point of supply in that the consumer's earth

conductor and neutral are both connected to the incoming supply neutral.

In an electricity distribution system where the system neutral is earthed only at the distribution sub-station, the neutral and earth connections will again be short-circuited but the impedance loop, as seen at the consumer's installation, will be sufficiently large not to significantly attenuate the injected carrier frequency.

I. E. Elliot
Eastern Electricity
Lowestoft
Suffolk

COMMITMENT IN WORK

It is heartening to find an editor who is prepared to take on the task of raising (by whatever degree) the level of awareness of his readers. Your excellent editorial in the January 1979 issue on military electronics, and more recent ones on the unpleasant social consequences of our profession, have been salutary.

What has been insufficiently stressed so far, though, is the absolutely imperative need for *individual commitment*. This applies right across the board - including involvement with "defence" projects, nuclear power ("clean, safe and cheap"), broadcasting and telecommunications (information manipulation) It is only too easy for the average engineer to look no further than the rim of his coffee cup; he has a wife and kids to support, he expects a certain standard of living and he expects society to provide it for him: the fact that his society is morally bankrupt, supported on very shaky economic foundations and in imminent danger of catastrophic collapse is something that he doesn't want to think about, let alone do anything about. Yet society is only made up of individuals; if individuals will not raise themselves (no-one can do it for them) from their ostrich posture no improvement in society's state can come about.

Commitment on this personal level can be painful. For instance, if you do not wish to work in socially harmful areas you are restricting the variety of jobs open to you, and you may be forced to accept a lower salary, with a consequent lowering of living standard. The latter also applies if you wish to be more conservative, say, in your use of energy; electric heating is the most wasteful and inefficient misuse of energy there is (except perhaps writing letters to magazine editors), but it is also the most convenient. The commitment to a saner way of living is fundamentally the same in either case. The misuse of technology, and electronics in particular, which you have so accurately portrayed can only be finally corrected by a "grass-roots" awakening of awareness at the individual level.

There are, fortunately, signs that this is happening. For example I was recently told by an employment agency that it was by no means uncommon for candidates to specify "no military involvement" on their job application forms; perhaps the almost continuous recruitment adverts from the likes of

MSDS, Ferranti, Plessey and GCHQ are indicative of the shortage of people prepared to work on such projects. On a wider scale, the extent of interest in renewable energy sources and of opposition to the nuclear juggernaut shows a change of attitude in many people. Perhaps you could help nurse it along?

One point on your editorial "Trickle, trickle little chip" (November 1979) concerning alternative (or "appropriate") technology for the developing nations. Firstly, alternative technology is not concerned primarily with producing goods — goods are not what the Third World needs. What it needs are reliable means of feeding and sheltering itself, so that AT is generally aimed at the agricultural, building and energy supply areas. For these areas (particularly the first two) labour intensive techniques are more appropriate than capital intensive ones — though microelectronics can still have a part to play. Alternative technology should not necessarily exclude sophistication where it is justifiable and applicable. Secondly, there is the danger that high technology produces a gap between its users and its end products, so that there is no feeling of identification between the maker and what he has made. This gap has been recognised as a major source of dissatisfaction in Western manufacturing industries; and it is one problem that the developing countries should try hard to avoid.

Tim Williams
Tunbridge Wells
Kent

SCIENTIFIC COMPUTER

I have followed with great interest the articles on the scientific computer by John Adams (April-September 1979). As an electronics engineer from a "pre-micro" era, I saw this as an ideal project to enable me to become updated. I accordingly constructed the hardware and now, with a limited amount of experience in "driving" it, I would like to offer a number of points which I feel are worthy of discussion:

(a) The "number cruncher" approach seems to me to be so very logical that it is surprising that more systems do not apply it. It must surely set the pattern for the future.

(b) I would be very interested to see detailed explanations of many more of the machine language sub routines, particularly those associated directly with the "number cruncher".

(c) The Adams computer is already excellent value for money, but could, I feel, become even better with upgraded monitor and Basic programmes. For example, there is no cursor, or backshift/delete facility (except in graphics). There is no apparent means whereby a list of results can be fed into the middle of a programme from a peripheral. Perhaps Mr Adams can be persuaded to look into this.

(d) Software programming in BURP is obviously somewhat limited at the present time. Could we have some information on how to set about writing our own, or converting those already available for the TRS80 or the Nascom, both of which employ the Z80?

If I were to ponder longer no doubt I could produce a long list of other desirable features and information requirements. I hope, however, that I have said sufficient to convince you that there are many engineers like myself who need to familiarise themselves with these latest techniques but will not have

either the time or the opportunity to attend any of the many courses being offered by device manufacturers. We must, therefore, resort to the written word, and immediately are faced with a bewildering array of text books — and who can guide us in our choice? As professionally I will be designing microprocessor controlled systems, machine language is of paramount importance. Articles on the approach to and construction of typical programmes would be of considerable interest. If one turns to the magazine press the various publications with "Computers" in their title, excellent though they may be, do not approach the subject from the design engineer's standpoint. There does, therefore, seem to be a void which I hope that a periodical of the high technical standing of *Wireless World* can fill. What is really needed is a "Foundations of Microprocessor and Peripherals" series by a "Scroggie of the micros"; perhaps he already exists in John Adams. These could be supplemented by a regular flow of articles describing in detail actual applications covering all spheres, not just the computer as it is popularly understood.

I hope that I may have said sufficient to convince you that far from being minority readership, microprocessors etc. are of considerable interest to a high percentage of your readers, many of whom have no professional interest in "wireless" these days.

J. W. H. Freeman
Red Forge Ltd
Redditch

The author replies:

May I take the opportunity to thank Mr Freeman and many others for their comments on my design for a computer which was published in your April-September issues 1979. They have been of great value in drawing up the specification for the monitor described in this issue, as well as giving food for thought for further ones.

With so many users of these machines, it would now, I think, be a good time for some individual or group to set up a users' club to distribute a newsletter and, perhaps, organise meetings etc.*

Might I also reply to Dr Whittington's letter published last month. I think it a mistake to look for 'mainframe' performance from an arrangement which costs only a few per cent of the price of such equipment. Constraints on format, language (such as they are) and speed are thus inevitable. I must take issue with Dr Whittington on one point though, as, whilst it is possible (just!) to make a FOR loop take 200ms, a more typical time for a loop covering, say, 10 program lines is 60ms. To put the machine in the context of the so-called 'benchmark' tests, which have been applied to five commercially available machines, for BM5, which computes.

$$A = \frac{K}{2} \times 3 + 4 - 5$$

for $K = 1$ to 100, the mean execution time was 27s for the 5, as against 21s for the Scientific Computer. A monitor which is in the development stage at the moment cuts this time down to 13.8s. Should one of the semiconductor manufacturers produce a 'number cruncher' which can run at a faster clocking rate than the 800kHz which the great majority of MM57109s seem to manage, at a reasonable price, then these times, measured at that clocking frequency, should be reduced even further.

After, perhaps, more experience with the monitors Dr Whittington will find them

easier to use. I must admit to a mistake in the original series in that I forgot to describe the register display facility which is present in original monitor. It is fully described in this issue. The COR command isn't quite so dangerous as is suggested as it does list back all the addresses at which it makes corrections. Experience has shown that using COR, or MOD as it now is, and then checking back for unwanted changes using this address list avoids the usual problem when, say, re-addressing a block of instructions for loading into an e.p.r.o.m., and that is missing one or two of the alterations required. MOD has a second use too, in that by changing the byte XX to YY, the computer just lists the addresses where that byte may be found.

Finally, there is a mistake on the p.c.b. supplied with the kit for the computer of which some constructors may not be aware. The 470-ohm resistor adjacent to the 'Data In' l.e.d. connector pin at the back of the board should be removed and this connector pin wired directly to pin 12 of the 4013 i.c. The l.e.d. will then perform as originally intended.

John H. Adams
Radlett
Herts

*We would be glad to hear readers' views on this suggestion. — Ed.

VHF RADIO AND ITS PROGRAMMES

May I respond to Mr MacKay and Mr Watson (October 1979 letters)* concerning the use of v.h.f. radio.

In the early days of v.h.f., the BBC certainly tried to encourage listeners to change over to these channels, for very good reasons of technical quality and freedom from interference. I cannot recall that we ever said that all broadcasting would be on v.h.f. only, with the implication that medium and long wave transmissions would be abandoned.

In the event, the public in general have been most reluctant to make the change and the v.h.f. channels are to this day (more than 20 years later) used by only a minority of listeners. Accordingly, it was a sensible choice to put Open University broadcasts on v.h.f. and to confine schools programmes to v.h.f., since this offered good coverage for the educational material while inconveniencing as few members of the general public as possible.

It is perhaps worth emphasising that the BBC is in no way on the defensive about the inclusion of educational material in our programming; together with information and entertainment, education is one of the prime requirements of our charter. Schools programmes are clearly of considerable importance in their field and the Open University is an imaginative and successful British venture which is very rightly supported by the Corporation.

The realities of the situation are therefore as follows. Educational broadcasting merits good coverage throughout the country; it is on v.h.f. for good reasons and could not be transferred to medium or long wave without inconveniencing far more listeners and nullifying the considerable investment in v.h.f. equipment by schools and others; insufficient v.h.f. channels are available to separate educational from other programming.

Turning now to other positive matters, it is clearly very much in the BBC's interests that the programmes which we make shall be received as well and as widely as possible. We are very conscious of the dissatisfaction

caused by the enforced sharing of channels by educational and other programmes and we examine most carefully what can be done to relieve this. The most satisfactory long term solution is the provision of more channels by extension of the v.h.f. broadcasting band. This has been an important factor in the World Administrative Radio Conference in Geneva, although if such extension is agreed it must be some years before existing mobile users (police, fire, ambulance etc.) can be moved elsewhere and new broadcasting networks created. For short-term relief we are looking into the feasibility of transferring a proportion of schools broadcasting to the night hours, with time-switch recording in schools for replay the next day. Furthermore, we have concentrated much of the educational programming on to the Radio 4 v.h.f. channel, avoiding Radio 3 where musical items in particular benefit from high quality stereo transmission. As a result, educational material on Radio 3 v.h.f. is in general transmitted outside normal programme hours, with the exception of an hour and a half on weekdays in the early evening. The sharing of a single v.h.f. channel by Radio 1 and Radio 2 is a separate problem, to which the only solution would be an additional v.h.f. channel.

I would not presume to challenge Mr MacKay's catalogue of shortcomings and perhaps I am indeed fulsome, irrelevant, contradictory, evasive, arrogant and smooth. Although anxious to please, I have found it difficult to demonstrate all these qualities within the compass of a single letter; but I have tried as best I can to set out the facts which, unwelcome though they may be, make up a problem for which a quick and easy solution is not available.

D. P. Leggatt

Head of Engineering Information Dept
BBC, London W1

* Owing to a clerical error the publication of this letter has been delayed. Apologies to readers and the correspondents concerned. — Ed.

PERCEIVING DIRECTION IN SURROUND SOUND

The article by Ken Farrar on the Soundfield Microphone (October and November 1979) prompts some observations on the development of surround sound which I feel it timely to make. Most technical developments tend to evolve from previous practice but it is always wise as new technology becomes available to take a long hard look, unhindered by the past, at the means and at the objectives. It is therefore to be hoped that before standards are finally set the full potential of Ambisonics is properly established.

Having been intrigued by the somewhat puzzling failure of binaural reproduction to recreate concrete centre-front sound sources, the writer has carried out many experiments in the field of perception of direction by our sensors. I use the word 'sensors' rather than ears because I now have doubts as to whether our outer ears are the sole mechanism.

The following facts emerged. Firstly, using white noise as a sound source, there was no difficulty in locating the direction of its origin *with one ear effectively closed*. This appears to indicate that there are clues on which the brain can operate to determine direction other than the generally accepted ones of inter-aural intensity, phase and transient

arrival-time differences. Secondly the frequency response of the ear changes quite markedly as the incident direction of the sound changes. This effect is in addition to the well known ability of the pinnae to introduce minute colorations which are direction dependent and from which we have learned to derive clues. The head appears to act as a baffle for sound coming from the side which intensifies mid-frequency components. These mid-frequency components are relatively reduced in loudness if the sound comes from the front. Thirdly there appears to be evidence that more than the outer ear may be involved in hearing. There is a passage which can convey sound between the nose and mouth and the inner ear and it was observed that the sound of white noise changed with the opening and closing of these apertures! This may have a bearing on what appears to be the ability to assess the distance of a sound source by the shape of the radiated wave-front. The more distant the sound source, the 'flatter' will be the portion of the wave-front affecting our ears. If a point source loudspeaker is replaced by one with a number of units so as to create an approximation to a plane wave, the sound in the latter case will appear to originate some distance behind the loudspeakers. Since the sound reaching the outer ears in both cases should be the same, it is impossible to explain these phenomena by conventional theory.

Returning to the failure of binaural sound to recreate concrete central front images, this can only be because some vital clue is missing. It would appear that a really concrete centre-front image can only be created by a sound coming from centre-front in actual practice. While the illusion of centre-front images created by the left-right speakers of conventional stereo are undoubtedly established by the dominance of the intensity/phase/transient time delay mechanism, the overall effect may be less than perfect. The fact that there are individuals for whom this illusion does not work confirms this. In any case this function is clearly over-sensitive to head movements.

This brings us back to the subject of four channel reproduction and I would like to suggest that before we are committed to the two front and two rear loudspeaker configuration — really an extension of stereo — experiments should be carried out with what could be a more logical system, i.e., one central front loudspeaker, one left loudspeaker, one right loudspeaker and one rear loudspeaker. For reasons too lengthy to discuss here, the writer believes that this format would have many advantages, just one of which would be that a centrally positioned soloist would tend to remain central even if one moved from the ideal 'central' seat.

James Kerr
Kerr Research
Wendover
Bucks

UHF CITIZENS' BAND IN AUSTRALIA

It is not recorded in any history book that King Canute sat on an Australian beach trying to curb the tide (your editorial, September 1979 issue). But recent Australian history has shown that our telecommunication authorities and government can do the same and succeed! Yes, c.b. is good fun, and the population has the right to expect a small part of the spectrum to be allocated for personal use. But our

Canutes here were far more canny in trying to stem the tide. Instead of telling the sea to draw back, they asked — can we get the sea to recede by providing another beach? Instead of asking the sea, they asked our population and industry. They asked if there were other frequencies which could be used, if equipment could be designed and manufactured within one year at a price competitive with its 27MHz s.s.b. counterpart. They asked if the coverage on another band of frequencies would be equivalent to the local coverage of 27MHz. And, most importantly, they asked what interference problems could result from the use of other frequencies.

The result was the introduction of the world's first u.h.f. c.b. service; 1MHz of spectrum for public use, 40 channels that anyone could use anytime, anywhere. All the answers to the questions have been fully vindicated. It is better service with minimum interference, and equipment was designed and produced within the period required and at a competitive price. What is more, it has injected sanity into an area which was fast becoming imbecilic. It has provided local industry with a new market, and employment and export opportunities.

New fraternities are springing up. Long distance truck drivers are enthusiastic and enterprising roadside cafe owners advertise the fact that they are on the air on channel 'x' and will accept messages to pass on to other travellers. Sporting and particularly boating clubs are taking to the medium. The flexibility of having 40 channels from which to select at will is a real benefit.

It has also given the amateurs a 70cm unit capable of providing 40 channels each of single and two frequency simplex, a fact that has not escaped the UK amateur, as this unit is already on the UK market.

Your editorial implies by omission that there is no other choice. The antipodean experience has shown that there is. It is not too late for the UK to consider alternatives, but it will be too late if the Home Office procrastinates. As we know from the multimillion dollar disaster in the States and our own experience, if the public wants something, some enterprising entrepreneur will provide it legally or illegally. You will then be stuck with it, to the continued disadvantage of wonderwomen watchers and radiocommunication users in general.

R. B. Hooper
Philips — TMC Ltd
Clayton Victoria, Australia

LEVY ON COPYING

Your columnist Mixer's notion in the November 1979 issue that the record industry's claim for a levy on all blank tape cassettes and recorders "would be just as reasonable, and stand just as much chance of being accepted" as a similar levy charged on the use of photocopying machines is not as incredible as Mixer seems to think, at least not in Scandinavia.

Backed by existing copyright laws, very similar to those in force in Britain, the Technical and Fiction Writers Union has effectively banned duplication of printed material by photocopy-machine "until a suitable fee has been negotiated." Their present claim is 3.3 pence per copy. In Sweden, the Government is already paying writers 0.18 pence per copy, based on statistics of the copies taken in universities, school, public libraries and by local and national authorities.

Gisle Hannemyr
Porsgrunn
Norway

NEWS OF THE MONTH

Europe-wide information retrieval uses packet switching

On-line information retrieval services throughout Europe — the kind using computerised data bases — are now being linked together into a comprehensive network by a dedicated telecommunications system. Any professional worker with access to a Teletype-compatible data terminal (with printer or v.d.u.), a telephone line and a password for the system can retrieve information from general and specialised data bases in a number of European countries at a standard tariff which is independent of distance. By the end of 1980 about 140 such data bases are expected to be available. To make connection, the user has to dial on his telephone one of the computerised information services in his own country which is linked to the system. These are known as "hosts" and in the UK, for example, one of them is BLAISE, the British Library's Automated Information Service. Another UK host is Infoline, which, incidentally, will be bringing into the system the well known IEE Inspec database of physics, electronics, computing and mathematical information.

This European link-up called Euronet-DIANE, was opened in November last year. Initiated by the European Communities Commission, it is intended in the first instance for the benefit of the present nine Common Market countries but probably later will bring in Switzerland, Norway, Sweden, Spain, Austria, Yugoslavia and Greece. Euronet is the hardware part, operated by the telecommunication authorities of the EEC. Its backbone is a dedicated high-speed data transmission system operating at 48,000 bit/s on the packet switching principle (in which packets of digital data are sent by the best route at a given time to achieve the most efficient use of available lines — often interleaving packets for different addresses). The international lines carrying this data stretch across Europe from Dublin through London, Paris and Frankfurt to Rome, with branches off to Amsterdam, Copenhagen, Brussels and Luxembourg. Exchanges for packet switching are located in London (in the Post Office's Electra House, Temple Place, London WC2, which also houses the management centre controlling the day-to-day operation of Euronet) and in Paris, Frankfurt and Rome. Users' terminals are connected through the hosts to this backbone by slower speed data transmission on public or leased lines working at anything from 110 bit/s to 9,600 bit/s. A detailed description of Euronet is given by P. T. F. Kelly of the UK Post Office in *The Radio and Electronic Engineer* (IERE Journal) for November 1979. (See also "Switching into European data" by D. E. Hadley and A. C. Barnes, *Post Office Telecommunications Journal*, Autumn 1979). We understand there is some possibility that viewdata terminals (Prestel in the UK) could be made compatible with the system.

DIANE is an acronym meaning Direct

Information Access Network for Europe and is the organisation of the various on-line information services themselves — the software side. At present there are 23 hosts, offering a spectrum of scientific, technical, medical, legal, social and economic knowledge. Inquiries about it can be made to:

Euronet DIANE Information, Jean Monnet Building, B4 009, ECC, Luxembourg (Grand Duchy). Local enquiries about Euronet in the UK can be made to the Post Office contact: Mr T. Lake, International Telecommunications, Landsec House, New Fetter Lane, London EC4 (tel: 01-583 4945 or 8832).

Many of the on-line information retrieval

systems available through DIANE use different sets of commands. The potential user is therefore faced with the possibility of having to learn several search languages. But recently a study carried out for the ECC by Scicon in the UK has devised a common command language which allows users to search on different retrieval systems using one language. This has been accepted as a formal guideline for use by the hosts and is already being implemented by some of them. The standard command language is not meant to replace existing sophisticated search languages but as an alternative to help users who need to search on a number of different systems.

CEI honours Sam Fedida

One of the UK's foremost engineering accolades, the MacRobert Award, has been given to Sam Fedida, well known to readers of this journal as the author of a series of articles (*Wireless World*, February to May 1977 and April to June 1978) dealing with Viewdata, the information system using telephone and television in a communication/display combination he had invented while working as a Post Office research engineer.

The prize of £25,000 and the MacRobert Medal were presented to Fedida by H.R.H. the Duke of Edinburgh in his capacity as founder president of the Council of Engineering Institutions (CEI) at Buckingham Palace on 5th December 1979. The MacRobert Gold Medal was also presented on this occasion, to Post Office Telecommunications for the development of Prestel, the first public Viewdata service in the world.



Sam Fedida was born in Alexandria, Egypt, in 1918. He was educated in England and graduated with a B.Sc.(Hons) at Imperial College, London, and during the second world war served as a radar officer in the R.A.F. After the war he joined Marconi, becoming a development manager in 1960 and Assistant Director of Research in 1965. He joined the Post Office Research Department as Manager of Computer applications in 1970 and soon afterwards invented the Viewdata system, which he demonstrated publicly in 1975. He had obtained an M.Sc. in computer sciences at Birkbeck College, London in 1973.

The MacRobert Award has traditionally been awarded for the development of a novel engineering project or process and has shown a general bias towards hardware. However, the last two decades have shown that software aspects of complex electronic systems are now at least as technically challenging and this award tends to indicate the CEI's awareness of the growing significance of information retrieval systems.

PET automatically checks impedance

A combination of instruments including a Rohde and Schwarz ZPV vector analyser, a signal generator and a Commodore PET computer can, according to Aveley Electric, a British distributor for Rohde and Schwarz, be used for automatic impedance measurements. Frequency range covered is from 0.4 to 1040MHz and the test permits automatic voltage measurements of magnitude and phase, measurement of S parameters, impedances and admittances as well as group delay measurements. Measured values are displayed on the screen of the PET or are fed out via an IEC bus-compatible printer.

Post Office introduces microprocessor pay-phones

A completely new type of Post Office pay-phone, featuring microprocessor control and a numerical key-pad instead of a rotatable dial, began trials on December 10. This marks the beginning of a Post Office programme to re-equip coin-operated call boxes and an initial order of 100 of the new units has been placed with Agitelco, a member of the AGI group.

Unlike the conventional pay-phone, cash is inserted before the required number is keyed and there is no "pay tone." Coins held in store are credited to the caller and this amount is indicated on a digital display. As the call proceeds the cost is deducted from the amount in credit and 10 seconds before the credit runs out the visual display requests more money, the display being accompanied by a "bleep" on the line. The microprocessor calculates the rate from meter signals received from the local exchange in the conventional manner, disconnects the call if there is no credit left or pays out unused coins. The rate of charge is similar to that of the conventional pay-phone and depends upon distance and time of day; a "follow-on" facility is included where, upon pressing a button, further calls can be made using credit still in store.

Operator calls can still be made although these will be restricted to the UK area initially and on these calls another "bleep" signal tells the operator that the call is coming from a new "blue payphone", so called because the phones have all instructions printed in blue. Each unit is housed in a stainless steel casing and the Post Office maintains that the microprocessor approach used in this unit offers advantages including ease of installation, faster servicing resulting from the "watchdog" action of the m.p.u. in reporting faults immediately and overall cheaper running due to the elimination of the special call-charging equipment at present necessary at local exchanges.

During the trial period the Post Office will be carrying out research into customer reactions and the extent of use of the new phone compared with that of the conventional type, with the intention of a realistic assessment of the quantity needed to cover the first phase of modernisation.



Microprocessor and Electronics Centre

A showroom for electronics manufacturers, funded by private and ICFC money, was opened by Lord Trenchard in December. Jeremy Prosser, of Prosser Scientific Instruments, had the idea of a base for electronics companies to show their wares in London, to conduct interviews and to meet their potential customers. One or two economists and marketing people evidently agreed with him and combined with him to set up the venture in the World Trade Centre in East Smithfield, near the Tower of London.

A coincident exhibition helped to set the scene for the opening ceremony (it actually opened its doors in September, but the celebratory junket was delayed a few months) though many exhibits were not, one felt, of the type to inflame the imagination of the civilised world. Examples of the ways in which electronics can enrich our lives and widen our horizons included the K9 dog machine from the Dr Who television programme, a toy train controlled by a microprocessor in a manner no one present felt able to discuss, and some 'Star Trek'-inspired 'phasors', which made funny noises. Measuring instruments were in evidence, as were microcomputers in various guises.

Lord Trenchard's opening speech was a worthy example of its kind, impressing on all of us the need to use microelectronics for all we were worth and spelling out to us the disastrous consequences of failing to do so. The effect of the homily was not heightened by his aside, on leaving the still-live microphone, that he supposed he was now going to be shown the exhibits, which he couldn't, of course, be expected to understand. Lord Trenchard is a Minister of State for Industry.

The Microprocessor and Electronics Centre will be permanently open and will run a series of small exhibitions throughout the year.

Aiwa to set up "micro" hi-fi plant in Wales

Speaking in response to Aiwa's decision to set up a British subsidiary of the Japanese company, Lord Trenchard, Minister of State for Industry said, "I am delighted at Aiwa's decision to set up a plant in the UK... Aiwa will be the first manufacturer of miniaturised hi-fi in the UK and the first Japanese audio manufacturer to come here."

In fact, both Toshiba and Matsushita preceded Aiwa in setting up plant in the UK, although this is the largest projected undertaking in the field of "micro" hi-fi here, the estimated cost being £2 million, drawing £600,000 of British government aid. "Micro" hi-fi employs microelectronic circuits in a complete package of about 12ins by 8ins and the UK manager, Mr Stephen Chorley, expects 50% of output from the Newbridge, South Wales, plant to be exported. About half of the components used will be British

and at the start of production in June 1980, between 70 and 100 new jobs will be made available to local people. The Welsh Development Agency has provided the factory on a 25-year lease to the Japanese company.

Zenith buys Heath

Zenith Radio Corporation has completed the purchase of Heath from Daystrom Inc, a wholly-owned subsidiary of Schlumberger Ltd. Heath, the Michigan-based electronic kit manufacturer, will be operated as a wholly-owned subsidiary of Zenith. New Zenith subsidiaries have been established to operate the 55 Heathkit Electronic Centres in the United States and the Heath business in Canada and Europe. Daystrom Inc, was acquired by Schlumberger in 1962.

Radio amateurs provide communications in Indian disaster

Radio amateurs provided emergency communications in disaster-struck Morvi, India, during the afternoon of August 11. Unusually heavy rains caused one of the Macchu dams to burst at both sides of the spillway, engulfing the entire city which had a population of 75,000 people. A wave seven or eight feet high devastated 80% of the buildings and left an estimated 10,000 people dead. The water continued to rise to about 15 feet and when these flood waters receded, the streets and houses were under 14 feet of mud.

Communications and power supplies were cut off almost immediately and even towns within 10 to 15km away remained unaware of the tragedy for 24 hours. When the news finally got out, India's Home Guard from the city of Rajkot, 70km away from Morvi, were the first to reach the devastated city and they set about extricating the wounded from the debris, disposing of bodies and organising relief.

The Federation of Amateur Radio Societies of India and the Radio & Electronics Society of India, realising that communications would be needed, held an emergency meeting and within three days volunteers were mobilised, equipped with transceivers, antennae and other communications equipment, borrowed from various amateurs. Flying indirectly from Bombay to Rajkot, a small team of radio amateurs joined other helpers. One of the local amateurs contacted the Home Guard and introduced the District Commandant to their facilities. The Com-

mandant indicated that these facilities were just what they desperately needed, their own vhf equipment being totally inadequate to the problem. A main station was set up in the Commandant's office at the Home Guard's base at Rajkot, a jeep was made available and was quickly fitted out with mobile hf and two-metre equipment.

The two-metre portable equipment in particular, proved to be invaluable to the working parties who went out into the mud-filled lanes.

The amateur's facilities were used by the Red Cross and many other relief groups; they gave up 18 days of their time to provide emergency communications round-the-clock. When the telephones were reconnected between Morvi and Rajkot, the amateur's usefulness diminished and operations were wound up on September 5.

The amateurs obtained a good deal of satisfaction from the provision of emergency communications but they were also quick to point out that they had come to realise just how unprepared they were for the event and how lacking they were in suitable equipment and trained manpower. Their hope now is that, with government and other help, they can improve this situation. A story like this must encourage organisations such as RAENET (Radio Amateur Emergency Network) in the UK and other services even if they do find little opportunity to put it into practice.

Report says "Space for 12 more radio stations in London"

A study of v.h.f. spectrum availability in the London area, carried out by the former IBA engineer Fred Wise and commissioned by the Community Communications Group (COMCOM), reports that there is space for at least a dozen small radio stations in the area. The report splits possible further coverage into three categories including small stations with a coverage radii of about 1.5km, medium size stations covering a sector of the city and larger stations, aimed at specialist interests, covering the entire city.

The forthcoming extension of the v.h.f. broadcast band to, initially, 104MHz and later to 108MHz (see News columns, January 1980 *Wireless World*) as a result of allocations at WARC '79, means that a further six stations

in the first category, four in the second and one in the third would be possible, but the latter would have to compete for space with both the BBC and the IBA.

Emphasis is placed in the report on the need for adequate representation of community radio interests in any plans to develop local or national services in the v.h.f. band. Commenting on the report, a spokesman for COMCOM said "We are delighted to have expert confirmation that our proposals for a "third force" of small, democratically-controlled, non-profit radio stations are technically feasible. Over the country as a whole, this finding shows there is room for many more stations than is officially admitted."

Hoff awarded microprocessor prize

The Franklin Institute has awarded the Stuart Ballantine Medal, one of the United States' most coveted awards for scientific and technical achievements, to Dr Marcian E. Hoff, for his work in developing the microprocessor.

In addition to his work on digital microprocessors, Dr Hoff, or Ted Hoff as he prefers to be called, has contributed to the development of the first high-density memories for both mainframe computers and small computers, and more recently the development of the first analogue microprocessor. Between 1962 and 1968, he worked on computer equipment design as a research

associate at Stanford. In 1968 he joined the then newly-formed Intel Corporation as applications research manager where he worked on a variety of microprocessor and memory devices. In 1969 he proposed the microprocessor architecture and his work led to the production of the first microprocessor, the 4004, in 1971.

Since 1974, Ted Hoff has specialized in Intel's telecommunications products, contributing to the development of l.s.i. circuit technologies as used in the a.-to-d. and d.-to-a. converters employed in telephone coder-decoder circuits and the 2920 analogue microprocessor.

NEWS IN BRIEF

The sixth European Conference on optical communication is to be held at the University of York from 16th to 18th September 1980. The papers presented will cover fibres and fibre cable, devices (i.e.d.s, lasers and detectors) integrated optics, equipment and techniques and total systems. The deadline for abstracts is 31st March 1980 and communications regarding the conference should be addressed to Conference Dept, The Institution of Electrical Engineers, Savoy Place, London WC2R 0BL.

Six training modules, which Texas Instruments describe as a complete introduction to microprocessor technology, are being run by them as an extended range of courses at their headquarters in Bedford. Subjects covered include an introduction to microprocessing, assembly language programming, microprocessor software development using a diskette-base operating system, advanced microprocessors, Pascal language programming, Pascal executive runtime support and target system debugging. A brochure covering the range of courses is available from Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK41 7PA.

South London College is running a short course of nine lectures on receiver decoders (Teletext), to be held in the lecture theatre on consecutive Tuesday evenings from 6.30 to 8.30, starting on January 29th 1980. Slides and demonstrations will be features of the lectures and the course is intended for television and telecommunication technicians and engineers. Fee for the course is £7. Contact A. A. Rowlands, Course Organiser, South London College, Knights Hill, London SE27 0TX.

The 65th convention of the Audio Engineering Society is to be held at the Hilton Hotel, Park Lane and the Park Lane Hotel from Feb. 25th to 28th, 1980. Pre-registration fees are non-members £17.50, members £12.50 and student members £3.00 (student non-members £4.50). Fees at the door are non-members £20, students £6, members £15 and student members £4. Details from Laurie Fincham, K.E.F. Electronics Ltd, Tovil Maidstone, Kent ME15 6QP.

B. Sandham, electrification planning engineer, British Rail Board, will present "Future Developments in Electrification (Railways)" at a joint IEETE/ITEME meeting to be held at the IEE, Savoy Place, London WC2 at 5.30pm on January 30, 1980.

The IEETE have two optical fibre events planned for February 1980. D. J. Blake of the Post Office, will present "Optical fibre communications systems" at Swansea University at 7.30pm on February 14, and an "unconfirmed" speaker will present "Optical fibres and cables" at Gwent College of Higher Education, Newport, on February 19.

K. Tabor of Post Office Telecommunications will present "Post Office System X" at Bucks Higher Institute of Technology, High Wycombe. The IEETE meeting will be held on February 28 at 7.30pm.

Car telephone service to go automatic

A service which will permit car radiophone users in the London area to dial direct or receive calls from any of Britain's 25 million telephones or 400 million numbers available on International Direct Dialling in 90 countries, is to be introduced by the Post Office in May 1980.

The new service will operate in exactly the same way as the 'phone at home and will enable 1,500 subscribers who have been waiting for connection to take advantage of this phone-in-a-car facility. At the moment it is necessary to call the radiophone operator, ask for the number and when an unoccupied radio channel is found the number is selected and routed through to the caller. With the new service it will no longer be necessary to follow special procedures such as depressing the "press to speak" button.

"New" radio frequencies, made available by reducing the bandwidth of existing channels, have been created to accommodate the increased number of subscribers using the service. At present, the London Radiophone service, which has been in operation since

1963, is stretched to its limit at about 3,500 customers. Customers using the current manual system are being given the opportunity to switch to the automatic process, but those who choose to remain with the old service will have to have their car equipment modified to work on the reduced bandwidth channels. Conversion will be carried out free of charge by the Post Office in conjunction with Radiophone suppliers under a carefully phased programme.

Customers will rent or buy the necessary equipment from three authorised suppliers; Marconi Communication Services Ltd, Pye Telecommunications Ltd, or Storno Ltd, who will install and maintain the hardware.

Two charge rates are applicable to the automatic service; normal (working hours, 8am to 6pm) at 3½p for eight seconds and cheap (evenings and weekends) at 3¼p for 15 seconds. The charge will depend on duration of call irrespective of distance and there will be no three-minute minimum. The quarterly rental will be £100, vat extra, and although the first subscribers will be dealt with in May

1980, work on the new service as a whole will begin in January 1980 and take 18 months to complete.

Additional equipment is required at the Radiophone stations and £1¼ million worth of the necessary work will be provided by Pye. These improvements will also permit users of the automatic system to make use of the facility in other Radiophone areas.

Datel 4800

A high-speed Datel service, to be known as Datel 4800, will enable users to send data at up to 4,800 bits/s over the national telephone network; the system is to be introduced by the Post Office this month and offers three types of synchronous operation; full duplex, half duplex and full duplex private circuit with half duplex public network operation as a standby facility. The system also incorporates customer test facilities enabling checks on circuits or modems before calling in PO engineers.

Is breath-testing BORIS bogus?

According to a report by Radio Australia, inventor Jim Blackwell has developed a "fool-proof" device which will keep intoxicated motorists off the road. He calls the equipment BORIS, which stands for Breath On Re-circulating Ignition System and Jim says the device is now ready for marketing after four years of development. It is fitted to the car's ignition system and the engine will not start "until the driver has blown into it. If the driver's blood alcohol level is above the legal limit, the engine does not turn over."

The inventor claims that tests at Sydney University prove that the gadget is 100% effective. The practical implications of the method, unless it is now possible to breath-print a particular driver, are that in normal use (and in the tests at Sydney University, presumably) the sober spouse and kids have to be chained up to a local lamp post or left at home; the naughty driver might otherwise be tempted to get one of them to blow into his BORIS so that he/she could roar off on a characteristic zig-zag path in a haze of alcohol and burning rubber. There's also a distinct odour of red herring in the air!

Hounsfield wins major German award

Dr Godfrey Hounsfield, who was joint winner of the 1979 Nobel Prize for Physiology and Medicine, received the 1979 Aachen and Munich Prize for Technology and Applied Natural Sciences at a ceremony in Munich recently. The prize, which is worth about £15,000, is also in recognition of Dr Hounsfield's invention and development work relating to computer tomography. The annual award was instituted in 1975 to mark the 150th anniversary of the founding of Aachen and Munich Insurance Company.

Meteosat fails

Saturday, 24 November, 1979 marked the 2nd anniversary (plus a day) of the successful operation of Meteosat 1 and at 19.30 hours on that day an apparent overload in a power supply circuit caused the spacecraft to switch itself into the stand-by mode.

A statement issue by the European Space Agency (ESA) on 6 December, 1979 points to the source of the trouble as being "a component fault in a power control unit. The fault manifests itself as a spurious signal in the circuit designed to produce protection against overload situations (such as short circuits). This prevents many of the satellite sub-systems from being switched on. This particular component is not duplicated so there is no way in which the problem can be avoided by choice of alternative circuits. However, it appears that the failure is inter-

mittent in nature and it may well be that the satellite can restore itself to a normal mode. The investigation is continuing and ground simulations with similar circuits are being used to try to identify possible actions and to gain an understanding of the likely longer term forecast for the affected missions."

It is impossible to generate or disseminate images or to distribute information via the S band transponders, although the data collection mission continues to function normally. M. L. Christieson, author of "Meteosat earth station", *Wireless World* June 1979, says, "The failure of this satellite is a great disappointment to the many people involved with this project." Its failure may carry important implications for Meteosat 2 which is scheduled for launch in September 1980 aboard the "Ariane" launch vehicle.

Store recorders aid disease research

Syringo Myelia, a disease which affects the central spinal canal and which causes pain, loss of touch sensation and paralysis is being placed under renewed scrutiny at the Midland Centre for Neuro-surgery, Smethwick, using Racal's 14 channel "store" recorders. Information from transducer probes inserted into brain and spine cavities is compared with electrical signals from the heart. The seven speeds of the machine permit a "time lapse" approach which it is hoped will eventually yield a coherent picture of the disease.

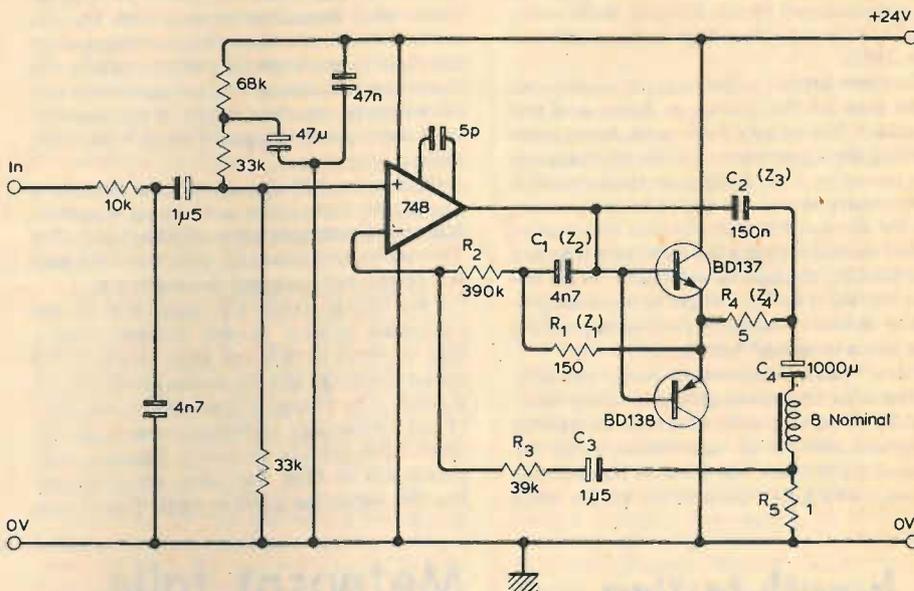


CIRCUIT IDEAS

Reverberation amplifier

An effective 100mW reverberation-spring amplifier can be constructed by combining a current dumping circuit with a feedback technique described by G. Hibbert in the August 1976 issue. The feedback around R_2 , R_3 , R_5 and C_3 provides an approximately equal output power when the load impedance drops at resonant frequencies. Current dumping is performed by R_1 , R_4 , C_1 and C_2 . Although the open-loop voltage gain of the op-amp is insufficient to cancel all of the cross-over distortion, with reverberation this is not audible. For other audio applications such as a headphone amplifier, the op-amp should be replaced by a high gain amplifier.

H. E. Riegstra
Amsterdam
Holland



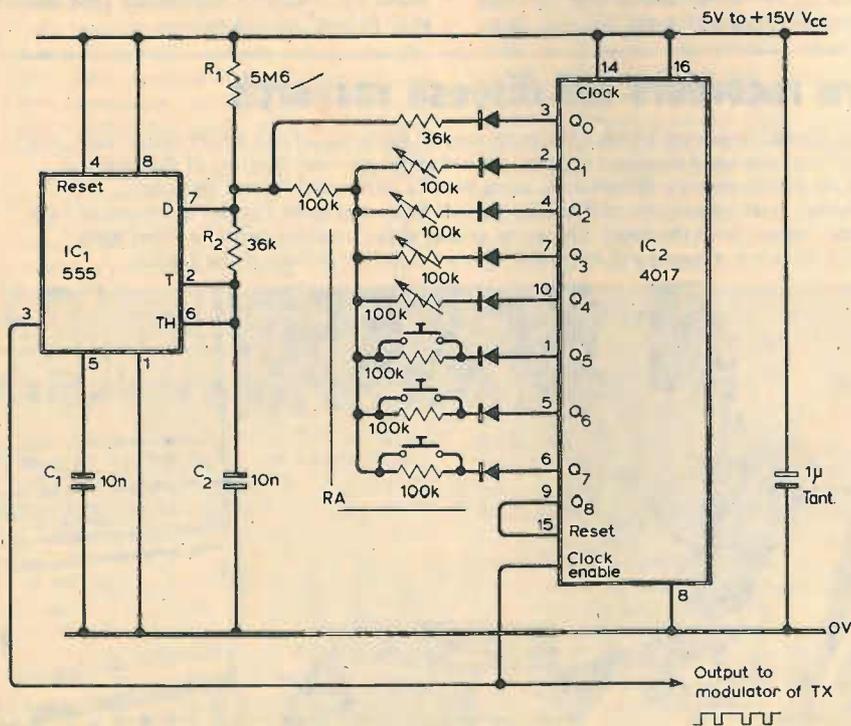
Radio control encoder

A simple seven-channel radio control encoder can be built with two i.c.s as shown. The circuit operates from 5 to 15 V at 2.5 to 8mA and will provide an output current of up to 200mA. The 555 is used in the astable mode with an off time of 0.25ms and an on time between 1 and 2ms except for channel 0 which produces a 0.5ms sync. pulse.

The decade counter is clocked by the

falling edge of the output and is reset when Q8 goes high. Resistor R_1 ensures that the 555 oscillates at a low frequency if no outputs are selected. If proportional control is not required, resistors R_A can be fixed values. For a supply below 8V a Zener regulator should be used to prevent variations in pulse width.

S. Ingham
Moseley
Birmingham

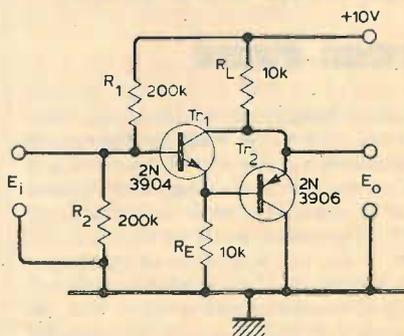


Unity gain buffer with wide frequency response

By d.c. coupling a n-p-n common emitter stage with a p-n-p emitter follower stage sharing a common load resistor, a unity gain buffer is formed which offers a high input impedance, wide frequency response, low output impedance and low current consumption.

The 3 dB bandwidth is above 80 MHz and by selecting better transistors this can be extended. Care in minimising the lead inductance and stray capacitance will also improve this figure. Current consumption is about a mA with a 10V supply. The circuit will operate from 3 to 30V without degrading its performance. It is important to select the correct input biasing resistors because they reduce the input impedance.

A. L. Equizabal
Vancouver
Canada

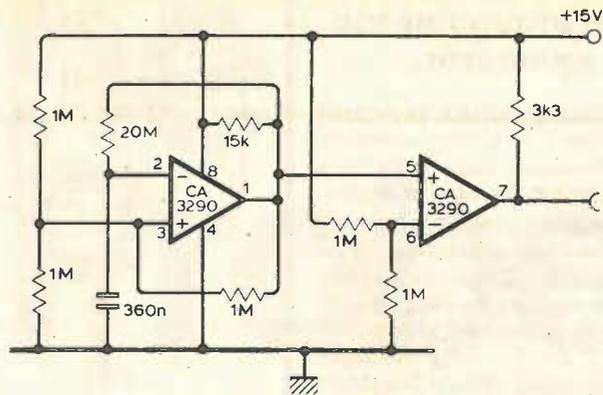


Low-frequency multivibrator

This multivibrator is based on the CA3290 dual voltage comparator which uses the bi.m.o.s. technique of combining bipolar and m.o.s. devices on a chip. The use of m.o.s. transistors in the input stage of the CA3290 provides an input impedance of around $1T7\Omega$ and common-mode rejection for input signals below the negative supply rail.

In the circuit diagram one half of the CA3290 is used as a conventional multivibrator. Because the input impedance is very high the value of the timing resistor can be large which enables a small low leakage timing capacitor to be used for a long time delay. The second half of the CA3290 is used as an output buffer so that the multivibrator frequency is not affected by output loading.

R. Buckley
RCA Solid State
Middlesex

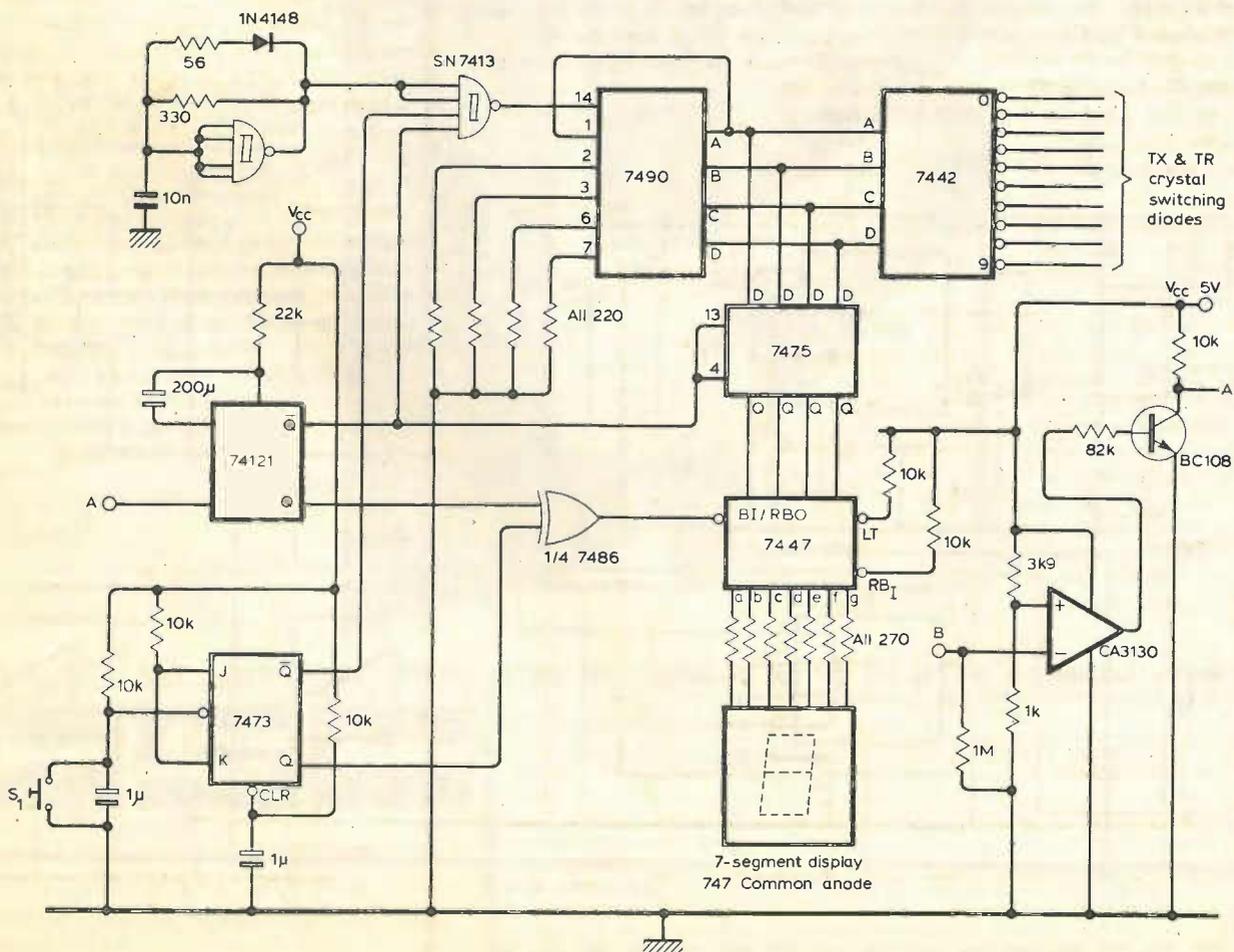


F.m. channel scanner

This circuit scans through 10 channels of an f.m. radio or transceiver by switching crystals in the local oscillator. Point B is connected to the audio switching transistor in the receiver which is normally saturated when no signal is present. On reception of a signal, point A rises to V_{cc} and triggers the 74121 which enables the display and

gates out the 7413 oscillator. The display is enabled for three seconds and if, during this time, the channel is wanted S_1 is pushed. The display disappears for the remaining period of the monostable pulse and is then enabled to confirm that the channel has been locked. If S_1 is pushed again the channel is released and the circuit continues scanning.

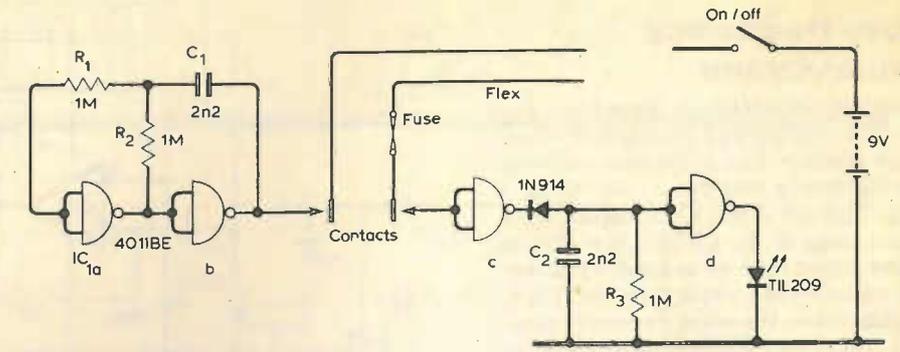
J. W. Jarvis
Huntingdon
Cambridgeshire



Analogue trigonometric function generator

When a function generator is needed where the output is a trigonometric function of the input variable, this is usually accomplished with a digital memory or with a non-linear circuit which approximates the function over a limited range. This circuit is comparatively simple and simultaneously provides the sine and cosine functions over an angle of $\pm 2\pi$. By using analogue dividers, other trigonometric functions can also be obtained.

The circuit operates by continuously sampling two harmonic waveforms, the phases of which are displaced by 90° . An oscillator generates sine and cosine waveforms at frequencies much higher than V_{in} . Purity of the waveforms has a direct influence on the quality of the outputs. The two waveforms are sampled and held by a dual analogue gate, C_1 , C_2 , and buffered by A_{1c} and A_{1d} . Sampling is synchronized to the harmonic waveforms and time displaced proportionally to the input voltage by the p.l.l. The 4046 is locked to the sine waveform and V_{in} is resistively summed with the phase-detector output which feeds the v.c.o. input. To remain locked to the input frequency the p.l.l. cannot allow a change in the v.c.o. input and therefore generates a voltage at the phase-detector output which exactly opposes V_{in} . Due to the linear characteristic of the phase-detector, the output square wave is displaced and its leading edge



Fuse tester

When it is necessary to test a mains fuse, unless the plug is taken apart, a conventional check relies on the resistance of the appliance. This circuit uses the capacitance between the line and neutral wires in the mains lead so a faulty connection or open circuit within the appliance cannot cause a misleading reading.

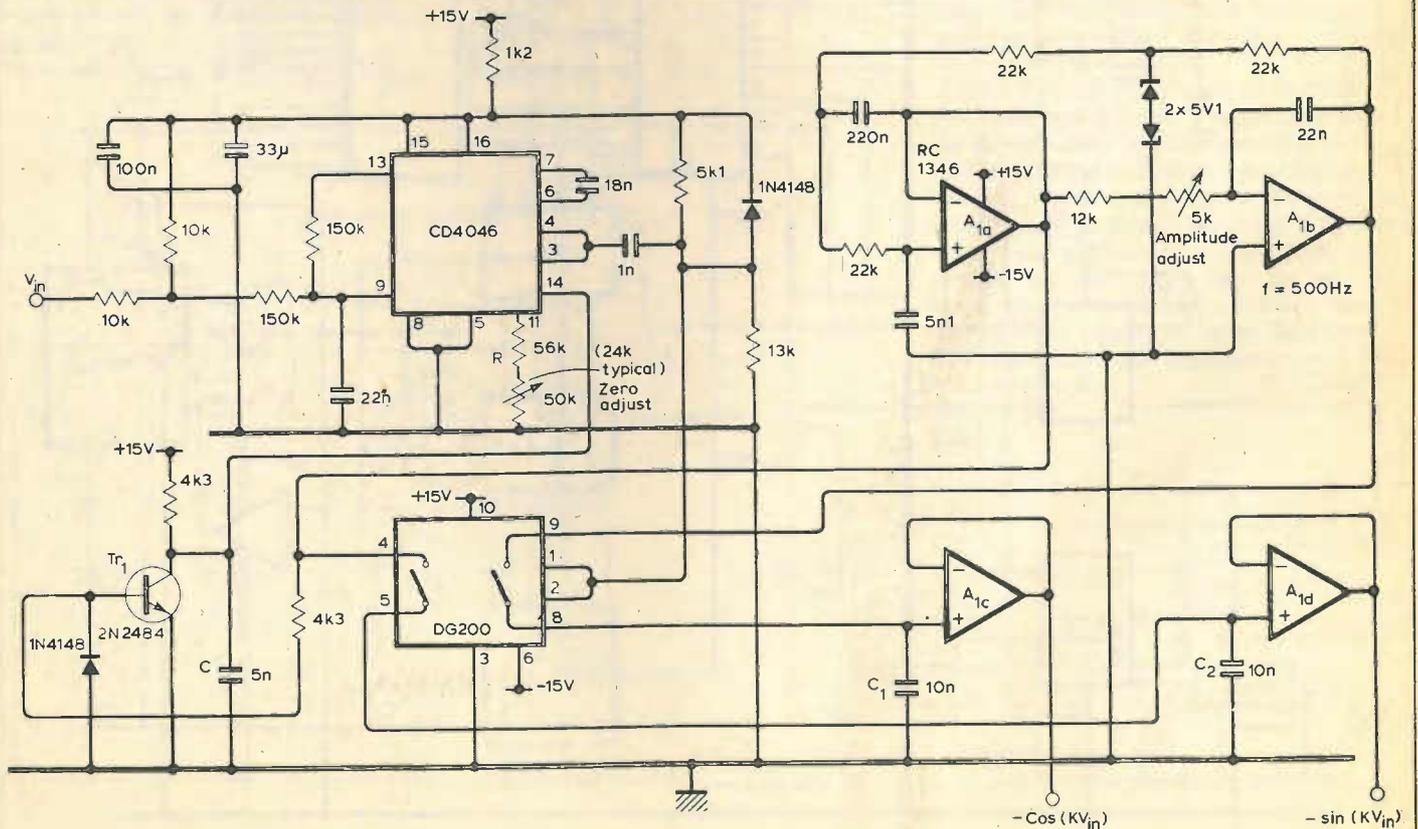
The oscillator formed by gates a and b feeds pulses into the neutral wire which induce a signal into the line. If the fuse is intact the induced signal is amplified by gate c, rectified and used to charge C_2 . The voltage on C_2 is amplified and used to drive the l.e.d. The fuse tester can be checked by touching the contacts with a finger.

P. Kelly and M. Dixon
Shrewsbury

used as a control for the two sample and hold circuits. To be symmetrical about $V_{in} = 0$, the p.l.l. should have zero phase shift at this point and this is achieved by adjusting the v.c.o. frequency. The input is coupled to the p.l.l. by a summing network so that V_{in} can vary symmetrically about ground by $\pm 4V$ which

simulates an argument variation of $\pm 2\pi$. Transistor Tr_1 squares the sinewave at the input of the p.l.l. to provide lock. Similarly, capacitor C is needed to eliminate lock loss near $V_{in} = 0$.

Y. Netzer
Haifa
Israel



The Logic Probes

Spend Less

Test More



LP-1 Logic Probe

The LP-1 has a minimum detachable pulse width of 50 nanoseconds and maximum input frequency of 10MHz. This 100 K ohm probe is an inexpensive workhorse for any shop, lab or field service tool kit. It detects high-speed pulse trains or one-shot events and stores pulse or level transitions, replacing separate level detectors, pulse detectors, pulse stretchers and pulse memory devices.

All for less than the price of a DVM

£31.00*



LP-2 Logic Probe

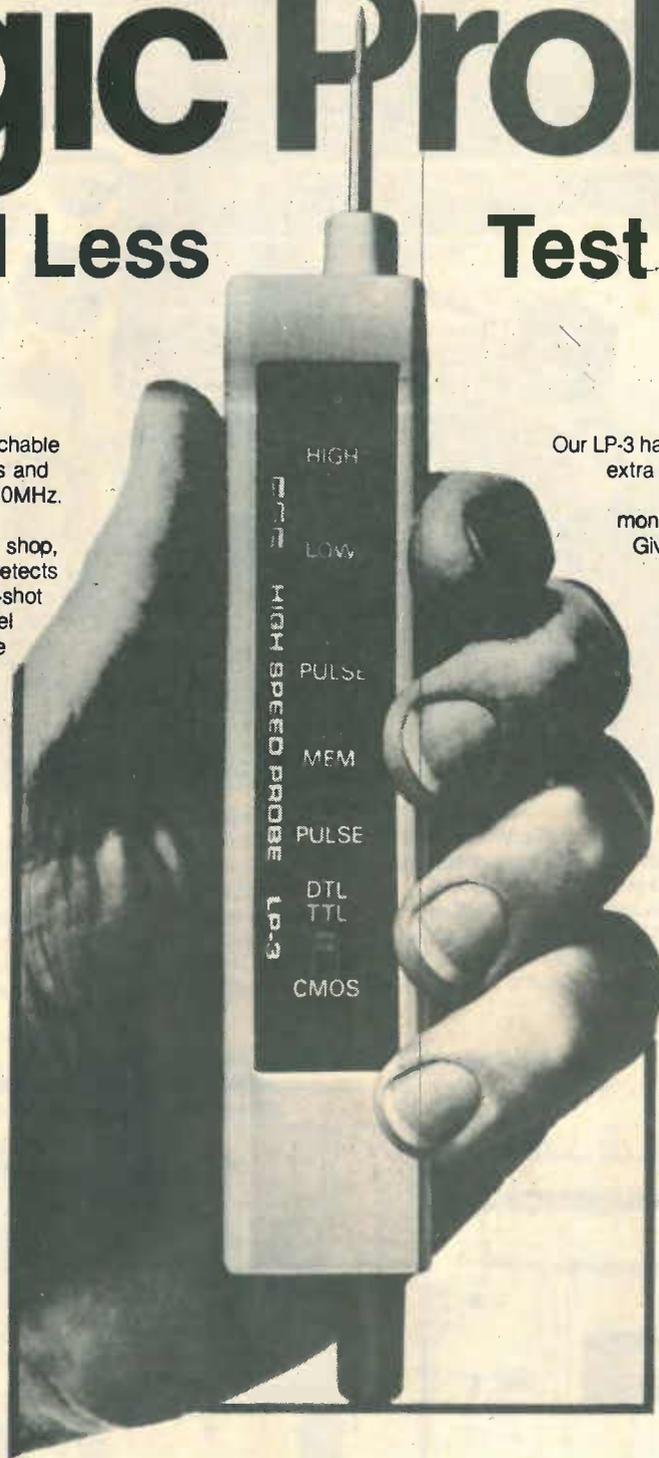
The LP-2 performs the same basic functions as the LP-1, but, for slower-speed circuits and without pulse memory capability. Handling a minimum pulse width of 300 nanoseconds, this 300 K ohm probe is the economical way to test circuits up to 1.5 MHz. It detects pulse trains or single-shot events in TTL, DTL, HTL and CMOS circuits, replacing separate pulse detectors, pulse stretchers and mode state analysers.

(Available in kit form LPK-1 £11-92)

£18.00*

The logic probes shown are all suitable for TTL, DTL, HTL and CMOS circuits.

*price excluding P.&P. and 15% VAT



LP-3 Logic Probe

Our LP-3 has all the features of the LP-1 plus extra high speed. It captures pulses as narrow as 10 nanoseconds, and monitors pulse trains to over 50 MHz. Giving you the essential capabilities of a high-quality memory scope at 1/1000th the cost.

LP-3 captures one shot or low-rep-events all-but-impossible to detect any other way.

All without the weight, bulk, inconvenience and power consumption of conventional methods.

£49.00*



The New Pulser DP-1

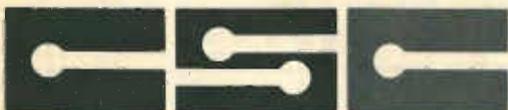
The Digital Pulser: another new idea from C.S.C. The DP-1 registers the polarity of any pin, pad or component and then, when you touch the 'PULSE' button, delivers a single no-bounce pulse to swing the logic state the other way. Or if you hold the button down for more than a second, the DP-1 shoots out pulse after pulse at 1000 Hz.

The single LED blinks for each single pulse, or glows during a pulse train. If your circuit is a very fast one, you can open the clock line and take it through its function step by step, at single pulse rate or at 100 per second. Clever! And at a very reasonable price.

£51.00*



CONTINENTAL SPECIALTIES CORPORATION



C.S.C. (UK) Limited,
Dept. 7J, Shire Hill Industrial Estate, Unit 1,
Saffron Walden, Essex CB11 3AQ.
Telephone: Saffron Walden (0799) 21682
Telex: 817477

C.S.C. (UK) Ltd., Dept. 7J, Shire Hill Industrial Estate, Unit 1, Saffron Walden Essex CB11 3AQ
Prices include P.&P. and 15% VAT

LP-1	£37.38	Qty.	LP-2	£22.14	Qty.	LP-3	£58.08	Qty.	DP-1	£60.38	Qty.	LPK-1	£14.86	Qty.
------	--------	------	------	--------	------	------	--------	------	------	--------	------	-------	--------	------

Name _____ Address _____

I enclose Cheque/P.O. for £ _____ or debit my Barclaycard/Access/
American Express card no. _____ exp. date _____

FOR IMMEDIATE ACTION — The C.S.C. 24 hour, 5 day a week service.
Telephone (0799) 21682 and give us your Barclaycard, Access, American Express
number and your order will be in the post immediately.

for FREE catalogue tick box

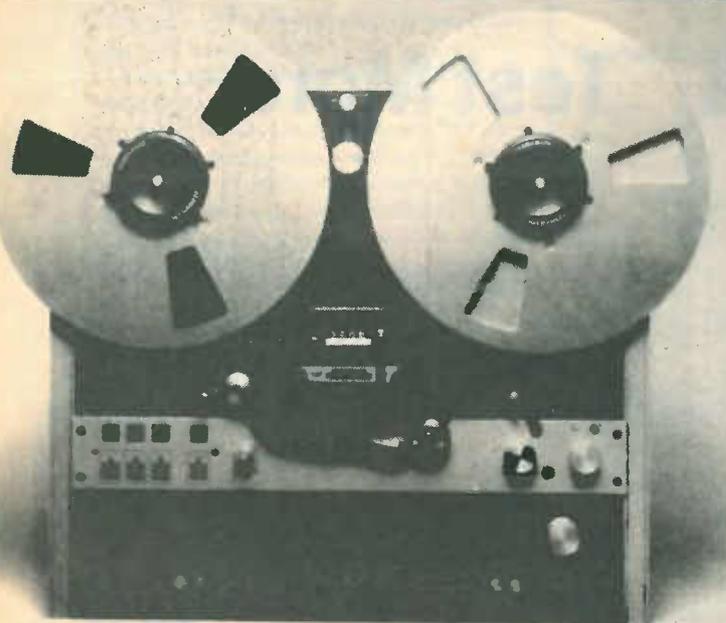
WW — 013 FOR FURTHER DETAILS

NEAL FERROGRAPH

RECORD

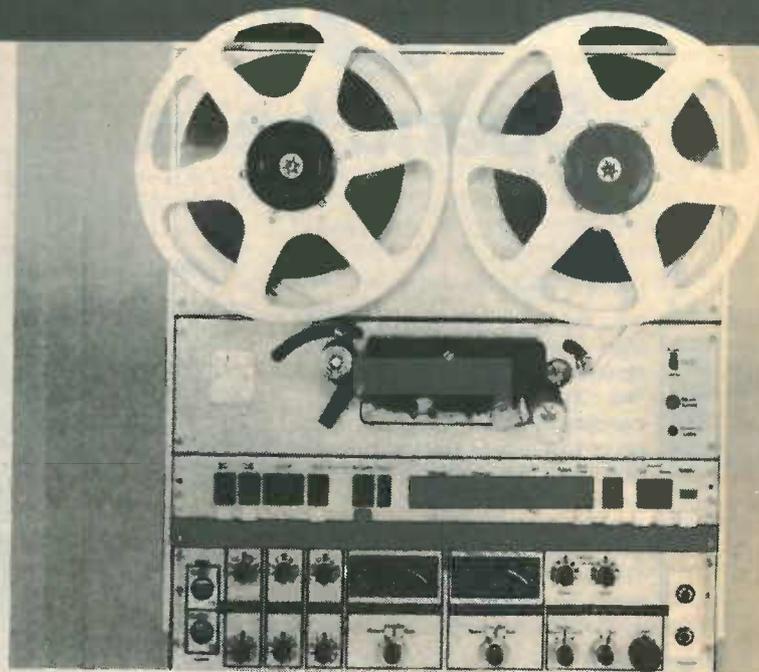


A complete range of reel to reel, cassette, and test equipment for the professional and enthusiast.



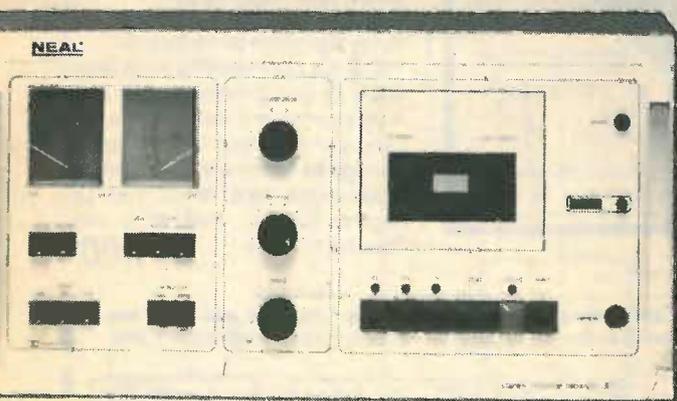
The Ferroglyph SP7

A transportable recorder for fast, safe tape handling under all conditions and a new concept that brings custom-building within the price range of standard models. It takes all spool sizes up to 27cm and provides 3 speeds and positive action push buttons in association with logic circuits as well as motion sensing and command memory. Based on the Logic 7, individual specification allows choice of mono full track or half track head, stereo half track or quarter track head, line-in/line-out, microphone inputs and many other features.



The Ferroglyph Studio 8

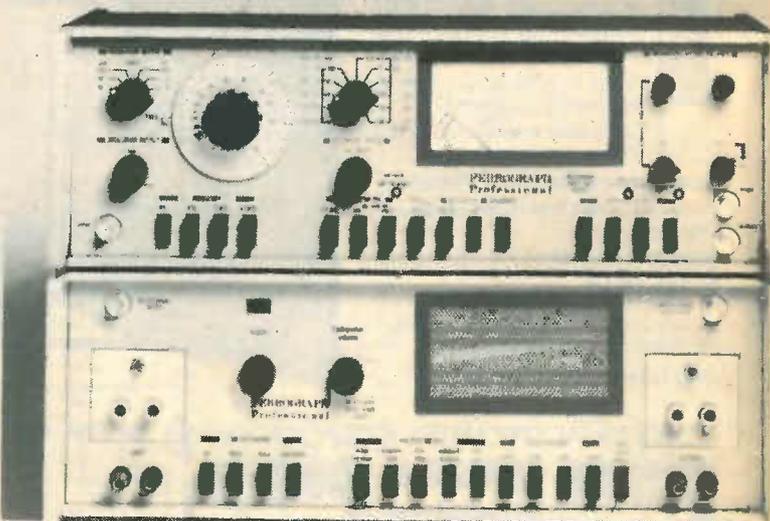
A professional studio tape recorder, logic controlled and offering a choice of stereo, twin track and full or half track mono heads, PPM or VU meters, IEC (CCIR) or NAB equalisation. It is designed to meet the needs of modern radio and television broadcasting organisations and features include servo-controlled run and spooling, tape motion sensing and three editing modes. For up to 10½" spools it accepts standard, long-play and double play ¼" tape and has total type protection by electronic interlocks.



The Neal 302

A studio cassette recorder that incorporates three a.c. motors for reliability and smooth effortless power. It is controlled by a full solid state logic system actuated by ultra light touch buttons. A massive decoupled flywheel and oversize capstan result in exceptionally low wow and flutter. Tapes are protected by constant monitoring and in the event of snag or snarl the machine returns to stop. The 302 is used by top recording studios and broadcasting stations for quality cassette copies and in-cassette duplication masters.

WW - 084 FOR FURTHER DETAILS



The Ferroglyph RTS2 and ATU1

An all-in-one audio test set, the RTS2 puts an end to the use of separate instrumentation and its inherent complication of connections. The result is faster, cheaper servicing. It combines in one easy to use compact instrument the measurement of gain, noise, frequency response, input sensitivity, output power, distortion and the parameters relating to recording equipment such as wow and flutter, crosstalk, drift and erasure. Linked with a Ferroglyph Auxiliary Test Unit, ATU1, its range of applications can be extended to include measurement on professional equipment.

Neal Ferroglyph, Simonside Works, South Shields, Tyne and Wear, NE34 9NX. Telephone: 0632 566321.

Spectrum analyser adaptor

Using an r.f. instrument for audio frequency measurements

by R. C. V. Macario, B.Sc., Ph.D., M.I.E.E. University College of Swansea

The unit described, based on two mixer integrated circuits, enables an r.f. spectrum analyser to display a.f. system responses without loss of performance accuracy. Examples of the application of the unit presented here are measurements of the frequency responses of active audio filters and radio receivers.

Many laboratories possess versatile r.f. spectrum analysers and often associated r.f. tracking oscillators. Unfortunately the lowest frequency of operation of these instruments is often confined to a few kilohertz and this means that audio-frequency filter circuit responses usually cannot be examined directly on such instrumentation — and, indeed, if an audio frequency network analyser is not to hand the measurement of audio frequency response becomes very tedious.

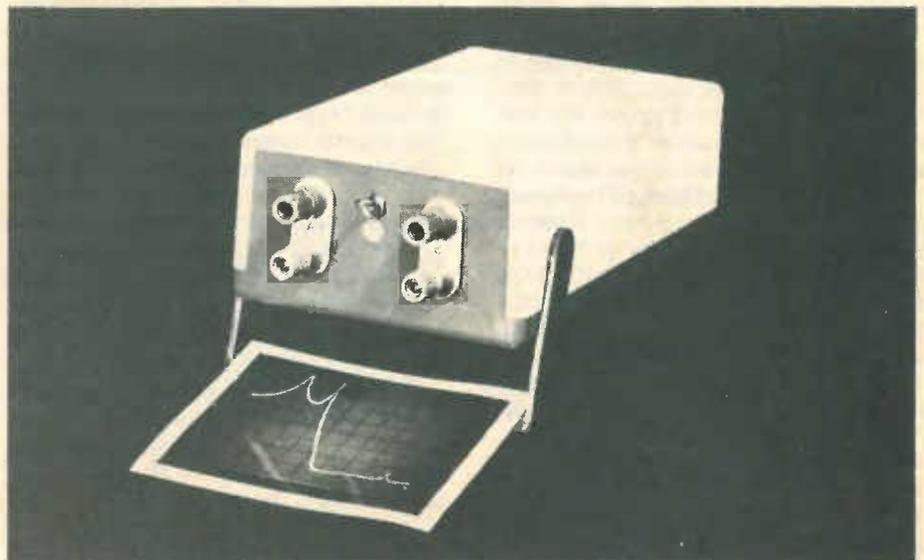
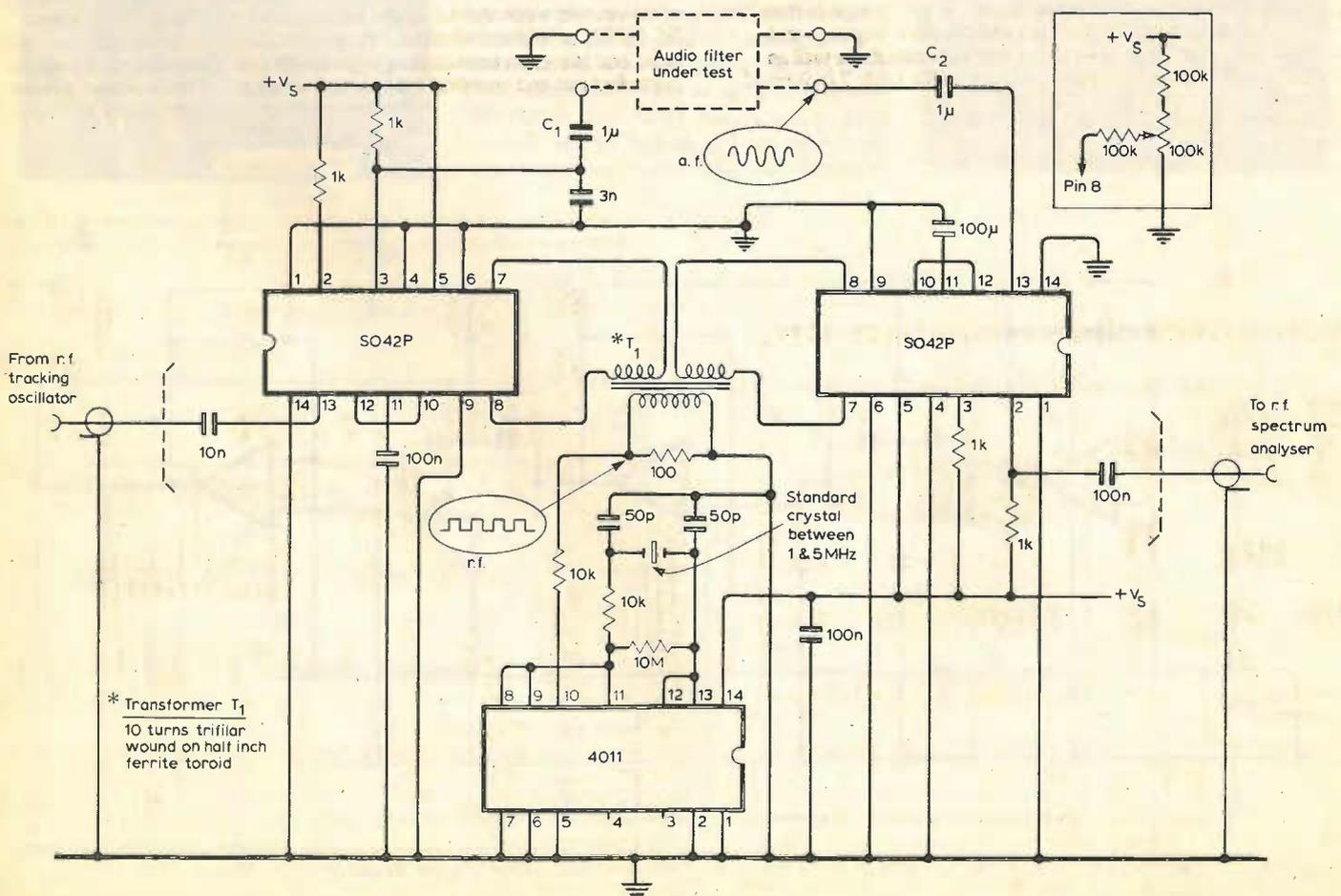


Fig. 1. The complete adaptor unit, with a photographed trace in front.

Fig. 2. Circuit diagram and waveforms of unit. To improve the carrier balance, add the circuit in the small box (top right) to pin 8 of each mixer.



* Transformer T₁
10 turns trifilar
wound on half inch
ferrite toroid

The unit shown in Fig. 1 provides a simple means of shifting an r.f. signal down to audio frequencies, and then up again to the same radio frequency. Operation is centred about a frequency determined by a c.m.o.s. crystal oscillator. This has good stability and its frequency is easily changed. The centre frequency can be between 1 and 5 MHz and is determined either by a crystal one has to hand or by the frequency required to match a receiver system being measured.

The frequency shift operation is carried out using the Siemens SO42P double balanced mixer device, which needs few external components. The natural signal balance of this device is about 30dB; if better than 50dB is required the balance circuit shown in a box as an option may be added. Two of these devices are used in the unit, as shown in the circuit diagram Fig. 2. (The circuit diagram of the mixer device itself is shown in Fig. 3 for reference as it makes clear the pin connection availability. Pins 11 and 13 are used as the signal input (unbalanced arrangement in Fig. 2); Pins 7 and 8 are used as the shift carrier input (balanced); the output (unbalanced here) is taken from pin 2.)

The principle of operation is quite simple. The swept r.f. input voltage is simply shifted down to audio frequencies (and d.c.) by choosing the appropriate unit crystal frequency. These audio frequencies are then shifted up again to r.f. by an exact counterpart circuit, the second SO42P. An aspect of the circuit is the symmetry of the two operations and the equality of the shifting r.f. reference waveform.

The c.m.o.s. oscillator (4011 quad 2-input Nand gate) produces a nine volt square-wave at the crystal frequency. This is divided down to produce a 100mV signal to each mixer via the untuned wideband transformer, T₁. The

maximum r.f. signal level that should be applied to the mixer inputs is 100mV peak-to-peak. This produces about 400mV peak-to-peak audio as an input to the test circuit. If the audio circuit under test produces gain then an attenuator must be inserted after the circuit under test. Responses down to 100Hz can be examined; for lower frequency responses the values of C₁ and C₂ should be increased, provided the r.f. analyser has a narrower bandwidth.

The r.f. spectrum analyser is tuned to the centre frequency of the unit, say, 2MHz. The response of the audio filter appears both sides of the centre frequency, e.g. ±10kHz. Normally one would view one side only with an r.f. sweep of, say, 1kHz per division. The dynamic range of the unit exceeds 60dB. The normal sweep rates, etc., of the spectrum analysers apply.

Construction

The circuit has been committed to a p.c. board which fits in a RS Components case type 509-383. Normal wander plug connections are assigned to the audio lines, whilst BNC sockets on the back of unit are assigned to the r.f. input and output. Because the circuit only takes 3mA it has been made battery operated using a 9V PP6 cell. A double-sided board construction is assumed.

Applications

Active filters. The unit arose because of a need to examine certain active audio filters. In particular, there is a great interest in limiting the bandwidth of a.m. medium and long wave broadcast transmissions^{1, 2} and to some extent good audio filtering in a receiver can aid this desire. Also, in the construction of s.s.b./i.s.b. phase shift modulators/demodulators the design of the audio frequency low-pass filter is as important

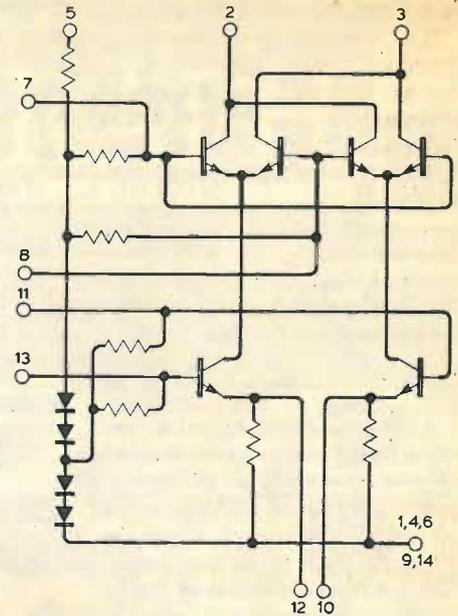
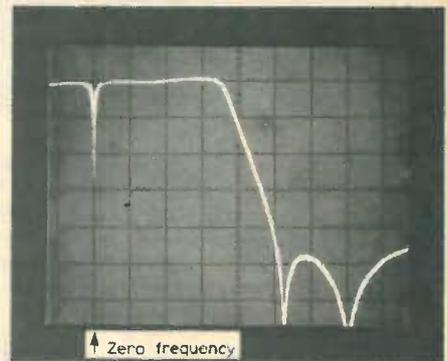
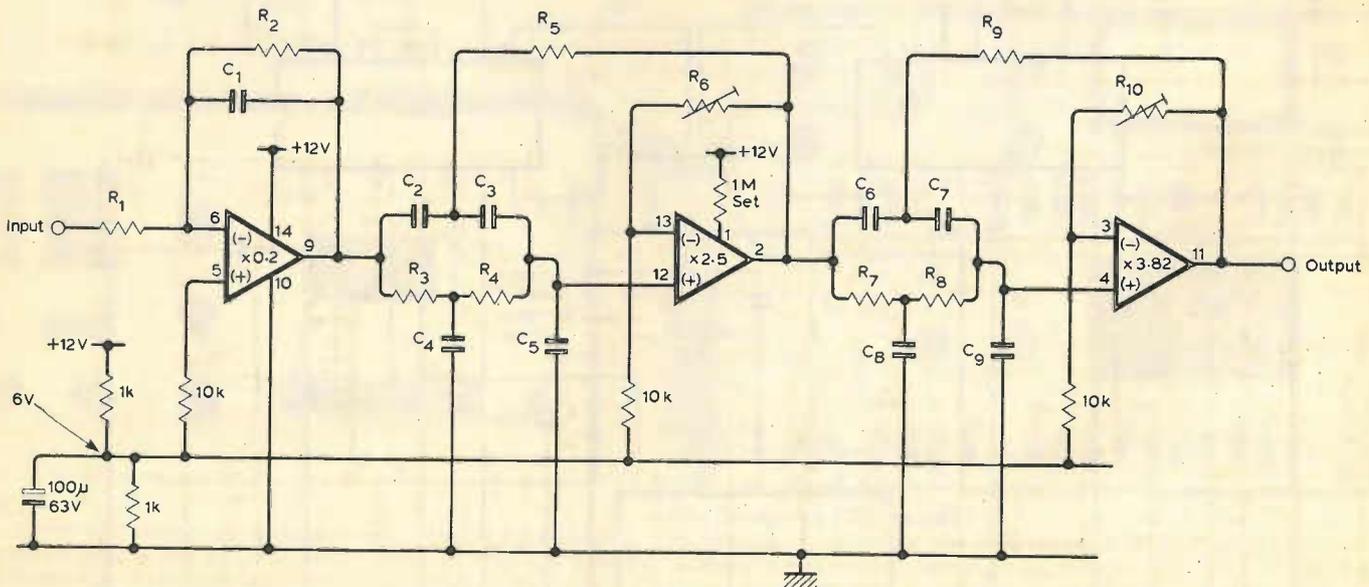


Fig. 3. Circuit diagram of the Siemens symmetrical mixer i.c. type SO42P (14 pin dual-in-line).

Fig. 4. Examples of active low-pass filters; (below) pole-zero realisation using op-amps; (opposite) conventional LC realisation using gyrators. Traces above diagrams show measured responses using the adaptor (vertical scales 10dB/div; horizontal scales 1kHz/div.).



One L 144 C J



Resistors: 1 — 56k; 2 — 12k; 3, 4 — 20k; 5 — 10k; 6 — 47k pot; 7, 8 — 16k; 9 — 8k2; 10 — 100k pot. Capacitors: 1 — 10n; 2, 3, 5, 6, 7, 9 — 1n5; 4, 8 — 3n.

as that of the phase shift networks³.

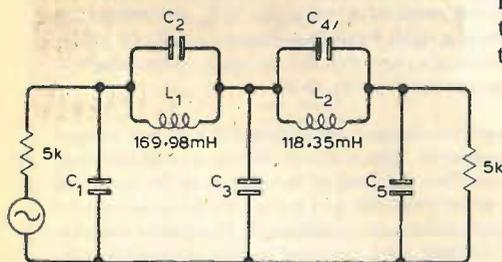
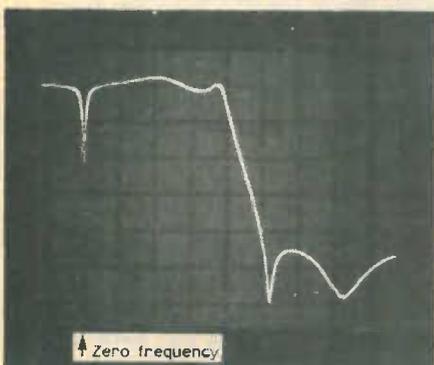
The usual approach today in the construction of audio filters is to use RC operation amplifier networks. An alternative, however, is to use a conventional LC filter synthesized design, replace the L by a gyrator and capacitance, and have an RC gyrator design. It is of interest to examine the number of components one needs in the two cases to realise the same filter performance. The filter performance considered for comparison is as follows:

- Cut-off frequency = 4kHz
- Stop band frequency = 5kHz
- Stop band attenuation ≥ 40dB

Consulting filter tables (Zverev, ref. 4) indicates a promising design is an elliptic design with:

- Maximum passband attenuation ≤ 1.25dB
- Minimum stopband attenuation ≥ 43dB

Fig. 4 summarises the two filter realizations.



tions. On the left-hand page the pole/zero realisation is accomplished by using a triple op-amp arrangement based on a synthesis technique given by Huelsman⁵. On the right-hand page an LC tabulated design⁴ is realised using gyrators⁶.

The feature of particular interest in Fig. 4 is the list of the number of components required. For example, in the op-amp design (one device only necessary e.g. Siliconix L144, Texas TL084), one requires 9 critical capacitors and 10 critical resistors. On the other hand, in the gyrator design one needs two devices, but only 7 critical capacitors and 5 critical resistors.

Photographs of the responses of two such filters, constructed on breadboards using 'stores' components are also shown in Fig. 4. In the gyrator version it is possible to 'tune' the response by means of R₁ and R₃ (inductances), so that it can be adjusted to be closer to the theoretical response.

Continued on page 74

Resistors: 1, 3 — 47k pot; 2, 4 — 12k. Capacitors: 1 — 16n2; 2 — 2n7; 3 — 18n6; 4 — 8n; 5 — 12n8; x — 1n2; y — 820p.

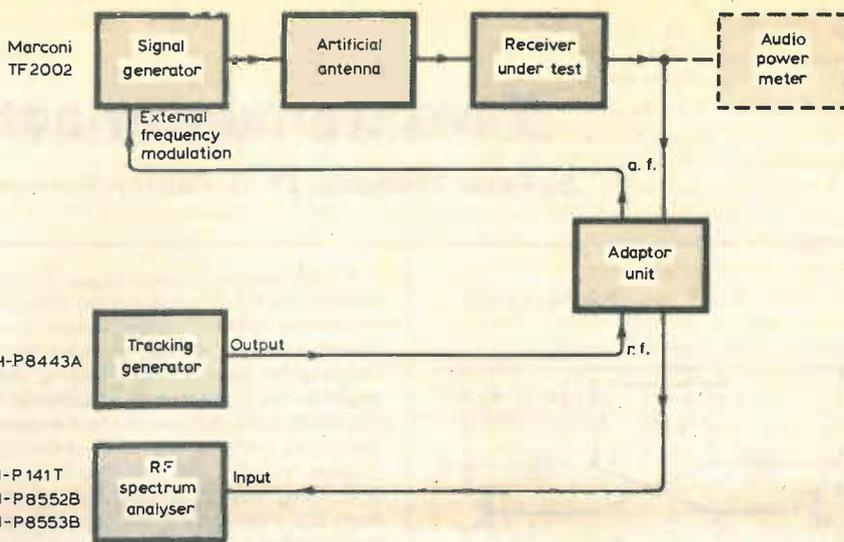
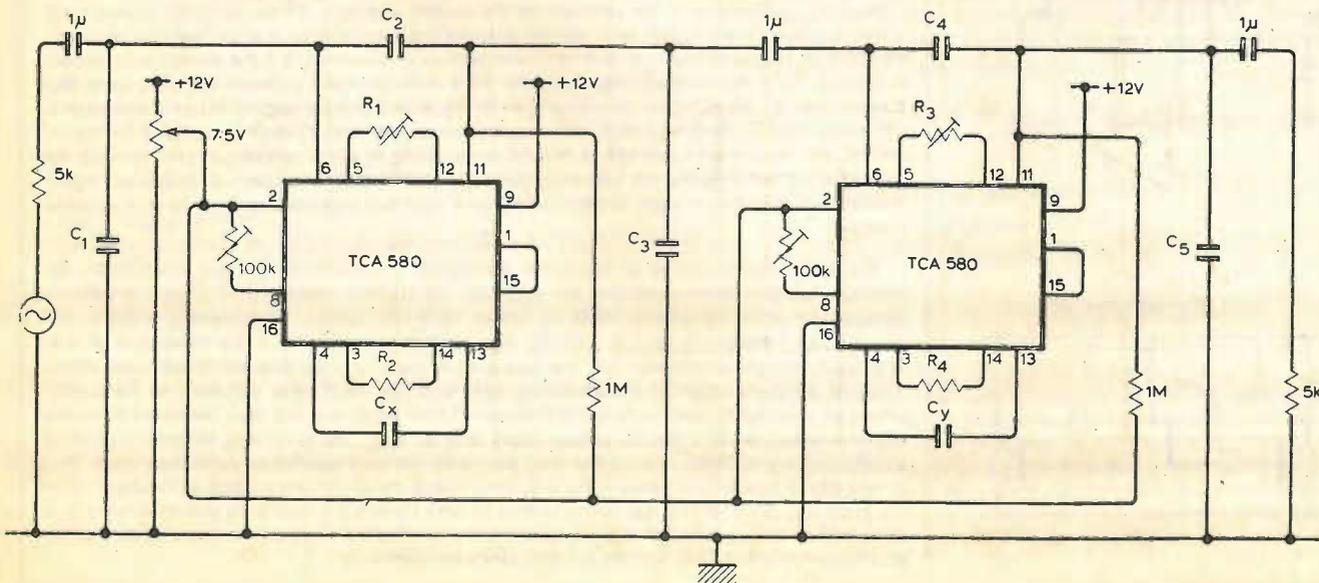
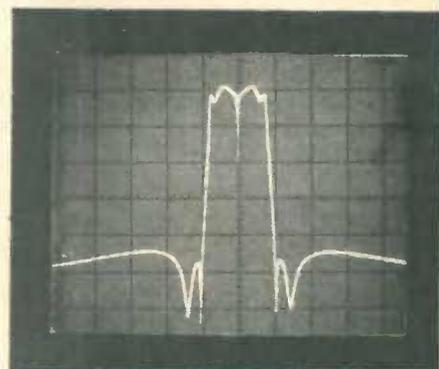


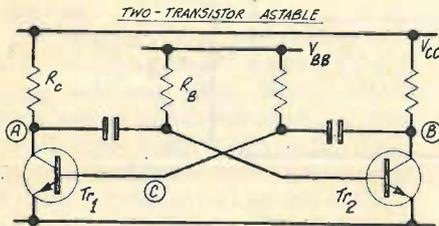
Fig. 6. Arrangement of apparatus for measuring frequency response of a radio receiver.

Fig. 5. Gyrator filter response as applied to a receiver response. Centre frequency is now the r.f. or i.f. frequency (vertical scale 10dB/div.; horizontal scale 5kHz/div.).

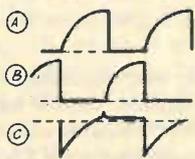


Two transistor astables

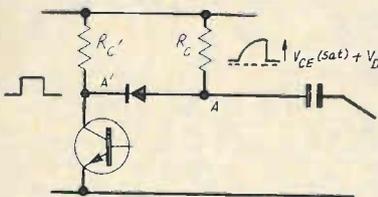
by Peter Williams, Ph.D. Paisley, College of Technology



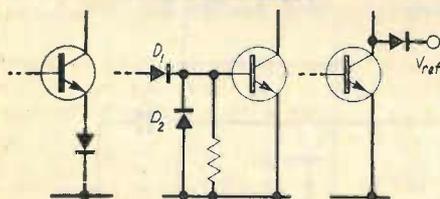
ASTABLE WAVEFORMS



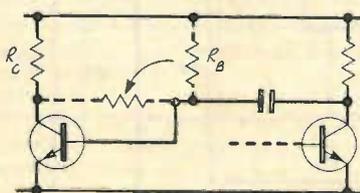
IMPROVED RISE-TIME



VOLTAGE LIMITATIONS



SELF-STARTING



The two-transistor astable shown is the standard text-book example. It was also justifiably the standard industrial form of astable, though it needs a number of additions and modifications to improve the rise-time, remove voltage-breakdown limitations, etc. These modifications remain important as applications of principles that can be applied to other generators and pulse circuits. This form of astable also remains useful but has lost its dominance in the face of integrated-circuit alternatives. If transistor Tr_2 increases its current the fall in collector voltage is coupled through the capacitor to the other base (Tr_1) driving that transistor off. The resulting rise in the collector voltage of Tr_1 is capacitively coupled back to the Tr_2 reinforcing its original increase in current. The switching is regenerative and any such change always proceeds to the limit of one transistor on (Tr_2) and the other off (Tr_1). When the potential at B falls rapidly it drives C to a correspondingly negative value, C having started close to zero (in practice 0.7V corresponding to $V_{BE(sat)}$). Point C then charges towards V_{BB} through R_B eventually passing zero and then, at 0.5V, bringing Tr_1 into conduction. The process is then repeated with Tr_1 saturated and Tr_2 cut off. Independent control of the two parts of the cycle is inherent in the use of different CR sections for the two transistors.

Ideally the collector waveform should be a squarewave and the base waveform a section of a perfect exponential followed by a period at zero volts. The departures from this ideal are indicated and can be explained as follows. When a transistor is driven into conduction the collector current can be very large depending on the current gain while the capacitor to which it is coupled sweeps the opposite base out of its conducting region. The transition is then slowed only by the device self-capacitances together with strays. Thus the fall-time at each collector is very short. When a transistor ceases to conduct, the capacitor has to charge through the full supply range via R_C and the opposite base-emitter diode. The rise time is thus of order $2.2R_C$ by the theory given earlier. As the timing cycle is of order $0.69CR_B$ if $V_{BB}=V_{CC}$ then the rise time clearly occupies a significant fraction of the on-duration $2.2R_C/0.69R_B$ or $3R_C/R_B$. It is not possible to reduce this greatly by manipulating the ratio R_C/R_B because that is constrained by the need to ensure saturation of the transistors when switched on. $R_B \approx 10R_C$ is a typical constraint leaving the rise time at 30% of the pulse width.

The rapid capacitor charging also shows up as a spike at the start of the base-waveform saturation region. The collector rise-time can be dramatically improved by isolating the collector from the capacitor during the recovery period. Assume the base voltage of a transistor has been swept negative so that it ceases to conduct. The capacitor begins to recharge and the potential at A rises exponentially due to the current through R_C . This rise is relatively slow and A' rises more rapidly reverse-biasing the diode. This isolates the collector from the capacitor and the rise-time is limited only by strays and self-capacitance. There is one disadvantage of the circuit and that is that R_C is involved in the recovery period while R_C/R_C' has to be driven by the transistor. For a given maximum current gain this requires a reduction in R_B shortening the pulse-duration or an increase in R_C increasing the rise-time. Thus an improved waveform at A' is obtained at the expense of a worsening at A. A second snag is that A is no longer pulled down to $V_{CE(sat)}$ i.e. the step transferred to the other base is reduced by V_D , 0.6V.

At low supply voltages the fact that the base-emitter junction is subjected to a reverse voltage equal in magnitude to the supply is of no consequence. Above about 5V this reverse bias may be enough to produce breakdown in the junction. This need not be dangerous as the current is limited by the peak current available from the other transistor but it clips the base waveform. This makes the oscillation frequency more dependent on supply variations. The simple circuit is largely free of this problem as the resistor voltage ratio remains supply-independent as discussed earlier. As soon as one of the voltages becomes dependent on a constant breakdown voltage the ratio ceases to be constant as the supply changes. Three possible solutions are shown (i) a diode in series with each emitter absorbs the reverse voltage at the expense of raising the collector saturation voltage: this can have serious consequences if the astable is to remain compatible with, for example, logic circuits; (ii) a more complex network requires up to two diodes where D_1 will generally be slower than D_2 , its stored charge helping to turn the transistor off rapidly; with D_2 omitted and D_1 of low capacitance the circuit becomes suitable for higher speeds, (iii) the collector voltage is caught by a diode at some reference level too low for breakdown to result during the following transition; the simple time-interval equation is again modified because the voltages depend partly on a constant reference and partly on a variable supply.

This is a problem that is all too rarely discussed. At switch-on the vast majority of two transistor astables begin oscillating immediately. The start-up requires only a slight imbalance between the initial conduction build-up, which normally applies. Theoretically however the circuit could immediately go into a stable, non-oscillatory condition. If the transistors go into that saturated state simultaneously, the loop gain is less than unity and oscillation never starts. The real difficulty arises if an otherwise satisfactorily oscillating astable has its output temporarily short-circuited. Both transistors would then be driven into their saturated state and the very small rise in collector voltage from zero to $V_{CE(sat)}$ on removing the short-circuit is insufficient to propagate around the loop and raise the loop-gain to an oscillatory level. One simple way of avoiding this possibility is to ensure that the quiescent state of both devices is in the linear region i.e. that if oscillation ceases for any reason the loop gain always returns to a value sufficient to re-establish it. Each base resistor is returned to its own collector meeting this condition with only a small shift in the frequency equations.

Two transistor astables

THEORY

The voltage at B switches from V_{CC} to $V_{CE(sat)2}$. Prior to that instant C is at $V_{BE(sat)1}$, and falls by $V_{CC} - V_{CE(sat)2}$. With the resistor returned to V_{BB}

$$V_1 = V_{BB} - V_{BE(sat)1} + V_{CC} - V_{CE(sat)2}$$

$$= (V_{CC} + V_{BB}) - (V_{BE(sat)1} + V_{CE(sat)2})$$

This is composed of the major term $V_{CC} + V_{BB}$, obtained for ideal transistors, reduced by the finite transistor voltage drops in saturation. The corresponding value of V_2 is $V_{BB} - V_{BE(th)1}$ since the transistor enters its linear region at some voltage $V_{BE(th)1}$, where $V_{BE(sat)} > V_{BE(th)} > 0$. Thus the interval between one transition and the next is

$$t_2 - t_1 = \tau \log_e \left[\frac{(V_{CC} + V_{BB}) - (V_{BE(sat)1} + V_{CE(sat)2})}{V_{BB} - V_{BE(th)1}} \right]$$

This result is greatly simplified if

$$V_{CC} = V_{BB} \gg V_{BE(sat)1}, V_{CE(sat)2}, V_{BE(th)}$$

$$\text{Then } t_2 - t_1 = \tau \log_e \left[\frac{2V_{CC}}{V_{CC}} \right]$$

$$= 0.69\tau \text{ where } \tau = R_B C$$

● When T_1 ceases conduction potential at A has a finite rise-time due to the collector time constant. Again assuming $V_{BE} \ll V_{CC}$, and defining the rise-time as the time taken for A to rise from 10 to 90% of its final value then

$$V_1 = 0.9V_{CC}$$

$$V_2 = 0.1V_{CC}$$

$$\text{and rise time} = \tau' \log_e 9$$

$$= 2.2\tau'$$

$$\frac{\text{rise time}}{\text{pulse width}} = \frac{2.2\tau'}{0.69\tau}$$

$$\approx \frac{3R_C}{R_B}$$

But $R_B \approx 10R_C$ is typical to ensure saturation of the transistor i.e. rise time $\approx 30\%$ pulse width

● Voltage breakdown in the base-emitter junction modifies the waveforms and the frequency, which in the simple case is

$$f = \frac{1}{T} = \frac{1}{2 \times 0.69\tau} = \frac{1}{1.38\tau}$$

and is independent of V_{CC} .

Let V_R be the voltage on the base-emitter at which it conducts clamping the capacitor

$$V_1' = V_{CC} - V_R$$

$$V_2' = V_{CC}$$

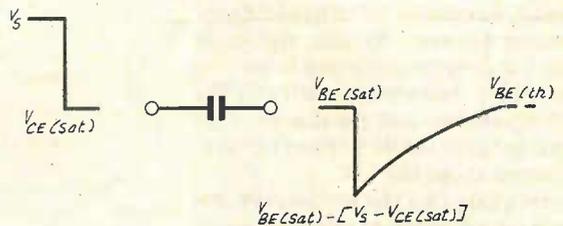
$$t_2' - t_1' = \tau \left(1 - \frac{V_R}{V_{CC}} \right)$$

$$f' = \frac{1}{2\tau \log_e \left(1 - \frac{V_R}{V_{CC}} \right)}$$

and depends on V_R, V_{CC} .

EXAMPLES

1. A two-transistor astable has the following values R_C 1k Ω , R_B 15k Ω , C68nF, V_{CC} & V_{BB} 5V, $V_{CE(sat)}$ 0.15V, $V_{BE(sat)}$ 0.7V, $V_{BE(th)}$ 0.5V. Evaluate the frequency of oscillation from first principles.



The waveform sketch is of a collector waveform falling from V_s to $V_{CE(sat)}$. Just prior to that instant the other base is at $V_{BE(sat)}$ and is driven down by the same amount. When the base recovers to $V_{BE(th)}$ the other transistor takes over the second half-cycle.

$$V_1 = V_s - (V_{BE(sat)} - [V_s - V_{CE(sat)}])$$

$$= 2V_s - [V_{BE(sat)} + V_{CE(sat)}]$$

$$V_2 = V_s - V_{BE(th)}$$

$$\therefore V_1 = 10 - 0.85 = 9.15V$$

$$V_2 = 5 - 0.5 = 4.5V$$

$$\therefore T = 2\tau \log_e \left[\frac{9.15}{4.5} \right]$$

$$= 1.42\tau$$

$$f = \frac{1}{1.42 \times 10^{-4} \times 68 \times 10^{-9}} = 1.04\text{kHz}$$

Note the likely tolerance on this figure is likely to be dominated by the τ value as the V_{BE}, V_{CE} values have made only a marginal difference — raising T from 1.39τ to 1.42τ .

2. For the previous question, show that the rise-time of the collector waveform is about 20% of the pulse width. Can this figure be improved?

When a transistor switches off the charging time-constant is $R_C C$ and the rise-time is taken for simplicity as the usual in level between the 10% and 90% levels. This is inaccurate as it fails to allow for the initial V_{BE} value, but it gives a useful guide.

$$\text{Thus rise-time} = R_C C \log_e \left[\frac{0.9V_s}{0.1V_s} \right]$$

$$= 2.2R_C C$$

$$\text{But collector on-time is } \approx 0.71R_B C$$

$$\frac{\text{rise time}}{\text{pulse width}} = \frac{2.2}{0.71} \times \frac{R_C}{R_B}$$

$$= \frac{2.2}{15 \times 0.71} \approx 20.6\%$$

say 20% allowing for the over-simplification.

The figure can be improved in theory by reducing R_C raising R_B or both (re-adjusting C as necessary to maintain τ). The limit is that the transistors must remain saturated i.e. $R_B / R_C < h_{FE(sat)}$. The guaranteed figure for saturated current gain is not likely to exceed say 20 making large improvements difficult. Circuit modifications are necessary for such improvements and an example is show opposite.

Townsmen 2m / 70cm aerial

Two-band design with no ground plane.

by B. J. P. Howlett, G3JAM

The continued withholding of the citizen's band by the Home Office has caused vastly increased occupancy of the amateur 2m and 70cm bands for everyday purposes of mutual communication between friends, and most of them use commercially-made private mobile radio equipment tailored for these frequencies, and for the 80 or so automatic/unattended repeater stations dotted about the UK.

Several years ago, the author foresaw the need for a somewhat tidier aerial for the average householder than the too-prevalent, quarter-wave, ground-plane, vertical aerial; an aerial which would be stick-like, with no ground-plane, and operating on both bands without switching. It should be weather-proof and cheap, and easily clamped to a short stub-mast with Jubilee clips from the local garage. It wasn't an easy job!

The first design, a half-wave rod driven from a quarter-wave concentric transformer, did work, but the thinness of the centre wire to match 50 ohms to 1200 ohms (the end resistance of a 12mm, half-wavelength rod at 145 MHz), relegated the design to the roof-space.

However, in the aerial shown diagrammatically in Fig. 1, the wire is 0.7mm and the inductor can be 127mm of p.v.c.-covered wire, fashioned into a hairpin shape and soldered on in parallel to the feeder cable at the point of entry. Very careful tests disclosed the interesting fact that the transformer needed to be about 0.185 wavelength long when the insulator/spacer S was 0.015 wavelength. With 12mm tubing, v.s.w.r., could easily be made 1:1, and the feeder did not radiate. Pro rata scaling from the 2m band to the 70cm band proved that the hairpin needed to be, not one-third, but $(1/3) \frac{1}{2} (= 0.5774) \times 127 = 73\text{mm}$ long at three times the frequency. The inductance changed inversely as the frequency.

Already it was felt that enough was known about the aerial to go ahead with a full patent for the matching features, and this has now been obtained (British Patent No 1527800).

From a practical viewpoint, the aerial suffered in rain and high winds. It had to be precision-made and sealed if water was to be kept out of the two joints, either side of the precision-turned insulator/separator. The solution,

Item	2m	70cm	Red	Yel.	Brn.	Grn.
Dipole A	96.5	30	27.4	24.5	22.2	19.9
Transf. T	40.64	13	10.55	9.43	8.55	7.67
Space S	2.0	0.8	0.6	0.6	0.6	0.6
Hairpin L, total wire length	12.7	7.24	-	-	-	-
Harmonic shield	29.3					

Dimensions are given in cm for 1cm wide material, as cut. Hairpin loop made of p.v.c. insulated hook-up wire.

shown in Fig. 2, was to build the aerial flat, from off-cut strips about 1 cm wide, with a flat drilled strip insulator (of Perspex, in the author's case), the whole lot being pushed into $\frac{3}{8}$ in plastic conduit and put on a high stub mast so that it would rattle, and keep the author awake at night.

Quite right! That is exactly what the

kinks are for; to stop the assembly rattling in a high wind. The kinks have no electrical purpose whatsoever. The two end-plugs, one drilled for the feeder, were actually cast from body-repair (the automobile kind) resin, but could be turned from solid material, of course.

Gone is the taut centre wire in the transformer, T. Instead (see construction diagram), the centre core of the feeder itself, UR43, (F) with the braiding stripped back, forms the "centre" wire. Actually, an insulated wire taped on to a wide strip is not unlike a coaxial line, except that there is the added advantage that, for fine matching adjustment, it can be flared away from the strip as shown.

So what about 70 centimetres? Well, around the outside of the plastic conduit, and directly over the middle of the 2m radiating element, a "cooking foil" (actually aluminium Silglas glazing strip), cylinder is glued, resonant at the third harmonic of 2m. This prevents radiation from the centre current maximum when the aerial is used at its third harmonic on 70cm, and leaves just the upper and lower half wavelengths (which are in phase) operating as a two-element colinear at 70cm.

The author is, perhaps, lucky to have discovered a matching and radiating system that can be adjusted to give very good matching at both frequencies at once. It did take four years, of course, and quite a bit of help along the way was given by other radio amateur

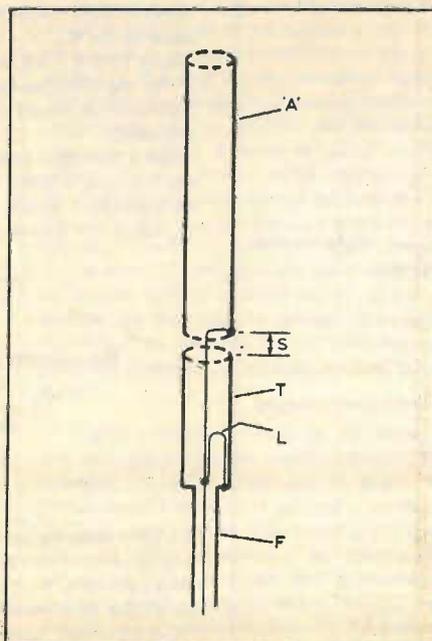
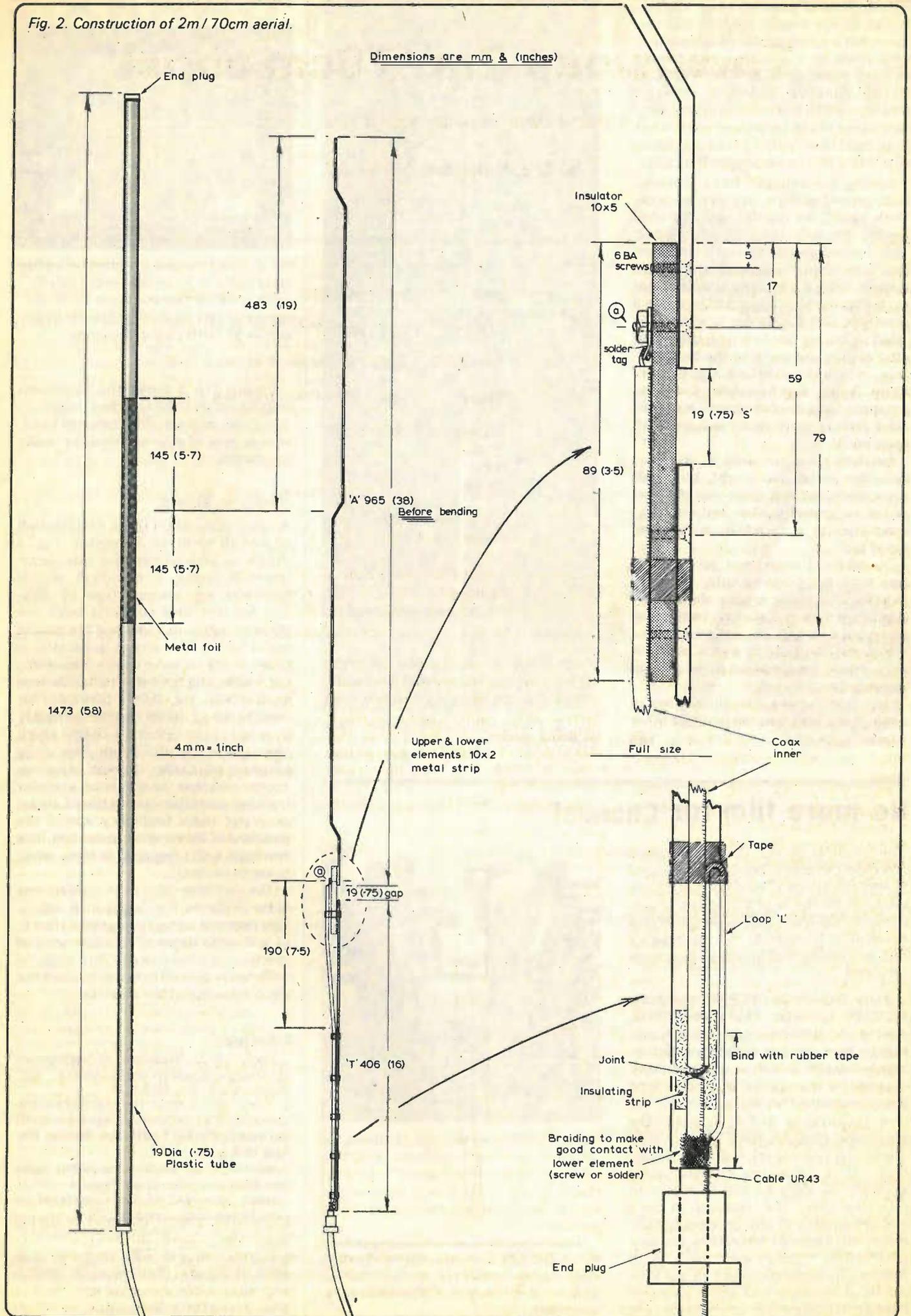


Fig. 1. Basic aerial, a half-wave element A and coaxial impedance transformer T. Loop inductor to augment impedance ratio obtainable.

Fig. 2. Construction of 2m / 70cm aerial.

Dimensions are mm & (inches)



friends. None of them ever saw the final model, except from a considerable distance, but a number of the early models were made by the author and farmed out for reports. G8NCW, G3PCA, G3IMC, G8LWA, G8BAM, G3YNC (callsigns given in a random order) were early users of the aerial, and some went on to build their own. Thanks are due to all of them for the assistance they gave.

Scaling the aerial to Band V television, proved a very pleasant surprise. With short, fat dipoles, and 75 ohm feeder, the inductor L is not needed. This helped the bandwidth problem. Red zone is particularly difficult in this respect, though it must be admitted that even 1cm wide material does quite a good job, and the feeder is absolutely 'dead', allowing one to pin up the feeder after setting the aerial to the best position, without upsetting the picture again. Some users have been known to get quite light-headed about this particular feature, only rarely encountered, apparently.

No dark plans are afoot to manufacture the aerial. No doubt, however, some character will make one or other of the suggested models and sell huge quantities in a clandestine manner. Good luck.

To others, I would say, please build one with my compliments. It was a challenge to make exactly the aerial I wanted; it was a challenge, in this day and age, to invent a virtually new aerial which turned out to be a new aerial, at least within the definition of the patents law, whatever that is.

The table shows the dimensions of aerials for single-frequency use in other bands. □

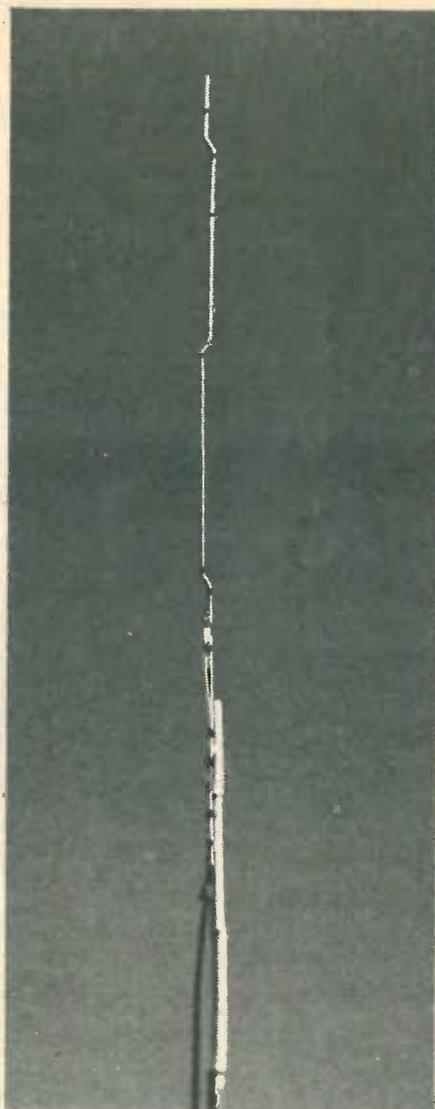


Fig. 3. Townsman without plastic tube cover.

No more film for Channel

The smallest of the UK independent television companies, Channel Island Communications (Television) of Jersey claim to be the first European broadcaster to use electronic news-gathering equipment exclusively. All the existing film processing facilities have now been removed.

Sony Broadcast BVP300 cameras, BVU100 U-matic video recorders, editing and time-base correction equipment is used and has so far proved to be highly reliable in almost all conditions. Channel's managing director, Ken Killip, expressed his enthusiasm for the new techniques, and feels that "the electronic cameras have given a new dimension to local television broadcasting". It is no longer necessary, for example, to have people in studio to interview them; the reduction in costs and elimination of film processing time means that outside interviews are now practicable. Camera sensitivity gives freedom from the necessity to use kilowatts of lighting and the automatic colour balance in the electronic



cameras obviates the use of filters for different lighting conditions. Running cost is "negligible", since tape produced by the U-matic is dubbed onto a master for broadcast, the original being refused.

There has been no union opposition to the use of the equipment, the technicians being "most impressed", according to Brian Turner, Channel's operations manager. □

continued from page 69

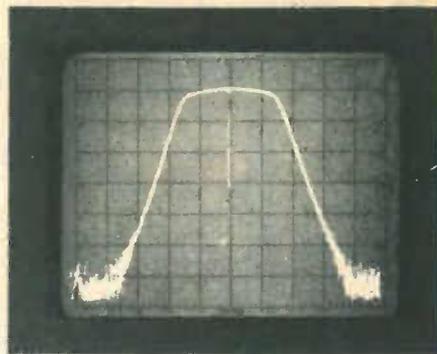


Fig. 7. Radio receiver selectivity response measurement, a car radio with 100µV input at 1MHz. (vertical scale 10dB/div. relative to 1W; horizontal scale 1kHz/div. relative to 1MHz centre frequency).

Finally, Fig. 5 shows the equivalent response of these filters when used in an a.m. radio receiver. The response bandwidth is now of course twice the audio bandwidth.

Radio receivers

Another application is the examination of overall receiver responses. Fig. 6 shows an arrangement for this measurement using a standard signal generator, e.g. Marconi type TF 2002. The adaptor unit converts both the input r.f. signal to audio and the output audio to r.f. The signal generator is tuned to the receiver centre frequency, e.g. 1 MHz, and the output set to desired output level, e.g. 100µV. Some adjustment in the a.f. levels may be necessary in order to keep within the 100mV pk-pk requirement, but this is not difficult to arrange at audio. It will now be appreciated that the spectrum analyser tracking generator sweeps the r.f. signal generator input frequency across the passband of the receiver under test. The resultant audio response is then selectively monitored.

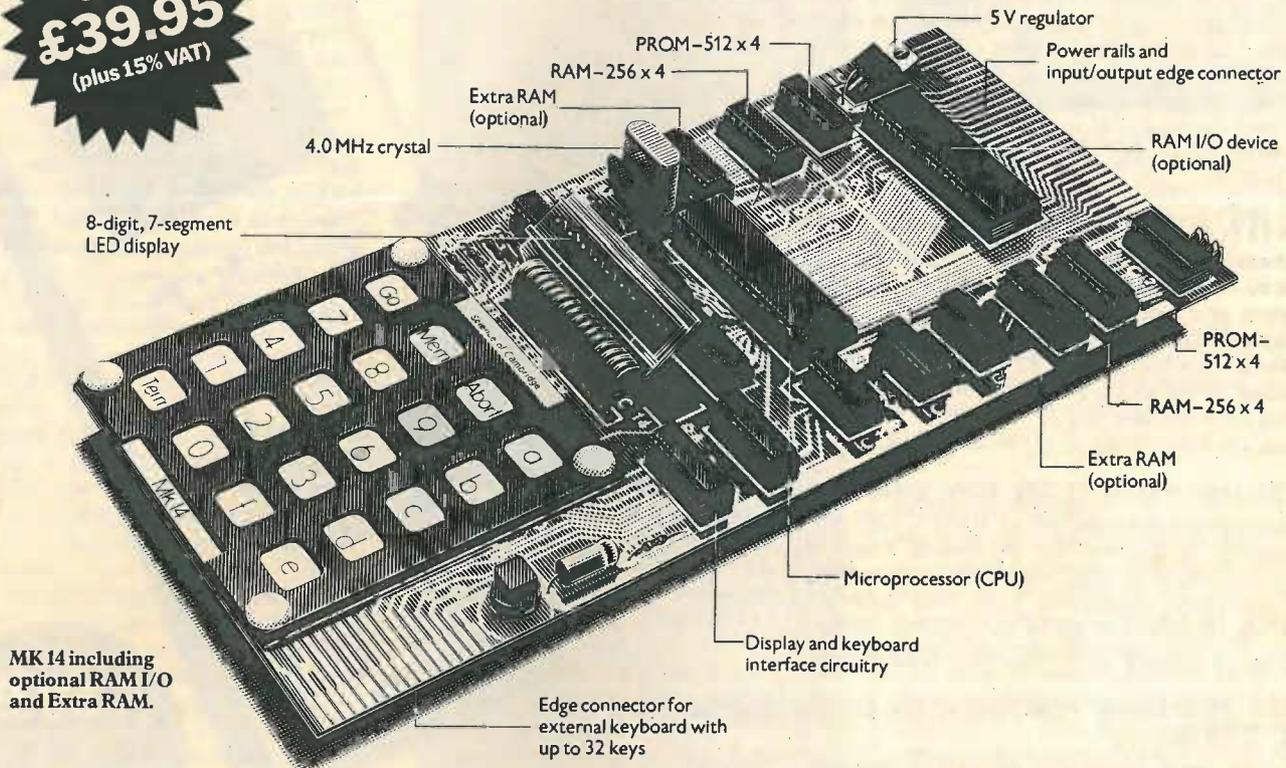
The response of a high quality car radio is shown for example in Fig. 7. This response is the aggregate of the r.f., i.f. and audio stages of the receiver. The spectrum analyser sweep rate must be sufficiently slow so as not to mislead the a.g.c. response of the receiver.

References

1. Reed, C. R. G. "Reduction of Interference by reduction of modulation bandwidth," *BBC Engineering J.*, Jan. 1972, p.23.
2. Eden, H. "A filter for the bandwidth limitation of a.f. programme signals in lf/mf sound broadcasting," *EBU Tech. Review*, 169, June 1978, p.118.
3. Macario, R. C. V. "Meeting mobile radio specifications with operational amplifier phasing networks," *I.E.R.E. Conference on Land Mobile Radio*, London, 1975.
4. Zverev, A. I. "Handbook of Filter Synthesis," Wiley 1967, p.222.
5. Huelsman, L. P. "Active Filters; lumped, distributed, integrated, digital and parametric," McGraw-Hill, 1970, Chpt. 2.
6. See Mullard TCA 580 data sheet. □

From Science of Cambridge: the new MK 14. Simplest, most advanced, most flexible microcomputer—in kit form.

only
£39.95
(plus 15% VAT)



MK 14 including optional RAM I/O and Extra RAM.

The MK 14 is a complete microcomputer with a keyboard, a display, 8 x 512-byte pre-programmed PROM, and a 256-byte RAM programmable through the keyboard.

As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard.

Yet in kit form, the MK 14 costs only £39.95 (+£6.60 VAT, and p+p).

More memory—and peripherals!

Optional extras include:

1. Extra RAM—256 bytes.
 2. 16-line RAM I/O device (allowed for on the PCB) giving further 128 bytes of RAM.
 3. Low-cost cassette interface module—which means you can use ordinary tape cassettes/recorder for storage of data and programs.
 4. PROM programmer and blank PROMs to set up your own pre-programmed dedicated applications.
 5. VDU Interface, displays 512 characters on 625 line domestic TV by memory mapping contents of MK 14. Incorporates a 64 character ASCII display chip, graphic facility, UHF modulator.
- All are available now to owners of MK 14.

A valuable tool—and a training aid

As a computer, it handles operations of all types—from complex games to digital alarm clock functioning, from basic maths to a pulse delay chain. Programs are in the Manual, together with instructions for creating your own genuinely valuable programs. And, of course, it's a superb education and training aid—providing an ideal introduction to computer technology.

A set of Further Applications Programs is available covering advanced programs, dealing particularly with the use of the I/O capacity of the

MK 14 including the VDU and several programs written in a form of interpretative language called MINIL.

SPECIFICATIONS

- Hexadecimal keyboard • 8-digit, 7-segment LED display • 8 x 512 PROM, containing monitor program and interface instructions
- 256 bytes of RAM • 4 MHz crystal • 5 V regulator requires single 8 V power supply
- Space available for extra 256-byte RAM and 16 port I/O • Edge connector access to all data lines and I/O ports.

Free Manual

Every MK 14 kit includes a Manual which deals with procedures from soldering techniques to interfacing with complex external equipment. It includes 20 sample programs including math routines (square root, etc), digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general

purpose sequencing, etc.

Designed for fast, easy assembly

The MK 14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

How to get your MK 14

Getting your MK 14 kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK 14, return it to us within 14 days for a full cash refund.

Science of Cambridge Ltd,
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Telephone: Cambridge (0223) 311488

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me the following, plus details of other peripherals:

- | | |
|---|--|
| <input type="checkbox"/> MK14 Standard Microcomputer Kit @ £46.55 | <input type="checkbox"/> Cassette @ £7.25 |
| <input type="checkbox"/> Extra RAM @ £4.14 | <input type="checkbox"/> VDU @ £33.75 |
| <input type="checkbox"/> RAM I/O device @ £8.97 | <input type="checkbox"/> PROM Programmer @ £11.85 |
| <input type="checkbox"/> PSU @ £6.10 | <input type="checkbox"/> Further Applications Programs @ £3.00 |

All prices include p+p and VAT. Allow 21 days for delivery.

I enclose cheque/money order/PO for £ _____ (indicate total amount.)

Name _____

Address (please print) _____

WW/1/80

Science of Cambridge

WW-009 FOR FURTHER DETAILS

Clock timer — 1

Random access memory stores 16 alarm times over seven days

By R. D. Clemow and T. C. Garden

The alarm timer was originally designed to operate with a time-code clock published in the February to April 1976 issues of *Wireless World*, but it can be adapted for use with other types of digital clock. The standard circuit offers 16 alarm times during a week, although this can be expanded to 64. Alarms can be inhibited on selected days and a back-up battery powers the volatile memory during a power cut.

There are many industrial and domestic situations where it is necessary to generate a number of alarm times. This design provides up to 16 alarm times, although it is possible to increase this to 64. The timer was primarily designed for use with a time-code clock, but it can be connected to a more conventional digital clock.

The design is based on a static 1K r.a.m. which stores the alarm times.

Although this form of storage is only suitable for multiplexed systems, it simplifies the circuit considerably.

The alarm times are stored as four digits of b.c.d. so that they can be easily compared with the clock time to the nearest minute.

One advantage of using a time-code clock is its automatic setting after a power cut. To make the timer compatible, a rechargeable battery is used to power the memory and a few associated i.cs during such a power cut.

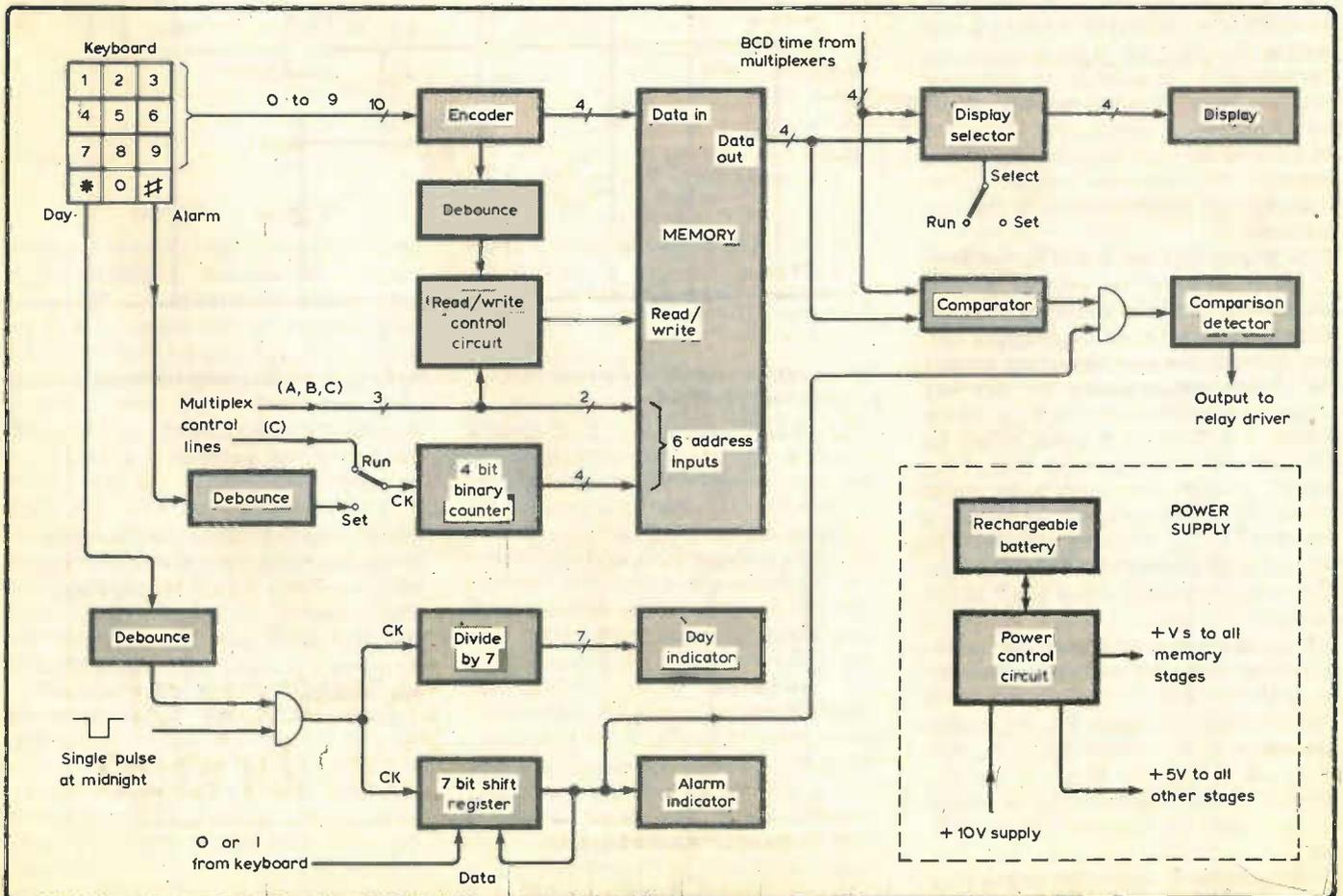
If it is necessary to inhibit alarms on certain days of the week this can be achieved by using an optional circuit. A day-of-the-week indicator comprising seven l.e.ds is also included.

Fig. 1. Block diagram of the complete timer. The circuit is designed for use with a multiplexed clock. All external connections refer to the time-code clock mentioned in the text.

The block diagram of the timer in Fig. 1 can be divided into four sections; the power supply, the day-of-the-week circuit, the memory input circuit and the memory output circuit.

Power supply

The power supply provides 5V to run both the timer and a clock. It also controls the charging/discharging of the back-up battery and provides control signals to prevent spurious clocking of the memory and shift registers when the mains supply is cut or restored. The 5V supply shown in Fig. 2. is based on a standard 3A regulator. Fig. 3. shows the battery charger and power control circuit which uses a constant current source around Tr_1 to charge the battery through D_1 R_1 with a current of about 45mA. Transistor Tr_2 regulates the 10V supply to provide 5V for the memory circuits. If the mains input fails, the 10V



supply decays rapidly and at 8V Tr₂ turns off via D₄ which enables the voltage regulator Tr₃ to supply current from the battery to the V_s line. Diodes D₁ and D₆ prevent damage to Tr₁ and Tr₅ from reverse currents. During normal operation Tr₄ is turned off and the power fail line is high. When the mains supply is removed the power fail line goes low as soon as Tr₂ has turned off and when the mains is restored, the clock display is blanked and Tr₄ is switched on via R₈. When the display blanking line goes low, Tr₄ switches off and the power fail line goes high. Capacitor C₁ prevents any switching noise reaching the power fail line which is also used to disable the memory during power cuts so that pulses on the memory read/write pin have no effect. This prevents data in the memory from being erased because if the main 5V supply fails, the memory is left in the write mode. If the timer is used with the time-code clock mentioned previously, some alterations are necessary to ensure that the display is always blanked at switch-on, see Fig. 4.

Although it is impossible to alter the data in the memory by interrupting the mains supply, the data will be lost if the battery is completely discharged after about six hours of continuous use. To indicate that a power cut has occurred, the on l.e.d. flashes until it is reset manually.

Day of the week circuit

Pressing the day key clocks a divide-by-seven counter and 7-bit shift register via a debounce circuit. The output of the counter is connected to the l.e.d. day indicator and the shift register is clocked with the counter so that they remain in step. The shift register can be set to enable or inhibit the alarm for each day of the week and the l.e.d. alarm indicator monitors the output of the shift register corresponding to the day indicated.

As shown in Figs. 5 and 6, the keyboard is inoperative with S₂ at run because the common line is left floating. With S₂ in the set position, pressing any key grounds the corresponding output pin. Therefore, pressing the day key triggers a monostable in IC₂₂ which produces a 150ms low pulse at pin 12. This pulse is gated through IC_{17a}, IC_{21a} and IC_{21b} to produce a low pulse which clocks the counter IC₈ whose output is decoded by IC₉. Pressing the day key therefore advances the indicator by one. The counter is reset when pin 9 of the decoder goes low.

If the day indicator is to be automatic it must be clocked at midnight when the tens-of-hours B bit goes low. This switches Schmitt trigger Tr₇, Tr₈ whose low edge is differentiated by C₁₃, R₃₈ and then fed to IC₈ via IC_{17a}. Diode D₁₁ prevents a spike appearing at the input of IC_{17a} when Tr₈ is turned off at 20.00 hrs.

Any necessary correction to the time

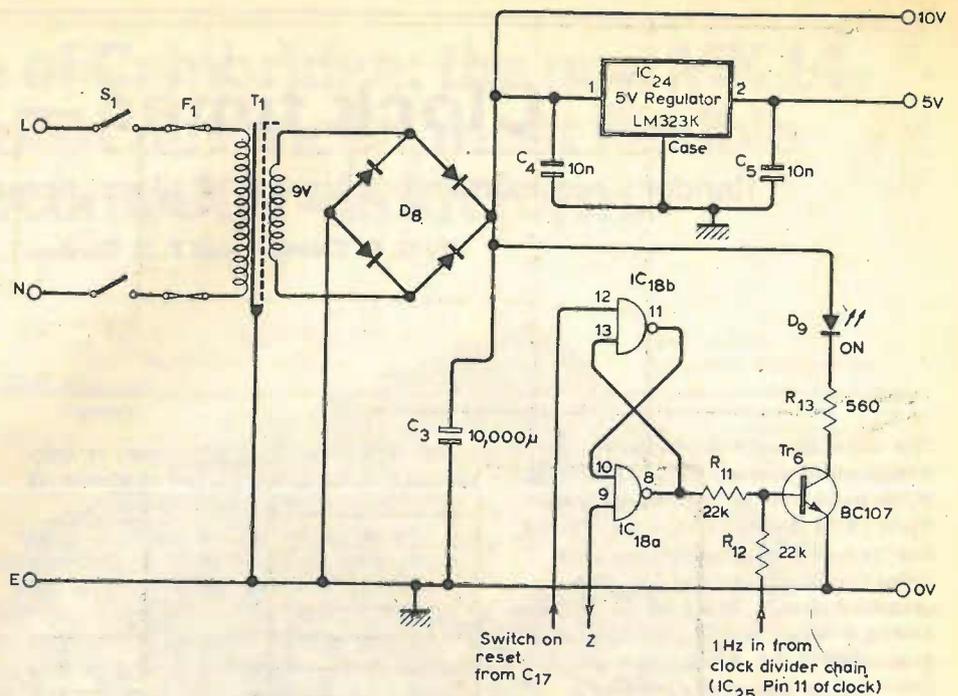


Fig. 2. Main 5V power supply.

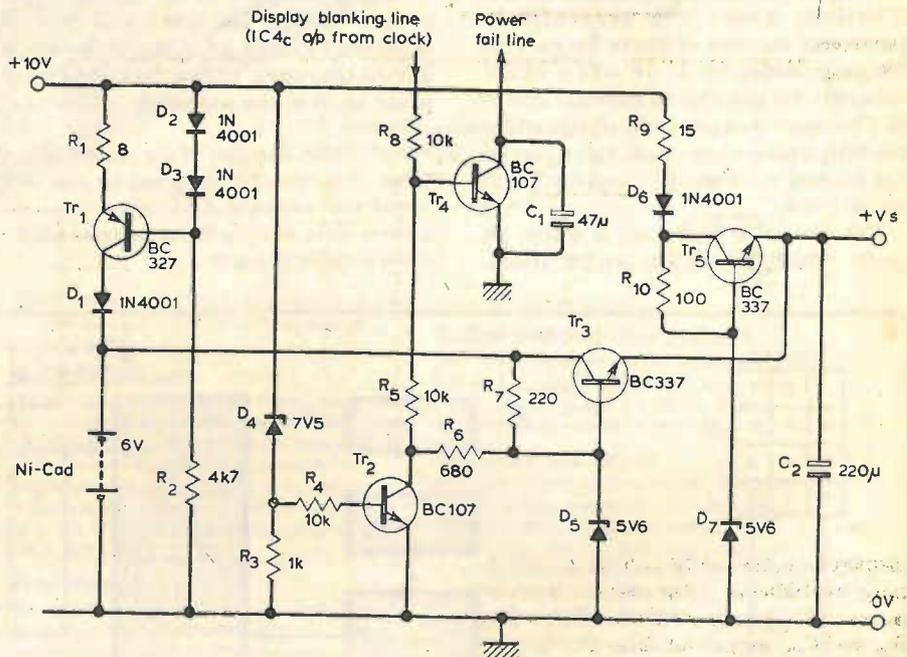


Fig. 3. Battery charger and power control circuit. Resistor R₁₀ is chosen for a trickle-charge current of about 45mA.

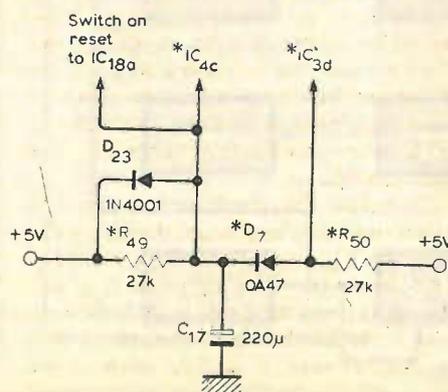


Fig. 4. Modifications to the time-code clock. The component numbers marked with an asterisk refer to the published clock circuit. C₁₇ replaces a 100µF capacitor and D₂₃ has been added to discharge C₁₇ during short breaks in the mains supply.

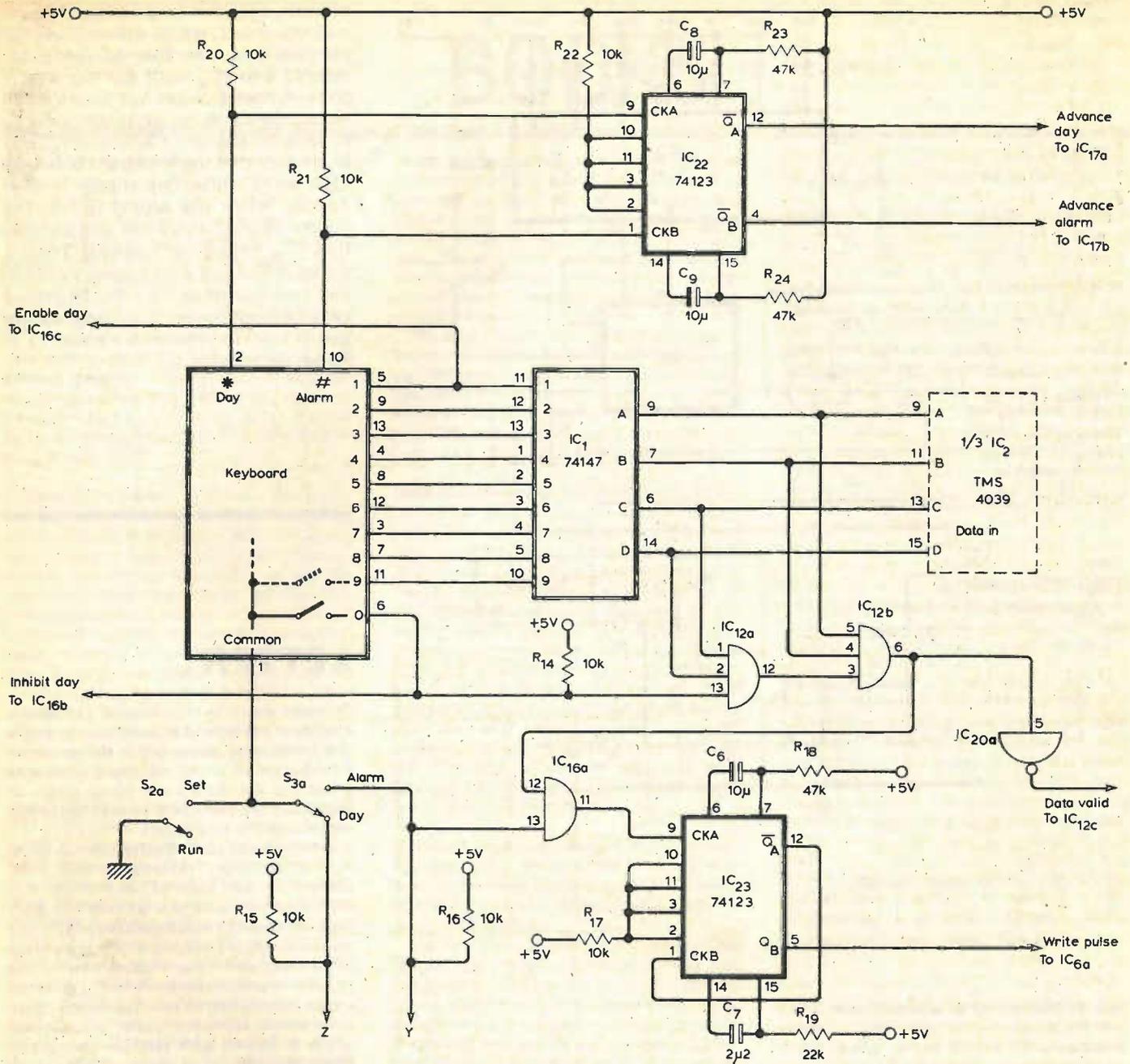


Fig. 5. Keyboard encoder and memory input circuit.

display is achieved by clocking the display at 100kHz. This causes a short pulse at IC_{17d} output which is filtered by R₃₃ and C₁₂ to prevent false clocking. If the power fail line goes low, IC₈ cannot be cleared and signals from IC_{17a} are blocked. When the mains is restored, the power fail line remains low while the 5V supply is recovering and only goes high when the display blanking line goes low. The day indicator is not clocked at midnight if the mains supply is interrupted when the midnight pulse is to be produced. If this occurs the day indicator will be one day behind when the supply is restored, but the flashing l.e.d. provides a warning.

The alarm enable/inhibit circuit is shown in Fig. 7. The output of IC_{21a} clocks IC₁₀ so that it is always in step with IC₈. The Q outputs of IC₁₁ are normally high and gates IC_{18c}, IC_{18d} recirculate data from Q7 to the data input. The alarm enable l.e.d. monitors the output of IC_{18d} and indicates whether the alarm is enabled or in-

hibited. With S₂ at set and S₃ at day, the Z line is grounded and the alarm is inhibited for the day indicated by pressing 0 on the keyboard. This clocks IC_{11b} via IC_{16b} so that its Q output goes low which forces the data inputs of IC₁₀ high and switches the alarm enable l.e.d. off. If the day key is then pressed, the new data is clocked in and the low pulse at IC_{21b} output clears IC_{11b} after IC₁₀ has been clocked.

To enable the alarm for the day indicated the 1 key is pressed which clocks IC_{11a} via IC_{16c} and clears IC_{11b} via IC_{17c}. This forces the data inputs of IC₁₀ low, the alarm enable l.e.d. is switched on and, if the day key is then pressed, data is clocked into IC₁₀. This also resets IC_{11a}. When entering data, an error can

Table 1. Power supply connections for the i.c.s.

IC	Vs	Type
1	8 16	74147
2	8 22	TMS4039
3	7 14	74266
4	8 16	74157
5	1 8	NE555
6	7 14	7474
7	10 5	7493
8	10 5	74LS93
9	8 16	74145
10	7 14	74LS164
11	11 4	7473
12	7 14	7411
13	7 14	7427
14	7 14	7410
15	7 14	74266
16	7 14	7432
17	7 14	7408
18	7 14	7400
19	7 14	7404
20	7 14	7404
21	7 14	74LS02
22	8 16	74123
23	8 16	74123

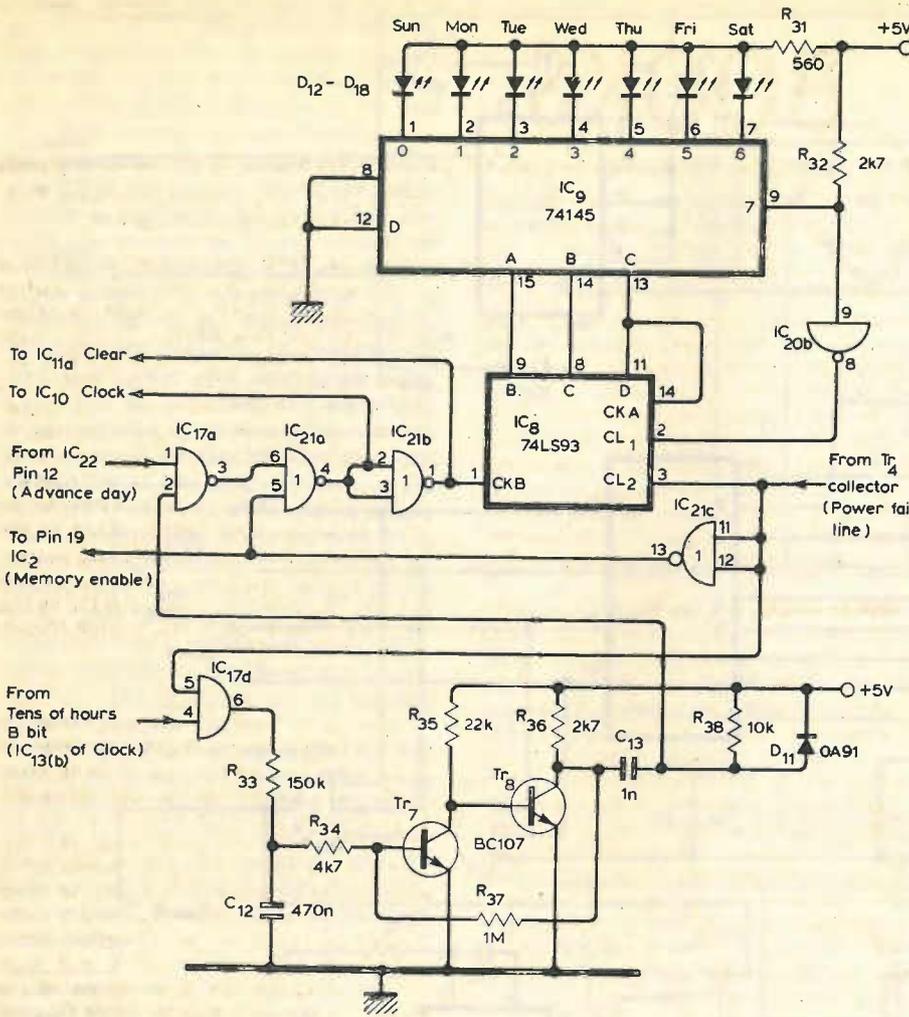
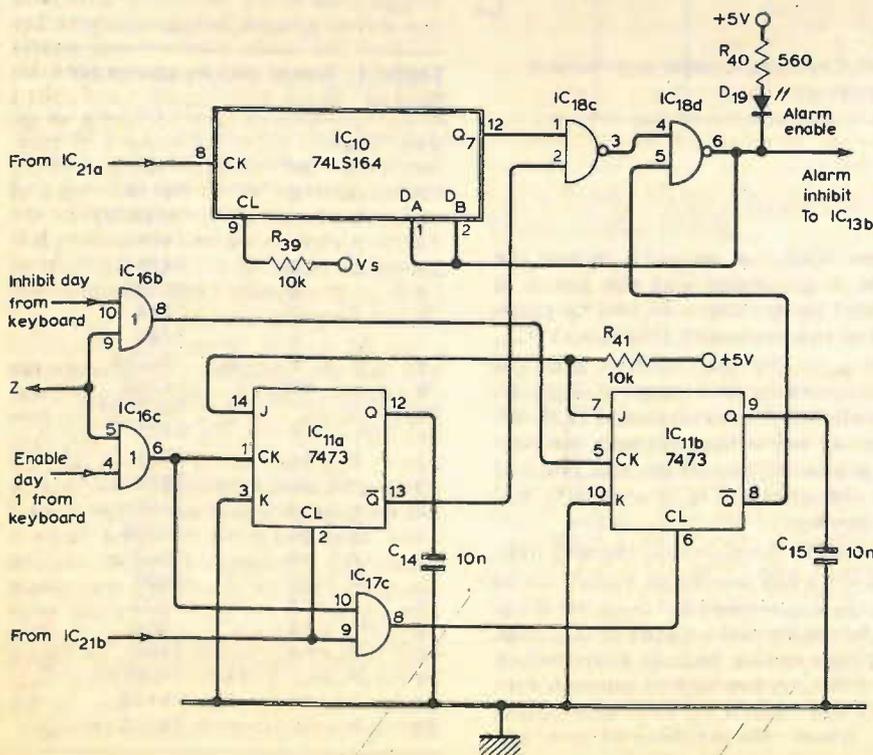


Fig. 6. Day-of-the-week indicator.

Fig. 7. Alarm enable / inhibit circuit.



be easily rectified by pressing the correct key, 0 or 1, which will override the previous data. Note that the data is not entered into IC₁₀ until the day key is pressed, therefore the last action when setting the alarm enable/inhibit must be to press the day key. Capacitors C₁₄ and C₁₅ ensure that the Q outputs of IC₁₁ go high when the mains supply is connected. When the supply is cut, the output of IC_{21a} stays low and ensures that IC₁₀ cannot be clocked. Table 1 shows which i.c.s are supplied by the V_s line and the main 5V line. To reduce battery drain as much as possible, low power t.t.l. i.c.s are used with V_s. □

To be continued

LETTER

In recent issues of your journal I noticed a number of articles and letters concerned with the controversy surrounding the potential introduction of a citizens' band service in Great Britain. As I have many years of experience as a user of c.b. I would like to add my thoughts on this subject.

Five years ago I installed the first c.b. set in my car; recently I replaced it with a 40-channel set. The price of the first set was \$150; the price of the new set only \$55. Both Japanese made sets perform admirably. I use c.b. mostly while travelling. Calling or tuning in to Channel 19 (by custom this is the highway channel in most of the US) gives me instant information on road conditions many miles ahead, accidents, traffic congestions, where to find an open gasoline station etc. When travelling in an unknown area I can find out about a good restaurant, how to find a landmark and, of course, location of speed traps and other hazards of civilisation. In general I find c.b. to be an invaluable companion which keeps me alert and awake on long trips. Being able to contact in most areas a member of the REACT group or a local police department on the emergency Channel 9 gives me an additional peace of mind.

Here and in your country the major opposition to c.b. seems to originate in the ham radio community having no experience with c.b. use. I feel that this opposition comes mostly from misunderstanding of the actual and beneficial use of c.b. and from non-willingness to share the r.f. spectrum with the less disciplined brethren.

Some of the letters in your magazine also reflect a certain fear of offending authority (local constable?). I assure you that the attitude of most US police departments is quite friendly towards c.b.; in many areas Channel 9 is continuously monitored by the local police to find out about emergencies. After 10 years of motorists warning each other of speed radar they still catch enough speeders.

Cass R. Lewart
Holmdel
New Jersey, USA

BOOKS

Beneath the City Streets, by Peter Laurie, an updated version of an earlier book of the same title, contains a good deal of information about government communication systems in the UK set up to cope with "external attack, almost certainly with nuclear weapons, and internal revolution". Most of the book however, is concerned with the citadels, bunkers and other dispersed centres of government that exist in Britain to deal with such emergencies. In a chapter on civil defence there is a 9-page section on over-the-horizon radar. Will feed the prejudices of those who hate the apparatus of the state. A Panther paperback from Granada Publishing, it costs £1.95.

Teletext and Viewdata, by Steve A. Money, is an attempt to explain the still cloudy subject of television data display systems, in a simple way, to non-specialists. The book is detailed, but not specific — the author covers the whole operation of a decoder without concentrating heavily on circuit technique or confining himself to specific component types: rather, a broad understanding is offered. Several commercial decoders are described and a glossary of data display terms is included as an appendix. The book has 151 pages, is published in hard back by Butterworth and Co., 88 Kingsway, London, WC2B 6AB, and costs £5.50.

Handbook of Electronic Formulas, Symbols and Definitions, by John R. Brand, concentrates a vast amount of information into a small enough book to be conveniently to hand when it is needed. The design of the book is unusual and completely logical; the symbol being dealt with is printed at the top of the page, being followed by its definition (and it is surprising to see how many meanings some symbols possess) and formula involving it, in the convenient transposition. Formulae have been expressed in suitable form for attack by electronic calculator. Three main sections of the 359 page book are: passive circuits, transistors and operational amplifiers; two useful appendices give a list of ratios obtainable from 5% passive component values, and a list of terms with their symbols — the reverse of the main body of the handbook. The publishers are Van Nostrand Reinhold Company Ltd, Molly Millars Lane, Wokingham, Berkshire, although the book is American, and the price is £11.95 in hard back.

Sound Recording for Motion Pictures by Charles B. Frater, is a broad introduction to current techniques and equipment and has helpful illustrations on most of its pages. Assuming no technical knowledge, it starts with elementary chapters on the nature of sound and electricity then goes on to specific techniques such as synchronous sound recording, transfer from tape to film, editing and dubbing. Dolby noise reduction and digital sound recording are just mentioned. Too general for those already working in the field, it seems intended for beginners going into the motion picture industry. With 210 pages, in paperback, the book is published by the Tantivy Press, London, at £2.95.

Newnes Book of Audio is another compilation of articles written by the half-dozen or so

people whose names seem to crop up most frequently in the audio magazines. It is intended for those who would like to buy high-quality equipment, but who are bemused by the technicalities inherent in any subject in which electronics plays a leading part, and in which advertisers tend to use pseudo-scientific expressions to give an aura of professionalism.

The first chapter is a general look at the whole field, and is followed by nine sections on individual components of an audio system, their use and testing. A very useful addition is a directory of makers and distributor\$. Butterworth and Co (Publishers) Ltd publish the book at £4.95 in paperback.

Microelectronics into the '80s is a view of the economic, commercial, technological and political factors which will govern the development of the industry in the next decade. It is published by Mackintosh International, a market consulting group who specialize in the electronics industry. Analyses of the semiconductor industry (its current state, government involvement, forward planning, finance) is presented for France, Italy, Japan, UK, USA and West Germany, and three articles by Mackintosh, Petritz and Barron give personal views on the future of integrated-circuit technology and application. The book contains 88 pages and costs £30. Mackintosh Publications Ltd, Mackintosh House, Napier Road, Luton.

Electronic Logic Circuits, by J. R. Gibson, is a first-level text, intended for students who have no previous knowledge. It is based on courses for first and second year students at Liverpool University.

The first two chapters are introductory, dealing with number systems, coding and components, and leading to an explanation of logic elements, Boolean algebra and circuit analysis. Chapters are then devoted to theoretical and practical logic design, both combinational and sequential, with a final section on applications.

Books on logic design tend to be very similar to one another, being of about the same length and possessing the same organization. This one is a little different, in that the author has not felt compelled to introduce logic functions via the usual Venn imagery, its explanation gaining clarity with the omission. Symbols used are those in common use in, for example, *Wireless World*. The book is published by Edward Arnold, 41 Bedford Square, London, WC1B 3DQ at £3.95 in paper back. It contains 114 pages.

Power Sources 7, edited by J. Thompson, is the latest in a series of books recording the proceedings of the International Power Sources Symposia held every two years. This one contains the 49 papers from the 11th symposium held in Brighton, 1978. Most of the contributions are accounts of advanced electrochemical research work in primary, secondary, high temperature and reserve batteries, including fuel cells, but the papers also contain reports on applications in vehicle propulsion, portable electronics, heart pacemakers, communications and other fields. Discussions on papers are included. Although its price is high at £65.00, this 774-page well-printed hardback book

will be good value to specialists in the field. Publishers are Academic Press, London.

Guide to Technical Short Courses is published by the Institution of Electrical Engineers, and is abstracted from their computer database Coursefinder. Courses listed are those on electrical or electronic engineering and are of the variety lasting less than one year. Full-time or part-time studies are covered, including intensive courses of up to two weeks duration, and are listed under the college, university or company running them. Details provided include the level of study, type and duration of the course, dates, subjects covered and general remarks. There are subject and geographical indexes. The guide is published at £25 by the IEE Marketing Department, Station House, Hitchin, Herts SG5 1RJ.

Volume 12 of the IBA Technical Review is entitled **Techniques for Digital Television**. As is usual in this series, the 70 page book consists of a number of contributions by IBA engineers on a central topic — in this instance, digital video processing. The discovery some years ago of the possibility of sub-Nyquist sampling rates (less than twice the maximum analogue frequency component) led to the design of a digital television studio using the proposals, and these articles describe the components of the system. In common with the other volumes in the series, this book is extremely well presented. Libraries or engineers and students directly involved in broadcasting can obtain a free copy by writing to IBA Engineering Information Service, Crowley Court, Winchester, Hants, SO21 2QA.

Electronic Projects Index for 1978 is now available. This is the second edition, the first covering the period 1972-77, and contains entries from a further eight publications. The compiler has taken constructional articles from sixteen electronics magazines and listed them by subject, with references and a short descriptive note on each, including an estimate of the type and number of components needed for many of the projects. Classification of the articles into types of equipment described is well done, and the index is simple to use and informative. It is published at £1.30, by post, by Central Library, Northumberland Square, North Shields, Tyne and Wear NE30 1QU.

Z80 Instant Programs — machine-code routines for Nascom and other Z80 Computer systems — is by J. Hopton. The programs are listed in memory location/Op-code/Meaning columns and are intended for a small Z80 system capable of up to 1000 program steps. New owners of computers may find the book useful, since it begins with very simple examples, such as the production of the delays and single tones, and finishes by programming for a game. Hex notation is used throughout. The book is published in paperback by Sigma Technical Press, 23 Dippons Mill Close, Tetchenall, Wolverhampton WV6 8HH, at the very high price of £7.50. There are 190 pages.

Electronic focusing

Simulation of the human eye mechanism

by D. Di Mario

Conventional focusing systems depend on the knowledge of distance but the human eye can focus without making any distance measurements. This article outlines an electronic system which simulates the eye's ability to use colour and luminosity differentiation for focusing an image.

MOST READERS will be familiar with the manual focusing ring and distance scale on common cameras, but Konica have produced an automatic focusing camera that performs a triangulation for indirectly calculating distance. Another system developed by Polaroid uses a beam of ultrasonic waves to measure distance. However, the human eye does not use any of the above methods. The purpose of focusing is to obtain the maximum amount of information from a given image area and the knowledge of distance is only a consequence which comes from our visual experience. The photographs in Fig. 1. illustrate what is meant by maximum information. The human eye operates more like a computer than a camera and focusing seems to be achieved by scanning the area and comparing the luminosity and colour of adjacent points. When the difference reaches a maximum the image is in focus. The block diagram in Fig. 2. is an electronic version of the eye, where a phototransistor moves back and forth between two positions which are close together. A reading of the light level is taken at each position and then compared, integrated, amplified, rectified and displayed as a peak reading from an instrument. The use of two phototransistors has been excluded because high linearity is required. A logarithmic amplifier was used to accommodate the great variation in input signal due to the large range of luminosity. In the prototype the phototransistor was glued to the centre of a 1½ in speaker with most of its diaphragm removed to reduce acoustic noise. A 200Hz oscillator was used to drive a 1W amplifier for the speaker and to provide gating pulses for the analogue switches. To avoid a beat frequency caused by the 100Hz of artificial light, a sync pulse was derived from the mains. The speaker and phototransistor were housed in a sealed probe which was placed in the image area.

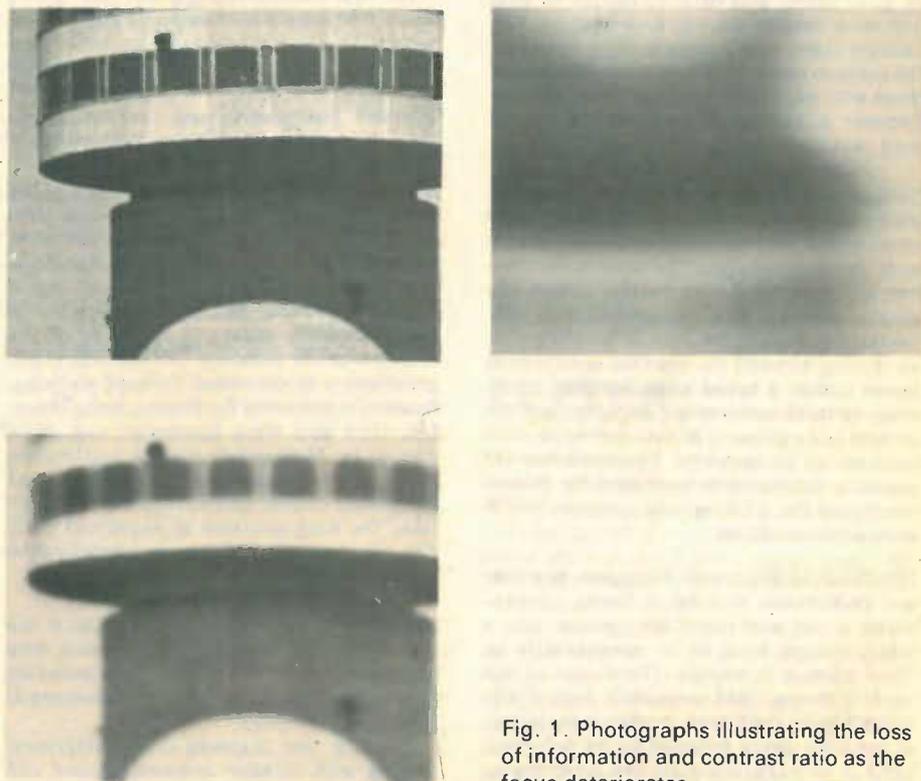
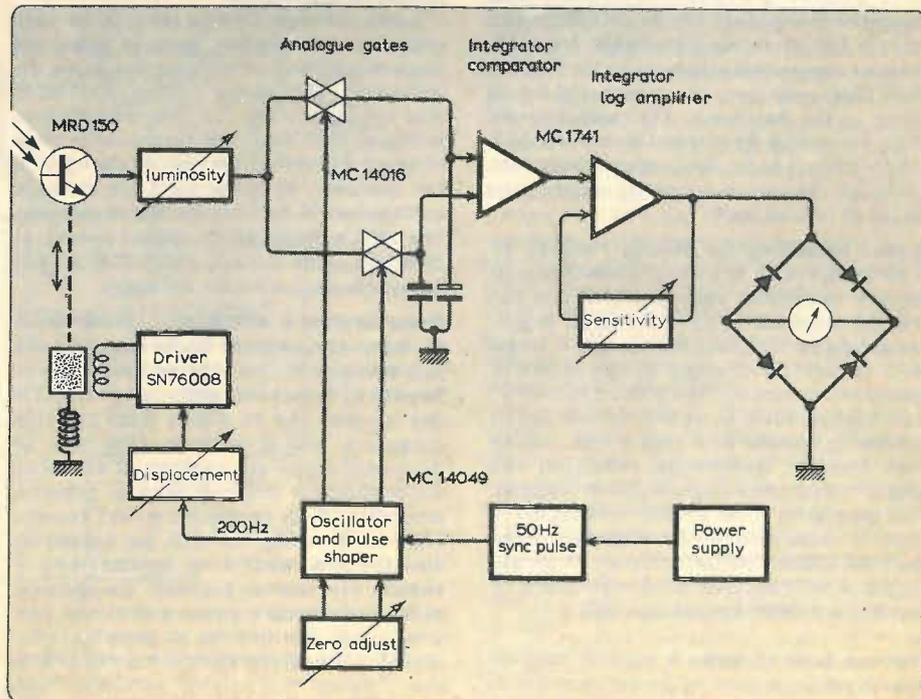


Fig. 1. Photographs illustrating the loss of information and contrast ratio as the focus deteriorates.

Fig. 2. Focusing system which measures light levels between two adjacent areas. The difference signal is amplified and displayed as a peak when the picture is in focus.



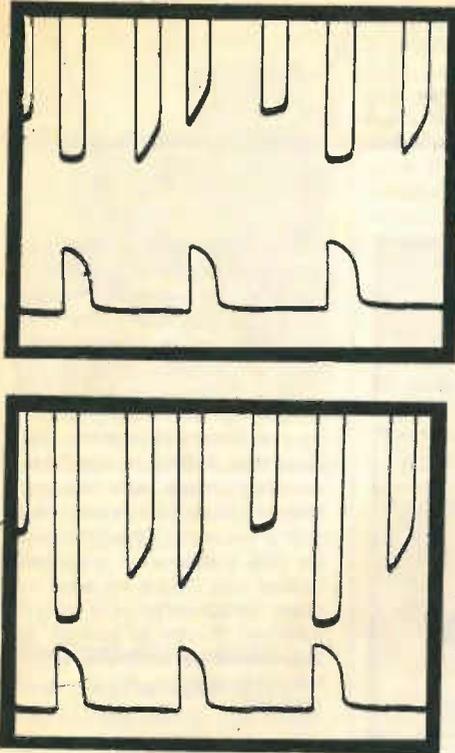


Fig. 3. Output of the phototransistor (top) and gating pulses when the picture is (a) out of focus and (b) in focus.

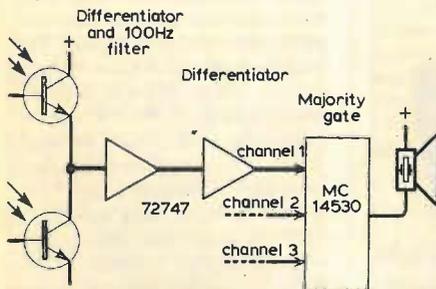


Fig. 4. Double differentiator used to detect a change in the variation of light. The majority gate ensures that a click is heard only when all of the channels produce a pulse at the same time.

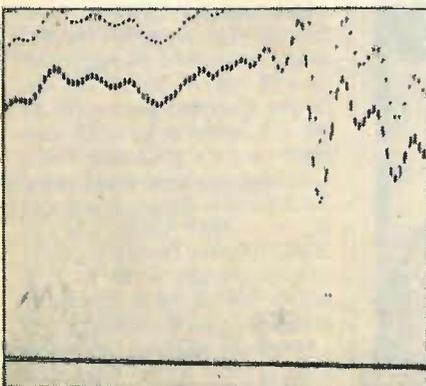


Fig. 5. Output of one channel (upper trace). The oscillation is the residual 100Hz artificial light frequency. Output from the majority gate (lower trace).

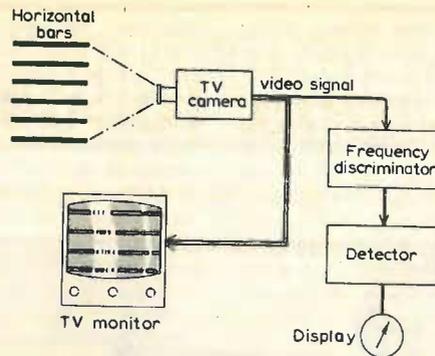


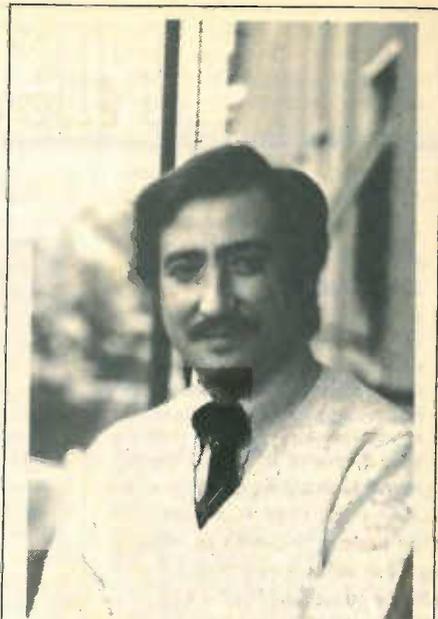
Fig. 6. Differentiation focusing system for television scanning. A focussing signal is obtained by detecting the high frequency content of a video signal.

In use the gating time is adjusted so that the instrument reads zero with the picture out of focus. The picture is then focused which should produce a peak reading. A photographic enlarger or a slide projector can be used for experimentation. To simulate the human eye accurately, several detectors should be used to cover the picture area. However, fairly accurate results can still be achieved with only one detector. Displacement of the phototransistor is dependent upon the required accuracy. A small displacement improves the point of exact focus but reduces sensitivity. In the prototype a 0.2mm displacement was used with a 300 x 300mm picture.

With very low light levels the human eye has difficulty in differentiating because the colour is absent and the depth of field is narrow. It seems that under these conditions focusing is achieved by time differentiation. The light value from a certain point is compared with the value seen a moment before until the variation of light reaches its maximum. Also, a large number of points are analyzed and when they seem to correlate we assume the picture is in focus. The diagram in Fig. 4. shows a method for constructing such a circuit. The outputs of the detectors are fed to a majority gate which gives a pulse at the output only when there are pulses simultaneously at the three inputs. Occasionally two output pulses are produced but they are always very close together and near the focusing point. During focusing a click is heard from the speaker and this corresponds to the point of best focus.

Television scanning is an ideal application for space differentiation focusing and a simplified system is shown in Fig. 6. When the picture is in focus the video signal has the highest percentage of high frequency signals. The reading on the instrument is very accurate and reaches its peak when the bars are in perfect focus.

In these examples there has been no attempt to implement a servomechanism for automatic focusing. The main purpose was to study the mechanism of focusing used by the human eye and to investigate an electronic simulation. □



The Author

Although born in England, D. Di Mario was educated in Italy and received a diploma in telecommunications. His career started in research and development at Autovox and he later worked with computers at NCR. After a period at Siemens where the author worked on electronic PABX and switching networks, he joined Italtel as a foreign contractor where he is currently involved in radio communication.

Pocket information

Do you know . . .

- wavelengths for BBC external services?
- what a gray per second is?
- how to build a simple graphic equalizer?
- whether UK colour sets work in Australia?
- the function of a c.m.o.s. 4040?
- what the Radio 3 900Hz test tone is for?
- the band for d.i.y. television?
- how accurate the GBR, MSF transmissions are?
- the exact value of the semitone ratio?
- how much speech power you need for a hall?
- a simple circuit for a 1.4V regulated supply?
- how to wind a crossover choke for 5mH?
- a near equivalent of the BC179?
- the maximum voltage of a completely red polyester capacitor?
- how to find the impedance of a loud-speaker?
- the Fourier series for a triangular wave?
- how to work out logs and trig. functions without tables?

The answers to these and countless other questions are contained in the 1980 edition of the Wireless World Diary. The list of telephone numbers for UK electronics organisations is expanded yet again, the tv standards section brought up to date and several new sections added. Unfortunately you can't buy it directly from the publishers, T. J. & J. Smith Ltd, of Deer Park Road, London SW19, and you will need to ask a retailer to order it through the book trade. *Wireless World* has a limited number of copies for overseas readers, price £1.92, inclusive obtainable from the editorial office.

NEW PRODUCTS

Dot matrix print mechanism

A mobile head consisting of 7 vertical needles, used to build up characters on a 7 x 5-dot matrix, constitutes the heart of the DP-822 print mechanism. This is a 21 character machine with primary feed working at about 580Hz, resulting in a printing speed of 2.5 lines per second at a character height of 2.9mm. Further features are a quickly replaceable ink ribbon and the capability, according to the makers, Roxburgh Electronics, to print a good copy on 2-ply carbonless paper. For microprocessor connection a complete interface or the controller chip alone can be supplied. Dimensions are 106mm wide by 145mm long by 52.5mm high and the printer weighs 570g. The unit operates from a 12V d.c. supply and has an operating temperature range of +5 to +45°C at up to 95% relative humidity. The one-off price is £50 and £34 each in quantities of 100. Roxburgh Electronics Ltd, 22 Winchelsea Road, Rye, East Sussex TN31 7BR.

WW 301



WW 301

Digital pH/mV meter

Mains or battery operation and a 3½ digit display are the principal features of the CD330 pH and mV meter recently introduced by Walden Precision Apparatus. Functions are selected by a switch on the front panel and the instrument operates over the ranges 0 to 13.99pH units, 0 to 199.9mV (positive or negative) and 0 to 1.999V (positive or negative). The voltage ranges are provided in order to cater for redox and specific ion measurements. A digital thumbwheel switch permits selection of the exact compensation temperature required, in the range 0 to 99°C. Price is £180 + £2 p. and p., excluding v.a.t. Walden Precision Apparatus Ltd, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3BD.

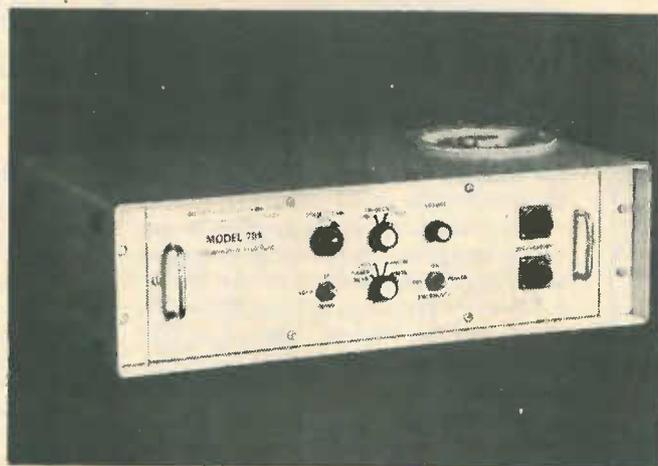
WW 302



WW 302

Underwater telephones

Designed mainly for diving bell applications, the Mesotech 715B underwater telephone is completely self-contained in a rugged, pressure-proof housing. Both speaker and microphone



WW 303

are mounted inside the bell and the unit has been developed with high pressure helium and oxygen atmospheres in mind. The 703A telephone unit is a single side-band transmitter/receiver for voice communication. It is a dual frequency unit operating at frequencies of 8.0875kHz for long range communication and 25kHz for short range, and features phase-lock loop frequency control; a telemetry in/out facility for data transmission is also included and it can be used on other frequencies as a pinger receiver. Techmation Ltd, 58 Edgware Way, Edgware, Middlesex HA8 8JP.

WW 303

Pocket l.c.d. multimeter

The model 130 l.c.d. digital multimeter has five functions, each with five ranges, and meets many of the measurement requirements for field service use. Each function and range is selected using two rotary switches. The multimeter has direct voltage ranges from 200mV (100µV resolution) to 1000V (1V resolution) with a maximum error of ±0.5% of reading plus 1 digit, and alternating voltage ranges from 200mV, (100µV resolution) to 750V (1V resolution) within ±1% of reading plus 5 digits. Maximum allowable inputs on these ranges are 1000V d.c. or peak a.c. non-switched, 750V peak switched, continuous except on the 200mV a.c. range where inputs above 300V are limited to 15s. The input impedance on these ranges is 10MΩ, shunted by less than 100pF. The meter has direct current and alternating current ranges from 2mA, (1µA res.) to 10A (10mA res.) within error margins of ±1% rdg. + 1d. to ±2% rdg. + 1d. on the d.c. ranges and from ±2% rdg. + 5d. to ±3% rdg. + 5d. on the a.c. ranges. Overload protection on the mA inputs is by a 2A fuse (250V) and the 10A input, which is unfused, can withstand 20A for 15s maximum. Resistance ranges are from 200Ω (100MΩ res.) to 20MΩ (10kΩ res.) with accuracies from ±0.5% rdg. + 4d. to ±2% rdg. + 1d. On these ranges the maximum open circuit voltage is 1.5V and the maximum allowable input is 300V d.c. or r.m.s. The accuracy figures quoted above are guaranteed for one year and are valid for operating temperatures from 18 to 28°C. The multimeter, which measures

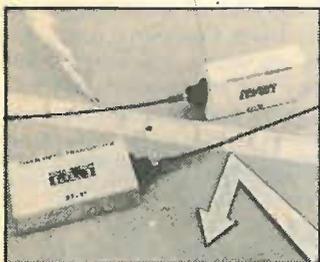


178×78×38mm and weighs only 400g, uses a 3½-digit, 0.6in-high l.c.d. and costs £79, excluding case and v.a.t. Keithley Instruments Ltd, 1 Boulton Road, Reading, Berks.

WW 304

Optical-fibre data link evaluation kits

Two kits intended for the evaluation of optical fibre data links are now available from the manufacturer, Burr-Brown. These are specified as the FODL-K1 and FODL-K2, the former employing the 3712T transmitter and 3712R receiver, while the later uses the 3713T transmitter and 3713R receiver. The main difference lies in respective



transmission speeds, that for the FODL-K1 being 25k baud, with a fibre optic cable 20 feet long complete with fitted connectors, compared with the FODL-K2 which is equipped with a six-foot long terminated cable but offers a transmission speed of 250k baud. Each transmitter/receiver combination is contained in a 42×77×17mm metal case. Burr-Brown International Ltd, Cassiobury House, 11-19 Station Road, Watford, Herts WD1 1EA.

WW 305

Constant voltage transformers

Recommended by the makers, Banner Electric Co, for a.c. applications where harmonics can radically affect circuit operation, the Sola CVS range of transformers contains harmonic-neutralizing circuits which obviate the need for additional LC filters. These transformers are smaller and are claimed to be more rugged than conventional

transformers using filters for waveform improvement, and stabilization error is within 5% of quoted output voltage. This margin is related to an input range of 15% about the nominal input voltage. The CVS range features a harmonic content of less than 3% (r.m.s.) in the sinusoidal output waveform at full load operation. The CVN range provides the same 5% level of load stabilization but the harmonic content is 20% (r.m.s.) and these transformers are therefore more suitable for use with solenoids, filaments, etc., and applications where rectification is usually



required. All transformers can be provided for either 50 or 60Hz operation, in power ratings from 30VA up to 7kVA, and they may be operated in cascade to obtain stabilization down to 0.25% if required. Banner Electric Co, Ltd, Pindar Road, Hoddesdon, Herts EN110EF.

WW 306

Multi-purpose mobile radio

A v.h.f./a.m. portable mobile radio, the Pocketfone P5001, can be held in the hand or worn on the body. A quick release holster is equipped for rapid, automatic switching of the send/receive facilities to or from a loudspeaker unit which may be clipped to the lapel of a coat. The portable can also be used inside vehicles. A



vehicle adaptor accepts the portable, making automatic connection to the vehicle antenna, to a rapid-charge system powered by the vehicle supply and to a high-power audio amplifier. The unit is available for bands in the frequency range 68-174MHz. Single- and up to six-channel versions are available. Transmitter output is 1W. Various plug-in options are offered and space is provided for the addition of tone signalling circuits. Among the varieties available are 5-tone encode/decode to the standard European systems, Pyecall two-tone decode, tonelock encode/decode, or a single tone encoder to provide switching of a talk-through repeater from the portable. There is a choice of interchangeable telescopic, coiled whip or pendant antennas, and also a choice of standard or heavy duty batteries. Pye Telecommunications Ltd, St Andrews Road, Cambridge CB4 1DW.

WW 307

Teletext/Prestel chips

Three m.o.s./l.s.i. chips are the basis of the GIM Televue system for teletext/viewdata television sets. This system, which can be accommodated on a single-sided



p.c. board 6 inches by 4 inches, is modular and can be extended from a basic teletext or viewdata decoder to a combined unit operating with a remote-control user's keypad. The set of chips is compatible with existing standard television circuits for digital tuning, channel indication and remote-control, as well as external accessories such as hard copy printers and keyboards, using GIM devices. The use of a standard, mask-programmed 8-bit microcomputer, i.c. PIC 1650, for control purposes means that "production costs are expected to be low enough to attract manufacturers of tv add-on equipment as well as the tv set makers, once quantity production levels have been reached." The video generator chip, although currently programmed for English language displays, has been mask programmed for other languages and character

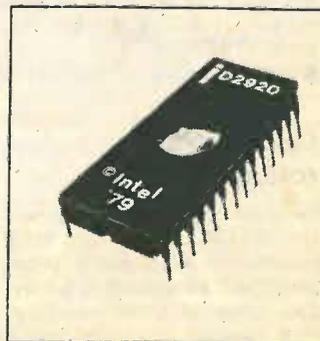
sets. The data acquisition chip takes data from either the tv receiver or telephone line via the appropriate interface, processes it according to requests and loads the data into a store. General Instrument Microelectronics Ltd, Regency House, 1-4 Warwick Street, London W1R 5WB.

WW 308

A-d-a microprocessor

Containing digital-to-analogue and analogue-to-digital converters, the Intel 2920 analogue signal processor contains a 25-bit digital processor, an e.p.r.o.m. and a small scratch pad r.a.m. The unit accepts analogue input signals between 0 and 10kHz (which limits its applications where digital filters are concerned) converts them into digital format, processes them at high speed under program control and then re-converts them into analogue form for output. The analogue section accommodates up to four inputs and eight outputs. Control of analogue and digital sections is carried out by an e.p.r.o.m. with a storage capacity of 192 24-bit words (4608 bits). The instruction format for each word is divided into five linked sectors; digital operator, source address, destination address, extent of shift and analogue operator. The r.a.m. scratch pad, which handles the arithmetic, is structured as a 40×25-bit memory. To boost processing flow, the r.a.m. has been designed with dual-port cells which can be addressed through either port. Typical applications of the 2920 might be low-pass and band-pass filters with up to 20 complex pole and/or zero pairs, threshold detectors, limiters, rectifiers, up to 25-bit multiplication and division, approximations to non-linear functions and waveform generators. Several units may be cascaded for complex processing with no loss of process rate. Intel International, Parc Seny, Rue de Moulin a Papier, 51 Boite 1, B-1160, Brussels, Belgium.

WW 309



SIDEBANDS

By Mixer

Spy fever

Some of that breakaway group over the Atlantic are obviously not especially averse to a fast buck.

In the land of the free, if we are to believe the evidence of television and film, one can no longer ring the butcher to order a couple of t-bone steaks without someone illicitly earwiggling in on the conversation and recording it on tape for, presumably, nefarious purposes. Concealed radio microphones, miniature cameras and telephone taps are big business and, as a natural consequence, so are the countermeasures for these little horrors. One American company, CCS, claims a yearly turnover of 25 million dollars in this field of activity.

Assuming that attack is the best form of defence, or perhaps stretching the analogy of setting a thief to catch a thief, CCS has managed to square its conscience by providing not only the defence, but the attack as well. Dismissing any inconvenient abstract notion of ethics as "arcane moral philosophy", Gerald Freeman, a New York public relations man, implied that if you want to get on in business, your first move must be to get yourself a bit of "candid surveillance" equipment. For example, it seems that no well-equipped businessman is now roadworthy without his security system for eavesdropping, his briefcase with a secret "conversations recorder", and a covert spy — a camera that shoots round corners.

CCS will, I think, have to recognize the new opportunities presented to them on entering the UK market. Have they properly understood the real function of the standard-issue umbrella, for instance? It is nothing to do with the weather: that long stem is of exactly the right proportions to conceal a directional microphone, its amplifier being concealed in a hip-flask. All those fountain pens — they aren't just for signing for expense-account lunches — most of them contain powerful telescopes for finding out what that rotter who's pinched one's seat on the 8.45 has got for 11 across and 21 down. Mr Freeman, we're way ahead of you.

Fish and chips

I've been waiting to use that heading for a couple of years now, and I finally located the excuse in a report in a daily paper, on the subject of what the future holds in store for us. Ever since the 'microchip' became the least-understood and and most-quoted household word since Einstein published his thoughts on relativity, any poor hack who can't think of a

thing to write about for his daily 500 words lies back with his feet on the desk for twenty minutes and dreams up a few uses for microprocessors. He then writes his piece entitled "Our Future With the Chip" or some such.

Since it is well known that the chip in question can do anything or that, if it can't now, it soon will, a lot of the brainstormed suggestions are feasible. I saw one last week, though, that gave every indication of having been brought forth by someone whose idea of a brisk walk is a belt down the M1 in an MGB; the end being confused with the means. The notion put forward was a fishing rod with an attached microprocessor, the idea being to set everything up automatically to catch any fish in any stretch of water at any time.

I've never been one for gratuitously attacking fish of any kind, except when they lie, surrounded by chips, in a piece of Daily Express, but I do have the distinct impression that whoever's diseased mind thought that one up had got hold of the wrong end of the stick. The whole idea, I've always thought, was to sit reflectively on the bank, pondering on the nature of the Universe: if a fish happens along and is unwise enough to investigate, then so be it, but it's the sitting that counts. If it is to be turned into a kind of production line, then the poor old fish are in for a pretty hectic time. Simply isn't cricket, at all.

Scots wha hae . . .

I have fulminated in the past over electronics being used for trivial purposes, when greater needs go unrecognized. It is gratifying, therefore, to see a genuine requirement which is capable of being fulfilled, simply and at little cost, with aim of giving a group of citizens a bit of peace and quiet.

One of my colleagues recently received a call from someone in a Scottish village, whose sleepy charm is currently being shattered fairly regularly by a Klaxon horn. It appears that the garage owner's telephone operates the horn so he can hear it over the noise of engines and British Leyland cars disintegrating. That would be all right in the normal way, but the village is a quiet one, and every time someone rings the garage to ask if their car is done yet, please, the whole village responds with a concerted leap into the air of about six inches.

One's heart goes out to these unfortunate denizens of the northern mists. There they all are, replete with haggis and fresh-caught local salmon, relaxing after a hard day tossing the caber and flogging about the grouse moor 'til fit to drop, when all Hell breaks loose at the

garage and the timeless tranquillity of this little corner of Scotland is shot to pieces.

What they want, it seems, is a small transmitter, driven by the telephone, which will trigger a pocket bleeper.

They must be a more easy-going lot up there than I had previously supposed. My image of the Scotsman of yore is of a great, red-haired, red-bearded, kilt-swinging, wild-eyed giant, careering about with his claymore and doing severe damage to whoever he took exception to. It would be a foolhardy garage-owner who would upset a village full of characters like that. I can only suppose that soft living has sapped their natural boisterousness.

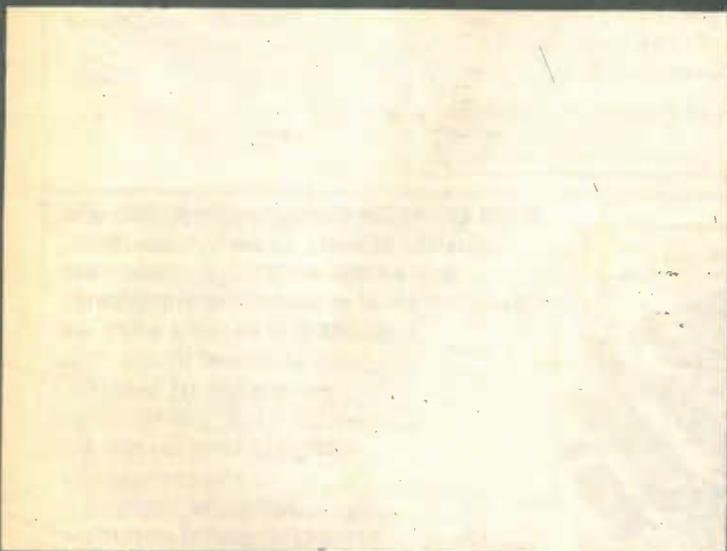
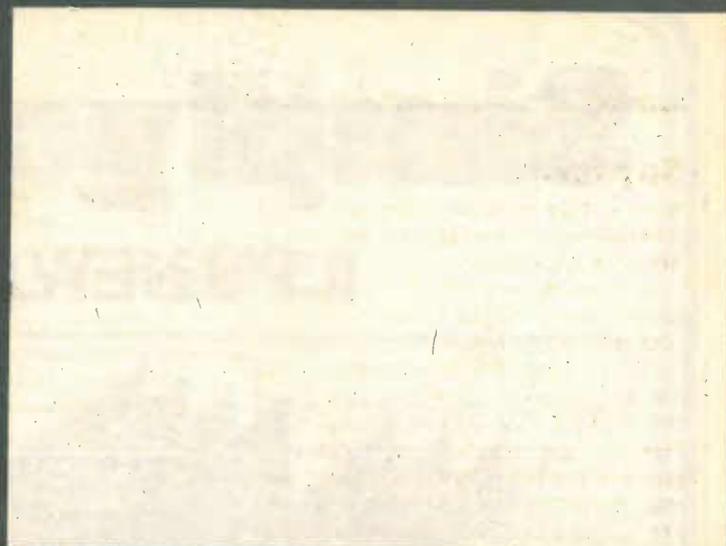
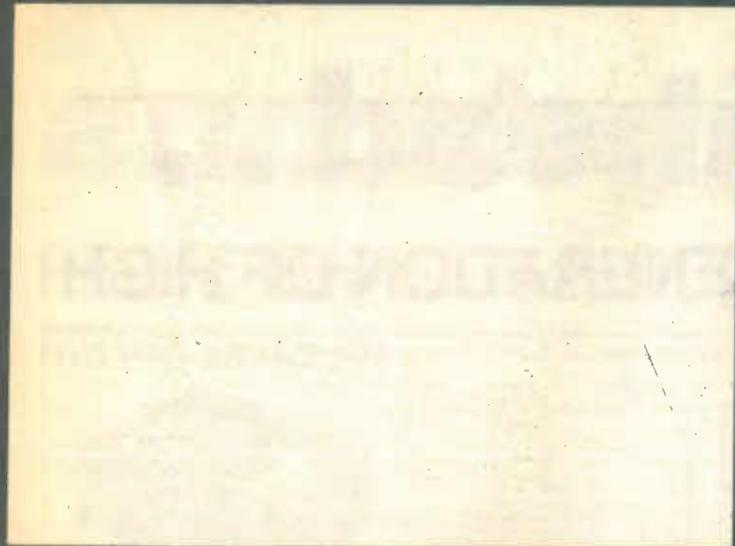
Ship chips

They tell me that sailing ships are coming back. It's all to do with the oil, you see — or rather the lack of it. I've seen several proposals, from sail assistance on propeller-driven ships to complete, full-blown(!) latter-day clippers, cleaving through the waves with acres of canvas billowing from the masts, miles of ropes, or sheets or whatever they call them, and all the romance of the old East India Company days. All those lovely old words will come back into everyday use — scuppers, marlin-spikes, t'gallants and microprocessors. Oh, yes; it is not, it seems, the intention to use more than a modicum of muscle-power to raise and lower the aforementioned canvas (nylon, more like) but to do it with motors under the control of silicone chips (they're the waterproof kind).

Well, I don't know about that. One might conceivably feel a little self-conscious bawling out "Heave-ho, my hearties" to a couple of boards full of i.c.s; there is also the matter of what sanctions to impose on a mutinous dog of a u.a.r.t. that won't.

Anyone with a little imagination could work this up into the ideal transport scheme. What you need is a sailing ship, with its computer, to start with. Satellite and shore-based nav aids, coupled into the computer together with heading information and met. forecasts, and maybe a maintenance man with another to stop him going potty, and you've got a virtually hands-off system. Pop all the cargo into the hold, point her in approximately the right direction, give her a shove and forget about her for a few weeks. Eventually a message will be received: "Yours of the 15th ult. turned up yesterday".

As I said, all you need is a little imagination.



NO COMPETITION

The superb 3.77 is the only choice in compact professional recorders.

Who says?

Hundreds of satisfied professional users— Broadcast authorities, studios, record companies, universities etc etc.

What makes it the best?

The 3.77 provides more performance and features for your £ than any other model. Like 3 speeds, flat metal fascia with excellent editing facilities, 100% variable speed control, logic control with motion sensing, line-up oscillator.

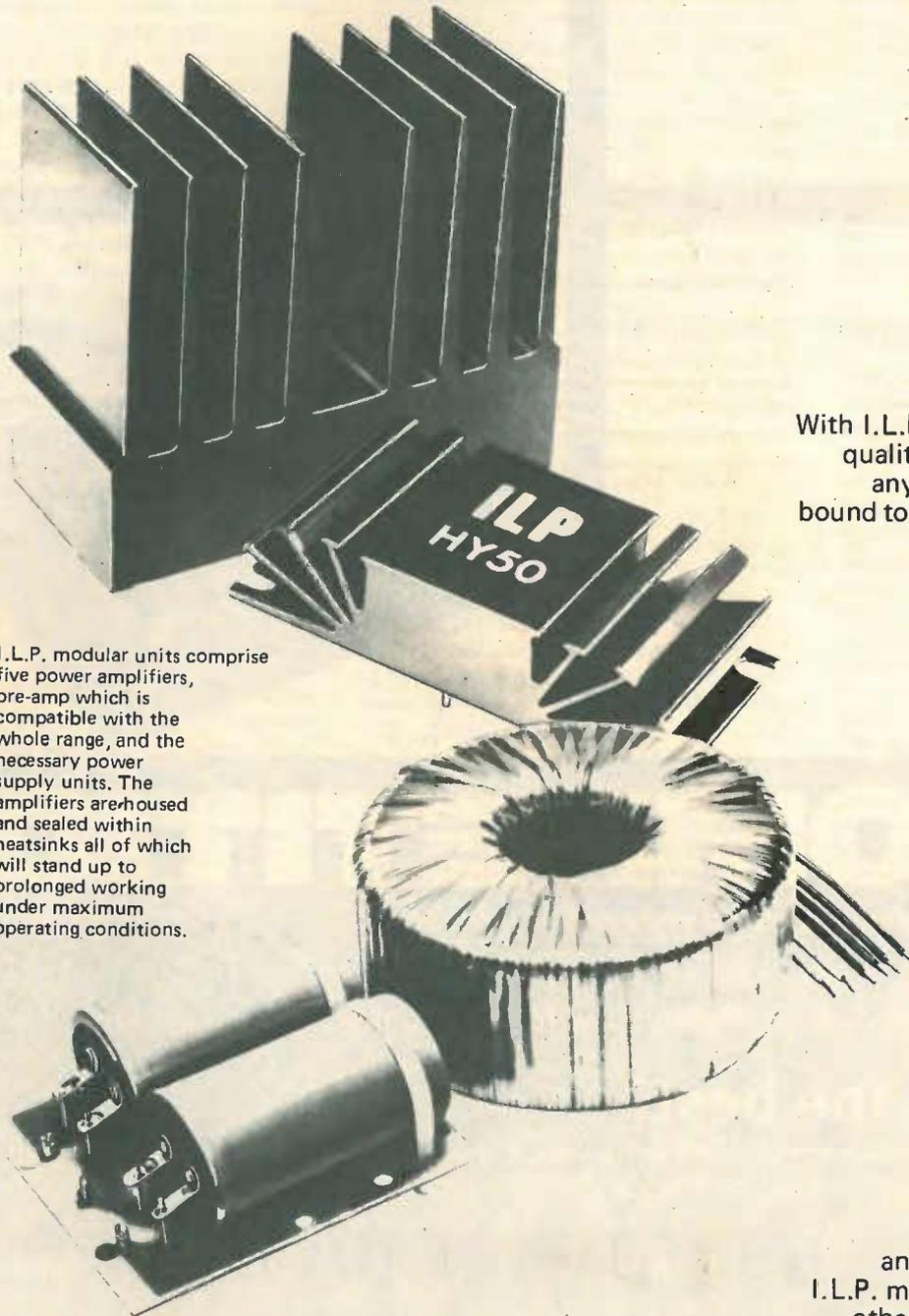
An **ITA** Product.

1-7 Harewood Avenue, Marylebone Road, London NW1. Tel: 01-724 2497. Telex: 21879

WW — 078 FOR FURTHER DETAILS

Simply ahead . . .

ILP'S NEW GENERATION OF HIGH



I.L.P. modular units comprise five power amplifiers, pre-amp which is compatible with the whole range, and the necessary power supply units. The amplifiers are housed and sealed within heatsinks all of which will stand up to prolonged working under maximum operating conditions.

With I.L.P. performance standards and quality already so well established, any advances in I.L.P. design are bound to be of outstanding importance — and this is exactly what we have achieved in our new generation of modular units. I.L.P. professional design principles remain — the completely adequate heatsinks, protected sealed circuitry, rugged construction and excellent performance. These have stood the test of time far longer than normally expected from ordinary commercial modules. So we have concentrated on improvements whereby our products will meet even more stringent demands such, for example, as those revealed by vastly improved pick-ups, tuners, loudspeakers, etc., all of which can prove merciless to an indifferent amplifier system. I.L.P. modules are for laboratory and other specialised applications too.

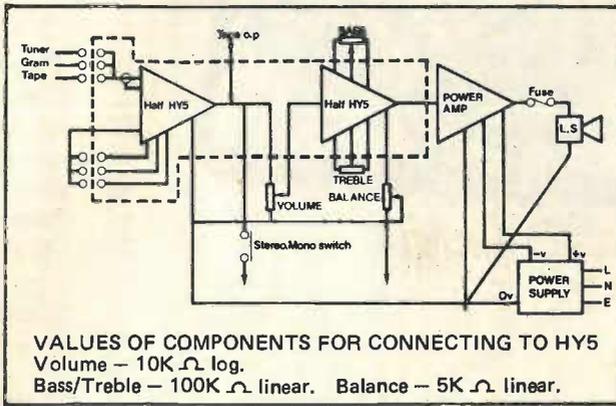
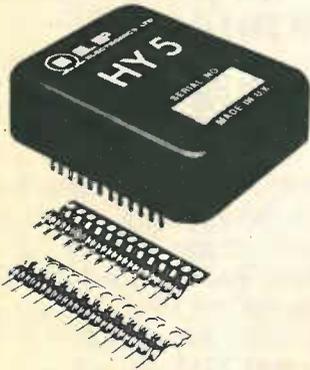
**PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS
IN ELECTRONIC MODULAR DESIGN**

AVAILABLE ALSO FROM A NUMBER OF SELECTED STOCKISTS

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER

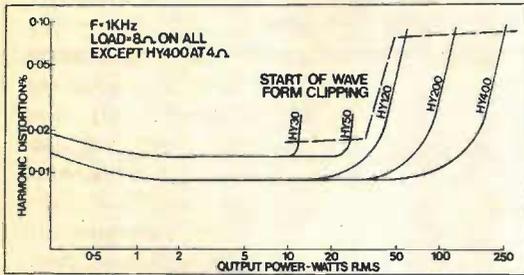


The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm, and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz-0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

VALUES OF COMPONENTS FOR CONNECTING TO HY5
 Volume - 10K Ω log.
 Bass/Treble - 100K Ω linear. Balance - 5K Ω linear.

£4.64 + 74p VAT

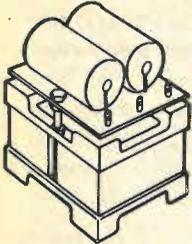
THE POWER AMPLIFIERS



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0 +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	£27.68 + £4.15

Load impedance - all models 4 - 16 Ω
 Input sensitivity - all models 500 mV
 Input impedance - all models 100K Ω
 Frequency response - all models 10Hz - 45Hz - 3dB

THE POWER SUPPLY UNITS

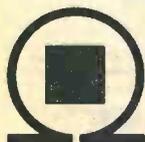


I.L.P. Power Supply Units are designed specifically for use with our power amplifiers and are in two basic forms - one with circuit panel mounted on conventionally styled transformer, the other with toroidal transformer, having half the weight and height of conventional laminated types.

PSU 30	$\pm 15V$ at 100ma to drive up to five HY5 pre-amps	£4.50 + £0.68 VAT
PSU 36	for 1 or 2 HY30's	£8.10 + £1.22 VAT
PSU 50	for 1 or 2 HY50's	£8.10 + £1.22 VAT
PSU 70	with toroidal transformer for 1 or 2 HY120's	£13.61 + £2.04 VAT
PSU 90	with toroidal transformer for 1 HY200	£13.61 + £2.04 VAT
PSU180	with toroidal transformer for 1 HY400 or 2 x HY200	£23.02 + £3.45 VAT

**NO QUIBBLE
 5 YEAR GUARANTEE
 7-DAY DESPATCH ON ALL ORDERS
 INTEGRAL HEATSINKS
 BRITISH DESIGN AND MANUFACTURE
 FREEPOST SERVICE - see below**

★ ALL U.K. ORDERS DESPATCHED POST PAID
HOW TO ORDER, USING FREEPOST SYSTEM
 Simply fill in order coupon with payment or credit card instructions. Post to address as below but do not stamp envelope - we pay postage on all letters sent to us by readers of this journal.



I.L.P. ELECTRONICS LTD.
 FREEPOST Graham Bell House, Roper Close,
 Canterbury, Kent CT2 7EP.
 Telephone (0227) 54778 Teléx 965780

Please supply
 Total purchase price £
 I enclose Cheque Postal Orders International Money Order
 Please debit my Account/Barclaycard Account No.
 NAME
 ADDRESS
 Signature

INPUT

FROM PHILIPS TEST & MEASURING INSTRUMENTS

OSCILLOSCOPES

NO WAITING FOR THESE TOP PRODUCTS

The **PM 2517** has set the standard and the pace in Europe for hand-held digital multimeters and still it remains in a class of its own.

Remember, its many important features include full four digits, so on mains voltage readings, for example, you might get 240.3 instead of the 240, which a 3½ digit meter would read.

Some other **PM 2517** plus points:

- LED or LCD display
- True RMS readings of AC voltage and current
- Autoranging with manual override
- Optional accessories include temperature and data hold probes

Reader inquiry number 220

- 15 MHz dual trace
- Auto triggering from either channel with adjustable level between peaks and TV triggering
- 5 mV sensitivity, Y and X (via A input)
- B invert facility

Reader inquiry number 221

The **PM 3207** - Super Scope - is a tough, general purpose oscilloscope which offers at a low price the quality and technology you expect from Philips Test and Measuring Instruments.

Both these instruments are available off the shelf from the **Philips Electronic Instruments Department** (see address below) or from the following distributors. **British Tungfram**, West Road, Tottenham, London N17 0RN. Tel: 01-808-4884. **Philips Service Centres** (25 throughout the country). Tel: 01-686-0505 for the address of your nearest branch. **Wessex Electronics Ltd**, 114-116 North Street, Downend, Bristol BS16 5SE. Tel: (0272) 571404.

PATTERN FOR THE FUTURE

The **PM 5519** colour TV pattern generator is already a widely used instrument. As a major manufacturer of Video cassette recorders, and colour television receivers - and the company which has developed the world's most advanced video disc system - Philips have carefully selected the best patterns for aligning and testing these products. With over 20 colour and b/w test patterns to choose from it is the most versatile pattern generator on the market.

- **PM 5519 I** for British system - versions available for other TV systems
- RF signals available in bands I, III, IV and V
- Variable Video Output (with 1 volt fixed position)
- External video and sound modulation facility
- Composite sync output for triggering - includes the line frame and blanking pulses to the local TV standard

Reader inquiry number 222

Some other Philips audio and video service instruments:

PM 5326 RF SIGNAL GENERATOR

- 100 kHz-125 MHz in 9 overlapping ranges

- Built-in 5 digit counter
- 50mV RF output at 75Ω can be attenuated to over 100dB
- Electronically stabilised output level
- Wobbulator facility

Reader inquiry number 223

PM 6307 WOW AND FLUTTER METER

- X-tal controlled oscillator
- High accuracy and frequency stability
 - 3150 Hz or 3000 Hz switchable
 - Separate 'Drift' and 'Flutter' indication

Reader inquiry number 224

All Philips audio and video service instruments are also available from Philips Service Centres (for details see end of PM 3207 section).

input advertisements are designed to meet the needs of our professional customers. They are a shop window for Philips Test and Measuring Instruments - and we will be changing the display frequently because we have a lot of products to show you.

Where you require full information about a product, tick the coupon and attach it to your name and address, or letterhead - or, of course, use the journal's reader inquiry service. You will receive in return a detailed information pack reflecting your specific requirements.

	Inquiry no.	
PM 2517 multimeter	220	<input type="checkbox"/>
PM 3207 oscilloscope	221	<input type="checkbox"/>
PM 5519 colour TV pattern generator	222	<input type="checkbox"/>
PM 5326 RF signal generator	223	<input type="checkbox"/>
PM 6307 wow and flutter meter	224	<input type="checkbox"/>

Pye Unicam Ltd
Philips Electronic Instruments Dept.
York Street, Cambridge, England CB1 2PX
Tel: Cambridge (0223) 358866 Telex 817331



Test & Measuring Instruments

TV GENERATORS

PHILIPS

LANGREX SUPPLIES LTD

Climax House, Fallsbrook Rd., Streatham, London SW16 6ED

RST Tel: 01-677 2424 Telex: 946708 RST

SEMICONDUCTORS

AA119	0.12	ASZ15	1.44	BC172	0.12	BD131	0.40	BF257	0.28	CR53	60	1.04	OA2201	1.15	OC203	2.02	ZTX502	0.18	2N1309	0.83	2N3771	2.02
AA120	0.31	ASZ16	1.44	BC173	0.14	BD132	0.44	BF258	0.30	GEX66	1.73	0A2206	1.15	OC204	2.88	ZTX503	0.20	2N1613	0.29	2N3772	2.30	
AA121	0.48	ASZ17	1.44	BC174	0.16	BD133	0.39	BF259	0.37	GEX51	4.60	OA2207	1.15	OC205	2.88	ZTX504	0.23	2N1671	1.73	2N3773	3.45	
AA122	0.21	ASZ20	1.72	BC178	0.18	BD137	0.40	BF260	0.35	GJ3M	0.86	OC16	2.30	OC206	2.88	ZTX531	0.23	2N1893	0.29	2N3819	0.41	
AA123	0.39	ASZ21	2.30	BC179	0.18	BD138	0.46	BF261	0.35	GM0378A	2.02	OC20	2.88	OC207	2.02	ZTX550	0.18	2N2147	1.02	2N3820	0.52	
AA124	0.31	AU113	1.96	BC182	0.13	BD140	0.51	BF262	0.35	MEJ340	0.92	OC22	2.88	OC208	1.44	IN916	0.08	2N2218	0.29	2N3866	0.83	
AC107	0.69	AU110	2.30	BC183	0.12	BD144	2.30	BF263	0.26	MJE370	1.35	OC25	1.04	R2009	2.59	IN4002	0.07	2N2220	0.21	2N3905	0.15	
AC125	0.23	AU111	1.96	BC184	0.13	BD181	1.26	BF264	0.23	MJE520	0.60	OC26	1.04	R2008	2.02	IN4003	0.08	2N2221	0.21	2N3906	0.15	
AC126	0.23	BA145	0.15	BC212	0.14	BD237	0.46	BF265	0.74	MJE521	0.63	OC28	2.36	TIC44	0.35	IN4004	0.08	2N2222	0.21	2N4058	0.16	
AC127	0.23	BA148	0.15	BC213	0.15	BD238	0.43	BF266	0.74	MJE522	0.63	OC29	2.30	TIC226D	1.38	IN4006	0.09	2N2223	0.16	2N4059	0.12	
AC128	0.23	BA154	0.10	BC214	0.17	BD239	0.43	BF267	0.74	MJE523	0.88	OC35	1.73	TIL209	0.23	IN4007	0.10	2N2224	0.20	2N4061	0.14	
AC141	0.29	BA155	0.12	BC237	0.10	BDX10	1.05	BF268	0.26	MPP102	0.35	OC36	1.73	TIP29A	0.47	IN4007	0.23	2N2225	0.21	2N4062	0.15	
AC141K	0.40	BA156	0.10	BC238	0.14	BDX32	2.30	BF269	0.24	MPP103	0.35	OC41	0.92	TIP30A	0.48	IN4007	0.23	2N2484	0.23	2N4062	0.15	
AC142	0.23	BAW62	0.06	BC301	0.38	BDY20	1.44	BF270	0.24	MPP104	0.35	OC42	0.86	TIP31A	0.51	IN4148	0.07	2N2646	0.63	2N4124	0.17	
AC142K	0.35	BAW63	0.07	BC302	0.38	BDY60	1.72	BF271	0.30	MPP105	0.35	OC43	2.59	TIP32A	0.55	IN5400	0.15	2N2904	0.29	2N4126	0.17	
AC176	0.23	BAX16	0.10	BC307	0.12	BF15	0.29	BF272	0.30	MPSA06	0.28	OC44	0.69	TIP33A	0.79	IN5401	0.15	2N2905	0.29	2N4286	0.23	
AC187	0.23	BC107	0.14	BC308	0.12	BF152	0.21	BF273	0.30	MPSA50	0.35	OC45	0.63	TIP34A	0.84	IN5401	0.15	2N2906	0.24	2N4288	0.25	
AC188	0.23	BC108	0.14	BC327	0.23	BF153	0.23	BF274	0.30	MPSU01	0.41	OC71	0.63	TIP41A	0.72	IN5210	0.08	2N2907	0.24	2N4547	0.40	
AC188	0.23	BC109	0.15	BC328	0.21	BF154	0.20	BF275	0.30	MPSU06	0.53	OC72	0.63	TIP42A	0.81	IN5211	0.08	2N2924	0.24	2N4548	0.40	
AC188	0.23	BC110	0.15	BC329	0.23	BF155	0.23	BF276	0.30	MPSU06	0.56	OC73	1.15	TIP2855	0.77	IN5211	0.08	2N2925	0.25	2N4549	0.40	
AC188	0.23	BC111	0.15	BC330	0.21	BF156	0.20	BF277	0.30	MPSU06	0.52	OC74	0.74	TIP3055	0.64	IN5211	0.08	2N2926	0.16	2N4550	0.40	
AC188	0.23	BC112	0.15	BC331	0.21	BF157	0.20	BF278	0.30	MPSU06	0.52	OC75	0.74	TIP3055	0.64	IN5211	0.08	2N2927	0.16	2N4551	0.40	
AC188	0.23	BC113	0.15	BC332	0.21	BF158	0.20	BF279	0.30	MPSU06	0.52	OC76	0.74	TIP3055	0.64	IN5211	0.08	2N2928	0.16	2N4552	0.40	
AC188	0.23	BC114	0.15	BC333	0.21	BF159	0.20	BF280	0.30	MPSU06	0.52	OC77	0.74	TIP3055	0.64	IN5211	0.08	2N2929	0.16	2N4553	0.40	
AC188	0.23	BC115	0.16	BC334	0.21	BF160	0.20	BF281	0.30	MPSU06	0.52	OC78	0.74	TIP3055	0.64	IN5211	0.08	2N2930	0.16	2N4554	0.40	
AC188	0.23	BC116	0.17	BC335	0.21	BF161	0.20	BF282	0.30	MPSU06	0.52	OC79	0.74	TIP3055	0.64	IN5211	0.08	2N2931	0.16	2N4555	0.40	
AC188	0.23	BC117	0.20	BC336	0.21	BF162	0.20	BF283	0.30	MPSU06	0.52	OC80	0.74	TIP3055	0.64	IN5211	0.08	2N2932	0.16	2N4556	0.40	
AD149	0.80	BC118	0.12	BCY33	1.04	BF178	0.28	BF284	0.30	MPSU06	0.52	OC81	0.74	TIP3055	0.64	IN5211	0.08	2N2933	0.16	2N4557	0.40	
AD161	0.80	BC125	0.18	BCY34	1.04	BF179	0.28	BF285	0.30	MPSU06	0.52	OC82	0.74	TIP3055	0.64	IN5211	0.08	2N2934	0.16	2N4558	0.40	
AD161	0.80	BC126	0.18	BCY35	1.04	BF180	0.28	BF286	0.30	MPSU06	0.52	OC83	0.74	TIP3055	0.64	IN5211	0.08	2N2935	0.16	2N4559	0.40	
AF106	0.52	BC138	0.18	BCY36	1.04	BF181	0.35	BF287	0.30	MPSU06	0.52	OC84	0.74	TIP3055	0.64	IN5211	0.08	2N2936	0.16	2N4560	0.40	
AF114	0.86	BC136	0.17	BCY40	3.25	BF182	0.35	BF288	0.30	MPSU06	0.52	OC85	0.74	TIP3055	0.64	IN5211	0.08	2N2937	0.16	2N4561	0.40	
AF115	0.86	BC137	0.17	BCY43	0.29	BF183	0.29	BF289	0.30	MPSU06	0.52	OC86	0.74	TIP3055	0.64	IN5211	0.08	2N2938	0.16	2N4562	0.40	
AF116	0.86	BC147	0.10	BCY58	0.18	BF184	0.29	BF290	0.30	MPSU06	0.52	OC87	0.74	TIP3055	0.64	IN5211	0.08	2N2939	0.16	2N4563	0.40	
AF117	0.86	BC148	0.09	BCY70	0.17	BF185	0.29	BF291	0.30	MPSU06	0.52	OC88	0.74	TIP3055	0.64	IN5211	0.08	2N2940	0.16	2N4564	0.40	
AF139	0.46	BC149	0.10	BCY71	0.20	BF186	0.29	BF292	0.30	MPSU06	0.52	OC89	0.74	TIP3055	0.64	IN5211	0.08	2N2941	0.16	2N4565	0.40	
AF186	1.38	BC157	0.15	BCY72	0.15	BF187	0.12	BF293	0.30	MPSU06	0.52	OC90	0.74	TIP3055	0.64	IN5211	0.08	2N2942	0.16	2N4566	0.40	
AF239	0.52	BC158	0.09	BCZ11	7.72	BF188	0.10	BF294	0.30	MPSU06	0.52	OC91	0.74	TIP3055	0.64	IN5211	0.08	2N2943	0.16	2N4567	0.40	
AFZ11	3.16	BC159	0.12	BD115	1.52	BF189	0.12	BF295	0.30	MPSU06	0.52	OC92	0.74	TIP3055	0.64	IN5211	0.08	2N2944	0.16	2N4568	0.40	
AFZ12	3.16	BC167	0.14	BD121	1.50	BF190	0.12	BF296	0.30	MPSU06	0.52	OC93	0.74	TIP3055	0.64	IN5211	0.08	2N2945	0.16	2N4569	0.40	
ASV26	0.46	BC170	0.13	BD123	1.50	BF191	0.12	BF297	0.30	MPSU06	0.52	OC94	0.74	TIP3055	0.64	IN5211	0.08	2N2946	0.16	2N4570	0.40	
ASV27	0.46	BC171	0.12	BD124	1.50	BF192	0.12	BF298	0.30	MPSU06	0.52	OC95	0.74	TIP3055	0.64	IN5211	0.08	2N2947	0.16	2N4571	0.40	

VALVES

A1834	10.58	E1800C	8.86	EF86	1.74	GXU1	16.10	PC97	1.38	QV5-3000A	UY41	1.44	5B254M	23.12	6E8B	2.44	12E14	34.50	5725	6.28	
A2087	13.35	E1800F	7.83	EF89	1.94	GXU2	28.43	PC90	1.38	Q206-20	UY85	1.20	5B255M	23.12	6E6W	1.73	13E1	62.20	5726	4.52	
A2134	10.66	E1800C	8.86	EF92	0.03	GXU3	30.49	PC94	1.15	R10	5.75	VLS631	15.24	5C22	46.00	6F6	2.02	19H4	28.75	5727	5.05
A2293	8.02	E1800F	11.62	EF93	0.03	GXU4	32.77	PC85	1.38	R17	1.89	XG1-2500	32.37	5J180E	851.00	6F23	1.34	19H5	40.25	5749	5.73
A2426	13.90	E280C	25.84	EF94	2.24	GXU5	12.00	PC88	1.56	R17	1.89	XG2-6400	92.96	8R70Y	2.30	6F28	1.83	24B9	43.87	5751	5.36
A2521	11.62	E280F	9.02	EF95	5.25	GZ32	1.44	PC189	1.61	R18	4.88	XG5-500	19.32	5U4G	2.80	6H1	14.38	30C15	1.84	5753	4.14
A2900	10.88	E280C	9.02	EF96	1.44	GZ33	4.00	PC189	1.51	R20	1.06	106.15	5V4G	1.75	6H2N	1.21	30C18	1.84	5840	5.06	
A3343	25.56	E280F	17.25	EF97	0.92	GZ34	2.18	PC806	2.07	RG3-250	32.49	XR1-1600A	27.54	5Y3GT	0.98	6H3N	1.21	30F5	1.93	5842	15.59
AZ31	1.26	E280C	19.43	EF98	0.96	GZ37	4.00	PC806	2.07	RG3-250A	34.09	XR1-3200	78.94	5Z3	1.73	6H6	1.73	30F11/2	1.28	5876A	13.06
AZ41	1.32	EABCO	1.80	EF98S	7.47	KT66	11.50	PCF82	1.15	RG3-1250	29.56	XR1-3200	78.94	5Z4G	1.73	6J4	6.10	30F12	2.07	5879	5.57
BK448	88.43	EAC91	0.92	EH90	1.61	KT88	13.80	PCF86	1.94	RG4-3000	75.44	XR1-3200A	76.94	6-30L2	1.79	6J7	9.04	30F14	1.84	5886	12.08
BK494	119.54	EAF42	2.44	EK90	1.24	KTW61	2.02	PCF87	1.84	RR3-250	48.68	XR1-6400	84.24	6AB4	1.44	6K4N	1.44	30L15	2.07	5885	4.07
BS90	31.53	EAF901	2.02	EL32	1.73	KTW62	2.02	PCF200	2.82	RR3-1250	86.20	XR1-6400A	84.24	6AB7	1.73	6K6CT	1.50	30L17	2.07	5905	6.33
BT5	43.47	EB41	2.30	EL33	4.02	KTW63	2.02	PCF201	2.82	S11E12	30.48	6AC7	1.61	6K7	1.73	6K8	2.02	30P19	1.30	6021	5.13
BT17	79.29	EB33	2.02	EL34	2.53	KTW64	2.02	PCF202	1.45	S130	2.30	6AF4A	1.84	6K8	2.02	6K8	2.02	30P19	1.30	6057	4.02
BT19	77.08	EB41	2.30	EL34TH	2.53	KTW65	2.02	PCF202	1.45	S130P	2.30	6AG7	2.30	6K8	2.02	6K8	2.02	30P19	1.		

Whoever sees it, you won't blush.

With JVC's help, no non-broadcast video producer need feel embarrassed when a producer from the broadcast side of the fence looks at one of his tapes. That's because JVC have developed, at an affordable cost, a portable camera which brings truly professional quality to CCTV.

It's the three-tube CY-8800E. Nothing at anywhere near the price handles colour so faithfully, with so small a registration error, with such excellent signal-to-noise ratio even in poor light.

But you don't have to believe an advertisement. Ask one of the Bell & Howell Video Centres (addresses opposite) to make an appointment to bring the camera to where you work. This will prove that among its other merits the CY-8800E travels well and is easy to carry around. Then try it on your shoulder and a tripod. This way you'll discover that it's going to serve you just as well in the studio as in the field.

Finally, when you've admired the pictures on the colour monitor, admire the features—features to optimise performance under all conditions. Fully automatic features that help make the CY-8800E so remarkably easy to use (which means you can concentrate on images, not have to apply half your mind to controls).

With the camera and monitor, the Video Centre demonstrator will be

bringing (probably wearing) the JVC CR-4400LE. This is the portable, but equally professional, recorder/player for 3/4" U-format cassettes. It's the perfect complement to the CY-8800E (indeed, it was designed to be just that).

The CR-4400LE will give you colour playback, direct into a monitor, on site.



It has an automatic assemble editing function and drop-out compensation. Best of all, its designers have made no concessions to quality to achieve portability. It records and plays as well as non-portable U-format equipment (with which, of course, its tapes are fully compatible).

Are all these claims valid? It will cost nothing except a phone call to a Video Centre to discover for yourself that the CY-8800E and CR-4400LE are as good as we think them to be.

If you'd prefer to read the leaflets first, use the inquiry service or send your name or headed notepaper to Dept CY/8, Bell & Howell A-V Ltd., Freepost, Wembley, HAO 1BR (no stamp needed). We're the exclusive distributor of JVC video equipment to industrial, institutional and commercial markets in the UK and Eire. And, of course, we offer the exclusive Bell & Howell Supershield warranty which guarantees free repairs and replacements (except for tapes and camera tubes) for two years from date of purchase. Plus free transportation to and from video workshop.† Plus free advice.

First-class equipment from JVC. First-class support from Bell & Howell Video Centres. And Supershield, a first-class guarantee.



BELL & HOWELL

Information systems. For work, education and entertainment.



JVC

†The two year guarantee and free advisory service apply throughout the United Kingdom and Eire and free transportation is provided in England, Scotland and Wales, excluding the Channel Islands and the Isle of Man.

WW-057 FOR FURTHER DETAILS

Great 1980 Sale

SUPER SOUND SAVING!
DINDY
LOW NOISE CASSETTES



SJ30 10 C30 15 min per side £2.00
 SJ55 10 C46 23 min per side (LP) £2.50
 SJ31 10 C90 45 min per side £3.50
 SJ32 10 C120 60 min per side £4.50

ALL REDUCED!

CAPACITOR PAKS

16201 18 electrolytics 4.7uF-10uF
 16202 18 electrolytics 10uF-100uF
 16203 18 electrolytics 100uF-680uF
All 3 at SPECIAL PRICE of £1.30
 16160 24 ceramic caps 22pF-82pF
 16161 24 ceramic caps 100pF-390pF
 16162 24 ceramic caps 470pF-3300pF
 16163 24 ceramic caps 4700pF-0.047pF
All 4 at SPECIAL PRICE of £1.80

RESISTOR PAKS

Order No. 16213 60W 100ohm-820ohm
 16214 60W 1K-8.2K
 16215 60W 10K-82K
 16216 60W 100K-820K
 16217 40W 100ohm-820ohm
 16218 40W 1K-8.2K
 16219 40W 10K-82K
 16220 40W 100K-820K
All 4 at SPECIAL PRICE of £1.80

IC SOCKET PAKS

IC	Pin	Part No.	Price
SJ36	14	2N3919	£0.17
SJ37	12	2N5458	£0.18
SJ38	11	2N4220	£0.28
SJ39	8	2N4860	£0.25
SJ40	7		
SJ41	6		
SJ42	5		
SJ43	4		
SJ44	3		

ALL AT ONLY £1.00 each

VOLTAGE REGULATORS

Part No.	Price	Part No.	Price
uA7805	£0.65	uA7905	£0.70
uA7812	£0.65	uA7912	£0.70
uA7815	£0.65	uA7915	£0.70
uA7818	£0.65	uA7918	£0.70
uA7824	£0.65	uA7924	£0.70
uA723 14 pin DIL	£0.35		
LM309K TO3	£1.10		

OPTOELECTRONICS

Part No.	Price	Part No.	Price
1510	707	LED ⁺	Display Price each £0.70
1511	747	LED	Display Price each £1.50
1512	727	LED	Display Price each (dual) £1.85
LEDs			
SJ78	.125	LED	Diffused RED £0.08
SJ79	.2	LED	Diffused RED £0.08
SJ120	.125	LED	Bright RED £0.09
SJ121	.2	LED	Bright RED £0.09
1502	.125	LED	Diffused GREEN £0.11
1505	.2	LED	Diffused GREEN £0.11
1503	.125	LED	Diffused YELLOW £0.11
1506	.2	LED	Diffused YELLOW £0.11
SJ80	.2	LED	Bright YELLOW £0.14
SJ82	.2	LED	Clear illuminating RED £0.10
SJ83	.125	LED	Clear illuminating RED £0.10

2nd QUALITY LED PAKS

Assorted colours & size £0.85
 S122 10 .125 RED £0.80
 S123 10 .2 RED £0.80

LED Clips

1508/.125 .125 5 for £0.10
 1508/.2 .2 5 for £0.12
 SJ81 1 Infra RED emitter - Fairchild FP100 £0.25
 SJ98 5 Photo Detector MEL11 + Oata £1.00
 ORP12 NORP 12 Cad Cell £0.45
 SJ99 4 ITT 5870 ST Nixie Tubes £1.00
 SJ29 Texas NPN silicon transistors 2S603=BC108 TO-18 metal can - perfect & coded

50 off £2.00 - 100 off £4.00 - 1,000 off £35.00

NICKEL-CAD RECHARGEABLE BATTERIES

S128 3500m Cell size - U2 £2.50

SUPER DUPER COMPONENT BOX

Min. 3lbs in weight consisting of a fantastic assortment of Electronic Components - Pots, Resistors, Condensers, Switches, Relays, Board-Semiconductors, Wire, Hardware, etc. etc. etc.
 * This is a large box and is sent separate to your order. £2.50 including P&P

CALCULATOR CHIP

GOM2-C500 24 pin MOS £0.50

IC INSERTION EXTRACTION TOOL

2015 £0.35 each

TRANSISTORS

Type	Price	Type	Price	Type	Price
AC107	£0.20	BC251	£0.10	OC29	£0.55
AC126	£0.14	BC261	£0.14	OC35	£0.55
AC127	£0.16	BC327	£0.12	OC36	£0.60
AC128	£0.15	BC328	£0.12	OC42	£0.18
AC129K	£0.24	BC337	£0.12	OC44	£0.20
AC176	£0.18	BC338	£0.12	OC45	£0.18
AC171K	£0.24	BC440	£0.25	OC71	£0.12
AC187	£0.16	BC441	£0.25	OC72	£0.16
AC187K	£0.28	BC460	£0.28	OC75	£0.18
AC188	£0.18	BC461	£0.28	OC81	£0.20
AC188K	£0.28	BC477	£0.15	TIP 29	£0.30
AD161/152MP	£0.85/pr	BC478	£0.15	TIP 29A	£0.30
AD140	£0.50	BC479	£0.15	TIP 29B	£0.32
AD149	£0.53	BC547	£0.08	TIP 29C	£0.34
AF239	£0.35	BC548	£0.08	TIP 30	£0.30
BC107	£0.08	BC557	£0.10	TIP 30A	£0.30
BC107A	£0.08	BC558	£0.09	TIP 30C	£0.34
BC107B	£0.07	BC559	£0.18	TIP 31	£0.30
BC107C	£0.08	BCY70	£0.13	TIP 31A	£0.30
BC108	£0.06	BCY71	£0.13	TIP 31B	£0.32
BC108A	£0.06	BCY72	£0.13	TIP 31C	£0.34
BC108B	£0.07	BD115	£0.46	TIP 32	£0.30
BC108C	£0.09	BD131	£0.30	TIP 32A	£0.30
BC109	£0.08	BD132	£0.30	TIP 32B	£0.32
BC109B	£0.07	BD135	£0.28	TIP 32C	£0.34
BC109C	£0.09	BD136	£0.28	TIP 34	£0.34
BC113	£0.10	BD239A/BD240A/MP	£0.80/pr	TIP 41A	£0.34
BC114	£0.12	BF115	£0.20	TIP 41B	£0.38
BC118	£0.16	BF167	£0.20	TIP 41C	£0.38
BC140	£0.20	BF173	£0.20	TIP 42A	£0.34
BC141	£0.20	BF195	£0.08	TIP 42C	£0.38
BC142	£0.18	BF195	£0.08	TIP 2955	£0.50
BC147	£0.07	BF196	£0.09	TIP 309.55	£0.45
BC148	£0.07	BF197	£0.10	ZTX107	£0.08
BC149	£0.10	BF257	£0.22	ZTX108	£0.08
BC157	£0.09	BF258	£0.22	ZTX109	£0.08
BC158	£0.09	BF259	£0.24	ZTX300	£0.10
BC159	£0.09	BF339	£0.20	ZTX301	£0.10
BC169C	£0.09	BF400	£0.20	ZTX302	£0.12
BC170	£0.08	BF479	£0.22	ZTX500	£0.12
BC171	£0.07	BF880	£0.22	ZTX501	£0.10
BC172	£0.07	BF884	£0.20	ZTX502	£0.12
BC173	£0.08	BF885	£0.20	ZTX506	£0.10
BC177	£0.13	BFX29	£0.20	ZN706	£0.09
BC178	£0.13	BFX84	£0.20	ZN706A	£0.10
BC179	£0.13	BFY51	£0.18	ZN708	£0.10
BC182	£0.07	BFY52	£0.15	2N1302	£0.15
BC182L	£0.07	BIP19/20MP	£0.70/pr	2N1303	£0.15
BC183	£0.07	MJE340	£0.50	2N1613	£0.18
BC184	£0.07	MJE340	£0.50	2N1711	£0.18
BC184L	£0.07	MJE3055	£0.50	2N1893	£0.18
BC207	£0.08	MPSA05	£0.18	2N2218	£0.18
BC208	£0.08	MPSA06	£0.18	2N2219A	£0.20
BC209	£0.08	MPSA65	£0.16	2N2221	£0.18
BC212	£0.07	MPSA55	£0.16	2N2222	£0.18
BC212L	£0.07	OC28	£0.50	2N2222A	£0.18
BC213	£0.07				
BC213L	£0.07				
BC214	£0.07				
UC214L	£0.07				

DIODES

Part No.	Price	Part No.	Price	Part No.	Price
AA119	£0.08	OA70	£0.08	IN4004	£0.08
BA100	£0.08	OA79	£0.08	IN4005	£0.07
BA14B	£0.13	OA81	£0.08	IN4006	£0.08
BA173	£0.13	OA90	£0.08	IN4007	£0.09
BAX13	£0.06	OA91	£0.08	IN5400	£0.12
BAX16	£0.08	OA96	£0.08	IN5401	£0.13
OA200	£0.08	IN34	£0.08	IN5402	£0.15
OA202	£0.07	IN60	£0.07	IN5404	£0.16
BY100	£0.18	IN414B	£0.06	IN5406	£0.19
BY126	£0.12	IN4001	£0.04	IN5407	£0.23
BY127	£0.14	IN4002	£0.04	IN5408	£0.28
OA47	£0.08	IN4003	£0.08	IS44	£0.03

LINEAR

Part No.	Price	Part No.	Price	Part No.	Price
CA270	£0.85	SN75013N	£1.85	TBA820	£0.85
CA308B	£1.70	SN76023N	£1.80	uA703	£0.20
CA390	£3.00	SN7615	£1.80	uA709C	£0.25
LM380	£0.80	TAA565	£0.30	uA710	£0.25
LM381	£1.35	TAA621A	£1.80	uA711	£0.25
LM3900	£0.80	TBA120B	£0.60	741P	£0.18
MC1310P	£0.88	TBA641A	£1.10	TAA661	£1.25
NE555	£0.18	TBA800	£0.76	TAA811	£1.25
NE566	£0.85	TBA810	£0.35		

THYRISTORS

Part No.	Price	Part No.	Price
THY1A/50 1 Amp 50v TO5	£0.18		
THY1A/400 1 Amp 100v TO5	£0.32		
THY3A/50 3 Amp 50v TO64	£0.28		
THY3A/200 3 Amp 200v TO64	£0.32		
THY3A/400 3 Amp 400v TO64	£0.40		
THY5A/50 5 Amp 50v TO66	£0.28		
THY5A/400 5 Amp 400v TO66	£0.40		
THY5A/600 5 Amp 600v TO66	£0.50		
C106/4 6 Amp 400v TO220	£0.42		

DIACS TRIACS SCR's

Part No.	Price
SJ84 8Amp 400v TO220 Plastic (non isolated tab)	£0.80
BR100	£0.15
D32	£0.15

SPECIAL OFFER COMPONENT PAKS

O/NO	Quantity	£ p
SJ1 200 Resistors mixed values		0.50
SJ2 200 Carbon resistors 1/2-1/2 watt preformed		0.50
SJ3 100 1/4 watt miniature resistors mixed values		0.50
SJ4 60 1/2 watt resistors mixed values		0.50
SJ5 50 1-2 watt resistors mixed pot values		0.50
SJ6 50 Precision resistors 1-2" tol. mixed		0.50
SJ7 30 5-10 watt wirewound resistors mixed		0.50
SJ11 150 Capacitors mixed types and values		0.50
SJ12 50 Electrolytic all sorts mixed		0.80
SJ13 50 Polyester/polyethylene capacitors mixed		0.50
SJ14 60 C280 type capacitors mixed		1.00
SJ15 40 High quality electrolytics 100-470mF		1.00
SJ16 40 Low volts electrolytics mixed values up to 10v		0.50
SJ17 20 Electrolytics transistor types mixed		0.50
SJ18 20 Tantalum bead capacitors mixed		0.50
SJ20 2 Large croc clips 25A rated ideal for battery chargers etc		2.50
SJ21 Large 7/16" Mains Neon Tester screwdriver chrome finish		0.55
SJ22 Small pocket size Mains Neon Tester screwdriver		0.85
SJ23 Siemens 220v AC Relay DPDT contacts 10 Amp rating - housed in plastic case		1.00
SJ24 Black PVC tape (1/2) 15mm x 25m - strong tape for electrical and household use, per roll		0.35
5 roll		1.50
SJ25 100 Silicon NPN transistors all perfect and coded - mixed types with data and equivalent sheet - no rejects		2.50
SJ26 100 Silicon PNP transistors, all perfect and coded - mixed types and comes data and equivalent sheet		2.50
SJ27 50 Assorted pieces of SCR's diodes and rectifiers incl. stud types, all perfect - no rejects, fully coded - data incl.		2.50
SJ28 20 TTL 74 series gates - assorted 7401-7460		1.00
SJ33 PC Board - mixed bundle PCB fibreglass/paper, single and double sided - super value!		0.75
SJ34 200 sq in (approx) copper clad paper board, single sided		0.80
SJ35 100 sq in (approx) copper clad fibre glass, single sided		0.80
SJ49 8 Dual gang carbon pots log and lin mixed values		1.00
SJ50 20 Assorted slider knobs - chrome/black		1.00
SJ51 1 Pack of 5 way incl. silver knobs		1.00
SJ52 1 Pack of vero board approx 50 sq. ins., mixed		1.00
SJ53 Mammoth IC Pack: approx. 200pcs assorted fall-out integrated circuits including logic 74 series. Linear audio and DTL, many coded devices but some unmarked - you to identify		1.00
SJ63 Instrument knob - black/winged (29 x 20mm) with pointed, 1/4" standard screw		



STAR DEVICES

More Than a Touch Better

£48.50
plus 2 year
guarantee

Full ASCII Encoded Touch Keyboard

Mark III

This professional quality touch sensitive keyboard has the full ASCII code set of characters available from the main keyboard, plus a separate 12 key pad to allow fast numeric entry. The MK III has a 'bleep' facility with volume control and power 'on' light plus a polyester sealed wipe clean surface making the unit particularly suitable for use in hostile environments. The MK III is supplied complete with mating gold plated edge connector in a low profile matt grey plastic case with non-slip feet.



STANDARD FEATURES

- ★ Operates from single +5 ± 0.25 Volt supply
- ★ Industry standard pad spacing 3/8"
- ★ Electronic hysteresis
- ★ 2 key rollover
- ★ ODD & EVEN parity check bits (bit 8)
- ★ Positive light touch keys — two user definable.
- ★ 7 bit parallel ASCII encoded output with positive & negative strobes.
- ★ Operating life typically greater than five million operations per pad
- ★ SHIFT LOCK PAD — Illuminating and electronically latched — reset by the operation of either SHIFT pad.

★ Repeat pad. Dimensions 14.4x8x1.2 inches. 365x203x31mm.

Patents Pending

Optional extras (all options are incorporated in the unit)

- A. Serial output compatible to RS 232/V24 **£6.00**
- A1. Internal Baud Rate Generator. For use with option A and/or C NOTE 1 **£5.00**
- A2. Internal Generation of ± 12 volts for use with option A. NOTE 2 **£8.00**
- C. 20 mA Current Loop Output — Passive. Details in handbook of simple conversion to active mode. **£6.00**
- D. On-Board +5 volt regulator. Requiring DC input of 7 to 12 volts **£4.00**
- E. Earphone socket & plug in earphone **£3.00**
- T. Teletypewriter (TTY) 102 character alphabetical upper-case-only link selectable by user **£10.00**
- U. Tri-state outputs on all data bits **£4.00**
- V. Open Collector outputs on all data bits **£4.00**

Various other options and modifications are possible with this keyboard. Contact STAR DEVICES for further details.

NOTE 1. With option A and/or C the Baud Rate may be externally supplied by the user.

NOTE 2. With option A the ± 12 volts @ 10mA may be externally supplied by the user.

A RANGE OF SEALED — WIPE CLEAN — TOUCH SENSITIVE HEXADECIMAL KEYPADS

- TYPE 980 — 16 S.P.S.T. (Form A) Switches **£7.20**
- TYPE 981 — One common with 16 connections **£6.70**
- TYPE 982 — 4x4 Switch Matrix **£6.70**

Contact Rating — 24 Volts @ 50mA Max. Resistive
Contact Bounce — Less than 1ms. Typically. Load
Operating Life — Typically greater than 2 million
operations per pad.
Termination by solder pad or 0.1" edge connector.

7	8	9	A
4	5	6	B
1	2	3	C
0	F	E	D

STAR DEVICES use a proved fully sealed — high technology — flexible membrane key switch requiring a light activation pressure. All character printing is done on the back surface thereby ensuring the unit stays looking good even after many millions of operations — simply wipes clean with a damp cloth.

Dimensions 4x3.5x0.125 inches
101.6x88.9x3.2 mm
Fixing centres 3.2 inches 81.3 mm

STAR DEVICES use a proved — fully sealed — high technology flexible membrane key switch requiring a light activation pressure. All characters are printed on the back surface there by ensuring that the units stays looking good even after many millions of operations — simply wipes clean with a damp cloth.

★ **CUSTOM KEYBOARD DESIGN & MANUFACTURING SERVICE — CONTACT US FOR DETAILS** ★

STAR DEVICES LIMITED

P.O. BOX 21 UNIT I
MILL LANE, NEWBURY
BERKSHIRE
UNITED KINGDOM
TEL: 0635-40405



The unique MK II keyboard with a dedicated pad for each ASCII character is available at £42.50

FULL DATE SHEET ON REQUEST.

The MK III is stocked by:
Newbear Computing Store —
Newbury 30505
Transam Components Ltd. — London
NW1. 01-402 8137
Cavern Electronics —
Milton Keynes 314925

U.K. & Overseas Trade enquiries welcomed



Please Supply the Following:

DESIGNED AND MANUFACTURED IN THE UNITED KINGDOM

MK III KEYBOARD Quantity. KEYPAD TYPE Quantity

Please circle Options required with your keyboard.

A A1 (Specify Baud Rate) A2 C D E T U V

CHEQUE/P.O. Enclosed for £ Make payable to STAR DEVICES LTD.

ACCESS — BARCLAY CARD — MASTERCARD — EUROCARD — TRUSTCARD — VISA

CARD NUMBER Expiry Date

NAME

ADDRESS

BLOCK CAPITALS PLEASE

Allow 7-10 days for delivery

Tel

POST & PACKING (including insurance) Keypad prices in brackets.
U.K. £1.50 (40p). EUROPE £3.00* (80p). OUTSIDE EUROPE £5.00* (£1.50). *This includes airmail delivery

★ U.K. ORDERS ADD 15% V.A.T.

PAYMENT SHOULD BE MADE IN STERLING DRAWN ON A U.K. BANK OR I.M.O.
MK III Handbook is available for £1.00 (inc. P&P). Refundable on purchase.

ELECTRO-TECH COMPONENTS LTD.

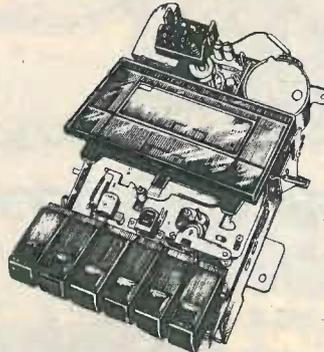
364 EDGWARE ROAD, LONDON, W.2. TEL: 01-723 5667

JVC-VICTOR HIGH FIDELITY STEREO CASSETTE TRANSPORT MECHANISM

ELECTRO-TECH COMPONENTS have secured a very large quantity of cassette transport mechanisms, equipped with all the latest improvements, as well as "SEN-ALLOY" type 1.5 micron record/replay heads, and solenoid-controlled auto-stop action. These were manufactured by JVC/VICTOR of Japan to specification of TANDBERG OF NORWAY, for inclusion in a cassette deck costing over £250. This mechanism alone would normally cost over £50.

FEATURES:

- ★ Close-tolerance, high-quality, top loading transport
- ★ "Sen-Alloy" (SA type) R/P head
- ★ Solenoid-driven autostop circuit
- ★ Automatic head cleaning device
- ★ Air damped "soft" cassette eject
- ★ Miniature microswitches for switching
- ★ Pre-aligned heads and calibrated motor speed regulator built in
- ★ Three-digit tape position counter
- ★ Six-function keyboard controls: "Record," "Rewind," "Forward," "Play," "Stop/Eject," "Pause."
- ★ PCB connectors and cables attached
- ★ High-mass balanced flywheel with permanent lubrication spindle
- ★ Full specifications for motor, heads, and switches available on request.



APOLOGY

WE REGRET THAT IN THE JAN. ISSUE OF W.W. DUE TO A TYPOGRAPHICAL ERROR THE CASSETTE DECK KIT (BELOW) WAS INCORRECTLY PRICED AT £15.95. THIS SHOULD HAVE BEEN £35.95. THE COMPONENT PARTS FOR THIS KIT COST OVER £40 IF BOUGHT SEPARATELY.

Price of above unit **£14.95 VAT inc.**

Plus **£1 P&P**

Trade and Export Enquiries Invited

Regular readers of WIRELESS WORLD will know of the original LINSLEY-HOOD CASSETTE DECK design, published in May 1976. Subsequent articles by Mr. Linsley-Hood have confirmed that the design far exceeded his original expectations, so much so that he published a number of improvements, modifications, and additional features to the original design, which are now incorporated in our:

★ CASSETTE DECK KIT BASED ON DESIGN OF MR. LINSLEY-HOOD ★

We have developed an outstanding stereo cassette kit with the aid of Mr. Linsley-Hood, to complement the improved specification and latest important advances in cassette electronics since the original design was published. The kit is ideal for use in conjunction with the JVC transport mechanism (above).

Included in the kit are two fibreglass PCB's, drilled and plated for immediate assembly, two VU meters, Dual LED Peak Meters, Variable Bias system, Power Supply, over 10 micro-circuit IC's for the most up-to-date performance, as well as monitoring amplifier, test and calibration cassette, etc.

Price of Kit (without transport mech.) **£35.95 VAT inc. plus £1.00 P&P**

Also available: A custom-designed case for the Kit, this is a fully screened enclosure, sloping panel, satin anodised, wood end panels, professional finish.

Price of Case **£9.75 VAT inc. plus £1.00 P&P.**

HERE IT IS! THE BRAND NEW 8022A HAND-HELD DMM

- Consider the following features:
- 6 resistance ranges from 200 ohm-20 ohms
- 8 current ranges from 2mA-2A AC/DC
- 10 voltage ranges from 200 mv-1000v DC-200 mc-750V AC
- Pocket size — weighing only 370 gms.
- Full overload protection — will withstand 6kv spikes
- Rugged construction — virtually indestructible
- Meets tough military specs — drop proof
- In line, pushbutton operation for single-handed usage
- Incorporates low power CMOS chip for low power consumption
- All this plus a 2-year full guarantee



For only **£89** SOFT CARRYING CASE **£7 extra**
Carriage and Insurance £3

Even more sophisticated the Fluke 8020A identical in most respects to the 8022A but in addition incorporates a conductance range from 2mS-200nS.

Price **£112**
Carriage and insurance £3.00

A handsome soft carrying case is included (this model only)

OFF THE SHELF DELIVERY ON THESE



DIGITAL MULTIMETERS

BRAND NEW FROM FLUKE!!! NOW AVAILABLE THE 8024A HAND HELD DMM

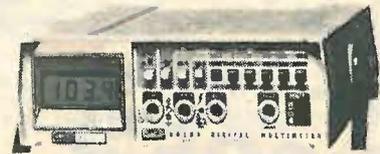
This model incorporates all the features of the 8020A but in addition has:

- A peak hold switch which can be used in AC or DC for volts and current functions.
- Audible continuity testing and level detection for sensing logic levels.
- A temperature (°C) range for use with a thermocouple.

£135
Carriage and Insurance £3

The following accessories are in stock now

Y8008 Touch and Hold Probe	£18.00
80K-40 High Voltage Probe	£45.00
81RF RF Probe to 100 MHz	£32.00
80T-150C Temperature Probe (C)	£55.00
801-600 Clamp-on AC Current Probe	£50.00



8010A AND 8012A BENCH MODEL D.M.M.s

The 8010A is a general purpose, bench/portable digital multimeter with more functions and features than ever offered for such a low price. Its companion, the 8012A, has identical characteristics except that it has two additional low resistance ranges, 2Ω and 20Ω to replace the 8010A's 10 ampere current range.

The 8010A and 8012A feature:

- 10 voltage ranges from 200mv - 1000v dc, 200mv - 75v ac.
- 3 conductance ranges from 2mS - 200 nS.
- 6 resistance ranges from 200Ω - 20MΩ - the 8012A has two additional resistance ranges 2Ω and 20Ω.
- 10 current ranges from 200μA - 2A AC/DC — the 8010A has two additional current ranges 10A AC and 10A DC.

8010A **£159** 8012A **£179**
Carriage and Insurance £3

The 8010A is also available with two rechargeable Nicad size C batteries installed in option; — 01 or **£178.00.**

LOW COST, AUTORANGING MULTI-FUNCTION COUNTER MODEL 1900A

- Autoranging in both frequency and period measurement modes
- Wide Frequency range — 5 Hz to 80 MHz
- High sensitivity — 25 mv, typically 15 mV
- Six digit LED display with leading zero suppression, automatic annunciation and overflow
- Optional internal battery pack providing 4 hours continuous operation
- Autoreset on all gate times, all function switches
- Four manually selected gate times providing resolution to 0.1 Hz
- Event counting to 10⁹ events with overflow indicator
- Signal input conditioning with switchable 1 MHz low pass filter and attenuator
- Rugged moulded case with convenient tilting/carrying handle
- Optional parallel data output with decimal point and annunciation
- Traditional high Fluke quality
- Self check

£175
Carriage and Insurance £3

TE200 R.F. SIGNAL GENERATOR



Accurately covers 120 KCS. To 500 MCS in 6 bands. Directly calibrated. Variable R.F. Attenuator 240v AC. Dimens. 140 x 215 x 170mm.

£52.95
P.&P. £1.25



TMK500 MULTIMETER 30,000 OPV

A sturdy and reliable instrument. Has internal buzzer. AC volts: 0 to 2.5, 10, 25, 100, 250, 500, 1000. DC volts: 0 to 0.25, 1, 2.5, 10, 25, 100, 250, 1000. DC current: 0 to 50 ua, 5 ma, 50 ma, 12 amp. Resistance: 0 to 6K, 80K, 8 meg, 80 meg. Decibels: —20 to +58 db. Short test: Internal buzzer. Size: 160 x 110 x 55 mm.

£20.50. P.&P. 75p

PLEASE ADD 15% VAT TO ALL ORDERS EXCEPT WHERE ITEMS MARKED "VAT INCLUDED."

CALLERS WELCOME

We are open 9 a.m. - 6 p.m. Monday-Saturday We carry a very large selection of electronic components and electro-mechanical items. Special quotations on quantities



IT 1/2 20,000 OPV AC volts: 0 to 10, 50, 100, 500, 1000. DC volts: 0 to 5, 25, 50, 250, 500, 2500. DC current 0 to 50 ua. 2.5 ma, 250 ma. Resistance: 0 to 6K ohms, 8 meg ohms. Decibels: —20 to +22 db. Capacitance: 10 pf, 0.01 uf, 0.1 uf. Size: 4 1/2 x 3 1/4 x 1 inch. **£10.95** P.&P. 75p



Y7206 EN 20,000 OPV AC Volts: 0-10, 50, 250, 500, 1000. DC Volts: 0-0.5, 5, 25, 125, 250, 500, 1000. DC Current: 0-0.05, 5, 250 mA. Resistance: 0-3k ohms, 300k ohms, 3 meg ohms. Decibels: —20 — +83 db. Dims: 127 x 90 x 32 mm. **£10.95** P.&P. 75p

8K ON BOARD MEMORY!

5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

2 KEYBOARDS!

56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

GRAPHICS!

64 character graphics option — includes transistor symbols! Only £18.20 extra!

MEMORY MAPPED

High resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

KANSAS CITY

low error rate tape interface.



2 MICROPROCESSORS

Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, -, *, /, squares, roots, logs exponentials, trig functions, inverses, etc.

Range 10⁻⁹⁹ to 9 x 19⁻⁹⁹ to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION

Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

RESIDENT BASIC

With extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR

Resident in EPROM

SINGLE BOARD DESIGN

Even keyboards and power supply circuitry on the superb quality double-sided plated through-hole PCB.

NEW LOW PRICE!

COMPLETE KIT NOW ONLY £249 + VAT

Cabinet Size 19.0" x 15.7" x 3.3"

Television by courtesy of Rumbelows Ltd., price £58.62

POWERTRAN

PSI Comp 80 Z80. Based powerful scientific computer. Design as published in Wireless World, April-September, 1979.

The kit for this outstandingly practical design by John Adams being published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.

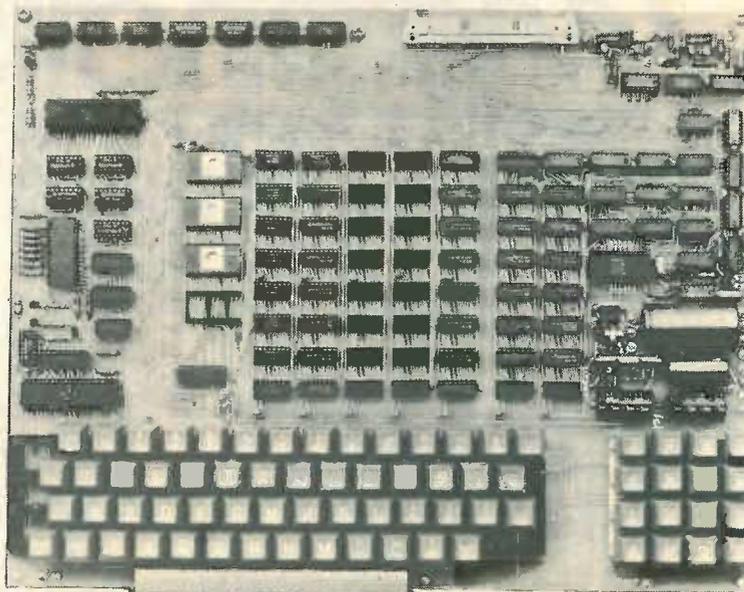
PSI COMP 80 Memory Expansion System

Expansion up to 32K all inside the computer's own cabinet!

By carefully thought-out engineering a mother board with buffers and its own power supply (powered by the computer's transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

- Mother Board:** Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug **£39.90**
- 8K Static RAM board** Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8" **£12.50**
Set of components including IC sockets, plug and socket but excluding RAMS **£11.20**
2114L RAM (16 required) **£5.00**
Complete set of board, components, 16 RAMS **£89.50**
- 8K ROM board** Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8" **£12.40**
Set of components including IC sockets, plug and socket but excluding ROMS **£10.70**
2708 ROM (8 required) **£8.00**
Complete set of board, components, 8 ROMs **£78.50**

Floppy Disk, PROM programmer and printer interface coming shortly!



PCB size 16.0" x 12.5"

UK Carriage FREE

POWERTRAN COMPUTERS

(a division of POWERTRAN ELECTRONICS)

PORTWAY INDUSTRIAL ESTATE
ANDOVER HANTS SP10 3NN

ANDOVER.
(0264) 64455

Value Added Tax not included in prices

PRICE STABILITY: Order with confidence! Irrespective of any price changes we will honour all prices in this advertisement until March 31st, 1980, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.

U.K. ORDERS: Subject to 15% surcharge for VAT! NO charge is made for carriage. *Or current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.

New books from Newnes Technical Books

Two Metre Antenna Handbook

F.C. Judd, G2BCX, FISTC, MIOA, Assoc. IPRE

- * A comprehensive book for all operators on 144MHz bands, which includes design descriptions of omnidirectional and directional arrays
- * Gives details for the first time of two original designs as well as the Slim Jim and the ZL
- * By an author and designer of wide repute

1980 166 pages £3.95 US \$9.00

Coming Shortly – the new eighteenth edition of Guide to Broadcasting Stations

- * Lists stations broadcasting in the long, medium, short and vhf bands in both frequency and geographical alphabetical order
- * More than 270,000 copies sold

200 pages approx. £3.50 approx. US \$8.00 approx.



Borough Green, Sevenoaks, Kent TN15 8PH, England.
Tel: (0732) 884567

Butterworths has companies in Australia, Canada, New Zealand, South Africa and the USA, where local prices apply

Largest range of quality components in the U.K. – over 8,000 types stocked



Head Office and Mail Order to Dept. P.W.
A. Marshall (London) Ltd.,
Kingsgate House, Kingsgate Place,
London NW6 4TA. Tel: 01-624 0805.
Telex: 21492.

Retail Sales: London: 40 Cricklewood Broadway, NW2 3ET. Tel: 01-452 0161/2 ALSO 325 Edgware Road, W2. Tel: 01-723 4242.
Glasgow: 85 West Regent Street, G2 2QD. Tel: 041-332 4133 AND Bristol: 108A Stoke's Croft, Bristol. Tel: 0272 426801/2.

TRANSISTORS				T.T.L.				TRIACS															
2N2219	0-38	2N6122	0-44	BC147	0-13	BD241C	0-85	SN7400N	0-17	SN7414N	-60	SN7442N	0-45	SN7475N	0-60	SN7494N	0-90	SN74145N	0-85				
2N2219A	0-39	2N6123	0-44	BC148	0-13	BD242A	0-85	SN7401N	0-17	SN7416N	0-25	SN7445N	0-75	SN7476N	0-45	SN7495N	0-76	SN74148N	1-35				
2N2221A	0-25	2N6128	0-48	BC149	0-15	BD242C	0-82	SN7402N	0-17	SN7417N	0-25	SN7446A	0-80	SN7478N	0-45	SN7496N	0-54	SN74150N	0-90				
2N2222	0-25	2N6140	1-10	BC160	0-38	BDX14	3-32	SN7403A	0-17	SN7420N	0-22	SN7447A	0-55	SN7481N	1-00	SN7497N	1-95	SN74151N	0-76				
2N2369	0-27	3N200	2-85	BC167	0-13	BDX18	1-90	SN7404A	0-15	SN7422N	0-22	SN7448N	0-80	SN7482N	0-80	SN74100N	1-40	SN74153N	0-85				
2N2369A	0-27	40361	0-65	BC168	0-13	BPX30	0-34	SN7405N	0-22	SN7425N	0-22	SN7449N	0-22	SN7483N	1-05	SN74107N	0-24	SN74154N	1-20				
2N2846	1-78	40382	0-55	BC169	0-13	BPX50	0-30	SN7406N	0-39	SN7426N	0-22	SN7451N	0-22	SN7484N	1-20	SN74118N	0-95	SN74155N	0-70				
2N2903	1-80	40406	0-73	BC177	0-22	BFY50	0-235	SN7407N	0-39	SN7427N	0-22	SN7452N	0-22	SN7485N	0-80	SN74119N	1-40	SN74157N	0-78				
2N2904	0-31	40407	0-57	BC178	0-22	BFY51	0-35	SN7408N	0-22	SN7430N	0-22	SN7454N	0-22	SN7486N	0-36	SN74121N	0-28	SN74158N	1-20				
2N2905	0-31	40408	0-82	BC179	0-22	BFY50	1-35	SN7409N	0-22	SN7432N	0-22	SN7459N	0-22	SN7489N	1-90	SN74122N	0-55	SN74159N	0-70				
2N2905A	0-31	40409	0-82	BC182	0-12	BFY59	0-55	SN7410N	0-20	SN7437N	0-24	SN7470N	0-39	SN7490A	0-36	SN74123N	0-55	SN74160N	0-70				
2N2906	0-25	40594	0-87	BC182L	0-12	BUZ08	2-70	SN7411N	0-20	SN7438N	0-24	SN7472N	0-30	SN7491A	0-60	SN74124N	1-20	SN74161N	0-70				
2N2907	0-25	40595	0-98	BC183	0-12	1300	0-37	SN7412N	0-20	SN7440N	0-18	SN7473N	0-36	SN7492N	0-36	SN74125N	0-45	SN74162N	0-70				
2N2926	0-17	40898	1-37	BC183L	0-12	1310	0-84	SN7413N	0-36	SN7441A	0-59	SN7474N	0-28	SN7493N	0-36	SN74126N	0-45	SN74163N	0-70				
2N3053	0-25	40613	0-88	BC184	0-12	MJ490	1-48	SN7414N	0-36	SN7441A	0-59	SN7474N	0-28	SN7493N	0-36	SN74127N	0-45	SN74164N	0-70				
2N3054	0-72	AC126	0-48	BC184L	0-12	MJ491	2-10																
2N3055	0-75	AC127	0-48	BC204	0-12	MJ2500	2-70	CMOS															
2N3439	0-85	AC128	0-48	BC205	0-17	MJ2501	2-75	CD4000	0-20	CD40188	1-05	CD4037	1-20	CD40718	0-20	CD4096	1-30						
2N3440	0-75	AC151	0-43	BC206	0-17	MJ2505	1-35	CD4001B	0-20	CD40198	0-52	CD4040	1-12	CD4072	0-27	CD4097	4-85						
2N3441	0-82	AC152	0-54	BC207	0-17	MJ3000	2-15	CD4002	0-18	CD40208	1-15	CD4041B	0-88	CD4073B	0-20	CD4098B	1-80						
2N3442	1-45	AC153	0-59	BC208	0-17	MJ3001	2-35	CD4006	1-25	CD4021	0-85	CD4042B	0-86	CD4075B	0-20	CD4503	0-85						
2N3883	0-29	AC158K	0-59	BC212	0-17	MJ3001	2-35	CD4007	0-18	CD4022B	1-00	CD4043	1-05	CD4076B	0-99	CD4507	0-89						
2N3702	0-14	AC178	0-58	BC212L	0-12	MJE340	0-82	CD4008B	0-99	CD4023B	0-20	CD4044	1-00	CD4077	0-70	CD4510B	1-20						
2N3703	0-14	AC178	0-58	BC213	0-12	MJE350	0-82	CD4009	0-58	CD4024B	0-76	CD4058	1-85	CD4078	0-27	CD4511	1-75						
2N3704	0-14	AC187	0-59	BC213L	0-12	MJE2955	1-85	CD4010	0-58	CD4025B	0-20	CD4059	0-80	CD4081B	0-20	CD4512	0-99						
2N3705	0-14	AC187K	0-65	BC214	0-12	MJE2955	1-85	CD4011B	0-20	CD4027B	0-55	CD4060B	1-15	CD4082	0-27	CD4514	2-54						
2N3706	0-14	AC188	0-65	BC214L	0-12	MJE3055	1-85	CD4012	0-20	CD4028B	0-80	CD4063	1-35	CD4085	0-99	CD4515	2-54						
2N3707	0-14	AC188K	0-65	BC214L	0-12	RZ808	2-45	CD4013B	0-52	CD4029B	1-10	CD4066	0-75	CD4086	0-99	CD4516	1-28						
2N3708	0-12	AD161	1-80	BC302	0-37	RZ0108	2-15	CD4014	1-00	CD4030	0-84	CD4067	4-65	CD4088B	0-95	CD4518B	1-20						
2N3709	0-12	AD162	1-80	BC303	0-54	RZ0109	2-15	CD4015	0-75	CD4031B	2-25	CD4068	0-27	CD4093B	0-85	CD4519	0-84						
2N3771	2-15	AF200	1-30	BC304	0-50	RZ0110	2-15	CD4016	0-52	CD4034B	2-48	CD4069B	0-20	CD4094	2-30	See catalogue							
2N3772	2-20	AF201	1-30	BC516	0-22	TIP30C	0-70	CD4017B	1-05	CD4035B	1-30	CD4070B	0-55	CD4095	1-30	See catalogue							
2N3773	3-15	AF239	0-70	BC517	0-22	TIP31A	0-54	LINEAR															
2N3789	0-38	AD113	1-70	BCY70	0-21	TIP31C	0-72	CA3046	0-77	LM339N	0-80	LM747CN	0-78	LM7812CH	0-85	NE565N	1-00	TA0100	2-00				
2N3790	0-38	BC107	0-18	BCY71	0-28	TIP32A	0-56	CA3089E	2-90	LM340T-5	0-88	LM748-8	0-50	LM7815CH	0-85	NE588N	1-75	TA0120	0-80				
2N3904	0-18	BC108	0-18	BCY72	0-18	TIP32C	0-82	CA3130	1-06	LM340T-12	0-88	LM748-14	0-50	LM78124CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3905	0-18	BC109	0-18	BCY73	0-18	TIP33A	0-86	CA3140	1-84	LM340T-15	0-88	LM748-16	0-50	LM78125CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3906	0-18	BC140	0-38	BCY74	0-18	TIP33C	1-18	LM301-8	0-40	LM340T-24	0-88	LM748-18	0-50	LM78126CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3907	0-18	BC141	0-32	BCY75	0-18	TIP34A	0-97	LM301-16	0-40	LM340T-30	0-88	LM748-20	0-50	LM78127CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3908	0-18	BC142	0-32	BCY76	0-18	TIP34C	1-31	LM301-24	0-40	LM340T-36	0-88	LM748-24	0-50	LM78128CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3909	0-18	BC143	0-32	BCY77	0-18	TIP34C	1-31	LM301-30	0-40	LM340T-48	0-88	LM748-30	0-50	LM78129CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3910	0-18	BC144	0-32	BCY78	0-18	TIP34C	1-31	LM301-36	0-40	LM340T-60	0-88	LM748-36	0-50	LM78130CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3911	0-18	BC145	0-32	BCY79	0-18	TIP34C	1-31	LM301-48	0-40	LM340T-72	0-88	LM748-48	0-50	LM78131CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3912	0-18	BC146	0-32	BCY80	0-18	TIP34C	1-31	LM301-60	0-40	LM340T-84	0-88	LM748-60	0-50	LM78132CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3913	0-18	BC147	0-32	BCY81	0-18	TIP34C	1-31	LM301-72	0-40	LM340T-96	0-88	LM748-72	0-50	LM78133CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3914	0-18	BC148	0-32	BCY82	0-18	TIP34C	1-31	LM301-84	0-40	LM340T-120	0-88	LM748-84	0-50	LM78134CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3915	0-18	BC149	0-32	BCY83	0-18	TIP34C	1-31	LM301-96	0-40	LM340T-144	0-88	LM748-96	0-50	LM78135CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3916	0-18	BC150	0-32	BCY84	0-18	TIP34C	1-31	LM301-120	0-40	LM340T-180	0-88	LM748-120	0-50	LM78136CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3917	0-18	BC151	0-32	BCY85	0-18	TIP34C	1-31	LM301-144	0-40	LM340T-240	0-88	LM748-144	0-50	LM78137CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3918	0-18	BC152	0-32	BCY86	0-18	TIP34C	1-31	LM301-180	0-40	LM340T-300	0-88	LM748-180	0-50	LM78138CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3919	0-18	BC153	0-32	BCY87	0-18	TIP34C	1-31	LM301-240	0-40	LM340T-360	0-88	LM748-240	0-50	LM78139CH	0-85	NE597N	1-80	TBA841B	3-00				
2N3920	0-18	BC154	0-32	BCY88	0-18	TIP34C	1-31	LM301-300	0-40	LM340T-420	0-88	LM748-300	0-50	LM78140CH	0-85	NE597N	1-80	TBA841B	3-				



NewBear Books



★ SEND FOR COMPLETE LIST. ★

GAMES

Chess & Computer	D. Levy	£ 7.16
Chess Skill in Man and Machine	P. Frey	£11.84
32 Basic Programs for the Pet		£ 8.90
Game Playing with Computers	D. Spencer	£10.20
Basic Computer Games	D. Ahl	£ 5.50
Star Ship Simulation		£ 5.10
Game Playing with Basic	D. Spencer	£ 4.10
Sargon	Spracklen	£ 9.50

MISCELLANEOUS

Intro. to TRS 80 Graphics		£ 5.75
Microprocessors C201	Zaks	£ 7.50
Scelbi Byte Primer		£ 9.95
Business Data Systems	Clinton	£ 5.75
The Systems Analyst	Atwood	£ 6.60
Your Home Computer	White	£ 4.95
Programming a Micro 6502	Foster	£ 7.95
6502 Applications Handbook	Zaks	£ 8.95

BASIC

Learning Basic Fast	De Rossi	£ 6.30
Basic Basic	J. S. Coan	£ 5.00
Advanced Basic	J. S. Coan	£ 5.50
Illustrated Basic	D. Alcock	£ 2.25
Basic with Business Applications	Hayden	£ 8.40
Basic Primer	Waite	£ 5.80
The Basic Handbook	Lien	£11.00

COBOL

Cobol Programming	Nickerson	£ 6.95
Learning Cobol Fast	De Rossi	£ 6.20
Cobol with Style	Hayden	£ 4.20
Reducing Cobol Complexity	Mc Clue	£11.30

PASCAL

Pascal: User Manual and Report	Springer-Verlag	£ 8.52
Problem Solving Using Pascal	Springer-Verlag	£ 7.84
Programming in Pascal	P. Grogono	£ 7.50
A Practical Intro. to Pascal	A. Addyman	£ 3.50
An Introduction to Programming and Problem Solving with Pascal	Schneider	£ 9.50
Introduction to Pascal	J. Welsh & J. Elder	£ 6.95

Z80 BOOKS

Z80 Programming for Logic Design	A. Osbourne	£ 5.95
Z80 Technical Manual	Zilog	£ 4.00
Z80 P10 Technical Manual	Zilog	£ 3.25
Z80 Programming Manual	Zilog	£ 4.50
Z80 Microcomputer Handbook	W. Barden	£ 6.95
Practical Microcomputer Programming (Z80)	Weller	£19.55
Z80 Instruction Handbook	Scelbi	£ 3.25
Z80 Assembly Language Programming	A. Osbourne	£ 6.95
Introduction to TRS 80 Graphics	Inman	£ 5.75
Zilog Data Book	Zilog	£ 3.50
Z8001/Z8002 Product Specification	Zilog	£ 3.75
Z8000 CPU Instruction Set	Zilog	£11.50
Z80 Micro Programming & Interfacing	Nichols	£ 7.10

NEW BOOKS

COBOL for Beginners	Worth	£ 7.75
BASIC for Everyone	Worth	£ 7.50
MICROS for Business Applications	Barden	£ 5.80
Fortran 77	Katzan	£13.75

★ CREDIT SALES (Minimum £10), Access and Barclaycard Welcome. "BY RETURN ORDER SERVICE" ★

CALLERS AND MAIL ORDER: 40 Bartholomew Street, Newbury, Berks. Tel: 0635 30505
 CALLERS ONLY: 220-222 Stockport Road, Cheadle Heath, Stockport Tel: 061 491 2290

RADIO SHACK LTD for DRAKE



TR-7 Transceiver

Ham Bands with 1.5-30 MHz receive with built-in 150 MHz frequency counter plus option of 0-1.5 MHz receive and/or any transceiving application 1.8-30 MHz.

RADIO SHACK LTD

For Communications equipment including Trio products and Trio testgear.

We are situated just around the corner from West Hampstead Underground Station (Bakerloo line). A few minutes' walk away is West Hampstead Midland Region station and West End Lane on the Broad Street Line. We are on the following Bus routes: 28, 59, 159. Hours of opening are 9-5 Monday to Friday. Closed for Lunch 1-2. Saturday we are open 9-12.30 only. World wide exports.

DRAKE ★ SALES ★ SERVICE

RADIO SHACK LTD

188 BROADHURST GARDENS, LONDON NW6 3AY

Giro Account No. 588 7151. Telephone: 01-624 7174

Cables: Radio Shack, London, NW6. Telex: 23718

WW - 072 FOR FURTHER DETAILS

the indispensable
BIRD43



THRULINE® WATTMETER
0.45-2300 MHz / 0.1-10,000 watts

The Standard of the Industry
What more need we say...

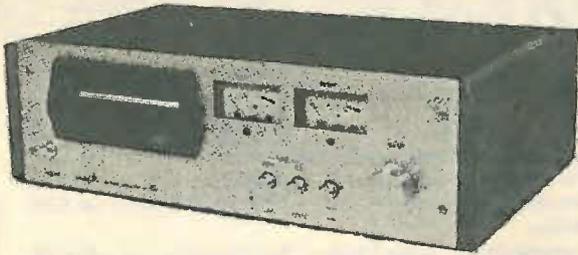
Exclusive UK representative

aspen electronics limited

2 KILDARE CLOSE, EASTCOTE, MIDDX. HA4 9UR
TELEPHONE: 01-868 1188 - TELEX 8812727

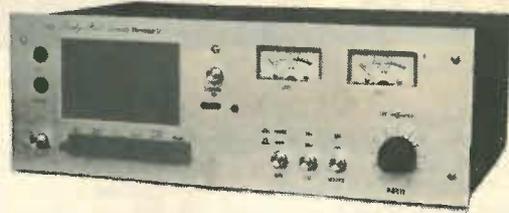
J. L. Linsley-Hood High Quality Cassette Recorders

LINSLEY-HOOD CASSETTE RECORDER 1



We are the Designer Approved suppliers of kits for this excellent design. The Author's reputation tells all you need to know about the circuitry and Hart expertise and experience guarantees the engineering design of the kit. Advanced features include: High quality separate VU meters with excellent ballistics. Controls, switches and sockets mounted on PCB to eliminate difficult wiring. Proper moulded escutcheon for cassette aperture improves appearance and removes the need for the cassette transport to be set back behind a narrow finger trapping slot. Easy to use, robust Lenco mechanism. Switched bias and equalisation for different tape formulations. All wiring is terminated with plugs and sockets for easy assembly and test. Sophisticated modular PCB system gives a spacious, easily built and tested layout. All these features added to the high quality metalwork make this a most satisfying kit to build. Also included at no extra cost is our new HS15 Sendust Alloy record/play head, available separately at £7.60 plus VAT, but included FREE as part of the complete kit at £81.50 plus VAT. REPRINTS of the 3 articles describing this design 45p No VAT. REPRINT of Postscript article 30p No VAT.

LINSLEY HOOD CASSETTE RECORDER 2



Our new improved performance model of the Linsley Hood Cassette Recorder incorporates our VFL 910 vertical front loading Super Hi-fi deck, as used in our new Linsley-Hood Cassette Recorder 1. This latest version has the following extra features. Ultra low wow-and-flutter of .09% — easily meets DIN Hi-fi spec. Deck controls latch in rewind modes and do not have to be held. Full Auto stop on all modes. Tape counter with memory rewind. Oil damped cassette door. Latching record button for level setting. Dual concentric input level controls. Phone output. Microphone input facility if required. Record interlock prevents re-recording on valued cassettes. Frequency generating feedback servo drive motor with built-in speed control for thermal stability. All these desirable and useful features added to the excellent design of the Linsley-Hood circuits and the quality of the components used makes this new kit comparable with built-up units of much higher cost than the modest £94.90 + VAT we ask for the complete kit.

SUPER BARGAIN OFFER LENCO FFR CASSETTE DECK

For those who missed our recent bargain CT4s we now are delighted to be able to offer Brand New Lenco FFR Decks complete with motor speed and auto-stop control board fitted and tested. These will operate with any supply between 9 and 16 volts. This deck can be used for both record and playback applications and is fitted with an erase head. A mono record/play head is fitted and we can supply an extra stereo head, if ordered with the deck at the very special price of £2 plus VAT. We also supply, with each deck and completely FREE, one of our specially moulded escutcheons. This deck would normally cost about £25 but we are able to offer them, while they last, at only £9.99 plus VAT.



VFL 910. Vertical front loading Super Hi-fi deck, as used in our new Linsley-Hood Cassette Recorder 2. £31.99 + VAT. Set of knobs £1.46 + VAT.

LENCO CASSETTE MECHANISMS

We hold stocks of a range of Lenco tape transports for all uses, we can also supply spare parts. For example: CRV Motors complete £4.00 plus VAT. CRV Drive Belts 90p plus VAT.

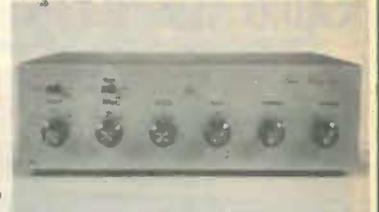
CASSETTE HEADS

A large range of cassette heads for domestic, industrial and audio visual purposes is available from us. The very best stereo head that we can find is our HS15 Sendust Alloy Super Head. This has an even better high frequency response than our HS14 which it replaces. Unlike cheaper and ferrite types this excellent high frequency performance is combined with a high output, thus maintaining the best possible signal to noise ratio. Price £7.60 plus VAT. 4-TRACK Record/play head. Scans all 4 tracks on cassette tape. Suitable for auto-reverse mechanisms, film sync, quadrophonics and many other purposes. Standard impedance £7.40 plus VAT. Full details of these and other heads are in our lists.

ALL UK ORDERS ARE POST FREE
Please send 9x4 SAE for lists giving fuller details and price breakdowns.

BAILEY 30 WATT AMPLIFIER

We have now completed our redesign of this popular amplifier to make it as easy to build as our latest kits. The power amplifiers are complete modules plugging into a power supply master board, all possible wiring has been eliminated but faith has been maintained with the existing metal work to enable owners to update if they wish. Send for full details in our list.



COME AND SEE US ON STANDS
C9 & C10 AT BREADBOARD '79

HART ELECTRONICS

Penylan Mill, Oswestry, Salop

Personal callers are always welcome
but please note we are closed all day Saturday

Instant easy ordering, telephone your requirements and credit card number to us on Oswestry (0691) 2894 Telex: 35661 Hartel G

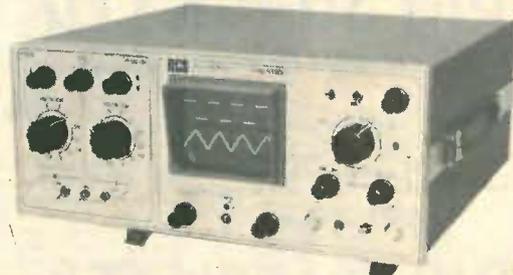
FREQUENCY COUNTERS — OSCILLOSCOPES — OFF-AIR RECEIVERS

20 MODELS AVAILABLE INCLUDING LED
VERSIONS AND TALKING READOUTS

250MHz
801 B/M
£250
Crystal
oven
3 parts 10⁹



MAINS
12V. BATTERY
PORTABLE
OSCILLOSCOPE



MODEL
S1500
15MHz
Dual Trace
£280

401A 50MHz 6 Digit £150
801B/M 250MHz 8 Digit £250
901M 520MHz 8 Digit £325
1001M 1-2GHz 8 Digit £550
OFF-AIR RECEIVER £125

A professional standard model dual trace DC to 15MHz. Usable to 25MHz with alternate, chop and single-channel A or B amplifier selection, 5mv/cm, accuracy 3%. Excellent triggering wide range time base.



R.C.S. ELECTRONICS, WOLSEY ROAD, ASHFORD, MIDDX. ASHFORD 53661

SUPPLIERS TO: Ministry of Defence, G.P.O., B.B.C., N.P.L. Government Depts., Crystal Manufacturers and Electronic Laboratories world-wide

WW — 028 FOR FURTHER DETAILS

U.K. RETURN OF POST MAIL ORDER SERVICE, ALSO WORLDWIDE EXPORT SERVICE

BSR DE LUXE AUTOCHANGER

Plays 12", 10" or 7" records, Auto or Manual. A high quality unit backed by BSR reliability. Stereo Ceramic Cartridge. AC. 200/250V. Size 13½ x 11¼ in. 3 speeds. Above motor board 3¼ in. Below motor board 2½ in. with Ceramic Stereo cartridge.



£20 Post £1.60

HEAVY METAL PLINTHS

Cut out for most BSR or Garrard decks. Silver grey finish.

Post £1.60

Model "A" Size 14½ x 12½ x 3 in.

£3.50

Model "B" Size 16 x 13¼ x 3 in.

£4.50

TINTED PLASTIC COVERS

Sizes 14½ x 12½ x 4¼ in or 14½ x 12½ x 3 in. **£3.50** each

15½ x 13½ x 4 in. **£4.18** x 13¼ x 4 in. **£6.**

17¼ x 9½ x 3½ in. **£2.18** x 12½ x 3 in. **£6**

14½ x 14¼ x 2½ in. Rosewood sides **£4.**

Post £1.60

BSR SINGLE PLAYER

Ideal replacement or disco deck with cueing device and stereo ceramic cartridge. 3 speeds. Large turntable, modern design.

£21

Post £1.60



BSR TWO-SPEED BUDGET MODEL £15

BSR P182 3 speeds flared aluminium turntable "S" shape arm, cueing device, ceramic cartridge **£24.** Post £1.60 BSR MP60/P128 Stereo Ceramic, balanced arm, cueing device. Bias compensator **£26.** Magnetic **£5** extra.

GARRARD AUTO CHANGER CC10A

3-speed stereo cartridge

Plays all size records. 7-in. turntable

£6.95 Post £1.60



B.S.R. P163 BELT DRIVE QUALITY DECK

Manual or automatic play. Two speeds.

Precision balanced arm. Slide in head, cueing device.

Bargain price

£30 Post £1.60

Suitable magnetio cartridge **£6.50.**



ELAC HI-FI SPEAKER 8in. TWIN CONE

Large ceramic magnet. 50-16,000 c/s.

Bass resonance 40 c/s.

8 ohm impedance.

10 watts. RMS. **£5.95** Post 75p

20 watt woofer bass unit only **£7.95** Post 75p



LOW VOLTAGE POWER PACK for MODELS

Ready made. Famous make. Will supply 10 volts D.C. at 400mA. With terminals and mains lead. **£2.75** Post 50p

POTENTIOMETERS

With spindles 5kΩ to 2MΩ. LOG or LIN.

L/S 35p. DP 60p.

Stereo L/S 85p. DP 45p.

Edge Pot 5K 5p.

Sliders Mono 65p. Stereo 85p.

80 Ohm Coax

FRINGE LOW LOSS **15p** yd.

PLUGS 10p. SOCKETS **10p.**

LINE SOCKETS **25p**

OUTLET BOXES **80p**

300 ohm FEEDER **5p** yd.

EMI 13½ x 8in. LOUDSPEAKERS

With tweeter and crossover. 10 watt: 3 or 8 ohm.

With tweeter and crossover. 8 ohm. 15 watts.

£9.95 Post 75p

£10.95 Post 75p

Bass woofer only 15 ohm. 20 watt. **£10.95** Post 75p

Suitable Bookshelf Cabinet

Teak finish. For EMI 13 x 8 speakers.

Size 16 x 11 x 8 inches approximately.

£9.50

Post £1.60

THE "INSTANT" BULK TAPE ERASER

Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E.

Will also demagnetise small tools

£7.50

Head Demagnetiser only **£5.00.** Post 50p



RELAYS. 12V DC 95p. 6V DC 85p. 240V AC 95p.

BLANK ALUMINIUM CHASSIS. 6 x 4—95p; 8 x 6—**£1.40;** 10 x 7—**£1.55;** 12 x 8—**£1.70;** 14 x 9—**£1.90;** 16 x 6—**£1.85;** 16 x 10—**£2.20.** ANGLE ALI. 6 x ¾ x ¼ in—**20p.**

ALUMINIUM PANELS. 6 x 4—**24p;** 8 x 6—**38p;** 14 x 3—**40p;** 10 x 7—**54p;** 12 x 8—**70p;** 12 x 5—**44p;** 16 x 3—**70p;** 14 x 9—**84p;** 12 x 12—**£1.1;** 16 x 10—**£1.18.**

PLASTIC AND ALI BOXES IN STOCK. MANY SIZES

VARIACAP FM TUNER HEAD with circuit & connections.

Some technical knowledge required **£4.95.**

TAG STRIP 28-watt 12p.

TAPE OSCILLATOR COIL. Valve type. 35p.

BRIDGE RECTIFIER 200V PIV ½ amp 50p. 8 amp **£2.50.**

TOGGLE SWITCHES SP 30p. DPST 40p. DPDT 50p.

MANY OTHER TOGGLES IN STOCK. Please enquire.

PICK-UP CARTRIDGES ACOS. GP91 **£2.00.** GP94 **£2.50.**

SONOTONE 9TAHC Diamond **£3.75.** V100 Magnetic **£6.50.**

RESISTORS. 10Ω to 10M. ¼W, ½W, 1W, 20% 1p; 2W, 10p.

HIGH stability. ½W 2% 10 ohms to 1 meg, 8p.

Ditto 5%. Preferred values, 10 ohms to 10 meg, 3p.

MATSUSHITA 18volt DC 33+45 RPM

HIGH QUALITY TURNTABLE



Our price **£20** inc. VAT. Post **£2**

Direct drive motor/die cast 12in turntable

RCS SOUND TO LIGHT KIT Mk. 2

£18

Kit of parts to build a 3 channel sound to light unit

1,000 watts per channel. Suitable for home or disco. Post 60p

Easy to build. Full instructions supplied. Cabinet **£4.50** extra.

Will operate from 200MV to 100 watt signal.

"MINOR" 10 watt AMPLIFIER KIT £12.50

This kit is suitable for record players, guitars, tape playback,

electronic instruments or small PA systems. Two versions

available: Mono, **£12.50;** Stereo, **£20.** Post 45p. Specification

10W per channel; input 100mV; size 9½ x 3 x 2 in. approx. SAE

details. Full instructions supplied. AC mains powered.

Input can be modified to suit guitar or mike.

R.C.S. STEREO PRE-AMP KIT. All parts to build this pre-amp.

Inputs for high, medium or low imp per channel.

With volume control and P.C. Board **£2.95**

Can be ganged to make multi-way stereo mixers **Post 35p**

MAINS TRANSFORMERS

250-0-250V 70mA, 6.5V, 2A ALL POST 75p. **£3.45**

250-0-250V 80mA, 6.3V 3.5A, 6.3V 1A **£4.80**

350-0-300V 100mA, 6.3V 3.5 amp **£5.80**

300-0-300V 120mA, 2x6.3V 2A C.T., 5V 2A **£10.00**

220V 45mA, 6.3V 2A **£2.50**

HEATER TRANSFORMER, 6.3V ½ amp **£2.00** 3 amp **£2.20**

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs available

2 amp, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V **£8.00**

1 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£8.00**

2 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£9.50**

3 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£12.50**

5 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£16.00**

12V, 100mA **£1.30** 20V, 40V, 60V, 1 amp **£4.00**

12V, 750mA **£1.75** 12V, 3 amp **£3.50**

100-0-10V 2amp **£3.00** 10V, 30V, 40V, 2 amp **£3.50**

30V, 5 amp and 17V-0-17V **£3.50** 40V, 2 amp **£3.50**

2 amp **£4.00** 20V, 1 amp **£3.50**

0, 5, 8, 10, 16V, ½ amp **£2.50** 20V-0-20V, 1 amp **£3.50**

9V, 3 amp **£3.50** 30V-0-30V, 2 amp **£8.00**

25-0-25V 2 amp **£4.50** 2 of 18V, 6 amp, each **£11.00**

30V, 2 amp **£3.50** 12-0-12V, 2 amp **£3.50**

30V, 1½ amp **£3.50** 9V, ¼ amp **£1.50**

AUTO TRANSFORMERS 115V to 230V or 230V to 115V 150W **£7.00**

250W **£8.00.** 400W **£9.00** 500W **£10.00**

FULL WAVE BRIDGE CHARGER RECTIFIERS

6 or 12V outputs, 2 amp, 75p. 4 amp, **£1.00**

CHARGER TRANSFORMERS: 1½ amp, **£1.60.** 3 amp, **£4.00.** 4 amp, **£5.50**

12V, 1½ amp Half Wave Selenium Rectifier **25p**

OPUS SPEAKERS

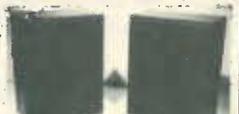
TEAK VENEERED CABINET

11 x 8½ x 7 in

50 to 14,000 cps.

15 watts 8 ohm

£20 pair Post £2



LOW VOLTAGE ELECTROLYTICS

1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V **10p.**

500mF 12V **15p;** 25V **20p;** 50V **30p;** 420mF/500V **£1.30.**

1000mF 12V **17p;** 25V **35p;** 50V **47p;** 100V **70p.**

2000mF 6V **25p;** 25V **42p;** 50V **60p;** 1200mF 75V **80p.**

2500mF 50V **62p;** 3000mF 25V **47p;** 50V **65p.**

4500mF 64V **£2;** 4700mF 63V **£1.20.** 2700mF/76V **£1.**

5000mF 35V **85p.** 5600mF/76V **£1.75.**

HIGH VOLTAGE ELECTROLYTICS

8/350V 22p **£8.8;** 450V 50p **£5.0;** 50+50/300V 50p

16/350V 30p **8.16;** 450V 50p **£3.2;** 32/450V 75p

32/500V 75p **16.16;** 450V 50p **10.00;** 100/275V 65p

50/500V **£1.20** 32+32/350V 50p **1.50;** 100/275V 70p

MANY OTHER ELECTROLYTICS IN STOCK

SHORT WAVE 100pF air spaced gangable tuner, **95p.**

TRIMMERS 10pF, 30pF, 50pF, 5p. 100pF, 150pF, 15p.

CERAMIC, 1pF to 0.01mF, 5p. Silver Mica 2 to 5000pF, 5p.

PAPER 350V-0.17p; 0.5 13p; 1mF 150V 20p; 2mF 150V

20p; 500V-0.001 to 0.05 12p; 0.1 15p; 0.25 25p; 0.47 35p.

MICRO SWITCH SINGLE POLE CHANGEVER 20p.

SUB-MIN MICRO SWITCH, 25p. Single pole change over.

TWIN GANG, 385 + 385pF 80p; 500pF slow motion 75p.

365 + 365 + 25 + 25pF. Slow motion drive 85p. 120pF 50p.

TRANSISTOR TWIN GANG, 50p.

NEON PANEL INDICATORS 250V. Amber or red 30p.

ILLUMINATED ROCKER SWITCH, single pole. Red 65p.

WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt 15p.

CASSETTE MOTOR. 6 volt **£1.00.**

CASSETTE MECHANISM. Mono heads, no motor **£3.00.**

VALVES special offer subject to being unsold 60p. Post free

6AM6 12X7GT PCF82 PL84 EBF80 EFB90

6K8G 35L8GT PCF86 PY33 ECC83 EM84

607G 954 PCL82 PY80 ECC84 EM85

6V6G 30PL1 PCL84 PY82 ECF80 EM87

1207G 35Z4GT PL81 PV83 ECL80 EY81

12K8M PCC84 PL82 EB91 ECL82 EY88

25Y5G PCC89 PL83 EBC81 EF41 E240

BAKER LOUDSPEAKERS

"SPECIAL PRICES"

Post £1.50 ea.

Model	Size	Power	Type	Our price	List price
8 or 16 ohms in		watts			
Major	12	30	Hi-Fi	£12	£17.25
Deluxe Mk II	12	15	Hi-Fi	£14	£19.75
Supert	12	30	Hi-Fi	£22	£27.60
Auditorium	12	45	Hi-Fi	£20	£27.60
Group 35	15	60	Hi-Fi	£30	£40.25
Group 45	12	40	PA	£12	£17.25
Group					

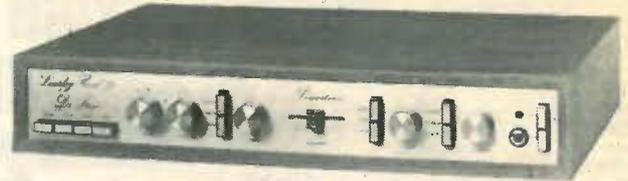
ASCENSION ISLAND YUGOSLAVIA UNITED STATES OF AMERICA JORDAN GREECE INDIA GUYANA PORTUGAL FALKLAND ISLANDS UNITED ARAB EMIRATES JAMAICA HOLLAND KENYA

EIRE GRENADA SAUDI ARABIA NEW ZEALAND NORWAY SINGAPORE ICELAND SWEDEN MALAYA INDONESIA BRAZIL SWITZERLAND ZAMBIA GIBRALTAR CHILE SPAIN

ELECTRONIC KITS OF DISTINCTION FROM **POWERTRAN**

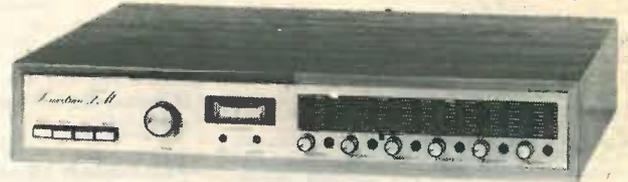
DE LUXE EASY TO BUILD LINSLEY-HOOD 75W STEREO AMPLIFIER £99.30 + VAT

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.



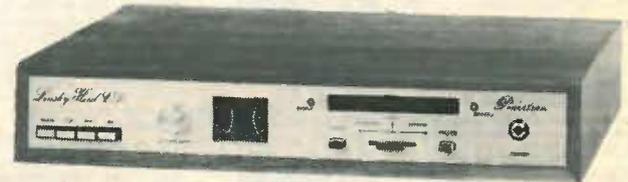
WIRELESS WORLD FM TUNER £70.20 + VAT

A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent a.m. rejection push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder, incorporating active filters for "birdy" suppression.



LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.



TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

As featured in Electronics Today International



Cabinet size 24.6"x15.7"x4.8" (rear) 3.4" (front)

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1/2% metal film) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibre glass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready built units selling for between £500 and £700!

COMPLETE KIT ONLY
£168.50 + VAT!

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more than a multi-meter and a pair of ears!

CHROMATHEQUE 5000 5-CHANNEL LIGHTING EFFECTS SYSTEM

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control setting or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB, controls, wire, etc. — Complete right down to the last nut and bolt!

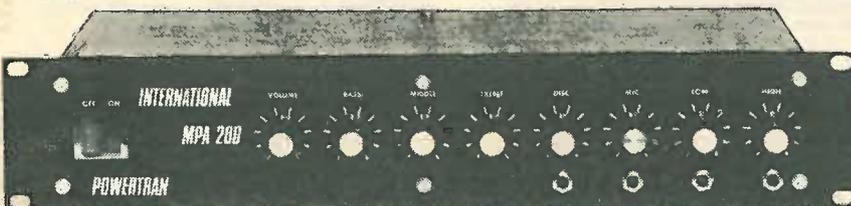
COMPLETE KIT ONLY
£49.50 + VAT



Panel size 19.0"x3.5". Depth 7.3"

MPA200 100W MIXER/AMPLIFIER

Featured as a constructional article in Electronics Today International the MPA 200 is an exceptionally low-priced but professionally finished general purpose, rugged, high-power amplifier which has an adaptable range of inputs such as disc, microphone, guitar, etc. There are 3 wide range tone controls and a master volume control. Mechanically the design is simplicity in the extreme with minimal wiring making construction very straightforward. Kit includes fully finished metalwork, fibreglass PCB's, controls, wire, etc. — Complete right down to the last nut and bolt!



Panel size 19.0"x3.5". Depth 7.3"

COMPLETE KIT ONLY
£49.90 + VAT

All kits also available as separate packs (e.g. P.C.B. component sets, hardware sets, etc.). Prices in FREE CATALOGUE.

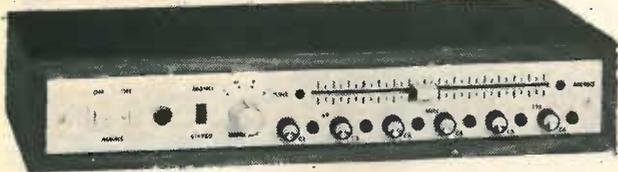
MUSCAT & OMAN
FRANCE
DENMARK
GAMBIA
AUSTRALIA
HONG KONG
NAURU
GERMANY
TUNISIA
LUXEMBOURG
NIGERIA
FINLAND
SOUTH AFRICA
CZECHOSLOVAKIA
AUSTRIA

NEW GUINEA
ISRAEL
GUERNSEY
CYPRUS
BELGIUM
UGANDA
BRUNEI
TRINIDAD
SOUTH WEST AFRICA
ITALY
JAVA
SIERRA LEONE
WINDWARD ISLANDS
CANADA
MALTA

T20+20 AND T30+30 20W, 30W AMPLIFIERS



WWII TUNER



SPECIAL PRICE FOR COMPLETE KIT £47.70 + VAT

AVAILABLE AS SEPARATE PACKS — PRICES IN OUR FREE CATALOGUE

Designed by Texas engineers and described in Practical Wireless, the Texan was an immediate success. Now developed further in our laboratories to include a Toroidal transformer and additional improvements, the slimline T20+20 delivers 20W rms per channel of true Hi-Fi at exceptionally low cost. The easy to build design is based on a single F/Glass PCB and features all the normal facilities found on quality amplifiers including scratch and rumble filters, adaptable input selector and headphones socket. In a follow-up article in Practical Wireless further modifications were suggested and these have been incorporated into the T30+30. These include RF interference filters and a tape monitor facility. Power output of this model is 30W rms per channel.

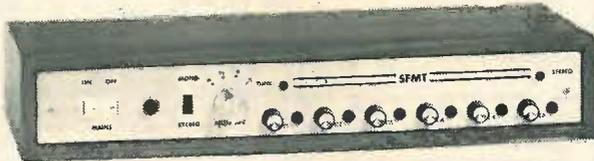
SPECIAL PRICES FOR COMPLETE KITS

T20+20 KIT PRICE £33.10 + VAT

T30+30 KIT PRICE £38.40 + VAT

AVAILABLE AS SEPARATE PACKS — PRICES IN OUR FREE CATALOGUE

POWERTRAN SFMT TUNER



PRICE FOR COMPLETE KIT £35.90 + VAT

AVAILABLE AS COMPLETE KIT ONLY

This is a simple, low cost design which can be constructed easily without special alignment equipment but which still gives a first-class output suitable for feeding any of our very popular amplifiers or any other high quality audio equipment. A phase-locked-loop is used for stereo decoding and controls include switchable afc, switchable muting and push-button channel selection (adjustable by controls on the front panel). This unit matches well with the T20+20 and T30+30 amplifiers.

Following the success of our Wireless World FM Tuner Kit this cost reduced model was designed to complement the T20+20 and T30+30 amplifiers and the cabinet size, front panel format and electrical characteristics make this tuner compatible with either.

**INCREASED CAPACITY AT OUR BIG NEW FACTORY
MEANS MANY PRICES DOWN! ALL OTHER FROZEN!**

Another superb design by synthesizer expert Tim Orr!

TRANSCENDENT DPX

As featured in Electronics Today International August, September October, 1979 issues

DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound — fully polyphonic i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano or a honky tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or should you prefer — strings on the top of the keyboard and brass at the lower end (the keyboard is electronically split after the first two octaves) or vice versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive? The harder you press down a key the louder it sounds — just like an acoustic piano. The digitally controlled multiplexed system makes practical sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrato comes in only after waiting a short time after the note is struck for even more realistic string sounds.



Cabinet size 36.3"x15.0"x5.0" (rear) 3.3" (front)
Also available as separate packs — prices in free catalogue

COMPLETE KIT ONLY £299.00 + VAT!

To add interest to the sounds and make them more natural there is a chorus/ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects. As the system is based on digital circuitry data can be easily taken to and from a computer (for storing and playing back accompaniment with or without pitch or key change, computer composing etc., etc.) and an interface socket (25 way D type) is provided for this purpose. Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet.

The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance and quality with ready-built units selling for over £1200!

EXPORT A SPECIALITY!

Our Export Department can readily despatch orders of any size to any country in the world. Some of the countries to which we sent kits last year are shown in this advertisement. To assist in estimating postal costs our catalogue gives the same as for U.K. customers but no Value Added Tax charged. Postage charged at actual cost plus 50p documentation and handling. Please send payment with order by Bank Draft, Postal Order, International Money Order or cheque drawn on an account in the U.K. Alternatively for orders over £500 we will accept Irrevocable Letter of Credit payable at sight in London.

**Value Added Tax not included in prices
UK Carriage FREE**

PRICE STABILITY. Order with confidence! Irrespective of any price changes we will honour all prices in this advertisement until February 28th, 1980, if this month's advertisement is mentioned with your order.

Errors and VAT rate changes excluded
U.K. ORDERS. Subject to 15% surcharge for VAT. No charge is made for carriage. * Or current rate if charged.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit

SALES COUNTER: If you prefer to collect your kit from the factory, call at Sales Counter. Open 9 a.m.-4.30 p.m. Monday-Thursday.

QUALITY: All components are brand new first grade full specification guaranteed devices. All resistors (except where stated as metal oxide) are low noise carbon film types. All printed circuit boards are fibreglass, drilled roller tinned.

**NEW FACTORY ON SAME INDUSTRIAL ESTATE
ADDRESS AND PHONE NUMBER UNCHANGED**

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NN

ANDOVER
(STD 0264) 64455



New Bear Components



CALLERS AND MAIL ORDER: 40 Bartholomew Street, Newbury, Berks. Tel: 0635 30505

Microcomputing I.C.'s

MC6800	£ 7.15
MC6802	£ 8.50
MC6821	£ 4.63
MC6850	£ 6.74
MC6810AP	£ 3.61
MC6840	£ 12.72
MC8602P	£ 2.88
MC14536P	£ 3.69
MC3459	£ 2.43
Z80 CPU 2.5MHz	£ 8.99
Z80 P10 2.5MHz	£ 7.99
Z80 CTC 2.5MHz	£ 7.99
Z80A CPU 4MHz	£ 13.99
Z80A P10 4MHz	£ 10.00
Z80A CTC 4MHz	£ 10.00
SC/MP 11	£ 8.88
(INS 8060N)	
INS 8154N	£ 8.18
8080A	£ 6.00
6502	£ 9.90
6522	£ 7.90
6532	£ 12.56
6551	£ 10.79
6545	£ 16.66
Z8001	£142.50
AMD 9511: arithmetic package	£136.50

ACORN.....

Disc Drives

SA400 SHUGART	5 1/4" S.S.	£ 189
6106 BASF	5 1/4" S.S.	£ 190
7100 DRI	8" S.S.	£4385
7200 DRI	8" D.S.	£ 430
6104 BASF	8" D.S.	£ 465

Plus range of Media, PSU's and Connectors.

Memories

4116 (16K DYNAMIC)	£ 6.99
2102-1*	£ 0.85
2102L-1*	£ 0.99
2112	£ 2.25
2114	£ 6.99
2708	£ 6.99
MC6803L7 (MIKBUG)	£ 13.65
2716 (INTEL)	£ 21.50

6502 BASED MICRO KIT	£85.00
8K RAM KIT	£95.00
MAINS ADAPTOR	£ 5.00
V.D.U. KIT	£88.00

SPECTRONICS

UV Eprom-Erasing Lamp

PE14	Erases up to 6 chips. Takes approx. 19 mins.	£ 56.00
PE14T*	Erases up to 6 chips. Takes approx. 19 mins.	£ 76.58
PE24T*	Erases up to 9 chips. Takes approx. 15 mins.	£111.22
PR125*	Erases up to 6 chips. Takes approx. 7 mins.	£237.84
PR320T*	Erases up to 36 chips. Takes approx. 7 mins.	£384.09
PC1000*	Erases up to 72 chips. Takes approx. 7 mins.	£842.83

UV Eprom-Erasing Cabinet

PC2000*	Erases up to 144 chips. Takes approx. 7 mins.	£1227.69
---------	---	----------

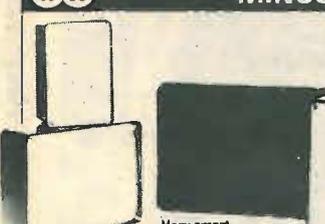
* Includes a 60 min. Timer.

TERMS: Credit Sales (minimum £10.00) Barclaycard and Access Welcome. Please add 15% VAT.

CALLERS ONLY: 220-222 Stockport Road, Cheadle Heath, Stockport Tel: 061 491 2290
SEND FOR OUR NOVEMBER CATALOGUE AND BOOK LIST.

West Hyde have the greatest range of instrument cases

WH MINOS



Very smart miniatures moulded in gloss black or white ABS with high impact strength. Front panels in aluminium, white PVC/steel or moulded. Guides for P.C.B.s, dividers or screens, also internal pillars for 'P' clips. Recess on the back for decals etc.

	L	B	H	
MIN 021	100	65	50	£2
MIN 025	135	85	50	£4
MIN 030	180	100	50	£1.01
MIN 040	200	130	65	£2.24

WH SWIFT



Swiftcase wins industrial design award at Hanover. A case for good looks, strength and efficiency. Particularly suitable for applications needing power dissipation.

	L	B	H	
SWF 212	432	268	88.9	£23.85
SWF 222	219	268	88.9	£18.35
SWF 312	432	268	133.4	£28.25
SWF 322	219	268	133.4	£22.50

IEA ELECTREX
International Electrical Electronic and Instrument Exhibition
National Exhibition Centre Birmingham
25-29 February 1980
HALL 4 STAND 4228

WH KNOBS



Send for Mentor Catalogue. Hundreds of knobs to choose from.

West Hyde stock thousands of knobs: collet, screw fixing, plastic, aluminium, fluted, textured, smooth, wing, pointer, insulated, slow-motion, digital, crank-handle, heavy-duty, contemporary, dual, diamond turned. With shafts 3 mm to 10 mm and diameters from 8 mm to 58 mm. See catalogue for prices.

WH CLASSIC II



Low cost but expensive appearance. 45 sizes. Elegant cases in natural anodised aluminium with gloss black top and bottom panels. Slots provided for PCBs, chassis etc. See catalogue for dimensions and prices.

WH HANDLES



West Hyde have a wide range of high quality handles in nylon, chromium, anodised, flush, extruded, carrying and heavy duty.

Chromium from 81p Extruded from 2.19
Nylon from 1.06 PVC from 76p
Pivoting from 4.37
Flush precision from 5.28
V. heavy duty from 8.25

WH PRINCESS



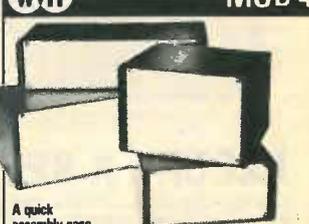
Moulded in two parts in ABS; in four sizes.

- The largest for keyboards displays etc.
- Prestige display of data inputs, large calculators.
- Still ample room for keyboard and visual display or meters.
- Elegant hand-held keyboards take a Eurocard.

Colour: black case base and either a black or tan top.

PR1	£16.50	PR2	£12.90
PR3	£7.95	PR4	£4.95

WH MOD-4



A quick assembly case in eight parts. A mass produced economy case in intensely shiny black or royal blue leather textured PVC steel with bright white steel panel. Eight pieces inc. aluminium chassis assembled with only eight screws.

	L	B	H		L	B	H		
401	178	152	76	£5.25	405	279	152	114	£6.59
402	178	152	114	£5.49	406	279	152	152	£6.99
403	178	152	152	£5.69	413	165	152	157	£5.75
404	279	152	76	£6.29	416	305	152	157	£7.25

NOTE NEW ADDRESS

All West Hyde cases are available with substantial discounts for quantities. Most cases have discounts at 5, 10 and 25 off with discounts up to 25% at 100 off. Prices do not include VAT. Except where otherwise state P&P 5% of order value. Send for catalogue. Prices correct at press date.
WEST HYDE DEVELOPMENTS LIMITED, Unit 9, Park Street Industrial Estate, AYLESBURY, BUCKS. HP20 1ET. Phone: Aylesbury (0296) 20441. Telex: 83570
WW - 046 FOR FURTHER DETAILS

LINES FROM OUR VAST STOCKS — IMMEDIATE DELIVERY

NEW STOCKS BELOW MANUFACTURERS' PRICES. Postage & packing add 50p per order.

CALCULATOR CHIPS General instrument GIMT4 on anti-static foam 24 pin D.I.L. socket for use with Bowmar display **£1.50** ea. Pack of 25 chips **£25**, 100 for **£30**, 500 for **£250**.

DISPLAYS BY HERULETT-PACKARD. Seven segment DL707 (5082-775) **95p**. Common anode half inch red display, brand new in makers cartons, 6 for **£5**, 50 for **70p** ea., 1,000 for **85p** ea.

TEA 120A, T.V. I.C. amplifier Siemens **55p**, 10 for **£5**, 100 for **£50**, 1,000 for **£350**.

BECKMAN 500 Triggerable clocking oscillator for use with calculator chips 5v supply with circuit **£1**, 10 for **£8**, 100 for **£85**.

BURROUGHS 8 DIGIT Panalex calculator display 7 segment 0.25" digits. Neon type with red bezel socket and data. **£1.95** ea. 10 for **£17**, 100 for **£140**.

HONEYWELL PROXIMITY DETECTOR integral amplifier 8v D.C. **£3.50** ea. 10 for **£30**.

MULLARD TB800, I.C. audio amplifier, **95p** ea. 10 for **£8**, 100 for **£70**, 500 for **£300**.

RCA CA308B, F.M. I.F. **£1.80**, 10 for **£12**.

RCA CA3090A, F.M. decoder **£2.50**, 10 for **£20**, 100 for **£175**.

BU 205 MULLARD, **£1.50** ea. 10 for **£12**, 100 for **£100**.

2N3906 80V version TD3 power, 10 for **£3.50**, 100 for **£25**, 500 for **£125**, 1,000 for **£200**.

BU208 103 Texas TV. Power transistors, **£1.75** ea. 10 for **£15**, 100 for **£120**, 1,000 for **£1** ea.

MC3110P-8N76115N F.M. STEREO DECODER, **£1.20** each, 10 for **£1** ea., 100 for **85p** ea.

MULLARD AD161-AD162 Matched pairs, 1 pair **80p**, 10 pairs **£5**, 100 pairs **£50**.

Cartons of 500 pairs **£200** EX-STOCK.

RADIATION DETECTORS Quartz Fibre Dosimeters. Pan type with clip with lens and scale 0-50R. Originally over **£5** OUR PRICE **95p** EACH, 10 for **£8**, 100 for **£80**, 1,000 for **£800**.

CLOCKING OSCILLATOR (Pye-Dynamical), thick film 1MHz supply 5v, 19x25x8mm **85p**, 10 for **£7**, 100 for **£60**, 500 for **£250**.

TV TUNERS by Mullard, U.H.F. 38 mcs size 34x24x14 **£2.50** ea., 10 for **£20**, 100 for **£175**, 500 for **£750**, 1,000 for **£1,250**.

MULLARD TUNER MODULES with data.

LP1171 combined AM/FM IF strip **£3.50**.

LP1179 FM front end with FM tuning gear, used with LP1171 **£3.50**, LP1171 and 85 pair **£5.75**, 10 pairs for **£50**, 100 pairs for **£400**.

CA3085 RCA POSITIVE VARIABLE REG. 5volt 100mA amp variable 1.8-24v **55p** ea., 10 for **£5**, 100 for **£35**, 1,000 for **£300**.

MULLARD LP1187 AM tuner modules with circuit **£2.50** ea., 10 for **£20**, 100 for **£175**.

LUSTRAPHONE RIBBON MIKE **£1.50**, + pre amp on chassis 3x2x1m, 10 for **£12.50**.

TA0991B (14-pin DIL) I.C. T.V. Sound & F.M. amplifier-detector by Ales on P.C. circuit board with other parts. Complete with data and connections. **60p**, 10 for **£5**, 100 for **40p** ea., 500 for **35p** ea. **AVO-B METER MOVEMENTS** for military version. Precision 37.5 micro-amp (50µa with integral shunt) movement **£10.80**.

TV SOUND
High quality TV sound from your Hi-Fi. Simply plug into aerial socket of your FM tuner, **£5.80** UK P&P 50p.
As reviewed by "Popular Hi-Fi", July '79.

PHOTO CONDUCTIVE CELL **£1.25**. High power Cds cell 800 mw for control circuits. Resistance 800 ohm to 4K. Max volts 240. Size 1 1/2x1in. 10 for **£11**, 100 for **£100**.

DYNAMIC MICROPHONE. Low imp. Foster inset. **£1.45**, 10 for **£11**, 100 for **£100**.

UHF TUNER BY GEC. 38mc/s with slow motion tuning. Size 5x3x2in. **£3** ea., 10 for **£25**, 100 for **£220**, 500 for **£1,000**.

TWO GANG MINIATURE VARICAP TUNER, 500pf with tuning knob, size 3x1 1/2x1 1/2in. **£1.25** ea., 10 for **£10**, 100 for **£85**.

ATES U14562 AUDIO I.C. AMPLIFIER 14 PIN D.I.L. 300 m. watts **55p** each, 10 for **£4.50**, 100 for **£35**.

GENERAL ELECTRIC 2+2 watt I.C. stereo audio chips with circuit & data **£1.95** each.

RCA CD4028AE 16 pin D.I.L. presaturation up-down counter **85p** each, 25 for **£18**, 100 for **£50**, 1,000 for **£325** (in anti static tubes of 25).

U.M.F. TV TUNER (preamp) with BF180 **85p** each. Built on P.C. board 2 x 2in (gold without data), 10 for **£4.50**, 100 for **£35**, 1,000 for **£250**.

MARCONI I.C. Oscillator Datil (TD99 can) **30p** each, 10 for **£2**, 100 for **£18**, 1,000 for **£125**.

PLESBEY FL432A I.C. IF amplifier (TD99 can) **85p** each, 10 for **£8**, 100 for **£35**, 500 for **£180**.

V.H.F. MODULATORS for TV games **85p** each. 2 transistor — on built P.C. sizes 2 x 2 x 1 1/4in, 10 for **£4**, 100 for **£35**, 500 for **£150**.

R.F. Filters for above modulators **20p** each with components and coils on built p. circuit, size 2 x 2 x 1 1/4in, 10 for **£3.50**, 100 for **£30**, 500 for **£125**.

HIGH VOLTAGE TV TRIPLER DIODES by I.T.T. stick type per 10 **£1.50**, per 100 **£15**, per 1,000 **£85**.

TBA225 ATEs voltage regulators **55p** ea. 5 volts 100 mA (amps) (TO99) per 10 **£4.50**, per 100 **£35**, per 1,000 **£280**, 12v TBA2625A. Also, 10 for **£1**, 100 for **£8**, 1,000 for **85p** each.

16 PIN low profile D.I.L. sockets **12p**, 10 for **£1**, 100 for **£8**, 1,000 for **85p** each.

THRISTORS, Motorola 2N5061 0.8 amp 60 volt **19p**, 10 for **19p**, 100 for **13p**, 1,000 for **11p** each.

ULTRASONIC TRANSDUCERS. 40Kcs, pair **£2.95**, 10 pairs **£25**, 100 pairs **£220**.

Henry's
404 Edgware Road
London W2 England
Phone 01-723 1008
TELEX 262284. REF 1400.

EXPORT ORDERS add 10% for carriage

TRANSFORMERS CONTINUOUS RATINGS

MAINS ISOLATOR VAT 15% 12 or 24-VOLT
PRI 120 or 240V Sec 120 or 240V
Centre Tapped and Screened

Ref. VA (Watts)	£	P&P
07* 2U	4.84	.91
149 60	7.37	1.10
150 100	8.38	1.31
151 200	12.28	1.31
152 250	14.61	1.73
153 350	18.07	2.12
154 500	22.52	2.47
155 750	32.08	OA
156 1000	40.92	OA
157 1500	56.52	OA
158 2000	67.99	OA
159 3000	95.33	OA

*115 or 240 sec only. State volts required. Pri. 0.220-240V.

30 VOLT RANGE
Pri 220-240V Sec. 0-12-15-20-24-30V
Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V and 15V-0-15V.

Ref. Amps	£	P&P
112 0.5	2.90	.90
79 1.0	3.93	1.10
3 2.0	6.35	1.10
20 3.0	6.82	1.31
21 4.0	8.79	1.31
51 5.0	10.86	1.52
117 6.0	12.29	1.67
88 8.0	16.45	1.89
89 10.0	18.98	1.89
90 12.0	21.09	2.24
91 15.0	24.16	2.39
92 20.0	32.40	OA

50 VOLT RANGE
Pri 220-240V. Sec. 0-20-25-33-40-50V.
Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 25, 30, 33, 40 or 20V-0-20V and 25V-0-25V Screened.

Ref. Amps	£	P&P
102 0-5	3.75	.90
103 1.0	4.57	1.10
104 2.0	7.88	1.31
105 3.0	9.42	1.52
106 4.0	12.82	1.75
107 6.0	16.57	1.89
118 8.0	22.29	2.39
119 10.0	27.48	OA
109 12.0	31.79	OA

60 VOLT RANGE
Pri 220-240V.
Sec. 0-24-30-40-48-60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60V, or 24V-0-24V and 30V-0-30V

Ref. mA	Volts	£	P&P
238 200	3-0-3	2.83	.63
212 1A, 1A	0-6-0-6	3.14	.90
13 100	9-0-9	2.35	.44
235 330, 330	0-9-0-9	2.19	.44
207 500, 500	0-8-9-0-8-9	3.05	.85
208 1A, 1A	0-8-9-0-8-9	3.88	.90
236 200, 200	0-15-0-15	2.19	.44
239 50MA	12-0-12	2.88	.37
214 300, 300	20-0-2-20	3.08	.90
221 700 (DC)	20-12-0-12-20	3.75	.90
206 1A, 1A	0-15-20-0-15-20	5.09	1.10
203 500, 500	0-15-27-0-15-27	4.39	1.10
204 1A, 1A	0-15-27-0-15-27	6.64	1.10

SCREENED MINIATURES Primary 240V

Ref. mA	Volts	£	P&P
238 200	3-0-3	2.83	.63
212 1A, 1A	0-6-0-6	3.14	.90
13 100	9-0-9	2.35	.44
235 330, 330	0-9-0-9	2.19	.44
207 500, 500	0-8-9-0-8-9	3.05	.85
208 1A, 1A	0-8-9-0-8-9	3.88	.90
236 200, 200	0-15-0-15	2.19	.44
239 50MA	12-0-12	2.88	.37
214 300, 300	20-0-2-20	3.08	.90
221 700 (DC)	20-12-0-12-20	3.75	.90
206 1A, 1A	0-15-20-0-15-20	5.09	1.10
203 500, 500	0-15-27-0-15-27	4.39	1.10
204 1A, 1A	0-15-27-0-15-27	6.64	1.10

AUTO TRANSFORMERS

Ref. VA (Watts)	TAPS	£	P&P
113 15	0-115-210-240V	2.73	.81
64 75	0-115-210-240V	4.41	1.10
4 150	0-115-200-220-240V	5.89	1.10
67 500	"	12.09	1.91
93 1500	"	20.64	2.39
95 2000	"	25.61	OA
73 3000	"	38.31	OA
80s 4000	0-10-115-200-220-240	84.55	OA
57s 5000	"	98.45	OA

Step Up or Step Down

CASED AUTO TRANSFORMERS
240V cable input USA 115V Flat pin outlets P&P Ref.

Ref.	VA	£	P&P
20VA	£6.55	1.03	56W
75VA	£8.50	1.31	84W
150VA	£11.00	1.31	4W
200VA	£12.02	1.67	65W
250VA	£13.38	1.67	69W
500VA	£20.13	1.89	67W
1000VA	£30.67	2.65	84W
1500VA	£42.82	OA	93W
2000VA	£54.97	OA	95W

MINI MULTIMETER
DC1000V, AC-1000V
AC/DC-1000Ω/V
DC-100mA. Res — 150K
Bargain at **£7.20**
VAT 15% P&P 71p

PANEL METERS
43mm x 43mm 82mm x 78mm

0-50µA	£6.20	0-50µA	£6.70
0-500µA	£5.95	0-500µA	£6.70
0-1mA	£5.95	0-1mA	£6.70
0-30V	£5.95	0-30V	£6.70

VU Indicator Edge 54mm x 14mm µA FSD **£2.60**
VU Panel Ind. 48 x 45mm, 250µA FDS **£2.60**
Carriage 76p VAT 15%

U4315 Budget Meter 20KΩ/V. Rangers to 1000V
2.5A AC/DC 500KΩ. Res in steel case **£15.85**.
P&P **£1.32**. VAT 15%.

NEW RANGE TRANSFORMERS
Pri 0-120; 0-100-120; (120V or 220-240V) Sec.
0-36-48 twice to give 72v or 92v.

2A	£13.35	PP	£1.40	4A	£20.65	PP	£2.11
3A	£16.17	PP	£1.70	5A	£29.30	PP	£2.47

METAL OXIDE RESISTORS 5% 1/4W (Electrolis)
390Ω - 470Ω - 510Ω - 560Ω - 820Ω 1K - 1K1 - 1K2 - 1K6 - 1K8 - 2K - 2K4 - 3K - 16K - 20K - 22K - 24K - 47K - 82K - 100K - 130K - 180K - 200K - 270K - 300K **£1.50** - 100.

MAINS ADAPTORS
MVA30. 6. 7. 5. 9v at 300mA plus direct into 13A socket (fused) 4-way multi plug **£4.00**
3300-3-6-9-12V at 300mA plus straight to 13A socket (fused) with multiplug **£4.60**
15% VAT. 55p P&P

*Send 15p for catalogue. Prices correct at 30/10/79.

£125.00
SAFGAN
ST-45
SINGLE TRACE
OSCILLOSCOPE



● 10mv/div ● 5MHz ● BRITISH ● CHOICE OF FRONT PANEL

ST-45 SPECIFICATION
VERTICAL SYSTEM
Sensitivity: 10mv/div-5v/div in 9 cal. steps.
Bandwidth (3dB)
DC Coupled: DC-5MHz
AC Coupled: 5Hz-5MHz.
Rise time: 70ns/c.
Input Impedance: 1MΩ + 22 pF approx. (for all ranges) 50Ω for 10mv/div-50mv/div.
Input coupling: AC, GND, DC.
Accuracy: ±5%. Max. input volts: ±400v peds.

HORIZONTAL SYSTEM
Timebase speed:
1µs/div — 50 ms/div IN 15 CAL STEPS with x 5 expansion to 200 ns/div and x 5 multiplier to 250 ms/div
Accuracy: ±5%
External Sensitivity: 1v/div approx.
External Bandwidth: DC—500 KHz.

ACCESSORIES
Passive Probe switched (X1; REF; x 10) 100 MHz bandwidth **£11.80** + VAT.
BNC to 4mm Socket Adaptor **£2.95** + VAT.

TRIGGER
Internal: 0.5div (10Hz-2MHz), 1 div (2MHz-5MHz)
External: 100mV (10Hz-2MHz), 200mV (2MHz-5MHz).
Bright Line Auto;
trace free-runs in absence of signal
Trigger Level: Selects triggering point
Trigger (+)ve and (-)ve slope selection

DISPLAY
Graticule: Blue, ruled 8x10 div's (4.6cmx8cm)
CRT: Thom-Brimar 1.5kV Monoaccelerator/P3;

FRONT PANEL
Black, silver, white, ST-45-S. The Silver Scope or black, gold, white, ST-45-G. The Gold Scope.

GENERAL
Power consumption: 10VA approx.
Mains selection: 200V-220V-240V rms (40Hz-60MHz)
Weight: 10lbs-4.5kg approx.
Case, aluminium with black pvc finish and black handle: front panel with black control knobs. Black feet and tilt-bar.

ORDERS TO: SAFGAN ELECTRONICS LTD.
56 Bishops Wood, St. Johns, Woking
Surrey GU21 3QB or Tel: Woking 66838.

Please send me ST-45-S ST-45-G Probe Adaptor

I enclose PO/cheque (Goods + 15% VAT + £3.00 p&p)

Name

Address

*Ex. VAT. UK

WW—064 FOR FURTHER DETAILS

Barrie Electronics Ltd.
3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/8
NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST.

WW—005 FOR FURTHER DETAILS

Z & I AERO SERVICES LTD.

Head Office: 44a WESTBOURNE GROVE, LONDON W2 5SF
Tel. 727 5641 Telex 261306

RETAIL SHOP
85 TOTTENHAM COURT ROAD, W.1
Tel. 580-8403

SPECIAL OFFER OF BRAND NEW USSR MADE MULTIMETERS



TYPE U4313
Sensitivity D.C. 20,000 o.p.v.
Sensitivity A.C. 2,000 o.p.v.
D.C. Current 60µA-1.5A
A.C. Current 0.6mA-1.5A
D.C. Volts 75mV-600V
A.C. Volts 15V-600V
Resistance 1K-1M
Capacity 0.5µF
Accuracy 1.5% D.C.
2.5% A.C.

U4315
20,000 o.p.v.
2,000 o.p.v.
50µA-2.5A
0.5mA-2.5A
75mV-1000V
1V-1000V
300Ω-500kΩ
0.5µF
2.5% D.C.
4% A.C.



TYPE U4324

D.C. Current 0.06-0.6-60-600mA-3A
A.C. Current 0.3-3-30-300mA-3A
D.C. Voltage 0.6-1.2-3-12-30-60-120-600-1200V
A.C. Voltage 3-6-15-60-150-300-600-900V
Resistance 500Ω-5-50-500kΩ
Accuracy D.C. 2.5% A.C. 4% (of F.S.D.)

Price complete with pressed steel carrying case and test leads
Packing and postage

£10.50
£1.50

PRICE complete with test leads and fibreboard storage case **£9.50**
Packing and postage **£1.20**

TYPE U4323 COMBINED WITH SPOT FREQUENCY OSCILLATOR



Sensitivity 20,000Ω/V
Voltage ranges 2.5-1000V A.C./D.C.
Current ranges 0.05-500mA D.C. only
Resistance 5Ω-1MΩ
Accuracy 5% F.S.D.
Oscillator output 1kHz 50/50 squarewave
465KHz sinewave modulated by 1KHz squarewave

PRICE, in carrying case, complete with leads and manual **£8.00**
Packing and postage **£1.00**

TYPE U4341 COMBINED MULTIMETER AND TRANSISTOR TESTER



Sensitivity 16,700Ω/V D.C., 3,300Ω/V A.C.
Current 0.06-0.6-6-60-600mA D.C., 0.3-3-0.3-30-300mA A.C.
Voltage 0.3-1.5-6-30-60-150-300-900V D.C.
1.5-7.5-30-150-300-750V A.C.
Resistance 2-20-200kΩ-2MΩ
Transistors Collector cut-off current 60µA max
D.C. current gain 10.350 in two ranges

PRICE, complete with steel carrying case, test lead, battery and instruction manual **£9.50**
Packing and Postage **£1.50**

THIS OFFER IS VALID ONLY FOR ORDERS ACCOMPANIED BY REMITTANCE WHICH SHOULD INCLUDE DELIVERY CHARGES AS INDICATED AND 15% V.A.T. ON THE TOTAL

OUR 1978 CATALOGUE/PRICE LIST OF VALVES, SEMICONDUCTORS, PASSIVE COMPONENTS AND TEST EQUIPMENT IS AVAILABLE. PLEASE SEND P.O. for £0.30 FOR YOUR COPY

WW-031 FOR FURTHER DETAILS

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

PLEASE ADD 15% TO ALL ORDERS INC. CARR.

CURRENT RANGE OF NEW L.T. TRANSFORMERS OPEN TYPE TAG CONNECTIONS ALL PRIMARIES 220-240V

Type	Sec Taps	Amps	Price	Carr
1	24-30-40-48-60v	12	£36.50	£2.00
2	24-30-40-48-60v	10	£31.50	£2.00
3	24-30-40-48-60v	8	£27.50	£1.75
4	24-30-40-48-60v	5	£16.75	£1.75
5	24-30-40-48-60v	3	£11.50	£1.25
6	24-30-40-48-60v	2	£7.50	£1.25

6-8-10-12-16-18-20-24-36-40-48-60v CAN BE OBTAINED FROM THE ABOVE RANGE

7	19-25-33-40-50v	10	£27.50	£2.00
8	19-25-33-40-50v	6	£19.50	£1.75
9	19-25-33-40-50v	3	£9.25	£1.25
10	19-25-33-40-50v	2	£7.75	£1.25

5-7-8-10-13-15-17-20-25-30-40-50v OR 25-0-25v OR 20-0-20v CAN BE OBTAINED FROM THE ABOVE RANGE

11	12-15-20-25-30v	10	£18.50	£1.75
12	12-15-20-25-30v	5	£10.50	£1.50
13	12-15-20-25-30v	2	£6.25	£1.25

3-4-5-6-8-9-10-12-15-18-20-24-30v OR 12-0-12v OR 15-0-15v CAN BE OBTAINED FROM THE ABOVE RANGE

14	12-24v	12v 60A, 24v 30A	£39.50	£3.50
15	12-24v	12v 30A, 24v 15A	£19.50	£2.00
16	12-24v	12v 20A, 24v 10A	£15.25	£2.00
17	12-24v	12v 10A, 24v 5A	£8.75	£1.50
18	12-24v	12v 4A, 24v 2A	£4.25	£1.25

HEAVY DUTY OF TRANSFORMERS
Type OT29EL 100 watts, 3.75v, 7.5v, 15v, 1.75k CT 4 EL34 2x25 mVA dc max. **£15.50**, pp £1.25. Type OT29EL 50 watts, 3.75v, 15v, 3.5k CT, rated 2x125 mVA dc max. **£8.95**, pp £1.

LOW POWER L.T. TRANSFORMERS

Clamped, open frame tag connections All primaries 240v

Type	Sec Taps	Amps	Price	Post
1	15v twice	200mVA ea	£2.25	75p
2	6v twice	500mVA ea	£2.25	75p
3	6v twice	4amps ea	£3.95	£1.00
4	6v twice	1½amps ea	£2.95	75p
5	6-9v twice	1amp ea	£2.95	£1.00
6	10v twice	½amp ea	£2.50	£1.00
7	12v twice	250mVA ea	£2.25	75p
8	12v twice	½amp ea	£2.25	75p
9	12v twice	1amp ea	£2.95	£1.00
10	24v CT	½amp	£2.25	75p
11	30v CT	2amps	£3.25	£1.00

HEAVY DUTY L.T. TRANSFORMERS

Pri 230-240v sec 76v 43.5amps Conservatively rated **£37.50** carr £5
Pri 415v sec 27v 55amps will give 15.5v from 240v input **£25** carr £5. Both types ex equipment

SPECIAL OFFER OF SURPLUS L.T. TRANSFORMERS BY FAMOUS MAKERS

ALL PRIMARIES 220-240v
No 1 Gresham sec 43v 3amps. Fully tropicalised open type wire connections. **£3.95** pp £1.25
No 2 Parmenko sec 30v 5amps shrouded top connections **£4.50** pp £1.50
No 3 Pri 220-240v sec 36v 6a open type tag board connections **£7.50** carr £1.50. These transformers are ideal for amplifier power supplies. Two will give 36-0-36v 6amps. Special offer for two **£15** inc carr.
No 4 Gardners 'C' core. Sec tapped 29-29-27-0-27-29-29v 50mA conservatively rated **£3.00** pp £1.
No 5 Gardners 'C' core. Sec tapped 28-8-21-0-21-28.8v 250mA/a and 10-7-0-7-10v 600mA/a **£3.00** pp £1.
No 6 Gardners 'C' core. Sec 12 6v 5.75amps conservatively rated **£5.75** pp £1.25. Hoy Gardners open type tag connections sec 55v ½amp conservatively rated **£2.50** pp £1. Sec 17v+2+1½+1 separate windings all at 20amps **£9.95** carr £2.

AEG L.T. TRANSFORMERS

Computer power supply designer. Pri 220-240v sec 10v 13.8amps and 22.8v 10.5amps. Conservatively rated open type, tag connections. Brand new fraction of makers price **£8.50** carr £2.
PARTIRIDGE Pri 110-220-240v secs 15.5-0-15.5v 1amp 4times 19v 1.8amps. Twice 27-0-27v 1.3a 27v 1.8amps. 'C' core type top panel connections **£8.95** carr £2.
WODEN Pri 220-240v secs 31v 7a. 26v 5a. 16v 4a twice. 25v 2a twice. Open type top panel connections **£12.00** carr £3.

HEAVY DUTY 'C' CORE L.T. TRANSFORMERS BRAND NEW

Fraction of makers' price
Primaries 110-220-240v cont rating No 1 sec 12v 40amps **£22.50** carr £3. No 2 sec 14v+3+1½v 40amps. Cont rating limited number **£25.00** carr £3 DC supply units, AC input 200-220-240v DC output, tapped 112v or 125v 3amps conservatively rated Plus or minus 3% choke/capacitor smoothed F.W. selenium rectification built on open chassis size 15 x 9½ins **£22.50** carr £5
'C' core pulse transformers AERE design 1:5kV ratio 1 to 1 top panel connections **£3.50** pp £1.

HIGH VOLTAGE TRANSFORMERS

Pri 240v sec 2500v 0.11a primary is also tapped at 260-280 300-330-350-387v to one variation on sec open type table top connections brand new. Fraction of makers price. **£15** carr £3. Parmeko potted type Pri 220-240v sec 1875v 80mA/a and 500v 31mA/a **£6.50** carr £2

H.T. TRANSFORMERS BY FAMOUS MAKERS ALL PRIMARIES 220-240v

No 1 890-710-0-710-890v 120mVA open type top panel connections **£4.95** pp £1.50
No 2 250-0-250v 50mA/a 6.3v 1.5a open type top panel connection **£3.00** pp £1. No 3 wooden type 8660281 sec 260-0-260v 150mA/a and 205-0-205v 60mA/a 6.3v 6a 6.3v 1a 5v 2a drop thru type tag connections **£4.95** pp £1.25. No 4 MT2 sec 350-0-350v 80mA/a 6.3v 3a 5v 2a or 6.3v 1a **£4.00** pp £1. No 5 MT7 350-0-350v 100mA/a 6.3v 3.5a 5v 2a or 6.3v 1a **£4.75** pp £1. No 6 Gardners 350-0-350v 60mA/a 6.3v 4a 5v 2.5a open type top panel connections **£4.50** pp £1.
No 7 sec tapped 370-390-410v 6mVA 'C' core top pane connections **£1.50** pp £1. No 8 sec 112v 262mVA and 6.3v 0.3a **£2.00** pp £1. No 9 Gardners sec 290v 350mA/a and 12 6a 2½amps **£4.50** pp £1.50. No 10 Pri 220-240v sec tapped 150 and 168v 3a open type. Top panel connections **£6.00** carr £2.

L.T. SMOOTHING CHOKES

Heavy duty open frame type. 24 mVA 45amps. Terminal block connections. Size 8x8x8 **£19.50** carr £4. 'C' core types 10 mVA 25amps **£7.50** carr £3. 10 mVA 7.7amps **£3.75** pp £1.25. 15 mVA 3.8amps **£3.50** pp £1.75. 75p. 100 mVA 2amps **£3.50** pp £1. 4.8 mVA 10amps open frame **£3.50** pp £1. Swinging 'C' core type 10 mVA 8amps 100 mVA 10amps to **£9.95** carr £1.50 HT chokes H 250 mVA **£3** pp £1.5 H 150 mVA **£2** pp 75p. 15H 75 mVA **£1.50** pp 75p. 50H 25 mVA **£1.50** pp 75p.

AC WKG BLOCK CAPACITORS BY FAMOUS MANUFACTURERS

MFD	Volts	Price
0.75	440VAC	50p
1	470VAC	60p
1.25	360VAC	65p
2	400VAC	75p
2.4	360VAC	75p
2.5	360VAC	75p
2.7+0.1	700VAC	£1.25
3	440VAC	£1.00
4	250VAC	£1.00
5	360VAC	£1.25
6	440VAC	£1.50
7.2	440VAC	£1.50
8.4	250VAC	£1.00

PP up to 2.5 MFD 25p, 2.7 to 15 MFD 50p +8% on total.

STANDARD OPEN TYPE RELAYS SINGLE HOLE FIXING 7 AMP CONTACTS BY FAMOUS MAKERS

Coil Voltage	Contacts	Price
240V AC	3C0	£1.00
240V AC	2C0	85p
240V AC	1C0	75p
115V AC	3C0	75p
115V AC	2C0	65p
48V DC	3C0	65p
24V DC	1C0	75p

Sealed 11 pin plug in type. 12v AC 3C0 **£1.50**, 8 pin 2C0 12v DC **£1**, 48v DC 2C0 **£1** pp 15p per relay. Please add VAT 15% on total. Miniature relay 6v DC 1C0 size 1¼ x ¾in, three for **£1** pp 25p. Elliott sealed contact relays type ERM 12v DC 1 make contact **£1** pp 25p.

LOW CURRENT L.T. TRANSFORMERS

No 1 sec 65v 2.2A and 30-0-30v 100 mVA tag connections **£4** pp £1.25. No 2 sec 27v 3A tag connections **£3.50** pp £1. No 3 sec 15-0-15v 2A tag connections **£2.75** pp £1. No 4 sec tapped 3-9-12-27-30-36v 1.8amps **£3.95** pp £1. No 5 sec tapped 18-22-27v 250 mVA twice **£2.75** pp £1. No 6 sec 24v 480 mVA twice **£2.95** pp £1. No 7 sec 28v 3amps and 4v 250 mVA **£1.95** pp 75p. No 8 sec 12v 3a GPO rating **£3.50** pp £1. HO1 12v ½a and 24v ¼amp **£1.50** pp 50p. No 10 sec 55v ½amp and 6.3v 1.5amp **£1.50** pp 50p. No 11 sec 60v 2a **£3.75** pp £1.25. No 12 sec 24-0-24v ¼a 4 5v 1a 150v 15 mVA potted **£2** pp £1.

BARGAIN OFFERS

Unimax micro switches. Type DAW15 double pressure roller lever action separate 1 CO each pressure 240v 15a contacts, three for **£1.50** pp 50p. ETA overvoltage switches 10 amp 250v panel mounting, three for **£2.50** pp 50p. Micro switches, overall size 1in x ¾in roller lever action 1 CO, 10 for **£2.50** pp 25p. Burgess standard plunger type 3BR74 1 CO, three for **£1** pp 25p. Sangmo panel mount hour meters 4 digits + 1/10 hour digit AC 240v size 1½ x 1½ x ¾in **£2** pp 25p.

Stonebridge GPO type resettable counter 12v DC 4 digits **£3** pp 25p. ENW counters 110v AC 6 digits, three for **£1** pp 50p.

HEAVY DUTY ISOLATION TRANSFORMERS 240-240V OR 240-110V UP TO 15 AMPS

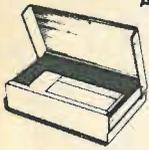
Large selection available. All by famous makers, fraction of list price. Please telephone us for further details.

AUTO STEPDOWN TRANSFORMERS FOR AMERICAN EQUIPMENT 240-110V 60-250 WATTS

Fully shrouded, fitted with American two or three pin outlet and three core 240v mains lead. Send see for latest price list. American plugs, sockets, adaptors also available.

YOUR COMPLETE RANGE OF ELECTRONIC HARDWARE...

BIMENCLOSURES



ALL METAL BIMCASES

Red, Grey or Orange 14swg Aluminium removable top and bottom covers. 18 swg black mild steel chassis with fixing support brackets.

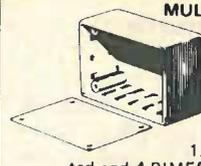
BIM 3000
(250x167.5x68.5mm)
£15.52



MINI DESK BIMCONSOLES

Orange, Blue, Black or Grey ABS body incorporates 1.8mm pcb guides, stand-off bosses in base with 4 BIMFEET supplied. 1mm Grey Aluminium panel sits recessed with fixing screws into integral brass bushes.

BIM 1005 (161 x 96 x 58mm) £2.48
BIM 1006 (215 x 130 x 75mm) £3.48



MULTI PURPOSE BIMBOXES

Orange, Blue, Black or Grey ABS with 1mm Grey Aluminium recessed front cover held by screws into integral brass bushes. 1.8mm pcb guides incorporated and 4 BIMFEET supplied.

BIM 4003 (85x56x28.5mm) £1.34
BIM 4004 (111x71x41.5mm) £1.84
BIM 4005 (161x96x52.5mm) £2.48

ALL METAL BIMCONSOLES

All aluminium, 2 piece desk consoles with either 15° or 30° sloping fronts, sit on 4 self-adhesive non-slip rubber feet. Ventilation slots in base and rear panel for excellent cooling. See latest catalogue for new styles and sizes

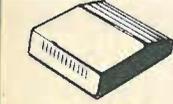


15° Sloping Panel

Model	Dimensions (mm)	Price (£)
BIM7151	102x140x51 [28]	11.36
BIM7152	165x140x51 [28]	12.28
BIM7153	165x216x51 [28]	13.43
BIM7154	165x211x76 [33]	14.83
BIM7155	254x211x76 [33]	16.36
BIM7156	254x287x76 [33]	17.71
BIM7157	356x211x76 [33]	18.83
BIM7158	356x287x76 [33]	19.92

30° Sloping Panel

Model	Dimensions (mm)	Price (£)
BIM7301	102x140x76 [28]	11.36
BIM7302	165x140x76 [28]	12.28
BIM7303	165x183x102 [28]	13.43
BIM7304	254x140x76 [28]	14.83
BIM7305	254x183x102 [28]	16.36
BIM7306	254x259x102 [28]	17.71
BIM7307	356x183x102 [28]	18.83
BIM7308	356x259x102 [28]	19.92



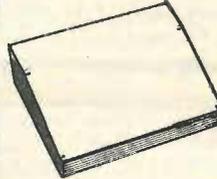
ABS & DIECAST BIMBOXES

6 sizes in ABS or Diecast Aluminium. ABS moulded in Orange, Blue, Black or Grey. Diecast Aluminium in Grey Hammettone or Natural. All boxes incorporate 1.8mm pcb guides, stand-off supports in base and have close fitting flanged lids held by screws into integral brass bushes (ABS) or tapped holes (Diecast).

Dimensions (mm)	ABS	Diecast	Hammettone	Natural
(50x50x25mm)	N/A	BIM5001/11	£1.54	£1.23
(100x50x25mm)	BIM2002/12	BIM5002/12	£1.66	£1.32
(112x62x31mm)	BIM2003/13	BIM5003/13	£2.24	£1.70
(120x65x40mm)	BIM2004/14	BIM5004/14	£2.81	£2.11
(150x80x50mm)	BIM2005/15	BIM5005/15	£3.19	£2.72
(190x110x60mm)	BIM2006/16	BIM5006/16	£4.94	£3.96

Also available in Grey Polystyrene with no slots and self-tapping screws
BIM 2007/17 (112x61x31mm) £1.06

LOW PROFILE BIMCONSOLES



Orange, Blue, Black or Grey ABS body has ventilation slots as well as 1.8mm pcb guides and stand-off bosses in base. Double angle recessed front panel with 4 fixing screws into integral brass bushes. 4 BIMFEET supplied.

BIM 6005 (143 x 105 x 55.5 [31.5] mm) £2.76
BIM 6006 (143 x 170 x 55.5 [31.5] mm) £3.58
BIM 6007 (214 x 170 x 82.0 [31.5] mm) £4.83

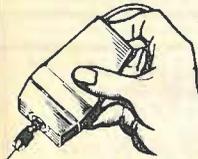
EUROCARD BIMCONSOLES



Orange, Blue, Black or Grey ABS body accepts full or 1/2 size Eurocards, with bosses in the base for direct fixing. 1.8mm wide pcb guides incorporated and 4 BIMFEET supplied. 1mm Grey aluminium lid sits flush with body top and held by 4 screws into integral brass bushes.

BIM 8005 (169x127x70[45] mm) £4.71
BIM 8007 (243x187x103[66] mm) £6.70

BIMTOOLS + BIMACCESSORIES



MAINS BIMDRILLS

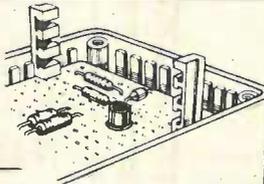
Small, powerful 240V hand drill complete with 2 metres of cable and 2 pin DIN plug. Accepts all tools with 1mm, 2mm or .125" dia. shanks. Drills brass, steel, aluminium and pcb's. Under 250g, off load speed 7500 rpm. Orange ABS, high impact, fully insulated body with integral on/off switch £11.21

Mains Accessory Kit 1 includes 1mm, 2mm, .125" twist drills, 5 burrs and 2.4mm collet £2.64

Mains Kit 2 includes Mains BIMDRILL as above, 20 assorted drills, mops, burrs, grinding wheels and mounted points, 1mm, 2mm, 2.4mm and .125" collets. Complete in transparent case measuring 230x130x58mm £23.57

BIMDAPTORS

Allows pcb's to be flat mounted sandwich fashion in BIMBOXES, BIMCONSOLES, and all other enclosures having 1.5mm wide vertical guide slots. One plastic BIMDAPTOR on each corner of pcb(s) enables assembly to be simply slid into place. 54mm long, 10 slots on 5mm spacing and can be simply snapped off to length. £1.15 per pack of 25.



BIMFEET

11mm dia. 3mm high, grey rubber self-adhesive enclosure feet. £0.81 per pack of 24.

12 VOLT BIMDRILLS

2 small, powerful drills easily hand held or used with lathe/stand adaptor. Integral on/off switch and 1 metre cable.

Mini BIMDRILL with 3 collets up to 2.4mm dia. £ 8.62
Major BIMDRILL with 4 collets up to 3mm dia. £14.49

Accessory Kits 1 have appropriate drills and collets as above plus 20 assorted tools. Mini Kit 1 - £16.10, Major Kit 1 - £20.70. Accessory Kits 2 have appropriate drills, collets plus 40 tools and mains-12V dc adaptor. Mini Kit 2 - £36.22, Major Kit 2 - £41.97. Accessory Kits 3 as appropriate Kits 2 plus stand/lathe unit. Mini Kit 3 - £48.30, Major Kit 3 - £54.05.

BIMPUMPS

2 all metal desoldering tools provide high suction power and have easily replaceable screw in Teflon tips. Primed and released by thumb operation with in-built safety guard and anti-recoil system.

BIMPUMP Major (180mm long) £8.51
BIMPUMP Minor (150mm long) £7.24

BIMIRONS



Type 30 General Purpose 27 watt iron with long life, rapid change element, screw on tip, stainless steel shaft and clip on hook. Styled handle with neon. £4.37

Type M3 Precision 17 watt iron, quick change tip, long life element, styled handle with clip on hook. £4.71

BIMBOARDS



DIL COMPATIBLE BIMBOARDS



Accept all sizes (4-50 pin) of DIL IC packages as well as resistors, diodes, capacitors and LEDs. Integral Bus Strips up each side for power lines and Component Support Bracket for holding lamps, switches and fuses etc. Available as single or multiple

units, the latter mounted on 1.5mm thick black aluminium back plate which stand on non slip rubber feet and have 4 screw terminals for incoming power.

BIMBOARD 1 has 550 sockets, multiple units utilising 2, 3 and 4 BIMBOARDS incorporate 1100, 1650 and 2200 sockets, all on 2.5mm (0.1") matrix.

BIMBOARD 1 £ 9.40
BIMBOARD 2 £22.37
BIMBOARD 3 £31.83
BIMBOARD 4 £41.53

DESIGNER PROTOTYPING SYSTEM

1, 2, or 3 BIMBOARDS mounted on BIM 6007 BIMCONSOLE with Integral Power Supply (±5 to ±15Vdc @ 100mA and fixed +5Vdc @ 1A). All O/P's fully isolated. Short circuit and fast fold back protection. Power rails brought out to cable clamps that accept stripped wire or 4mm plug.

DESIGNER 1 £58.65
DESIGNER 2 £64.97
DESIGNER 3 £71.30

...FROM **BOSS**
INDUSTRIAL MOULDINGS LIMITED

All quoted prices are 1 off and include Postage, Packing and VAT. Terms are strictly cash with order unless you have authorised BOSS account. For individual data sheets or short form catalogue on all BOSS products send stamped, self addressed 4 x 8" envelope

2 Herne Hill Road London SE24 0AU
Telephone: 01 737 2383
Telex: 919693 Answer Back 'LITZEN G'
Cables & Telegrams: 'LITZEN LONDON SE24'

The 7208 600 MHz Mini Counter

the quality low cost counter

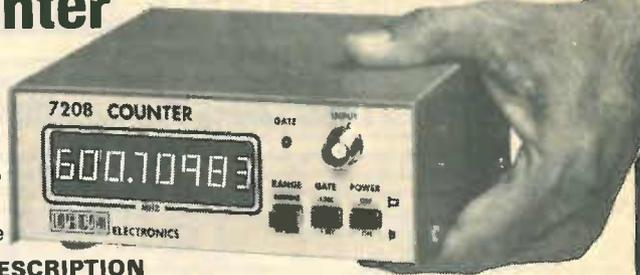
FEATURES . . .

- All Metal Cabinet ● 8 Digit .4" LED Display ● Built-in Prescaler ● Automatic Dp Placement ● Gate Light ● IC Sockets Included ● 240V or 12V Operation ● Proportional Control Crystal Oven (Optional) ● Built-in VHF-UHF Preamp ● Completely Portable with Rechargeable Batteries (Optional).

AVAILABLE FROM THE EXCLUSIVE U.K. DISTRIBUTORS:

SOTA COMMUNICATION SYSTEMS LTD.

26 CHILDWALL LANE, BOWRING PARK, LIVERPOOL L14 6TX
MERSEYSIDE. TEL. 051-480 5770 Telex 627110 SOTA G



DESCRIPTION

The Davis 7208 VHF-UHF Frequency Counter incorporates the latest LSI technology in a wide range portable instrument at a reasonable price. The 7208 offers outstanding features including an all metal cabinet for RF shielding, large 8 digit display, built-in prescaler, automatic DP, and with the built-in VHF-UHF preamp the 7208 can directly measure low level RF signals from RF generators. The 7208 can also be operated completely portable with the Ni-Cad battery option. Price £145.00 + VAT.

WW - 079 FOR FURTHER DETAILS

ASTRA-PAK

92 GODSTONE ROAD
WHYTELEAF SURREY CR3 0EB

All prices include V.A.T. Add 25p for P&P (Extra for overseas). Discounts over £10 less 5%, over £20 less 5%, over £50 less 10%, over £100 less 20%. Send SAE for complete list of components.

7400	0.12	7495	0.54	74190	1.05	74LS113	0.36	4007	0.16	4095	0.72
7401	0.12	7496	0.60	74191	0.99	74LS114	0.36	4008	0.92	4086	0.78
7402	0.12	7497	2.38	74192	0.99	74LS123	0.82	4009	0.45	4089	1.55
7403	0.12	74100	0.94	74193	1.05	74LS124	2.45	4010	0.48	4093	0.65
7404	0.13	74104	0.40	74194	0.90	74LS125	0.44	4011	0.15	4094	1.80
7405	0.13	74105	0.40	74195	0.84	74LS126	0.44	4012	0.18	4095	1.10
7406	0.28	74107	0.28	74196	0.90	74LS132	0.99	4013	0.42	4096	1.10
7407	0.28	74109	0.45	74197	0.80	74LS136	0.40	4014	0.80	4097	3.50
7408	0.14	74110	0.46	74198	1.48	74LS138	0.53	4015	0.77	4098	1.12
7409	0.14	74111	0.70	74199	1.48	74LS139	0.53	4016	0.42	4099	1.90
7410	0.13	74116	1.80	74221	1.50	74LS151	1.05	4017	0.77	4404	1.00
7411	0.18	74118	0.82	74273	2.15	74LS153	0.50	4018	0.87	4412	0.30
7412	0.21	74119	1.30	74279	1.25	74LS154	1.20	4019	0.42	4428	0.80
7413	0.25	74120	0.82	74283	1.70	74LS155	0.86	4020	0.92	4445	1.50
7414	0.54	74121	0.25	74284	8.85	74LS156	0.86	4021	0.82	4449	0.30
7416	0.27	74122	0.40	74293	1.35	74LS157	0.47	4022	0.82	4501	0.17
7417	0.27	74123	0.53	74298	1.92	74LS158	0.53	4023	0.15	4502	0.88
7420	0.13	74125	0.44	74390	1.92	74LS160	1.22	4024	0.98	4507	0.50
7421	0.28	74126	0.85	74393	2.12	74LS161	0.50	4025	0.15	4508	2.25
7422	0.17	74128	0.62	74LS00	0.15	74LS162	1.22	4026	1.28	4510	1.05
7423	0.25	74132	0.68	74LS01	0.19	74LS163	0.69	4027	0.50	4511	0.88
7425	0.20	74135	0.68	74LS02	0.19	74LS164	1.20	4028	0.67	4512	0.82
7426	0.25	74136	0.75	74LS03	0.19	74LS168	2.00	4029	0.88	4514	2.85
7427	0.25	74137	0.94	74LS04	0.20	74LS169	2.00	4030	0.48	4515	2.80
7428	0.34	74141	0.58	74LS05	0.20	74LS170	1.76	4031	2.34	4516	1.02
7430	0.13	74142	2.00	74LS08	0.19	74LS173	1.05	4033	1.25	4518	0.98
7432	0.24	74143	2.00	74LS09	0.19	74LS174	1.12	4034	2.00	4519	0.50
7433	0.32	74144	2.00	74LS10	0.19	74LS175	1.05	4035	1.00	4520	1.05
7437	0.24	74145	0.64	74LS11	0.19	74LS189	2.85	4036	2.40	4521	2.00
7438	0.24	74147	1.30	74LS12	0.19	74LS190	0.81	4037	0.99	4522	1.35
7440	0.13	74148	1.18	74LS13	0.46	74LS191	0.81	4038	1.00	4527	1.60
7441	0.62	74150	0.99	74LS14	1.10	74LS192	1.80	4039	2.80	4528	0.92
7442	0.55	74151	0.60	74LS15	0.19	74LS193	1.80	4040	0.88	4529	1.10
7443	0.90	74153	0.60	74LS20	0.19	74LS195	1.12	4041	0.77	4536	3.58
7444	0.90	74154	1.05	74LS21	0.19	74LS196	1.20	4042	0.72	4553	4.20
7445	0.70	74155	0.63	74LS22	0.19	74LS197	1.20	4043	0.82	4555	0.85
7446	0.70	74156	0.63	74LS26	0.24	74LS221	1.12	4044	0.82	4556	0.85
7447A	0.64	74157	0.63	74LS27	0.40	74LS247	0.97	4045	1.40	4558	1.25
7448	0.60	74159	1.70	74LS30	0.19	74LS248	0.97	4046	1.32	4568	1.40
7450	0.13	74160	0.80	74LS32	0.25	74LS249	0.97	4047	0.98	4583	0.75
7451	0.13	74161	0.80	74LS37	0.27	74LS251	1.00	4048	0.80	4585	1.03
7453	0.13	74162	0.80	74LS38	0.27	74LS253	1.05	4049	0.42		
7454	0.13	74163	0.80	74LS40	0.19	74LS257	1.05	4050	0.42		
7459	0.13	74164	0.89	74LS42	0.53	74LS259	1.05	4051	0.84		
7470	0.28	74165	0.89	74LS47	0.97	74LS266	0.39	4052	0.84		
7472	0.22	75166	0.99	74LS48	0.97	74LS273	2.50	4053	0.84		
7473	0.26	74167	2.70	74LS49	0.97	74LS279	0.50	4054	1.10		
7474	0.26	74170	1.68	74LS51	0.19	74LS283	1.00	4055	1.00		
7475	0.30	74172	4.00	74LS54	0.19	74LS289	2.85	4060	0.98		
7476	0.28	74173	1.18	74LS55	0.20	74LS293	0.90	4066	0.48		
7480	0.45	74174	0.89	74LS73	0.30	74LS298	1.60	4067	3.50		
7481	0.90	74175	0.88	74LS74	0.34	74LS352	0.82	4068	0.24		
7482	0.80	74176	0.88	74LS75	0.45	74LS353	1.05	4069	0.17		
7483	0.72	74177	0.88	74LS76	0.32	74LS365	0.50	4070	0.17		
7484	0.90	74178	1.20	74LS78	0.32	74LS366	0.50	4071	0.17		
7485	0.88	74179	1.10	74LS83	0.78	74LS367	0.50	4072	0.17		
7486	0.26	74180	0.90	74LS85	0.90	74LS368	0.50	4073	0.17		
7489	2.00	74181	1.02	74LS86	0.35	74LS386	0.37	4075	0.17		
7490	0.35	74182	0.75	74LS93	0.95	74LS670	2.00	4076	1.05		
7491	0.65	74184	1.20	74LS95	1.10	4000	0.14	4077	0.46		
7492	0.46	74185A	1.20	74LS107	0.36	4001	0.15	4078	0.22		
7493	0.40	74186	7.20	74LS109	0.36	4002	0.16	4081	0.17		
7494	0.80	74188	2.70	74LS112	0.38	4006	0.92	4082	0.20		

WW - 073 FOR FURTHER DETAILS

MAIL ORDER PROTECTION SCHEME (Limited Liability)

If you order from mail order advertisers in this magazine, except for classified advertisements, and pay by post in advance of delivery, Wireless World will consider you for compensation if the advertiser should become insolvent or bankrupt, provided

1. You have not received the goods or had your money returned; and
2. You write to the publisher of Wireless World explaining the position not earlier than 28 days from the day you sent your order and not later than 2 months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the advertiser has been declared bankrupt or insolvent up to a limit of £3,550 per annum for any one advertiser so affected and up to £10,000 per annum in respect of all insolvent advertisers. Claims may be paid for higher amounts, or when the above procedure has not been complied with, at the discretion of Wireless World, but we do not guarantee to do so in view of the need to set some limit to this commitment and to learn quickly of readers' difficulties.

This guarantee covers only advance payments sent in direct response to an advertisement in this magazine (not, for example, payments made in response to catalogues, etc., received as a result of answering such advertisements. Personal advertisements are excluded.

Codespeed Electronics

P.O. BOX 23, 34 SEAFIELD ROAD, COPNOR, PORTSMOUTH, HANTS, PO3 5BJ
8 DIGIT 0.1" LED DISPLAY multiplexed, common cathode. 99p each. **DIGITAL ALARM CLOCK MODULE** with 0.7" display, with data £5.99 each. **4 DIGIT CLOCK LCD** 0.5" digits, supplied with data, £4.99 each. **MM5316** digital alarm clock chip, with data £2.29 each. **REJECT CALCULATORS**, untested, but good value for spares, £2.50 each. **LED WRISTWATCH IC** Mostek MK5030, with data 99p each. **LED WRISTWATCH DISPLAY** type DIS501, 0.1" digits. With data 99p each. **SUPER SAVER** purchase an MK5030 and a DIS501 for only £1.50 the pair. **NOTE** the MK5030 and DIS501 are housed in a 'legless flatpack' style package and require some fairly fine soldering. **20 KEY KEYBOARDS** calculator keyboards, 2 for 99p (not for use with NORTEC4204 calc. chip). **4 DIGIT 0.8" LED DISPLAY** common cathode, with data £3.75 each. **DIGITAL MULTIMETER CHIP** MM5330 IC to build a 4 1/2 digit multimeter, with data £3.49 each. **SUPER QUALITY JACK SOCKETS** 1/4" (6.35mm) jack sockets, mono 25p each, stereo 25p each. **SLIDE POT KNOBS**, please state colour required, 11p each. **ROTARY VOLUME CONTROL KNOBS**, nice style, 18mm diam, black with coloured cap. Please state colour required, 18p each. **10 LED DISPLAYS**, untested material. 0.1" digits, common cathode. 95p. **6 DIGIT 0.1" LED DISPLAY** multiplexed, common cathode, 99p. **555 TIMER IC** with data and applications booklet, 23p. **POLARIZING FILM**, max 19" wide, any length, only 2p per sq inch. Any size cut. **SLIDER SWITCHES** 2 pole, change over, 16p each. **PUSH BUTTON SWITCHES**, spring loaded (momentary) with one n.o. contact 14p each. **CALCULATOR CHIP**, Nortec 4204, 4 function and constant, with data, 80p. **2102 MEMORIES**, dynamic memories for your micros, with data, 95p each. **MM5314** digital clock chip, with data, £1.99 each. **WRISTWATCH LCD**, supplied with polarizers and data sheet, 99p each.
NEW CATALOGUE AVAILABLE FROM JANUARY. SEND S.A.E. FOR YOUR FREE COPY POST AND PACKING PLEASE ADD 35p (OVERSEAS ORDERS ADD 99p)
V.A.T. ADD 15% TO THE TOTAL OF GOODS AND P&P
FULL SATISFACTION GUARANTEE ON ALL ITEMS

WW - 045 FOR FURTHER DETAILS

TV TUBE REBUILDING

Faircrest Engineering Ltd., manufacture a comprehensive range of equipment for processing all types of picture tubes, colour and mono. Standard or custom built units for established or new businesses. We export world-wide and have an excellent spares service backed by a strong technical team.

Full training courses are individually tailored to customers' requirements.

For full details of our service contact Neil Jupp

FAIRCREST ENGINEERING LTD.

Willis Road, Croydon, CRO2XX.
01-684 1422, 01-689 8741

WW - 020 FOR FURTHER DETAILS

PPM2: PEAK PROGRAMME METERS

- ★ Approved by broadcasting authorities in the U.K. and overseas for critical programme monitoring.
- ★ Reviewed *Studio Sound* September, 1976. Meets IEC268-10A, draft BS5428-9.
- ★ Accurate law at and between all PPM marks with minimal preset adjustment. Marginal adjustment is retained to allow compensation for the tolerance in scale markings between meter manufacturers and different meters from the same maker.
- ★ Decay matching of all boards allows use with twin movements without pairing.
- ★ Flat frequency response at all PPM marks and also below minimum calibration point.
- ★ Gold plated connector and floating input protected against mains or static voltages on the signal lines. Supply input protected against reverse polarity.
- ★ Close tolerance components with excellent temperature and ageing characteristics used throughout.
- ★ Soak tested boards. *Ernest Turner* meter movements 640, 642, 643, and TWIN flush mounting adaptors and illumination kits from stock. Scalings available 1/7, IEC268-10A Type 11a-12/TEST/+12 Type 11b used by EBU and conforming to CCITT recommendation N15(1972) but not recommended by us except for EBU and measuring instruments.

Stereo Disc Amplifier 2 ★ 10 Outlet Distribution Amplifier 2 ★ Stabilizer ★ Peak Deviation Meter ★ Chart Recorders.

SURREY ELECTRONICS

The Forge, Lucks Green, Cranleigh, Surrey GU6 7BG. Tel: (04866) 5997

Penny Dropped?



Switchcraft QG Connectors are money savers

Because we have introduced an attractive new quantity discount structure. Switchcraft are still the same high quality, with unique features such as captive design screws and shell ground terminals.

Two new additions to the range are —

FAS-DISCONNECT

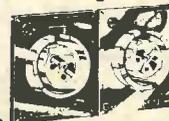
A new non-locking feature allowing immediate disconnection that requires only a 4 lb (1.8 kg) force. Great for that fast equipment take-down in hard to reach, darkened areas. Stage hands never had it so good!

REAR MOUNTED RECEPTACLES

The new Y series QG receptacles permit a complete sub assembly to be soldered, cleaned and tested prior to chassis mounting. Available with PC or solder terminals with lock or Fas-disconnect latching, the Y series offers real savings in production costs. Extra colour trim escutcheons provide functional panel trimming and colour coding.

Switchcraft QG Connectors are just right for audio mixers consoles, PA systems and in computer applications.

The professionals choose Switchcraft QG and save the pennies!



F.W.O. Bauch Limited

49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502

WW — 070 FOR FURTHER DETAILS

ORGAN and PIANO KEYBOARDS

	Price inc. VAT	P & P
4-Octave C-C	£32.20	£2.75
5-Octave C-C	£34.50	£2.75
5-Octave F-F	£34.50	£2.75
6-Octave C-C	£36.80	£3.00

DALSTON ELECTRONICS
40a Dalston Lane, Dalston Junction
London, E8 2AZ Tel: 01-249 5624

STEREO DISC AMPLIFIER 3

A reference amplifier for disc monitoring and transfer when replay signals of the highest quality are required.



Please ring or write for six page specification leaflet.

Reviewed in November issues of Gramophone, Hi-Fi for Pleasure and Popular Hi-Fi.

Dominus P.O. Box 1

Cranleigh, Surrey GU6 7JF. Tel. 04866 6477

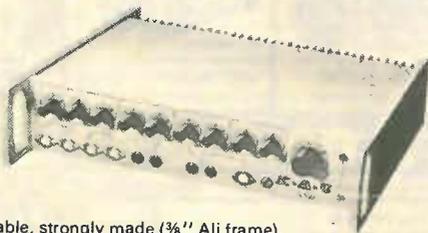
K.A.C. A150 MIXER AMPLIFIER

150 WATTS SINE WAVE POWER

£199.50

Rm. P inc. VAT.

Trade Enquiries welcome



Mono, all purpose, reliable, strongly made (3/8" Ali frame).
Double anodised fascia. Full electronic short circuit protection.
Six independent inputs: Dual Phono, RIAA, change-over fader for Discos.
Twin Jack output sockets: 8Ω 150W; 4Ω 100W; 16Ω 80W. (R.M.S.)

K.A.C. Electronic Inv. Ltd., 20 Priory St., Tonbridge, Kent
CALL FOR DEM or PHONE (0732) 358109 FOR LEAFLET

WW — 065 FOR FURTHER DETAILS

OHIO SCIENTIFIC Superboard II. Fully built 50Hz model for British tv sets, cassette interface, uses your tv as a vdu, full keyboard, 8K basic, 4K ram. We are the only people who include a free power supply and modulator kit in our price of £188 + 15% vat post free.

SINCLAIR PRODUCTS. New 10MHz scope £145. pfm200 £51.95, case £3.40, adaptor £3.40, connector kit £11.27. Microvision tv £91, adaptor £8.88, pdm35 £29.76, adaptor £3.40, case £3.40. dm350 £71.82, dm450 £102.17, dm235 £51.95, rechargeable batts £7.99, adaptor £3.94, case £9. Enterprise prog calculator + accessories £19.95.

COMPUTER GAMES. Chess Champion 6 £49.95. Chess Challenger 7 £84. Philips G7000 home computer £149. Videopaks £12.95. Atari video-computer £147. Cartridges £14.85.

COMPONENTS. 1N4148 0.9p. 1N4002 3.1p. 741 18p. bc182, bc184, bc212, bc214, bc458 5.5p. Resistors 1/4W 5% E12 10R to 10M 1p, 0.8p for 50+ of one value. 16V electrolytics .5, 1, 2, 5, 10, 22mf 5p, 100mf 6p, 1000mf 10p. 1 lb FeCl £1.30. Dalo pen 84p. 40 sq ins pcb 45p. Polystyrene capacitors E12 53V 10 to 1000pf 3p. 1n2 to 10n 4p. Ceramic capacitors 50V E6 22pf to 47n 2p. Zeners 400mW E24 2v7 to 33v 7p.

TV GAMES. AY-3-8500 + kit £7.26. Rifle kit £5.27. AY-3-8600 + kit £17.28. Stunt cycle chip + kit £18.66. AY-3-8603 chip £13.63.

TRANSFORMERS. 6.0-6V 100ma 76p, 1 1/2 £2.60. 9.0-9V 75ma 76p, 1a £2.22, 2a £3.13. 12.0-12V 100ma 82p, 1a £2.60.
IC AUDIO AMPS with pcb. JC12 6W £2.08. JC20 10W £3.14.

BATTERY ELIMINATORS, 3-way type 6/7 1/2 / 9v 300ma £3.14. 100ma radio type with press-studs 9v £3.57. 9 + 9v £4.79. Car converter 12v input, output 4 1/2 / 6 / 7 1/2 / 9v 800ma £2.66.

BATTERY ELIMINATOR KITS: 100ma radio types with press-studs 4 1/2v £1.49. 6v £1.49. 9v £1.49. 4 1/2 + 4 1/2v £1.92. 6 + 6v £1.92. 9 + 9v £1.92. Stabilised 8-way types 3/4 1/2 / 6 / 7 1/2 / 9 / 12 / 15 / 18v 100ma £2.50, 1Amp £5.30. Stabilised power kits 2-18v 100ma £2.98, 1-30v 1A £6.20, 1-30v 2A £11.24. 12v car converter 6/7 1/2 / 9v 1A £1.35.

T-DEC AND CSC BREADBOARDS. s-dec £3.78. 1-dec £4.59, u-dec £4.69, u-dec £7.16, exp 4b £2.64, exp 300 £6.61, exp 350 £3.62, exp 325 £1.84.

BI-PAK AUDIO MODULES. s450 £25.06. AL60 £5.06. ps100 £17.33. spm80 £4.74. bmt 80 £6.08. Stereo 30 £21.57. AL30A £4.08. pal 2 £8.38. ps12 £1.58. ma60 £36.27.

SWANLEY ELECTRONICS

Dept. WW, 32 Goldsail Rd., Swanley, Kent

Post 30p extra. Prices include VAT unless stated. Official and overseas orders welcome. Lists 24p post free. Mail order only.

CROPICO - A CERTAIN MEASURE OF PERFECTION

Cropico, established as one of Britains leading manufacturers of precision electrical measuring equipment, offer a wide range of instruments which have been proved for accuracy and performance throughout the world.

- | | |
|----------------------------------|----------------------------------|
| Resistance Boxes | D.C. Null Detectors |
| Resistance Bridges | Digital Temperature Indicators |
| Resistance Standards | Electronic Standard Cell |
| D.C. Potentiometers | Multimeters, Digital or Analogue |
| Thermocouple Reference Junctions | Wattmeters, Digital or Analogue |
| Thermocouple Switches | Insulation Test Sets |
| Pt 100 Switches | Earth Resistance Meters |
| Pt 100 Simulators | Fluxmeters |
| | And many more |

Cropico - Britains leading manufacturer, exporter and importer of precision electrical measuring equipment.

Request full details — Visitors Welcome

CROPICO LTD., Hampton Road,
Croydon CR9 2RU
Telephone: 01-684 4025 and 4094
Cables: CROPICO-CROYDON
Telex: 945632 CROPICO G



CROPICO

WW — 067 FOR FURTHER DETAILS

FOTOLAK

POSITIVE LIGHT SENSITIVE AEROSOL LACQUER

Enables YOU to produce perfect printed circuits in minutes!
Method Spray cleaned board with lacquer. When dry, place positive master of required circuit on now sensitized surface. Expose to daylight, develop and etch. Any number of exact copies can of course be made from one master. Widely used in industry for prototype work.

FOTOLAK	£2.00	Pre-coated 1/16 Fibre-glass board	
Developer	30p	204mm x 114mm	£1.50
Ferric Chloride	50p	204mm x 228mm	£3.00
		408mm x 228mm	£6.00
		487mm x 305mm	£9.00

Plain Copper-clad Fibre-glass.	Single-sided	Double-sided
Approx. 3.18mm thick sq. ft.		£1.50
Approx. 2.00mm thick sq. ft.	£2.00	
Approx. 1.00mm thick sq. ft.	£1.50	£1.75
Clear Acetate Sheet for making master, 260mm x 260mm		12p

Postage and packing 65p per order. VAT 15% on total

G. F. MILWARD ELECTRONIC COMPONENTS LIMITED

369 Alum Rock Road, Birmingham B8 3DR. Telephone: 021-327 2339

HI-FI TONE ARM BARGAINS

— from Britain's Leading Audio Store



ARISTON 8A 100 — low mass high quality arm. 'S' shaped. Low compliance. Universal SME type Head Shell. Complete with anti-skating device. SONIC PRICE **£15.95**



AUDIO TECHNICA AT-1007 'S' shaped arm. Low compliance magnesium universal head shell. Low capacitance heads. High trackability. SONIC PRICE **£29.95**

ALL LEADING MAKES OF HI-FI and MANY OTHER ACCESSORY BARGAINS AVAILABLE FROM THE COMMUNICATIONS CENTRE:

ALL GOODS SUPPLIED WITH FULL 2 YEARS GUARANTEE

LONDON'S LEADING HI-FI SPECIALISTS
SONIC SOUND AUDIO

OPEN 9.00am - 6.00pm Mon - Sat
248-256 Tottenham Court Road, London W1
Tel: HI-FI Dept 01-580 9311 RADIO Dept 01-637 1908

WW — 075 FOR FURTHER DETAILS

PROBABLY THE MOST INEXPENSIVE QUALITY SIGNAL GENERATOR AVAILABLE TODAY

Audio Range: 10Hz-100Khz, in four switched ranges.

Distortion
Extremely low.
(.0015% typical, @ 1Khz).

Output
1v into 600Ω, with Fixed and Variable Atten.
Sine and Square Wave.
Based on a Linsley Hood design.
Battery or Mains.

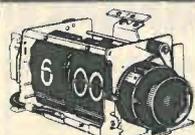


£36.00 (batty.)
Tax extra £5.40
P&P £2.00

TELERADIO ELECTRONICS

325 FORE STREET, EDMONTON, LONDON N9 0PE
01-807 3719 Closed Thursdays SAE for lists

WW—060 FOR FURTHER DETAILS



MECHANISM WITH ALARM

£5.00



Assemble it in an evening!
MECHANISM & CASE
Inc. assembly instructions

£6.99

DIGITAL 24 HOUR CLOCK

- SILENT RUNNING
- LARGE ILLUMINATED NUMERALS

AS USED IN **BRAUN** DIGITAL CLOCKS

THREE FOR **£13.50**

MECHANISMS 10 FOR **£39. 100 FOR £300**

HALF PRICE OFFER

● AC MAINS
● SIZE 6 3/8 x 2 3/8 x 2 3/4
Your receipt is a 2-year guarantee

Henry's Radio

HENRY'S RADIO
404 EDGWARE ROAD,
LONDON W2 1ED 01-723 1008

EXPORT ENQUIRIES INVITED

DELIVERY FROM STOCK

A.C. ADAPTOR (Battery Charger) 120 vac input, 5.8 vdc. at 200 mA output. USA type mains plug to 3.5 mm jack plug. Brand new & boxed £1.25 each.

A.C. ADAPTOR (Battery charger) 117 vac input, 4.5 vdc at 150 mA output. USA type mains plug to 2.5 mm jack plug. Brand new & boxed £1.00 each.

VARICAP TUNER HEADS, 4 button type, 22K res. with AFC switch & station indicator, Brand new £2.00 each.

SCREWS. Pack of nuts, bolts, washers, tags, self taps etc. Mixed BA & metric. Sold by weight. £2.00 per kilo.

LOW VOLTAGE ELECTROLYTICS. Pack of mixed values & voltages. Approx. 150 items £1.50.

JAYBEAM STARBEAM UHF set top aerials. Brand new & boxed £2.00 each.

MODERN TELEPHONES Type 746 with dials, colour cream, used but new condition. £8.00 each.

ERSIN MULTICORE SOLDER 3 core solder wound on a plastic reel. 20 swg. Ally 60/40 tin lead. Available in 500 gm reels. £5.70 each.

CHANNEL MASTER COLORATOR aerial rotator Model 9502. Rotation speed 1 rpm, gear ratio 3200:1, 3 conductor wire for economy, pinpoint positioning to within one degree. Few only at £45.00. We also stock Jaybeam T.V. and Radio aerials. SAE for lists.

ISEP SLOTTED HORIZONTAL RAIL available in 9 ft. lengths. £4.00 each.

WATCH STRAPS Black stainless steel 50p each. Black plastic 25p each. Watch spring bars 10p each. Discount for Quantity.

RADIOGRAM lid pumps £1.00 each, 2 for £1.50.

RIBBON CABLE 19 way decimal coded, 4 metres for £1.25.

PYE TELECOM Yagi aerials. 4 element, very rugged construction, 71.1 MHz (Ideal for four metres). Brand new £10.00 each.

DISGUISED MOBILE AERIALS (dustbin lids). Available in mid band & high band. Brand new £5.00 each.

BYX25-100 & BYX25R Rectifiers, 1000v 20A mounted on fitted heatsink. Ex-Equip. £1.25 each.

BZY93C75 Diodes, 75v 20W Zener mounted on fitted heatsink similar to above. Ex-Equip. 75p each.

FERRANTI MICROSPOT CATHODE RAY TUBES Type 3H/1010 Suitable for Photographic Multi-Channel Recorder Systems. Fitted with a mounting collar and prism cemented to the faceplate, screen aluminised Phosphor P. The tubes are also fitted with mounting units type MU1053 and deflection coil type SC48A. Few only at £55.00 each.

RADIOTELEPHONE EQUIPMENT

Pye Westminster W15AM high band & low band available. Sets complete and in good condition but are less speakers, mikes, cradles and LT leads. (sets only) £70.00 each.

Pye Westminster W15AM mid band 6 channel similar to above (sets only) £45.00 each.

Pye Westminster W15AMB (Boot Mount) low band complete with control gear and accessories, good condition £80.00 each.

Pye Westminster W30AM low band, sets only no control gear, complete and in good condition. £45.00 each.

Pye Westminster W30AM mid band, sets only good condition. £35.00 each.

Pye Base Station F27 Low & High band, few only at £75.00 each.

Pye Base Station F30 AM Low & High band, with & without T/T Prices from £220.00 each.

Pye Cambridge AM10B (Boot Mount) low band, 12.5 kHz, sets only, no control gear, good condition, £20.00 each.

Pye UHF Link U450L Base Station Tx £15.00 Rx £15.00 or £25.00 for the two. Sold as seen.

Pye BC14 Battery Charger for PF1 (Pocketfone) batteries, will charge up to 12 Tx batteries & 12 Rx batteries at the same time. £15.00 each.

Pye RTC Controller units, for remotely controlling a VHF or UHF fixed station radiotelephones over landlines. £35.00 each.

Pye PF1 Pocketfones suitable for conversion to 70cm, sets complete but less batteries, supplied with service manual. £26.00.

Pye PF2FMB Low band FM portable, complete and good condition but untested, few only at £65.00 each.

Pye PF2UB UHF portable, complete and good condition but untested, few only at £65.00 each.

Pye Europa MF5U 3 channel UHF mobile good condition £90.00.

Pye Reporter MF6AM High band mobile, very good condition £200.00.

Pye Olympic M212 UHF mobile, new condition, £185.00.

Pye Voltage Converter MF24PU 24v plug-in converter for Europa range of sets, to provide for 12 volt floating ground from 24 volt supply. £15.00.

PHILLIPS 25" Monochrome Monitor new condition with service manual. £25.00, carriage £2.00.

IC TEST CLIPS, clip over IC while still soldered to pcb or in socket. Gold plated pins, ideal for experimenters or service engineers. 28 pin DIL £1.75. 40 pin DIL £2.00. Or save by buying one of each for £3.50.

IC AUDIO AMP. PCB. Output 2 watts into 3 ohm speaker. 12 volt DC supply. Size approx 5 1/2" x 1 1/2" x 1" high, with integral heatsink, complete with circuits. £2.00 each.

NICAD CHARGER CONVERTER PCB. (Low power inverter). Size 4" x 1 3/4" x 1" high. 12v dc supply. 60v dc output through pot on pcb for charging portable batteries from mobile supply. Only needs one BFY50/51/52 or similar transistor which can be mounted direct on the pcb pins on the board fitted with a star type heatsink (not supplied) £2.00 each.

10.7 MHz SSB XTAL FILTERS (2.4 kHz Bandwidth) Low imp. type. Carrier and unwanted side-band rejection min -40db (needs 10.69835 & 10.70165 xtals for USB/LSB. not supplied) Size approx 2" x 1" x 1", £10.00 each.

LOW PASS FILTERS (Low imp. type). 2-9 MHz, small metal encapsulation. Size 1 1/2" x 3/4" x 3/4". 75p each.

BSR AUTOCHANGE RECORD PLAYER DECKS with cue device. 33-45-78 rpm for 7" 10" 12" records. Fitted with SC12M Stereo Ceramic cartridge and styli. Brand new £12.00 each.

XTALS FOR TV SY NC GEN. 20.25 kHz for 405 line, B7G glass type. £2.00 each.

RED LEDs (Min. type) 5 for 70p.

VIDICON SCAN COILS (Transistor type, but no data) complete with vidicon base £6.50 each. Brand new.

UR41 ATTENUATOR CABLE, Nominal 72ohm, overall dia. approx. 1/4", Att. per 100ft: 100 MHz 218dB, 200 MHz 316dB, 600 MHz 449dB, 3000 MHz 625dB. Ideal for Rx or Low power Tx fixed attenuators. Supplied with attenuation graph. 4 metres for £1.00.

HIGH QUALITY RELAYS, 4 pole C/O, 3A contacts, 12V DC coil, 150 ohm. Size approx. 1 1/4" x 3/4" x 1 1/2", with plastic covers. 80p each or 2 for £1.50.

OSMOR REED RELAY COILS (for reed relays up to 1/8" dia., not supplied) 12V, 500ohm coil, 2 for 50p.

RIGHT ANGLED UHF SERIES ADAPTORS, PL259 to SO239 £1.00 each.

BACK-TO-BACK SO239 SOCKETS, £1.00 each.

SEMICONDUCTORS

BFY50 Transistors 4 for 60p.
 BSX20 (VHF osc/mult) 3 for 50p.
 BC108 (metal can) 4 for 50p.
 BC109 (metal can) 4 for 50p.
 2N3819 fet. 3 for 60p.
 BC158 PNP Silicon 4 for 50p.
 741CG Op Amps 4 for £1.00.
 TIP 2955 Silicon PNP 2 for £1.50.
 LM309K 5v Regulator £1.00.
 BCY72 Transistors 4 for 50p.
 BC107 (metal can) 4 for 50p.

PBC108 (plastic BC108) 5 for 50p.
 BF152 (UHF amp/mixer/ 3 for 50p.
 BC148 NPN Silicon 4 for 50p.
 BAY31 Signal Diode 10 for 35p.
 SCR400V at 3A stud type, 2 for £1.00.
 1N4148 (1N914) diodes 10 for 25p.
 LM340/12 12v Regulator £1.00.

VALVES

EZ81 new 50p.
 ECC81 new 50p.
 ECC83 new 50p.
 E180F new £3.00.
 85A2 new 80p.

QQZ06-40 ex-equip. £10.00.
 QQV03-20A ex-equip. £5.00.
 QQV03-10 ex-equip. £1.20.
 QQV02-6 ex-equip. £2.00.
 6B8H ex-equip. 60.

Large Stocks of Quartz Crystals for R.T. equipment HC6U, HC18, HC25, £2.00 each. Ring your requirements or SAE for lists.

PYE WESTMINSTER PCBs ALL BRAND NEW

TX AUDIO PCB AT268838	Order code WS0	£8.00
MULTI-CHANNEL OSC. PCB FOR AM & FM AT26812/8 10 channel Low band	Order code WS1	£10.00
AT26811/10 & /2 6 channel High band	Order code WS2	£7.00
RX MULTIPLIER PCB FOR AM & FM AT26808 Low band / 24	Order code WS3	£7.00
AT26808/23 30MHz band	Order code WS4	£5.00
FM TX MOD DRIVER PCB AT26826/68 B band (will tune High band)	Order code WS5	£15.00
PA BOARDS WITH ALL TRANSISTORS AND HEATSINKS /screen covers not supplied)		
AT10784/10 P band (will tune Low band)	Order code WS7	£18.00
Low band pcb only, complete except for transistors and heatsink (for spares only)	Order code WS8	£1.50
AM 10.7MHz IF PCB WITH XTAL FILTER AT26805/10 25kHz spacing	Order code WS9	£15.00
AT26805/11 50kHz spacing	Order code WS10	£10.00
AM TX MULTIPLIER/DRIVER PCB AT26838/13 B band (will tune high band)	Order code WS11	£10.00
AT26838/14 Low band	Order code WS12	£10.00
TX FILTER W15AM AT10787/21	Order code WS13	£4.00
AT10787/23	Order code WS14	£4.00
AT10787/30	Order code WS15	£4.00

A selection of items below from our 1980 catalogue, the products we stock are by Eagle, Weller, Draper, Spiralux, Knipex, Servisol, Barnard's & Babani, Newnes, Jaybeam, Vero, and others. If you send us £1.35 you will receive the catalogue plus five bi-monthly shortform catalogues to keep you up to date with prices and special offers. A free pack of Blob Board comes with this month's issue.

EAGLE MA780T Electric fully automatic 6 section retractable car aerial with built-in voltage sensor. Remote drive system makes fitting easier. Aerial length, 1,000mm, below wing 220mm, lead length 9,000mm, flexible drive link 700mm. Price £16.95 plus VAT.

EAGLE DD7 Paging microphone, impedance 600 ohm or 50 K ohms, sensitivity 2.25mV at 50 K ohms, frequency response 300-9000 Hz. desk or wall mounted. £14.85 plus VAT.

EAGLE MULTIMETER EM50 50,000 opv. DC volts: 0-1200 volts, AC volts: 0-1200 volts, DC current 0-6A, Resistance 0-10 megohms. Price £19.95 plus VAT.

DRAPER super-chrome 1/4" square drive socket sets. 38 piece, 9 AF hexagon sockets, 3 AF bi-square sockets, 11 MM hexagon sockets, 9 BA hexagon sockets, and 6 accessories. Price £12.75 plus VAT.

SPIRALUX metric nut spinner sets, contains 8 nut spinners 4, 4.5, 5, 5.5, 6, 7, 8, 9, 10mm. Packaged in a plastic wallet with cellulose acetate handle. Price £7.53 plus VAT.

WELLER TCP3 IRONS 24 volt series, 3 wire power units, for applications requiring earthed tip. TCP3 irons £13.84, PU3D power units £24.12 plus VAT.

WELLER instant heat guns Model No. 8100D £13.21 each plus VAT.

WELLER cordless soldering irons Model No. WC100 £25.47 plus VAT.

JAYBEAM "STEREOBEAM" VHF/FM antennas Model SMB2, folded dipole and reflector with universal clamp. £8.00 each. Full range of Jaybeam aerials and accessories available. (See 1980 Catalogue).

ECA TVT78/78 semiconductor equivalent and data books. Data covering 12,000 transistors and more than 60,000 equivalents. 2 volumes for £6.00 Zero VAT.

ORYX DE-SOLDER TOOLS model SR3A, desoldering pump with built-in safety guard. Price £6.50 plus VAT.

AUCTION NOTICE

As from Sat. 3rd February 1980 we will hold weekly auctions on Saturday mornings of Radio & Electronic components & equipment, you bring and buy. Entries will be accepted on morning of sale from 8 am. The Sale will start at 10 am. So come along and bring something with you to sell. Light refreshments will be available.

Callers welcome by appointment
 S.A.E. for all enquiries

TERMS OF BUSINESS: CASH WITH ORDER

Carriage:
 Packing and carriage charges for orders of under £5.00 nett invoice value — 75p.
 Orders exceeding £5.00 but less than £20.00 invoice value — 50p.
 Over £20.00 carriage paid.
 VAT at 15% must be added to the total of all orders.

B. BAMBER ELECTRONICS
 DEPT. W.W., 5 STATION ROAD,
 LITTLEPORT, CAMBS CB6 1QE
 Tel: ELY (0353) 860185

**there are
transformers
and...**



OEM — let Drake Transformers advise you on a component specification and design to solve that special problem. Pre-production prototypes and development undertaken as necessary.

Well known over a quarter century for personal service and high-quality products, Drake specialise in the design and manufacture of transformers and other wound components for large and small quantity production.

Expertise and service put **DRAKE TRANSFORMERS** in a class of their own.

DRAKE TRANSFORMERS LIMITED

South Green Works Kennel Lane
Billericay Essex CM11 2SP

Telephone: Billericay (02774) 51155
Telex: 99426 (prefix Drake)

WW — 036 FOR FURTHER DETAILS

Versatile Professional Hand Tools

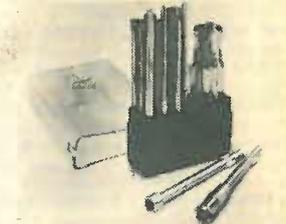
'SERIES 99' from XCELITE

99MP Multi-purpose tool kit



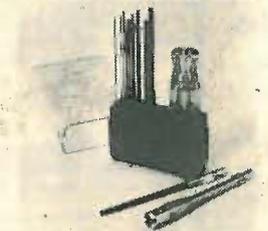
All most needed 99 Series tools etc. strips or other tools.

99PS50 13pc. S/driver, n/driver set.
(inch sizes)



Also available with metric sizes. Ref. 99PS51mm.

99PS40. Allen Hex Socket S/driver set
(inch sizes)



Also available:
99PS41mm (metric).
99PS41mmBP (metric ballpoint).
99PS40BP (inch sizes—ballpoint).

99SM Service Master



Versatile 23 pc. set of quality tools in roll-up, plastic coated canvas case. Quick change tools and tool combinations for assembly and service work.

Check our prices. Complete Xcelite catalogue freely available on request from:

SPECIAL PRODUCTS DISTRIBUTORS LTD.

81 Piccadilly, London W1V 0HL
Tel. 01-629 9556. Cables: Speciproq, London, W.1
Telex 265200 (Answerback RACEN G)

The 99 Series is the complete selection of interchangeable tools.

WW—054 FOR FURTHER DETAILS

**JD ELECTRONICS
ELECTRONIC VALVES**
BELOW ARE A FEW EXAMPLES
FROM OUR EXTENSIVE STOCK

OB2	1.00	5656	7.00	EH90	0.90	CV371	12.00
OC3	1.50	6442	15.00	EL32	1.00	CV395	8.00
OD3	1.50	A1834	7.00	EL38	8.00	CV416	3.50
2J56	45.00	A2134	8.00	EL41	1.20	CV2203	6.00
3B24W	7.00	A2521	9.00	EL84	1.00	CV2179	8.00
3D21A	15.00	BT17	45.00	EL85	3.00	CV2220	12.00
6AG5	0.90	DA41	16.00	EL86	1.75	CV2224	15.00
6AS6	1.00	DA42	10.00	EY84	6.00	CV2347	12.00
6AT6	1.25	DM160	3.00	G1/371K	20.00	CV2492	3.20
6AU6	0.75	E88CC	3.20	GXA160	8.00	CV3998	5.00
6BA6	0.80	E180F	5.00	M505	45.00	CV4003	1.00
6BH6	1.00	EA76	1.75	M506A	45.00	CV4004	1.00
6BJ6	1.00	EABC80	0.75	M591B	56.00	CV4006	5.50
6BR7	5.00	EB91	0.60	ME1400	4.00	CV4007	1.00
6CH6	4.50	EC88	1.75	QQV03-20A	12.50	CV4010	1.20
6J4W	4.00	EC90	1.00	QQV06-40A	15.00	CV4014	1.20
6J6	0.75	ECC40	1.20	X61M	2.00	CV4015	5.00
6L6G	2.00	ECC81	0.75	X79	10.00	CV4024	1.20
6Q7G	0.90	ECC82	0.75	CV120	35.00	CV4025	1.10
6X5GT	0.75	ECC83	0.75	CV131	1.50	CV4044	7.50
25L6GT	0.90	EF86	1.00	CV138	1.00	CV4055	4.50
805	10.00	EF91	1.00	CV140	0.75	CV4062	9.00
807	1.75	EF92	1.50	CV276	6.00	CV5031	45.00
931A	3.00	EF95	1.00	CV370	60.00	CV5311	5.20

(VAT EXTRA)

Please contact us for quantity discounts and types not listed above. Export enquiries welcome. All our valves are tested and guaranteed. We supply Government Departments, Universities and major manufacturers.

**UNIT D6, PEAR INDUSTRIAL ESTATE
STOCKPORT ROAD WEST
LOWER BREDBURY
STOCKPORT, CHESHIRE SK6 2BP
TEL: 061-406 2441**

video
amplifiers
music centres
electronic organs

Read all about home entertainment ideas for the nineteen-eighties in the new Hi Fi Yearbook and Home Entertainment. Still the leading reference book on Hi Fi it's now bigger and better than ever, with over 550 pages and new sections covering other types of home entertainment equipment: radios, electronic organs, colour TVs, video recorders and electronic TV games. There are specifications, prices and illustrations for the equipment covered, as well as informative articles written by experts.... Plus directories of manufacturers, suppliers and dealers.

Hi Fi Year Book and Home Entertainment 1980 available at leading newsagents and bookshops from November 1st. Price £3.75. If in difficulty order direct from the publishers @ £4.25 inclusive.

ORDER FORM

To: General Sales Manager, Room CP34,
IPC Business Press Ltd., Dorset House,
Stamford Street, London SE1 9LU

Please send me.....copy/copies of Hi Fi Year Book and Home Entertainment 1980 @ £4.25 a copy inclusive, remittance enclosed. Cheque/p.o. should be made payable to IPC Business Press Ltd.

Name.....
(please print)
Address.....

Registered in England No. 677128
Registered Office: Dorset House, Stamford Street, London SE1 9LU WW

BEST SELLERS' BEST BUY

Who makes what? And where can you find them? The Trader Year Book tells you. It's the essential guide to buying and selling for busy retailers as well as an invaluable reference work for everyone in the audio/TV/domestic electrical business. Separate sections cover Products, Trade Addresses, Proprietary Names, Wholesalers, Service Agents and Depots, Trade Organisations and Electricity Board Offices. There's lots of technical and legal information too. In short, a book that's good for trade.

**ELECTRICAL AND ELECTRONIC
TRADER YEAR BOOK 1980/1**

MAIL THIS COUPON NOW.

To IPC Electrical-Electronic Press Limited, General Sales Department, Room CP34, Dorset House, Stamford Street, London SE1 9LU.

Please send me.....copies of the Electrical and Electronic Trader Year Book 1980/81. I enclose cheque/p.o. numberto the value of..... (£6.50 per copy inclusive). Cheques made payable to IPC Business Press Ltd.

Name _____
Address _____

Company registered in England. Registered address: Dorset House, Stamford Street, SE1 9LU.
Registered number: 677128. WW

AVO digital thermometers -better by degrees



Now you can get Avo quality in digital thermometers. There are two units to choose from. The AT1, a battery operated, portable unit which is fast, accurate and easy to use; and the AT2, a battery/mains bench top model. Both feature large, easy to read displays, and together cover a wide temperature range from -65° to $+1200^{\circ}\text{C}$.

The range of 5 thermocouple probes enables measurement of anything from solid surfaces to the inside of a joint of beef!

Learn about the full benefits of the new Avo digital thermometers, get in touch with us today or contact your usual Avo distributor.



AVO LIMITED,
Archcliffe Road, Dover, Kent,
CT17 9EN.
Tel: 0304 202620 Telex: 96283

Thorn Measurement & Components Division

You'll never meet a better meter

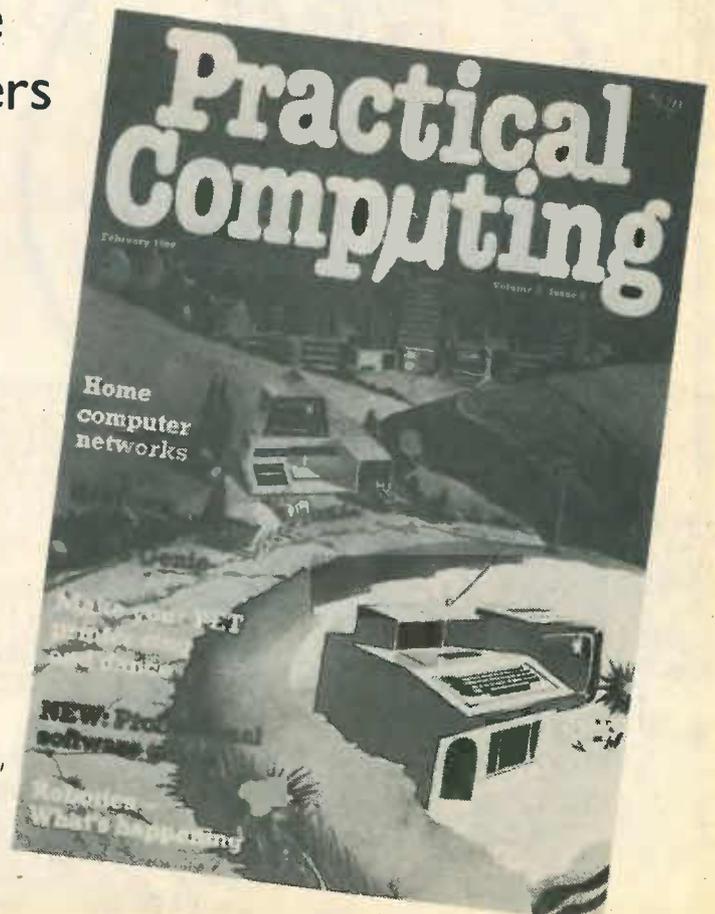
WW - 083 FOR FURTHER DETAILS

In three years there will be 300,000 personal computers in Britain: an essential part of every professional person's working life. Practical Computing is the leading journal in this important and fast growing area.

February Issue

on sale now at all good newsagents at 50p.
Oakfield Ho., Perrymount Rd., Haywards Heath,
W. Sussex RH16 2DH.

Subscriptions: £6, Subscription Servicing,
2nd Floor postroom,



Electronic Brokers

49/53 Pancras Road London NW1 2QB Tel: 01-837 7781. Telex 29869

No.1 in Second User Minis & Peripheral



TEXAS SILENT 700

Model 725KSR Terminal mounted in integral carrying case complete with built-in acoustic coupler, 64 ASCII character set with 5 x 7 dot matrix, 30 cps. Weight 35lbs. Dimensions 21½" x 19" x 6½". **£695.00.**

Model 733ASR **£1,450.00.** Model 742 **£1,750.00.**



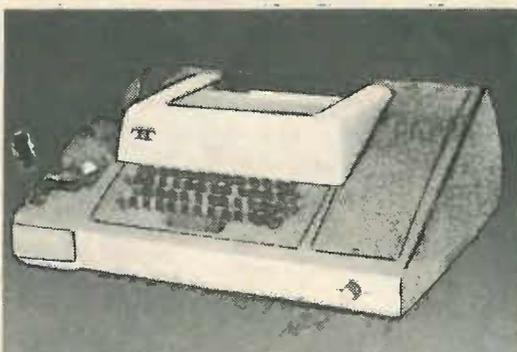
DEC PDP11/04 — SPECIAL PURCHASE

PDP11/04-BD 9-slot 5¼" Processor with 8kW MOS and DL11W interface **£3,250.**



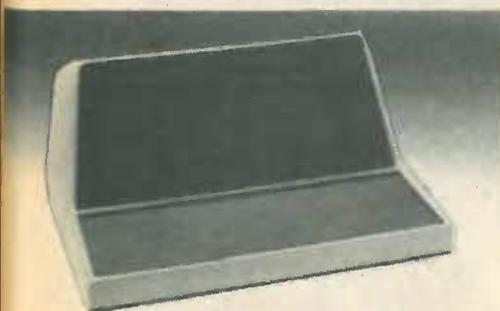
TERMIPRINTER 7075

Typewriter-quality Keyboard Send/Receive Impact Printer providing full upper and lower case character set, switch-selectable print speeds of 10, 15 and 30cps, 118-column print line with pin-feed platen suitable for paper rolls or continuous stationery (paper width 12.85") Standard V.24 (RS232) interface **£575.00.**



ASR33 and KSR33 TELETYPE

Input/Output terminals with 64 ASCII character set, 110 baud operation. Paper tape punch and reader (ASR33 only). Choice of interface (20mA or RS232) KSR33 — **£425.00.** ASR33 — **£650.00.** Pedestal **£30.00.**



BALL MIRATEL MONITOR

9" diagonal P4 phosphor tube Bandwidth 12MHz (-3dB) Input voltage 220V 50/60Hz 24W Output voltage +15V DC (short circuit protected) +12kVDC 12 6V rms Separate horizontal and vertical sync Supplied complete with high and low voltage power supplies amplifier and attractive moulded plastic housing including space for keyboard. Case dimensions — 20" x 19" x 10½" (including keyboard space 20" x 7"). Full technical manual provided **£95** (total including carriage and VAT **£123**).



SHUGART FLOPPY DISC DRIVES

SA400 Minifloppy — 110/220KB capacity, 35 tracks, transfer rate 125kbits/sec, AV access time 550msec Power requirements +5VDC +12VDC. PRICE: **£195.00**

SA800 Floppy — 400/800KB capacity, 77 tracks, transfer rate 250kbits/sec AV access time 260msec Power requirements +24VDC, +5VDC -5VDC. PRICE: **£395.00**

DEC EQUIPMENT

PDP11/40 System 48KW Parity Core Processor complete with KT11D Memory Management, DL11 Asynchronous Interface, RK11D Disc Controller, RK05J Disc Drives, 2 x 6ft. Rack Cabinets, Full DEC maintained in immaculate condition (or could be reconfigured to suit) **£9,750.00**
 PDP11/05 5¼" Processor with 8KW core memory **£1,850.00**
 RK05J Add-on disk drive **£1,850.00**
 MM11DP 16K parity core (for PDP11/04 and 11/34 series). BRAND NEW SURPLUS — ONLY **£995.00**
 PR11 High Speed Paper Tape Reader & Control **£1,450.00**
 Large stocks of DEC modules and add-ons

PRINTERS & TERMINALS

CENTRONICS 101 Matrix Printer **£750.00**
 CENTRONICS 102 Matrix Printer **£895.00**
 GE TERMINET 300 KSR Impact Printer **£625.00**
 GT TERMINET 1200 RO Impact Printer **£695.00**
 HAZELTINE H-1200 VDU **£375.00**
 HAZELTINE H-2000 VDU from **£395.00**
 SCOPE DATA Electrosensitive Printer **£495.00**
 TEKTRONIX 611 XY Storage Monitor **£1,350.00**

NEW ASCII KEYBOARDS — NEW LOW PRICES

		Mail Order Total
KB756 56-station ASCII Keyboard mounted on P.C.B.	£45.00	£53.40
KB756MF As above, fitted with metal mounting frame for extra rigidity	£50.00	£59.20
KB710 10-key numeric pad, supplied with connecting cable	£8.00	£9.70
KB701 Plastic enclosure for KB756 or KB756MF	£12.50	£15.20
KB702 Steel enclosure for KB756 or KB756MF	£25.00	£30.40
KB2376 Spare ROM Encoder	£12.50	£15.20
KB15P Edge connector for KB756 or KB756MF	£3.25	£4.30
DC-512 DC converter to allow operation at 5V only (plugs in to P.C.B.)	£7.50	£9.20
KB771 71-station ASCII Keyboard including numeric/cursor control cluster, mounted in steel enclosure	£95.00	£115.00
DB25S Mating connector for KB771	£4.25	£5.40
PERK 56-station ASCII Keyboard for PET. Complete with PET interface, built-in power supply and steel enclosure	£145.00	£172.50

Discounts available for quantities

MISCELLANEOUS

AMPEX 1" x 3000' Video Tape **£15.00**
 CALCOMP 565 Drum Plotters **£1,250.00**
 CIPHER 100X Magnetic Tape Drive **£950.00**
 DATA GENERAL NOVA 1210 4K CPU **£795.00**
 DIGITRONICS P120 Paper Tape Punches **£75.00**
 EMI 15" Diagonal TV Monitors **£100.00**
 SEALECTRO 11x20 Patch Boards **£12.50**

WW—050 FOR FURTHER DETAILS

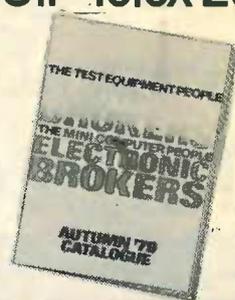
Electronic Brokers

49/53 Pancras Road London NW1 2QB Tel: 01-837 7781. Telex 298694

ONLY SMALL SELECTION OF OUR VAST STOCKS SHOWN HERE — SEND FOR LATEST CATALOGUE

Electronic Brokers unique catalogue contains 62 pages plus update of second user Test Equipment, and Mini Computers and Peripherals. Vast lists of Signal Sources, Oscilloscopes, DVMs, Counters, Recorders, DEC Computers, VDUs, Teletypes, etc. Largest stocks — most cost effective.

LATEST EDITION. SENT FREE IN UK
Airmail to overseas addresses £2.00



MARCONI INSTS.

TF 2162 M.F. Attenuator
0-11 1dB. Steps of 0.1 dB.
DC-1MHz 600Ω
Large Stocks

£135.00



SOLARTRON

7055 Microprocessor Controlled D.M.M.
Without processor option
With processor option

£975.00
£1300.00

NEW EQUIPMENT

HAMEG SCOPES

(from W. Germany)

from 10MHz to 50MHz
See ad. at top of index
page at rear of this
magazine

AVAILABLE EX-STOCK

ICE MULTIMETERS

(from Italy)
Microtest 80, Supertesters
680G & 680R and their
accessories always in stock.



HEWLETT PACKARD

Spectrum Analyser System
141T Display
8552A IF Section
8554L RF Section
500KHz-1250MHz

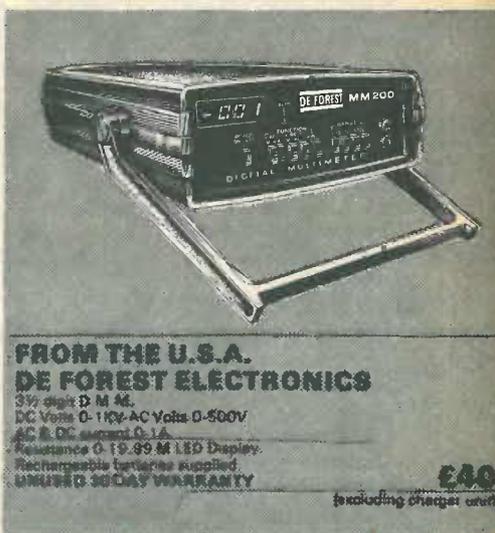
TOTAL PRICE £5,250



HEWLETT PACKARD

202H FM/AM Signal Generator
54 to 216 MHz

£495



FROM THE U.S.A. DE FOREST ELECTRONICS

3 1/2 digit D.M.M.
DC Volts 0-10V AC Volts 0-500V
AC & DC current 0-1A
Resistance 0-19.99 MΩ LED Display.
Rechargeable batteries supplied.
UNLIMITED 30 DAY WARRANTY

£40

(excluding postage cost)

Unless otherwise stated all equipment offered in the Electronic Brokers advertisement is refurbished and in the case of Test Equipment also calibrated. Test equipment is guaranteed for 12 months; computer peripherals for 3 months.

Hours of Business:
9 a.m.-5 p.m., Mon.-Fri.
Closed lunch 1-2 p.m.

A copy of our trading conditions is available on request.

Add 15%
VAT to ALL
PRICES

Carriage and
Packing
charge extra
on all items
unless
otherwise
stated.

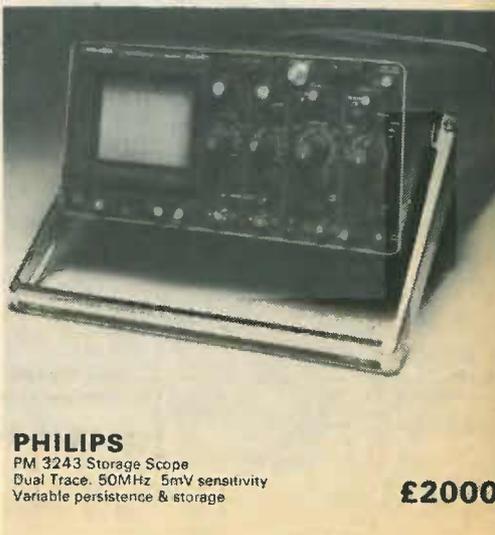
WW — 051 FOR FURTHER DETAILS



MARCONI INSTS.

TF2930A Wave Analyser
2GHz-76kHz

£725



PHILIPS

PM 3243 Storage Scope
Dual Trace. 50MHz 5mV sensitivity
Variable persistence & storage

£2000

No.1 in Second User Test Equipment

BRIDGES

GENERAL RADIO

1608A LCR Bridge. Accuracy typically 0.5% £1450

MARCONI INSTR.

Univ. Bridge TF1313A (0.1%) £790
In Situ Univ. Bridge TF2701 £395
Univ. Bridge TF1313 £395

WAYNE KERR

Univ. Bridge B221 (0.1%) £275
Low Impedance Adaptor Q221 £75
Univ. Bridge B642 £695
A.C. Testmatic A60 £1500

CALIBRATION EQUIPMENT

NEWLETT PACKARD

DC Voltage Source & AC/DC Diff. Voltmeter 741B £975

FLUKE

833AB AC/DC Differential Voltmeter £975

TEKTRONIX

Time Mark Generator 184 £275
Time Mark Generator 2901 £450
5nS Pulse Generator 2101 £525

DIGITAL COUNTERS

GOULD ADVANCE

600MHz Counter TC15+15P1 £495
80MHz Counter TC17 or TC17AE195

FLUKE

12.5MHz Multi-Function Counter 1910A-01 £285
520MHz Communications Counter 1920A-06 £490
12.5MHz Multi-Function Counter 1925A £405
12.5MHz Univ. Timer Counter. 1953A-15-16 £850
515MHz Communications Counter 1980A-01 £295
520MHz Multifunction Counter 1912A £480

PHILIPS

80MHz Timer Counter PM6612 £405
1GHz Timer Counter PM6615 £795
512MHz Freq. Counter PM6645 £500

520MHz Automatic Freq. Counters PM6664 £305

520MHz Counter PM6614 £450

80MHz 9 digit Univ. Counter PM6611/02 £350

50MHz Counter Timer. PM 6604 £150

SYSTRON DONNER

50MHz Counter Timer 6250 £175
LF Freq. Counter 6220 £160

DIGITAL VOLTMETERS

& MULTIMETERS

ADVANCE

True R.M.S. Voltmeter DRM6 £150

DATRON

5 1/2 digit D.M.M. 1051 £995

FLUKE

4 1/2 digit D.M.M. 8600A £290
4 1/2 digit D.M.M. 8600A-01 £335
8300A D.M.M. £199
8800A D.M.M. 5 1/2 digit £599
3 1/2 digit D.M.M. 8022A (NEW) £89
3 1/2 digit D.M.M. 8020A £99

HEWLETT PACKARD

5 1/2 digit D.M.M. 34702A + 34740A £295

5 1/2 digit D.M.M. 3490A £550

PHILIPS

4 digit D.M.M. PM2424 £300
3 1/2 digit D.M.M. PM2513A £95
Autoranging D.M.M. PM2514 £125
Autoranging D.M.M. PM2527 £400
D.M.M. PM2517E £120
D.M.M. PM2522A £200

D.M.M. PM2522 £175
D.M.M. PM2532 £235
D.V.M. PM2443 £350

WESTON

3 1/2 digit D.M.M. 4449 £49.50

SCHLUMBERGER-SOLARTRON

5 1/2 digit Digital Multimeter A243 £595

4 1/2 digit D.M.M. 7050 £350

D.M.M. (Microprocessor Controlled) 7065 £1150

—with processor option £1450

OSCILLOSCOPES

COSSOR

35MHz Dual Trace CDU 150 £450

75MHz Dual Trace 4100 £695

HEWLETT PACKARD

500kHz High Sensitivity 130C £345

75MHz Dual Trace 1707B £925

T.D.R. System 140A + 1415A £1200

T.D.R. System 140B + 1415A £1500

75MHz Dual Trace 1707A 850

Storage Scope 1703A £1850

PHILIPS

15MHz Portable Dual Trace PM3211 £450

25MHz Portable Dual Trace PM3212 £625

25MHz Portable Dual Trace PM3214 £700

120MHz Portable Dual Trace PM3260 £1095

100MHz Portable Dual Trace PM3262 £1300

5MHz Battery Miniscope PM3010 £250

50MHz Portable Scope PM3240 £950

TEKTRONIX

10MHz Dual Trace Battery Miniscope 326 £795

24MHz Dual Trace 545B + CA £299

50MHz Dual Trace 547 + 1A1 £775

25MHz Split Screen Storage Scope 434 £1600

Large stocks of Plug Ins for 500 series mainframes at new low prices. Details on request.

500MHz Scope 7904 c/w 7A19, 7A26, 7B92 £5995

35MHz Scope T932 £550

1MHz Miniscope/D.M.M. 213 £950

Vectorscope 526 £550

TELEQUIPMENT

10MHz Single Trace P7CRT S54AR (Mint) £175

50MHz Dual Trace D75 £695

OSCILLOSCOPE PROBES

ELECTRONIC BROKERS (NEW)

X1 Probe Kit EB90 £9

X10 Probe Kit EB91 £11

X1X10 Probe Kit EB95 £15

RECORDERS

BRUSH

Multipoint 8 Channel Chart Recorder 816 £695

PHILIPS

Single Channel Chart Recorder PM8110 £225

RACAL

Store 4FM Tape Recorder £2600

SHANDON SOUTHERN

6 Channel Recorder 10-650 £725

WATANABE

6 Channel Chart Recorder MC641 £2250

SIGNAL SOURCES

ADVANCE

J2E Oscillator (MINT) £90

J4 Oscillator £140

HEWLETT PACKARD

203A Variable Phase Sine & Square Wave Generator 0.005Hz-60kHz £495

651B Oscillator 10Hz-10MHz. 0.1mV-316V into 50 or 600Ω Sine Wave only. Metered O/P £415

608D VHF Signal Generator 10-420MHz 0.1μ V-O 5V into 50Ω AM: 0-95% £420

608E VHF Signal Generator, 10-480MHz £450

608F VHF Generator. 10-455MHz £450

612A UHF Signal Generator. 540-1230MHz £850

4204A Decade Oscillator. 10Hz-1MHz £750

MARCONI INSTRUMENTS

TF144H/4 AM Signal Generator. 10kHz-72MHz £750

TF144H/4S AM Signal Generator. Same spec. as 144H/4 but hermetically sealed meters £550

TF801D/1 AM Signal Generator. 10kHz-470MHz £400

TF801D/8S AM Signal Generator. Similar spec. to TF801D/1 £600

TF801D/5M1 AM Signal Generator. 10-400MHz 0.1μ V-1V into 50Ω. AM 0.90% @ 1kHz Demodulator output, 75MHz Crystal £450

TF995B/2AM/FM Signal Generator. 200kHz-220MHz £675

TF1101 R-C Oscillator. 20Hz-200kHz. Metered O/P £100

TF1370A R-C Oscillator £275

TF2012 UHF Signal Generator. 400-520MHz £900

TF2005R Two Tone AF Signal Source. 2 identical oscillators 20Hz-20kHz + 10dBm O/P 0-111dB attenuator £299

TF2101 MF Oscillator. 30Hz-550kHz £115

TF2102M/1 AF Oscillator 3Hz-30kHz £195

TF 1060/3 UHF Signal Generator 470-960MHz £750

TF2100 Oscillator £150

SINGER

FM-10 Decade Switched FM Signal Generator. Up to 500MHz £1200

PHILIPS

PM5167 Function Generator. 1MHz-10MHz Sine, square ± pulse, ramp, triangle, single shot with variable phase £675

PM5127 Function Generator. Sine / square / triangle / pulse signals £395

PM5108 Function Generator. Sine, square / triangle / pulse signals. Offset. TTL output. Stepped and continuous attenuation. Frequency range 1Hz-1MHz £250

PM5324 AM / FM Signal Generator £450

TELONIC

2003 Sweeper Main Frame c/w 3302, 3331, 3341, 3351, 3360 and 3370 modules. Frequency range 0-300MHz sweep width with 0-100% of the range 0-62dB O/P attenuator in 1dB steps. O/PZ 75 Sweep time 0.01-50S. Internal 5 & 10MHz markers. Internal AM/FM modulation. Internal detector £1150

TEXSCAN

VS40 Sweep Generator. Frequency range 1MHz-300MHz £650

WAVETEK

135 Lin/Log Sweep Function Generator. 0-2Hz-2MHz. 10V into 50Ω. Sine square triangle. Sweep time 10μS-10000S £2

SOUND LEVEL METERS

BRUEL & KJAER

Sound Level Meter 2203 £1

GENERAL RADIO

Portable Sound Level Meter, 1983 £1

Portable Sound Level Meter, 1981 £1

1933 & 1935 Portable Sound Level Meter with data cassette recorder £26

MISCELLANEOUS

ADVANCE

Power Supply PMA 50 0-15V 5A (selectable) £1

Power Supply PM 53 0-15V 10A (selectable) £1

BIOMATION

16 Channel Logic Analyser 1650 £41

BOONTON

True R.M.S. Voltmeter 93A £3

BRADLEY

DC Voltage Calibrator 126B £2

BRUEL & KJAER

Electronic Voltmeter 2409 £2

DATA LABS

Power Line Disturbance Monitor £3

DYMAR

LF Wave Analyser 1771 £3

AM/FM Mod. Meter 1785 £3

LF Distortion Meter 1765 £2

R.F. Power Meter 1581 £3

GRETSCH

Complex Ratio Bridge CR1B £6

GENERAL RADIO

Vibration Analyser 1911A £21

HEWLETT PACKARD

Camera 195A £2

Camera 198A £2

True R.M.S. Voltmeter 3400A £5

16 Channel Logic Analyser 1600A £20

AC Voltmeter 400F £19

Wave Analyser 310A £9

LYONS

Pulse Generator PG22 £2

MARCONI INSTRUMENTS

AF Transmission Test Set TF2332 £4

Quantization Distortion Tester TF23 £4

Deviation Meter TF791D £1

Electronic Voltmeters TF2604 £2

Q meter system TF1245/46/47 £8

Divider TF2422 £1

Sine Sq. Pulse & Bar Generator TF2905 £4

AM / FM Mod. Meter TF2300A £5

RF Millivoltmeter TF2603 £5

Diff Voltmeter TF2606 £2

D.F.M. TF2331 £4

A.F. Power Meter TF893A £1

P.C.M. Regen. Tester TF2342 £3

Quartz. Dist. Tester TF2343 £4

PHILIPS

Pulse Generator PM5715 £5

AC Millivoltmeter PM2454B £2

Pattern Generator PM5501 £1

Wow & Flutter PM6307 £2

ROHDE & SCHWARZ

Stereocoder MSC £10

SOLARTRON

Frequency Response Analyser 117 £39

OLIVETTI PRINTER & KEYBOARD type Te 300
with PUNCH & READER. Upper case ASCII with V24 Interface. 240 volt operation.
£125 each

TELETYPE MODEL 390
with PUNCH & READER
£325 each

HONEYWELL VDU
1920 Character Upper Case ASCII. With edit and block transmission. Limited quantity with data
NEW LOW PRICE £200 each

BRUEL & KJOER EQUIPMENT
AUDIO FREQUENCY SPECTROMETER type 2112 **£175 ea.**
BEAT FREQUENCY OSCILLATOR type 1013 **£140**
BEAT FREQUENCY OSCILLATOR type 1014 **£140**
BEAT FREQUENCY OSCILLATOR type 1022 **£140**
AUTOMATIC VIBRATION EXCITER CONTROL type 1018 **£90**
AUTOMATIC VIBRATION EXCITER CONTROL type 1019 **£90**
AUTOMATIC VIBRATION EXCITER CONTROL type 1016 **£90**

INFRA RED IMAGE CONVERTER type 9606 (CV 144)
1 3/4" diameter. Requires single low current 3KV to 6KV supply. Individually boxed. With data
£12.50 each P&P 75p
Infra Red Lamps also advertised

STRATHEARN AUCTION — YES WE WERE LARGE PURCHASER OF COMPONENTS & TEST GEAR

The following is a selection from the purchases

BC337	8p	2N3704	8p	8TF60	5p	MC1458	15p
BC327	8p	2N5447	8p	TLO82CP	15p	LM3900	30p
BC251	8p	2N5449	8p	T1592	10p	4013	30p
BC171A	8p	2N3053	8p	T1593	10p	741	12p

Timer 555 **15p**
16 pin DIL Socket **10p**. 14 pin DIL Socket **8p**
LED type TIL 209 Red with holder **10p** each
SLOTTED OPTO SWITCH supplied with data — normally over £2. OUR PRICE **75p** each
MICROSWITCHES SPCO — 1.2p each; SP — **8p** each
ROCKER SWITCHES 2 pole c/o — **15p** each
Spring Action TERMINALS — normally over **30p** ea. OUR PRICE **15p** each
TOROIDAL TRANSFORMER 0-115V-230V Input; 13.5V — 0 — 13.5V rated 8VA output **£1.70** each. P&P **75p**
Sub-min TRANSFORMER 0-120-240V Input; 12V-0-12V rated 4VA Output **75p** each P&P **50p**

ALL GOODS ARE GUARANTEED TO BE NEW AND FULL SPEC. DEVICES. 100 off discount 25% — other discounts by arrangements.

POLAROID SPECTRUM ANALYSER
5" Display. These are supplied with STU 2 plug-in. 1 to 4.5GHZ.
£125 each

TELEQUIPMENT SERVICE SCOPE MINOR
Modern style — Small size 5x7x11" approx. Circuit diagram supplied.
£55 each

4K RAM
Signetics
22 pin with data type 2680
65p each
Four for **£2**

STEPPING MOTORS
6/12 position with additional where the rotor is coils. Device can be used as a tacho. Diagram supplied. Will actually work on 5 volts. 12/24 recommended.
£1.50 each P&P 75p or 5 for £5 P&P £1.50.

IF YOU CONSIDER THE PRICE ON ANY OF OUR ADVERTISED ITEMS TOO HIGH — PLEASE MAKE US AN OFFER WE CAN CONSIDER

- TEKTRONIX Spectrum Analyser Plug-in 1L30 **£425 ea.**
- TEKTRONIX 1A4 Plug-in **£325 ea.**
- ADVANCE Oscilloscope type OS250 DB. DC-10MHZ **£225 ea.**
- WOLKE WOW & FLUTTER METER ME105 **£175 ea.**
- ADVANCE AC Voltmeter VM77E **£100 ea.**
- HEWLETT PACKARD RMS Voltmeter type 3400A **£150 ea.**
- MARCONI Spectrum Analyser type TF1094 100HZ to 30MHZ with 6HZ resolution 5" display. Complete with trolley **£75 ea.**
- R&S GEN BN 41026 SCR 1000-19000MHZ **£120**
- R&S GEN BN 41027/2 SBR 1700-2700MHZ **£140**
- R&S GEN BN 41022 SDR 500-1000MHZ **£90**
- R&S GEN BN 41023/2 SOAF AM/FM Video **£200**
- R&S GEN BN 1524 USVU 0.9-2.7 GHz **£180**
- R&S GEN BN 4105 SMLM Power Sig Source **£180**
- R&S GEN BN 2412/50 NRD 0-3200MHZ **£120**
- R&S GEN BN 4242 SWH 50KHZ-12MHZ **£120**
- R&S POLYSCOPE BN 4244 SWO **£300**
- R&S GEN BN4105 SMLM 30-305 MHz **£75**
- R&S GEN BN1523 USVD 280-940 MHz **£120 ea.**
- R&S GEN BN422 WIO 30-300MHZ **£120**
- FERROGRAPH Recorder Test Set RTS 2 **£190**
- HEWLETT PACKARD Oscilloscope type 120B **£240**
- HEWLETT PACKARD AC Converter type 3461A **£250**
- HEWLETT PACKARD Synchronizer type 8708A **£80**
- RACAL Auto Freq Converter 803R 500MHZ **£80**
- COHU DC Voltage Standard 303B **£350 ea.**
- AVO Precision meter **£75 ea.**
- PYE pH Meter Model 79 **£120**
- POLARAD Sig source Model 1208A 7-11GHZ **£120**
- FLUKE RMS Voltmeter type 910A **£80**
- TELEONIC SWEEPER SM2000 0-1800MHZ in 3 plug-in units **£150**
- WAYNE KERR Bridge CT 530 with adaptor **£150 ea.**
- TELEONIC SWEEPER SD-3 450-900MHZ with markers **£85 ea.**
- TWENTY MILLION Megohm meter Bby E.1. **£40 ea.**
- AVO 8 Mk 3 or similar **from £50**
- HEWLETT PACKARD Oscilloscope type 140A with Reflector meter plug-in **£250**
- MARCONI Gen type TF8010/1 **£150**
- COSSOR COU130 small, compact main/battery Oscilloscope. Batteries supplied **£240**
- LABGEAR UHF/VHF PAL Colour Bar Gen. CM6052/CB **£90 ea.**
- MARCONI GEN TF1066B **£350**
- RANK FLETTER Meter type 1740 **£50 ea.**
- AVO Sig Gen HF135/Taylor 68A/M **£120 ea.**
- TEK scope 545A with H plug-in **£125 ea.**
- TEK scope 545A with CA plug-in **£175 ea.**
- H.P. scope 175A 50MHZ Dual trace Single Trace **£175 ea.**
- WAYNE KERR Universal Bridge CT375 **£125 ea.**
- MARCONI Wave Analyser TF2330 **£500 ea.**
- NOISE GENERATOR CT410 — covers audio to VHF **£8 ea.**
- NAGARD Pulse Generator 5002C **£50 ea.**
- MARCONI Wave Analyser type TF455E **£50 ea.**
- SOLARTRON DVM LM1420 with AC unit LM1477 **£40 ea.**
- CALCOMP Drum Plotter type 564 **£1,500**
- MARCONI Bridge TF868B **£120**
- VARIACS EX-Equipment Good condition 8 Amps 20 AMPS **£25 ea.**
- Some 3 phase available. Please enquire. CARRIAGE ALL UNITS **£4 ea.**

TRANSFORMERS — Standard Mains input. Secondary outputs.
6KV 0.125A **£15 ea.**
3440V 0.66A with matching 40H Choke **£30 the pair.**
8V 600 Amps **£25.**
5KV 300MA **£15.**
12KV 30MA **£20.**
3KV 50MA **£5 ea.** 4 Volts 250 Amps **£10 ea.**
18KV 30MA **£80.**
22.5KV 110MA **£50 ea.**
60KV 0.0273 **£190.**
Input 200V 50HZ Sec 100KV 0.05 **£150.**
MULTI PURPOSE MAINS TRANSFORMER 4 windings each winding 0-10-110-125 at 4 BA **£15 ea.**
425V 50HZ 2 Wire Input. Output 8.5KV 2.55KVA. Could be run on 240V at 1/2 rating **£15 ea.**
STEP DOWN ISOLATING TRANSFORMER. Input 220, 250V 50HZ Output 115V 1.8KVA BRAND NEW. These are very conservatively rated **£20 ea.**

CAPACITORS
10mfd 10KV DC Working **£4 ea.**
2mfd 5KV **£4 ea.**
0.5 mfd 5KV **£4 ea.**
200mfd 4KV Rapid discharge **£10 ea.**
0.5 mfd 10KV **£4 ea.**
8 mfd 2.5KV **£4 ea.**
CARRIAGE on these units will be charged at cost.

INFRA RED QUARTZ LAMPS. 230V 620 Watts. Size 1 3/4" x 1/2" dia. **£1.50.** P&P **50p.**
BRIDGE RECTIFIER. 2 Amp **80p ea.**
PHOTODIODE DETECTOR 4" fly leads, **25p ea.**
A SUPERIOR KEYBOARD. Size 3 x 2 1/2 x 2" high with 12 Alno Reed Switches. Blue keys marked in green 0-9 and a star with one black. NOW **£4 ea.** P&P **75p.**
AMPHENOL. 17-way chassis mount edge connectors 0.1 spacing. **15p ea.**
I.E.C. Standard MAINS LEAD. Moulded (3 vertical flat pins centre offset) **80p ea.** P&P **50p.**
FANS. 115V 13 Watts. Size 3 1/4 x 3 1/4 x 1 1/2" BRAND NEW. **£4.50 ea.** Second hand **£2.50 ea.** P&P **75p.**
MOTOROLA REGULATORS. type 7812 12V 1 amp **85p ea.** Miniature **MOTORS** 12V with geared wheel (8 teeth 3/16" dia). Size 1 1/4 x 3/4" dia. New **30p ea.**
MOTOR. 12V DC with pulley and integral semiconductor Speed Control. New **£1 ea.** P&P **50p.**
LEDEX ROTARY SOLENOIDS. 115V DC. No switch assembly, **15p ea.**
DIAMOND H CONTROLS ROTARY SWITCH. Single pole 10-way. Printed Circuit Mount. New **10p ea.**
DELAY LINE. 50 nanosecs. 3 connections, ground-in-out. Size 2 x 7/16 x 1/8". New **25p ea.**
PULSE TRANSFORMER. Sub min. Size 1/2 x 5/16 x 1/4". Secondary centre tapped. New **20p ea.**
MOTOR by Inland Motor Corp. DC High Torque. Reversible. Usable torque at 5V. Max voltage 24V **£2.50 ea.** P&P **£1.50.**
REMO TY TYPE MULTIPLIER. Two high voltage outputs and focus **£2 ea.** P&P **£1.**
DON'T TAKE CHANCES. Use the proper EHT CABLE. 10p per metre or **£7.50 per 100 metres/drum.** P&P **£1.50.**
MOTOR by Eastern Air Devices Inc. 1.25V reversible with toothed shaft (10 teeth 1/4" dia). Size 2 1/4 x 2 1/4" dia **75p ea.** P&P **£1.50.**
PHOTOGRAPHIC LAMPS. Pearl 230V 500 watt. Screw cap **75p ea.** Box of 12 **£5.50** P&P **£1.50.**
Decoupling **CAPACITORS** 0.05mfd 10V. Size 0.25" between leads 1/4" height. **100 for £1.** P&P **50p.**
CAPACITORS 0.01mfd. Size 5/16" between leads. 1/2" height. **100 for £1.** P&P **50p.**
MYSTERY IC PACK. Some 40 pin — good mixture — all new devices. **25 ICs for £1.** P&P **50p.** You find out what they are and we will buy the information from you.
SUPERIOR 19" RACK CABINET. Approx 4" 6" high x 33" deep. Instrument front panel position can be adjusted. Chocolate colour. These are new but have slight scratches and imperfections — hardly noticeable. **£35 each.** Carr. **£4.**
VACUUM PUMPS — TRAPS, ETC. Send for list.
10V Way Multi-Colour Ribbon Cable. New. **40p per metre.** P&P **50p.**
SPEAKERS 2 1/2". 50 ohm 0.2W. New **40p each.** P&P **50p.**
RAPID DISCHARGE capacitors 8mfd 4kV. **£5 each.** P&P **£1.50.**

GEN UHF 4 button tuner. **£2.50 each.** P&P **85p.**
540 INCH METER 110V AC 3 rpm 50 cycle. Very small **50p each.** P&P **50p.**
CENTAUUR 115V AMS. 4.5 x 4 x 1 1/2" **£4.50 each.** P&P **75p.**
EX-LIBRE Equipment. tested **80p each.** P&P **75p.**
POTTER & BRUMFIELD TIMER RELAY. 115V AC. Heavy duty. 7 pole c/s with 2 second delay Charge R & C for different timing **80p each.** P&P **85p.**
CONTRACTORS. Heavy Duty 24V DC 5 brake **£1 each.** P&P **85p.**
PC UHF/VHF 6 button tuner **£4.50 each.** P&P **£1.**
DIGITAL 24-HOUR CLOCK with built-in alarm as used in Braun Digital clocks. Silent running. Large illuminated numerals. AC mains. Size 6 1/2 x 2 1/4 x 2 1/4" **ONLY £3.75 each.** P&P **50p.**
531A PHOTO MULTIPLIER in stainless steel container with window and built-in resistor network. **£2 each.** P&P **£1.**
SLIDER CONTROL 500W. Log Scale track. Complete with knob. Length 3 1/2". **25p each.** P&P **25p.**
RANCO 280V 18A THERMOSTATS with Control knobs calibrated 50-200 degree F. **£2.50 each.** P&P **£1.**
SOLID STATE UHF TUNERS. 30 ecc **£1 each.** P&P **75p.**
BRAND NEW blue wire wraps. 30 metres for **£1.** P&P **25p.**
5in SOLID RUBBER RINGS (1" dia. rubber). Keep the kids (or dog) happy. 4 for **£1.** P&P **£1.25.**

TRANSFORMERS
AUTO 240V Input 115V. 1 Amp output **£1.25 each.** P&P **£1.25.**
240V Input Sec. 6V, 1.86A Size 2 1/2 x 2 x 2". Good quality **£1.50 ea.** P&P **£1.**
240V Input. Sec. 12V 0.92. Size 2 1/2 x 2 x 2". Good quality. **£1.50 ea.** P&P **£1.**
240V Input 12V 100MA. Size 60 x 40 x 42mm **50p each.** P&P **75p.**
240V Input Sec. 12-0-12V 50MA. Size 53 x 45 x 40mm. **£1 each.** P&P **75p.**
115V Input Sec. 5V 250MA. Size 1 1/16 x 1.5 x 1 1/4" 2 for **50p.** P&P **75p.**

SEMICONDUCTORS
At 2p each.
1K5083 1344.
At 5p each.
BC147, BC488, BC157, BC158, BC237, BF197, OA90, OA81, BA154, BA243.
At 25p each.
TIP31 TIP41A 2N5296, AF139, 2TX341.
8Y 12 10p, BF181 20p, BQ239 40p, BQ241 40p; MA343AT 40p; BQ222 50p; BQ233 & BQ234 Comp Pair 25W — **80p per pr.** at **50p each.**
Regulator TBA635 8 to 20V in — 5V out 100MA T05 Con. **50p each.** BF256C **20p.**
TV AMPLIFIER TBA 120 **20p each.**

Integrated Circuits

7453	5p	709	15p	75325	£1
7451	5p	74H74	12p	SN15862	4p
7401	5p	74H51	7p	MC4028	80p
7402	12p	74S38	10p	7417	14p
7476	20p	74S02	12p	7441	40p
7495	35p	74154	70p		

MOTOROLA DUAL in Line 6 pin Opto Coupler **30p each.** Gold plate tester version **50p each.**
AMB140 4K RAMS STATIC 5 Volt ceramic **£4 each.**
2708 **£5.50 each.** P&P **25p.**
TELEPHONES. 706 style Black or Grey. **£5.50 each.** 746 style Black or Grey **£7.50 each.** Older style Black **£2.50 each.** Postage **£1 each.**
Honeywell humidity Controllers **50p each.** P&P **40p.**
THYRISTOR TIMER. Solid State. 15 secs adjustable (reset) in plastic relay case. Standard 7 pin base. Series delay **80p each.** P&P **85p.**
MINIATURE PC MOUNT SLIDE SWITCH. Single pole 3-way **10p each.**
DIGITAL to ANALOGUE CONVERTER. 8 bit will fit standard TT1 socket. With data. **£2.50 each.** P&P **25p.**
VARIACS. 2 amp Standard 240 Volts **£10 each.** P&P **£1.50.**
ELECTROSTATIC VOLTMETERS. 7.5KV **£5 each.** P&P **£1.** Other ranges available. Please enquire.
TRIMMERS. Sub min 0.25 to 1.25pF. 1 to 4 5pF. 7 to 45pF. All at **6p each.**
CROWN replacement MOTOR for IBM GOLFBALL TYPEWRITER 115V 50HZ 1350 rpm. **£4.50 ea.** P&P **£1.50.**

CRYSTALS
19.2KHZ FLAT METAL CASE — **50p each.**
10 MHZ B7G **50p each.**

EX-NAVAL 4ft dia STEEL DISHS. NEW CRATED. 1ft deep at centre. These are plain steel dishes with holes for various aerial options. **£22.50 ea.** Carriage **£4.**

LISTS AVAILABLE — WRITE OR PHONE.

Minimum order £3 value of goods. P&P or Carriage and VAT at 15% on total must be added to all orders.
CALLERS VERY WELCOME STRICTLY BETWEEN 9am-1pm and 2-5pm Monday to Saturday inc.
BARCLAYCARD (VISA) and ACCESS taken. Official orders welcome

CHILTHEAD LTD
NORWOOD ROAD, READING TELEPHONE NO. READING 669656
(2nd turning left past Reading Technical College in King's Road then first right — look on right for door with "Spoked Wheel")

<p>TTLs by TEXAS</p> <p>7400 11p 74259 140p 4018 80p 7401 12p 74278 280p 4019 40p 7402 12p 74283 110p 4020 100p 7403 14p 74283 150p 4021 110p 7404 14p 74298 150p 4022 100p 7405 18p 74298 200p 4023 20p 7406 32p 74366 100p 4024 22p 7407 32p 74366 100p 4025 20p 7408 17p 74367 100p 4026 130p 7409 18p 74390 200p 4027 80p 7410 18p 74390 200p 4028 90p 7411 20p 74390 200p 4029 100p 7412 20p 74390 200p 4030 100p 7413 20p 74390 200p 4031 200p 7414 20p 74390 200p 4032 200p 7415 20p 74390 200p 4033 200p 7416 20p 74390 200p 4034 200p 7417 20p 74390 200p 4035 110p 7418 20p 74390 200p 4036 220p 7419 20p 74390 200p 4037 220p 7420 20p 74390 200p 4038 110p 7421 20p 74390 200p 4039 220p 7422 20p 74390 200p 4040 100p 7423 20p 74390 200p 4041 80p 7424 20p 74390 200p 4042 80p 7425 20p 74390 200p 4043 80p 7426 20p 74390 200p 4044 80p 7427 20p 74390 200p 4045 110p 7428 20p 74390 200p 4046 110p 7429 20p 74390 200p 4047 100p 7430 20p 74390 200p 4048 50p 7431 20p 74390 200p 4049 50p 7432 20p 74390 200p 4050 50p 7433 20p 74390 200p 4051 80p 7434 20p 74390 200p 4052 80p 7435 20p 74390 200p 4053 80p 7436 20p 74390 200p 4054 80p 7437 20p 74390 200p 4055 120p 7438 20p 74390 200p 4056 120p 7439 20p 74390 200p 4057 120p 7440 20p 74390 200p 4058 120p 7441 20p 74390 200p 4059 120p 7442 20p 74390 200p 4060 110p 7443 20p 74390 200p 4061 120p 7444 20p 74390 200p 4062 120p 7445 20p 74390 200p 4063 120p 7446 20p 74390 200p 4064 120p 7447 20p 74390 200p 4065 120p 7448 20p 74390 200p 4066 120p 7449 20p 74390 200p 4067 120p 7450 20p 74390 200p 4068 120p 7451 20p 74390 200p 4069 120p 7452 20p 74390 200p 4070 30p 7453 20p 74390 200p 4071 20p 7454 20p 74390 200p 4072 20p 7455 20p 74390 200p 4073 20p 7456 20p 74390 200p 4074 20p 7457 20p 74390 200p 4075 20p 7458 20p 74390 200p 4076 107p 7459 20p 74390 200p 4077 107p 7460 20p 74390 200p 4078 107p 7461 20p 74390 200p 4079 107p 7462 20p 74390 200p 4080 107p 7463 20p 74390 200p 4081 107p 7464 20p 74390 200p 4082 107p 7465 20p 74390 200p 4083 107p 7466 20p 74390 200p 4084 107p 7467 20p 74390 200p 4085 107p 7468 20p 74390 200p 4086 107p 7469 20p 74390 200p 4087 107p 7470 20p 74390 200p 4088 107p 7471 20p 74390 200p 4089 107p 7472 20p 74390 200p 4090 107p 7473 20p 74390 200p 4091 107p 7474 20p 74390 200p 4092 107p 7475 20p 74390 200p 4093 107p 7476 20p 74390 200p 4094 107p 7477 20p 74390 200p 4095 107p 7478 20p 74390 200p 4096 107p 7479 20p 74390 200p 4097 107p 7480 20p 74390 200p 4098 107p 7481 20p 74390 200p 4099 107p 7482 20p 74390 200p 4100 107p 7483 20p 74390 200p 4101 107p 7484 20p 74390 200p 4102 107p 7485 20p 74390 200p 4103 107p 7486 20p 74390 200p 4104 107p 7487 20p 74390 200p 4105 107p 7488 20p 74390 200p 4106 107p 7489 20p 74390 200p 4107 107p 7490 20p 74390 200p 4108 107p 7491 20p 74390 200p 4109 107p 7492 20p 74390 200p 4110 107p 7493 20p 74390 200p 4111 107p 7494 20p 74390 200p 4112 107p 7495 20p 74390 200p 4113 107p 7496 20p 74390 200p 4114 107p 7497 20p 74390 200p 4115 107p 7498 20p 74390 200p 4116 107p 7499 20p 74390 200p 4117 107p 7500 20p 74390 200p 4118 107p</p>	<p>93 SERIES</p> <p>9301 180p 9302 175p 9303 310p 9310 275p 9311 275p 9312 180p 9313 165p 9316 225p 9321 180p 9322 150p 9323 390p 9388 200p 9370 200p 9374 200p</p>	<p>VEROBOARDS 0.1" 0.15" (copper clad)</p> <p>2.5x3.75" 48p 43p 3.75x5" 87p 81p 3.75x3.75" 87p 81p 3.75x17" 64p 64p 4.75x17.9" 290p Pkg of 100 pins 80p Spot face cutter 80p Ven in/wrap tool 118p Pwr/Wrap tool + 2 wire spoons + comb 370p Combs 7p</p>	<p>LINEAR ICs</p> <p>AY1-0212 600p AY1-1313 280p AY1-1320 320p AY1-5050 140p AY3-1270 100p AY5-1224A 240p AY5-1315 800p AY5-1317A 775p CA3019 80p CA3048 70p CA3048A 220p CA3080E 72p CA3088 48p CA3089E 225p CA3090AQ 375p CA3130E 80p CA3160E 100p CA3161E 140p CA3162E 450p CA3189E 400p DAC1408-B 780p FX20 800p ICL7106 200p ICL8038 340p LF356P 85p LF358P 75p LM10C 425p LM301A 120p LM318 200p LM319 225p LM324 80p LM339 75p LM348 175p LM380 75p LM381AN 160p LM709 36p LM710 80p LM71D 130p LM725 380p LM725 100p LM747 70p LM748 35p LM2917 250p LM3500 70p LM3509 80p LM3911 130p LM3914 250p LM3919 150p MC1310P 120p MC1485L 48p MC1496 100p MC3340P 120p MC3360P 120p MK5039B 75p MM5180 80p</p>	<p>TRANSISTORS</p> <p>AC125 25p BC127/8 20p AC176 25p AC187/8 25p AF116 50p AD149 70p BF161/2 45p BF167 20p BF180/8 11p BF187 11p BF188 11p BF189 11p BF190 11p BF192 11p BF193 11p BF194 11p BF195 11p BF196 11p BF197 11p BF198 11p BF199 11p BF200 11p BF201 11p BF202 11p BF203 11p BF204 11p BF205 11p BF206 11p BF207 11p BF208 11p BF209 11p BF210 11p BF211 11p BF212 11p BF213 11p BF214 11p BF215 11p BF216 11p BF217 11p BF218 11p BF219 11p BF220 11p BF221 11p BF222 11p BF223 11p BF224 11p BF225 11p BF226 11p BF227 11p BF228 11p BF229 11p BF230 11p BF231 11p BF232 11p BF233 11p BF234 11p BF235 11p BF236 11p BF237 11p BF238 11p BF239 11p BF240 11p BF241 11p BF242 11p BF243 11p BF244 11p BF245 11p BF246 11p BF247 11p BF248 11p BF249 11p BF250 11p BF251 11p BF252 11p BF253 11p BF254 11p BF255 11p BF256 11p BF257 11p BF258 11p BF259 11p BF260 11p BF261 11p BF262 11p BF263 11p BF264 11p BF265 11p BF266 11p BF267 11p BF268 11p BF269 11p BF270 11p BF271 11p BF272 11p BF273 11p BF274 11p BF275 11p BF276 11p BF277 11p BF278 11p BF279 11p BF280 11p BF281 11p BF282 11p BF283 11p BF284 11p BF285 11p BF286 11p BF287 11p BF288 11p BF289 11p BF290 11p BF291 11p BF292 11p BF293 11p BF294 11p BF295 11p BF296 11p BF297 11p BF298 11p BF299 11p BF300 11p</p>	<p>MEMORIES</p> <p>2102-2L 120p 2107 120p 2111-2 225p 2112-2 225p 2114 225p 2114-2L 600p 4027 375p 4044 800p 4118 900p 4121 900p 4122 900p 4123 900p 4124 900p 4125 900p 4126 900p 4127 900p 4128 900p 4129 900p 4130 900p 4131 900p 4132 900p 4133 900p 4134 900p 4135 900p 4136 900p 4137 900p 4138 900p 4139 900p 4140 900p 4141 900p 4142 900p 4143 900p 4144 900p 4145 900p 4146 900p 4147 900p 4148 900p 4149 900p 4150 900p 4151 900p 4152 900p 4153 900p 4154 900p 4155 900p 4156 900p 4157 900p 4158 900p 4159 900p 4160 900p 4161 900p 4162 900p 4163 900p 4164 900p 4165 900p 4166 900p 4167 900p 4168 900p 4169 900p 4170 900p 4171 900p 4172 900p 4173 900p 4174 900p 4175 900p 4176 900p 4177 900p 4178 900p 4179 900p 4180 900p 4181 900p 4182 900p 4183 900p 4184 900p 4185 900p 4186 900p 4187 900p 4188 900p 4189 900p 4190 900p 4191 900p 4192 900p 4193 900p 4194 900p 4195 900p 4196 900p 4197 900p 4198 900p 4199 900p 4200 900p 4201 900p 4202 900p 4203 900p 4204 900p 4205 900p 4206 900p 4207 900p 4208 900p 4209 900p 4210 900p 4211 900p 4212 900p 4213 900p 4214 900p 4215 900p 4216 900p 4217 900p 4218 900p 4219 900p 4220 900p 4221 900p 4222 900p 4223 900p 4224 900p 4225 900p 4226 900p 4227 900p 4228 900p 4229 900p 4230 900p 4231 900p 4232 900p 4233 900p 4234 900p 4235 900p 4236 900p 4237 900p 4238 900p 4239 900p 4240 900p 4241 900p 4242 900p 4243 900p 4244 900p 4245 900p 4246 900p 4247 900p 4248 900p 4249 900p 4250 900p</p>	<p>TRANSISTORS</p> <p>BF259 36p BF39 36p BF40 25p BF41 25p BF42 25p BF43 25p BF44 25p BF45 25p BF46 25p BF47 25p BF48 25p BF49 25p BF50 25p BF51 25p BF52 25p BF53 25p BF54 25p BF55 25p BF56 25p BF57 25p BF58 25p BF59 25p BF60 25p BF61 25p BF62 25p BF63 25p BF64 25p BF65 25p BF66 25p BF67 25p BF68 25p BF69 25p BF70 25p BF71 25p BF72 25p BF73 25p BF74 25p BF75 25p BF76 25p BF77 25p BF78 25p BF79 25p BF80 25p BF81 25p BF82 25p BF83 25p BF84 25p BF85 25p BF86 25p BF87 25p BF88 25p BF89 25p BF90 25p BF91 25p BF92 25p BF93 25p BF94 25p BF95 25p BF96 25p BF97 25p BF98 25p BF99 25p BF100 25p BF101 25p BF102 25p BF103 25p BF104 25p BF105 25p BF106 25p BF107 25p BF108 25p BF109 25p BF110 25p BF111 25p BF112 25p BF113 25p BF114 25p BF115 25p BF116 25p BF117 25p BF118 25p BF119 25p BF120 25p BF121 25p BF122 25p BF123 25p BF124 25p BF125 25p BF126 25p BF127 25p BF128 25p BF129 25p BF130 25p BF131 25p BF132 25p BF133 25p BF134 25p BF135 25p BF136 25p BF137 25p BF138 25p BF139 25p BF140 25p BF141 25p BF142 25p BF143 25p BF144 25p BF145 25p BF146 25p BF147 25p BF148 25p BF149 25p BF150 25p BF151 25p BF152 25p BF153 25p BF154 25p BF155 25p BF156 25p BF157 25p BF158 25p BF159 25p BF160 25p BF161 25p BF162 25p BF163 25p BF164 25p BF165 25p BF166 25p BF167 25p BF168 25p BF169 25p BF170 25p BF171 25p BF172 25p BF173 25p BF174 25p BF175 25p BF176 25p BF177 25p BF178 25p BF179 25p BF180 25p BF181 25p BF182 25p BF183 25p BF184 25p BF185 25p BF186 25p BF187 25p BF188 25p BF189 25p BF190 25p BF191 25p BF192 25p BF193 25p BF194 25p BF195 25p BF196 25p BF197 25p BF198 25p BF199 25p BF200 25p BF201 25p BF202 25p BF203 25p BF204 25p BF205 25p BF206 25p BF207 25p BF208 25p BF209 25p BF210 25p BF211 25p BF212 25p BF213 25p BF214 25p BF215 25p BF216 25p BF217 25p BF218 25p BF219 25p BF220 25p BF221 25p BF222 25p BF223 25p BF224 25p BF225 25p BF226 25p BF227 25p BF228 25p BF229 25p BF230 25p BF231 25p BF232 25p BF233 25p BF234 25p BF235 25p BF236 25p BF237 25p BF238 25p BF239 25p BF240 25p BF241 25p BF242 25p BF243 25p BF244 25p BF245 25p BF246 25p BF247 25p BF248 25p BF249 25p BF250 25p BF251 25p BF252 25p BF253 25p BF254 25p BF255 25p BF256 25p BF257 25p BF258 25p BF259 25p BF260 25p BF261 25p BF262 25p BF263 25p BF264 25p BF265 25p BF266 25p BF267 25p BF268 25p BF269 25p BF270 25p BF271 25p BF272 25p BF273 25p BF274 25p BF275 25p BF276 25p BF277 25p BF278 25p BF279 25p BF280 25p BF281 25p BF282 25p BF283 25p BF284 25p BF285 25p BF286 25p BF287 25p BF288 25p BF289 25p BF290 25p BF291 25p BF292 25p BF293 25p BF294 25p BF295 25p BF296 25p BF297 25p BF298 25p BF299 25p BF300 25p</p>	<p>TRANSISTORS</p> <p>2N3064 65p 2N3065 45p 2N3066 45p 2N3067 45p 2N3068 45p 2N3069 45p 2N3070 45p 2N3071 45p 2N3072 45p 2N3073 45p 2N3074 45p 2N3075 45p 2N3076 45p 2N3077 45p 2N3078 45p 2N3079 45p 2N3080 45p 2N3081 45p 2N3082 45p 2N3083 45p 2N3084 45p 2N3085 45p 2N3086 45p 2N3087 45p 2N3088 45p 2N3089 45p 2N3090 45p 2N3091 45p 2N3092 45p 2N3093 45p 2N3094 45p 2N3095 45p 2N3096 45p 2N3097 45p 2N3098 45p 2N3099 45p 2N3100 45p 2N3101 45p 2N3102 45p 2N3103 45p 2N3104 45p 2N3105 45p 2N3106 45p 2N3107 45p 2N3108 45p 2N3109 45p 2N3110 45p 2N3111 45p 2N3112 45p 2N3113 45p 2N3114 45p 2N3115 45p 2N3116 45p 2N3117 45p 2N3118 45p 2N3119 45p 2N3120 45p 2N3121 45p 2N3122 45p 2N3123 45p 2N3124 45p 2N3125 45p 2N3126 45p 2N3127 45p 2N3128 45p 2N3129 45p 2N3130 45p 2N3131 45p 2N3132 45p 2N3133 45p 2N3134 45p 2N3135 45p 2N3136 45p 2N3137 45p 2N3138 45p 2N3139 45p 2N3140 45p 2N3141 45p 2N3142 45p 2N3143 45p 2N3144 45p 2N3145 45p 2N3146 45p 2N3147 45p 2N3148 45p 2N3149 45p 2N3150 45p 2N3151 45p 2N3152 45p 2N3153 45p 2N3154 45p 2N3155 45p 2N3156 45p 2N3157 45p 2N3158 45p 2N3159 45p 2N3160 45p 2N3161 45p 2N3162 45p 2N3163 45p 2N3164 45p 2N3165 45p 2N3166 45p 2N3167 45p 2N3168 45p 2N3169 45p 2N3170 45p 2N3171 45p 2N3172 45p 2N3173 45p 2N3174 45p 2N3175 45p 2N3176 45p 2N3177 45p 2N3178 45p 2N3179 45p 2N3180 45p 2N3181 45p 2N3182 45p 2N3183 45p 2N3184 45p 2N3185 45p 2N3186 45p 2N3187 45p 2N3188 45p 2N3189 45p 2N3190 45p 2N3191 45p 2N3192 45p 2N3193 45p 2N3194 45p 2N3195 45p 2N3196 45p 2N3197 45p 2N3198 45p 2N3199 45p 2N3200 45p 2N3201 45p 2N3202 45p 2N3203 45p 2N3204 45p 2N3205 45p 2N3206 45p 2N3207 45p 2N3208 45p 2N3209 45p 2N3210 45p 2N3211 45p 2N3212 45p 2N3213 45p 2</p>
--	---	---	---	---	---	---	--

**CAMBRIDGE
LEARNING
ENTERPRISES**

*Self
Instruction
Courses*

Microcomputers are coming - ride the wave! Learn to program.

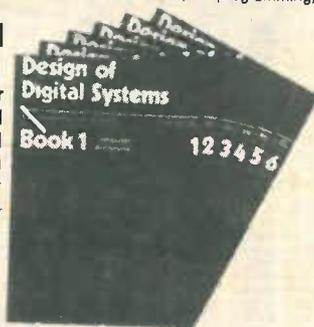
Millions of jobs are threatened but millions more will be created. Learn BASIC- the language of the small computer and the most easy-to-learn computer language in widespread use. Teach yourself with a course which takes you from complete ignorance step-by-step to real proficiency with a unique style of graded hints. In 60 straightforward lessons you will learn the five essentials of programming: problemn definition, flowcharting, coding the program, debugging, clear documentation.



- Book 1** Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.
- Book 2** High and low level languages; flowcharting; functions; REM and documentation; INPUT, IF...THEN, GO TO; limitations of computers; problemn definition.
- Book 3** Compilers and interpreters; loops, FOR...NEXT, RESTORE; debugging; arrays; bubble sorting; TAB.
- Book 4** Advanced BASIC; subroutines; string variables; files; complex programming; examples; glossary.

Understand Digital Electronics

Written for the student or enthusiast, this course is 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 finally to an understanding of the design and operation of calculators and computers.



- Book 1** Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems.
- Book 2** OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.
- Book 3** Half adders and full adders; subtractors; serial and parallel adders; processors and ALU's; multiplication and division systems.
- Book 4** Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; ROMS and RAMS.
- Book 5** Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding.
- Book 6** CPU; memory organisation; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming, assemblers; computers; executive programs; operating systems.

GUARANTEE - No risk to you

If you are not completely satisfied your money will be refunded on return of the books in good condition.

Please send me:-

....**Computer Programming in BASIC (4 books) @ £7.50**

....**Design of Digital Systems (6 books) @ £11.50**

All prices include worldwide surface mailing costs (airmail extra)

IF YOUR ORDER EXCEEDS £15, DEDUCT £2

I enclose a cheque/PO payable to Cambridge Learning Enterprises for £.....

or please charge my Access/Barclaycard account no.....

Telephone orders from credit card holders accepted on 0480-67446 (Ansafo). Overseas customers (inc Eire) send a bank draft in sterling drawn on a London bank, or quote credit card and number.

Name

Address

Cambridge Learning Enterprises, Unit 37, Rivermill Site, FREEPOST, St. Ives, Huntingdon, Cambs PE17 4BR England.

Communications



Communications Equipment and Systems
National Exhibition Centre
Birmingham England
15 April - 18 April 1980

AN INVITATION TO



Communications 80, the fifth in a series of international expositions dealing with the applications of communications equipment and systems, particularly in the major growth areas of data and business communications which are being created by the converging technologies of computing and telecommuni-cations. The other important themes of the exposition are PTT telecommunications, civil fixed and mobile radio and emergency communications.

Communications 80 will attract visitors from all over the world (from 69 countries at the last event in 1978) who will be coming to see the latest developments in communications technology displayed by leading international manufacturers. Many of the visitors will also attend the integral conference, organised by the Institution of Electrical Engineers in association with leading international learned societies, to learn about the latest technical advances in communications equipment and systems.

Communications 80, the world's leading international ex- position in the field, is actively supported by the International Telecommunication Union - the world telecommunications authority representing 153 governments; the British government, through the Home Office; the British Post Office; Cable and Wireless Ltd; and the two main UK trade associations - the Electronic Engineering Association and the Telecommunications Engineering and Manufacturing Association.

Please make a note of the dates and venue of **Communications 80** - Tuesday 15 April to Friday 18 April, 1980, at the National Exhibition Centre, Birmingham, England.

You cannot afford not to come if you make, use or specify communications equipment and systems.

I am interested in attending

Communications 80

Please send me details of exhibition conference

Name

Position

Company

Address

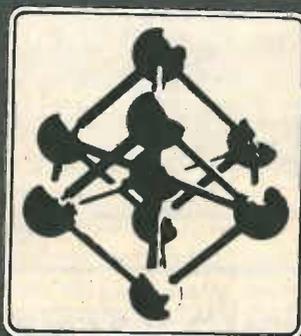
Complete, detach and mail to

Tony Davies Communications
c/o Industrial and Trade Fairs Ltd, Radcliffe House,
Blenheim Court, Solihull, West Midlands B91 2BG, England.
Telephone: 021 705 6707 Telex: 337073

NOW IN ITS
FIFTH YEAR

A major exhibition of computers, peripherals, terminals and services, held each spring in the most highly industrialised area of Western Europe.

COMPEC EUROPE'80



Centre International Rogier, Brussels, May 6, 7 & 8, 1980

The ever-growing international attendance gives Compec Europe exceptional status as a sales platform for providers of hardware, software and services from every country. Ensure participation in its benefits by posting the coupon below.

COMPEC EUROPE'80 STAND RESERVATION FORM

To: The Exhibition Manager, Compec Europe, Room 821, Dorset House, Stamford Street, London, SE1 9LU, England.

Please provisionally reserve for us stand space at Compec Europe 80 and send the undersigned more information.

Name _____ Company _____

'Scope' for Better Performance



Aplab

LEADERSHIP THRU' TECHNOLOGY

APLAB 3131 PORTABLE OSCILLOSCOPE 5" DUAL TRACE, 15 MHz (3dB) AT £260 + VAT

APLAB 3131 Dual Trace DC to 15 MHz Triggered Oscilloscope has, two fully calibrated 12 step vertical Attenuators from 5mV/cm to 20V/cm and a fully triggered Time base with 18 calibrated sweep speeds, 5" flat-faced CRT with a full 10 cm x 8 cm graticule. Channel II Attenuator also acts as calibrated Horizontal Amplifier control in X-Y mode. An Attractive case of 11"H x 8½"W x 15"D. Weighs only 26 lbs. Operates on 110/220VAC 45-65 Hz at 25 W.

APLAB 3030 MINI-OSCILLOSCOPE AT £170 + VAT

10 MHz, Portable (10 lbs), Triggered, Calibrated Scope. 3" CRT, 1KV Acc. potential: DC-10 MHz Bandwidth, 5mV/div. - 20V/div. sensitivity, 0.2 sec/div - 0.5µS/div. sweep speeds 1,2,5, sequence. EXT X, 400mV/div, 1 MHz bandwidth. Dimensions : 8½"H x 4½"W x 10½"D.

For discounts, distributorships and direct purchases contact:

CROUCHCLIFF LIMITED

VICTORIA HOUSE, 26 QUEEN VICTORIA STREET, READING RG1, ITG, U.K., TELEPHONE: (0734) 69 28 26/(0734) 59 50 47
TELEX: 84 77 77 'DELRAYG'.

WW - 069 FOR FURTHER DETAILS

ELECTRONIC VALVES WANTED

All Types Receiving, Transmitting, Industrial

PL504 - PL802 - PCL805 - CV131 - CV136 -
CV138 - CV329 - CV345 - CV450 - 805 -
807 - 813 - 2K25, Etc.

Phone/write to:
PYPE HAYES RADIO LTD.
606 Kingsbury Road
Birmingham B24 9PJ
021-373 4942

**ANY MAKE-UP OR COPY
QUERIES CONTACT
JOHN GIBBON
OR TONY FAYERS
01-261 8353**

TERMINALS

EXTEL MATRIX PRINTERS

featuring:-

- ★ optically coupled RS-232 interface
- ★ switched crystal controlled Baud rates
- ★ simple twin stepper motor mechanism
- ★ compact size
- ★ full 8½inch paper width
- ★ impact printing
- ★ Baudot code suitable for either teleprinter or microprocessor applications
- ★ fully tested

£150 plus VAT



ITEL Model 1051

- ★ IBM GOLFBALL Typewriter
- ★ RS232/V24 Interface
- ★ Correspondence-quality upper / lower case
- ★ Integral paper tape reader and punch
- ★ Operates as stand alone typewriter
- ★ Operates as self-contained word processor
- ★ Selectric / EBCDIC coded

£425 plus VAT



COMPUTER APPRECIATION, 86 High Street, Bletchingley, Redhill, Surrey RH1 4PA
Tel: Godstone (0883) 843221

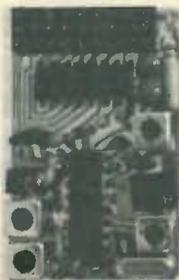
IT'S HAPPENED AGAIN!

THE PART THREE CATALOGUE IS PUBLISHED & WE HAVE MOVED TO BIGGER PREMISES.

Yes, it's here at last - the all new Part Three Catalogue. Fun for all the family, and the usual update on all that is new, worthwhile and exciting in the world of Radio and Communications. A big section on frequency synthesis techniques covering broadcast tuners, to communication quality transmitter systems. More new products than ever - RADIO CONTROL parts, crystal filters, ceramic filters for 455kHz and the new range of TOKO CFSH low temperature coefficient types for 10.7MHz. Details on new radio ICs, including the new HA11225, the CA3189E lookalike with 84dB signal to noise, and adjustable muting threshold. Radio control ICs - and an updated version of the RCM&E 8 channel FM receiver - now with an Ambit designed screened front end, with 27MHz ceramic bandpass filter. LCD panel clock/timer modules - the neatest and best LCD panel DVM yet (only £19.45 each + VAT), the new 5 decade resolution DFM3 for LW/HF/VHF with LCD readout. The DFM6 with fluorescent display to 10kHz resolution on VHF, 1kHz on SW. A 1kHz HF synthesiser with five ICs - the list is endless. Get your copy of the catalogue now. Post publication price is 60p (inc PP etc). The previous two sections are also required for a complete picture: Parts 1 & 2 £1 the pair. All 3 £1.50. And don't miss our spot the gibbon contest, together with a quiz to see if you can spot the differences between a neolithic cave drawing and a circuit diagram of one of our competitor's tuners.

(* Yes, we still haven't learnt how to spell.)

Updated RCME FM radio control RX kit



- 8 Channel RC receiver (FM)
- * Single IC RF/IF/Detector
- * Single IC decoder
- * 27MHz ceramic filter input
- * FET RF stage with double tuned bandpass filter
- * Dual ceramic filter IF
- * Based on RCM&E FM system
- * Best quality SLM servo connector block
- * ONLY £16.10 inc VAT (kit) (includes new SLM case)

DOES YOUR ONE GLOW GREEN IN THE DARK ??

Our DFM4 does, since it uses a vacuum fluorescent display for direct readout of MW/LW/FM. Basically the same as the DFM2, (LCD Version). £24.45 kit (inc VAT) Transformer with all necessary windings for DFM4 - £2.50 inc VAT.



Not illustrated here - but also now available is the DFM6. This is a vacuum fluorescent display version of our immensely popular DFM3 (LCD). Resolution is 100Hz to 3.9999MHz, 1kHz to 39.999MHz, and 10kHz to 200.00MHz+; all standard IF offsets (inc. 10.7MHz on shortwave) are available via diode programming.

New series of radio modules in fully screened cans:



UM1181 VHF band 2 VARICAP TUNERHEAD

5 tuned circuit, with image/spurii better than -80dB, buffered LO output, MOSFET RF stage, FET IF preamp, tunes with only 1% to 8v, -9dBm 3rd order intercept. 1000 off price £12.00 inc VAT. (1000 off OA)

911225 FM IF strip with all mod cons for the HiFi tuner: All types use 80dB S/N Hitachi IC, with muting, AFC, AGC, meter outputs for signal level and centre zero. IF preamp stage.

'A' Dual linear phase ceramic filters, with MOSFET (AGC'd) IF preamp and a 3rd narrow filter with DC filter selection. Dual tuned FM detector stage. £23.95 inc VAT (built)

'B' Dual ceramic filters, single tuned detector stage £14.95 inc VAT (All 'A' series units are set up with a spectrum analyzer for best THD)

91072 AM RADIO TUNER MODULES - DC TUNED and DC SWITCHED Available February '80

All include buffered LO output, mechanical IF filter (TOKO CFM0) 1-10v tuning bias, switching by a single pole to earth

A MW/LW (150 to 350kHz LW range) with ferrite rod antenna

B As 'A' but also including SW1 or SW2 (specify.)

SW1 = 1.8 to 4MHz SW2 = 5 to 10MHz

C With both SW ranges

Prices - one off inc VAT

'A' £14.43 'B' £15.90 'C' £17.50 (Custom types OA)

There is a danger - when advertizing in some magazines - that because we do not find space to list everything we sell in every ad., that some readers forget about half the ranges we stock. So to summarize the general ranges:

- TOKO** Chokes, coils for AM/FM/SW/MPX, Audio filters etc
Filters: Ceramic for AM/FM, LC for FM, MPX etc.
Polyvaricons
ICs for radio, clock LSI, radio control, MPX decoders etc
- Micrometals** Dust iron cores for toroids for resonant and EMI filters
Toroid mounts
- Hitachi** Radio/audio/mpx linear ICs
100W MOSFETs, small signal FETs, MOSFETs and bipolar

And the following groups of products from a broad range of sources:

- Semiconductors** -specializing in radio devices, Plessey SL1600, EUROPE's best selection of AM/FM and communications devices. Power MOSFETs, WORLD'S LOWEST NOISE AUDIO small signal transistors, BAR graph LED drivers for linear and log.
CD4000 series CMOS, TTL/LPSNTTL, standard linears (741, 301, 3080 etc). MPUs, memories. Small signal transistors from AEG BC237/8/9 families etc. (1000 off BC239C : 5.2p ea)
LEDs: AEG 3mm/5mm round, 2.5x5mm flat, red, green, orange, yellow. The best prices you will find for quality products.
MOSFETs for RF signal processing, including the BF960 UHF device, and 3SK51 for VHF. Varicap diodes for 17:1 capacity ratio tuning

FREQUENCY READOUT LSI from OKI, with a one-chip answer to most digital frequency display needs (and various modules).

Crystal and ceramic ladder filters from leading manufacturers, ferrite rods, various ferrite beads and a range of crystals for 'standard' frequencies and both AM and FM radio control at 27MHz. Trimmer capacitors.

METERS - a new range of linear movement types, plus many 'indicator' types for VU, all types of tuning indicators etc.

SOCKETS - a new range that are better quality than Texas low profile, yet better priced.

Modules for AM/FM/STEREO, complete kits for tuners, audio amplifiers from Larshoit.

SWITCHES - complete low cost DIY systems for push button arrays, keyboard switches.

DOUBLE BALANCED MIXERS - MCL SBL1, replacement for MD108 etc. And cheaper.

OUR LATEST MOVING EXPERIENCE :: At last, we have moved to the address below. There is car parking for customers approaching via North Service Road (an extension of North Road Avenue, entrance opposite the Brentwood Fire Station.) Pedestrian access from the High Street (alongside 117 High Street). The new building is six times bigger than our Gresham Road offices, and we will be installing a much expanded sales counter in the fullness of time. **NEW TELEPHONE NUMBER (0277) 230909, TELEX NUMBER (as before) 995194 AMBIT G.** See you there!

200 North Service Road, Brentwood, Essex.

VALVES

Minimum Order £1.00

VALVES VAT IS INCLUDED

A1065	1.40	EH90	0.80	PL94	0.75	1A3	0.70	6F12	0.90	19G3	11.50
A2293	8.50	EL32	1.10	PL504	1.60	1L4	0.50	6F14	0.90	19G6	6.90
A2900	8.00	EL34	1.75	PL508	1.50	1R5	0.65	6F15	1.30	19H5	19.55
ARB	0.75	EL37	3.45	PL509	3.65	1S4	0.45	6F17	1.15	20D1	0.75
ARR3	0.70	EL38	4.60	PL519	5.50	1S5	0.45	6F24	4.75	20F2	0.75
ATP4	0.60	ELB1	1.20	PLB02	3.15	1T4	0.45	6F33	4.75	20E1	1.30
E12H	3.55	ELB2	0.70	PLB06	3.45	1U4	0.80	6H6	1.50	20F1	0.65
CY31	1.20	EL24	0.90	PY33	0.70	2X28	1.30	6J4	1.50	20F3	0.80
DAF96	0.70	ELB6	1.05	PY80	0.70	2021	0.80	6J4WA	2.00	20P4	1.30
DET22	21.95	EL90	0.90	PY81/800	0.70	2K25	12.40	6J5GT	1.35	20P5	1.30
OF96	0.70	EL91	3.25	PY82	0.60	2X2	0.90	6J6	0.85	25L6GT	0.95
DK96	1.05	EL95	0.80	PY83	0.60	3A4	0.70	6J7	0.80	25Z4G	0.85
OH76	1.00	EL96	1.85	PY86	0.80	306	0.60	6J7G	0.80	30C15	1.15
DL92	0.60	EL504	1.85	PY500	1.55	1021	23.00	6K7	0.80	30C17	1.35
DY86/87	0.65	ELB02	1.70	PY809	6.45	3E29	6.60	6K7G	0.60	30C18	2.10
EH55L	13.80	EM31	1.50	PY801	0.70	454	0.60	6K8GT	0.65	(See PCF805)	
EB0CF	8.32	EM80	0.70	QOV03/10	2.85	4PR608	106.80	6L6M	2.15	30F5	1.15
EB8CC/01	3.60	EM81	0.70	QOV03/12	2.85	58/254M	8.90	6L6GT	1.75	30F12	1.70
EB8CC	3.20	EM84	0.70	QOV03/20A	2.85	58/255M	8.80	6L75	0.75	30R12	1.45
E92CC	1.60	EM87	1.15	QOV03/25A	2.85	58/258M	8.80	6L8	0.70	30R14	2.05
E90CC	1.60	EY51	0.55	14.40	5R4GY	1.30	6Q7G	0.95	0.95	30L17	1.15
E180CC	1.60	EY81	0.65	QOV03/25A	2.85	5U4G	1.10	6SA7	0.65	30P12	1.15
E180F	6.80	EY86/87	0.85	21.30	5V4G	0.80	6S07	0.90	0.90	30P11	1.15
E192CC	3.95	EY88	0.65	QOV06/40A	16.10	5Y3GT	0.80	6SJ7	0.80	30PL13	1.25
E476	2.25	EZ80	0.65	16.10	5Z3	1.15	6S7GT	0.80	0.80	30R14	1.25
EABC80	0.60	EZ81	0.70	QV03-12	2.90	5Z4G	0.85	6SK7	1.05	35L6GT	1.15
EB91	0.65	EY601	1.05	SCL/400	4.50	5Z4GT	0.90	6SL7GT	0.85	35W4	0.80
EB033	1.15	GZ32	0.75	SCL/600	4.50	6AB4 see EC92	6.50	6SN7GT	0.85	35Z4GT	0.85
EBF80	0.60	GZ33	3.95	SP61	0.95	6AB7	0.70	6S07	0.85	50C5	1.35
EBF83	0.60	GZ34	2.30	TZ21	11.80	6AC7	0.70	6V6GT	0.95	50CD6G	1.45
EBF89	0.80	GZ37	2.80	TZ2/125	52.80	6AH6	1.15	6X4	0.70	75	1.25
EC52	0.50	KT66	6.30	UZ5	1.15	6AK5	0.95	6X5GT	0.65	76C1	1.05
EC91	8.20	KT88	8.95	UZ6	1.00	6AKB	0.60	6Y6G	1.10	76	0.95
EC91	1.05	MH4	1.15	UZ7	1.15	6AL5	0.50	6Z4	0.75	78	0.95
ECC81	0.65	ML6	1.15	UY91	0.85	6AL5V	0.80	6-30L2	2.05	80	0.90
ECC82	0.60	N78	10.45	UZ81	0.85	6AM6	3.25	787	0.90	85A2	1.45
ECC83	0.65	OA2	0.65	UZD1	0.65	6AM6	1.30	7V4	0.90	723A/8	12.80
ECC84	0.80	OB2	0.70	UB00	11.50	6AN8	3.60	9D2	0.70	80	1.00
ECC85	0.60	PABC80	0.60	UB01	0.90	6AQ4	6.20	9D6	0.85	805	20.70
ECC86	1.40	PC85	0.60	UBC41	1.20	6AQ5	0.90	10C2	0.70	807	1.15
ECC88	0.75	PC86	0.95	UABC80	0.90	6AQ5V	1.45	10F18	0.70	813	13.30
ECC189	0.95	PC88	0.85	UAF-42	0.85	6AS6	0.90	10P13	1.20	8298	16.00
ECF80	0.60	PC900	1.45	UB90	0.70	6AT6	0.85	11E2	12.40	832A	5.20
ECF82	0.55	PC934	0.75	UBF89	0.60	6AU6	0.55	12A6	0.70	866A	3.20
ECF801	0.90	PCC85	1.05	UBL1	1.15	6AV6	0.60	12AT6	0.55	931A	12.00
ECH34	1.15	PCC89	0.85	UBL21	2.60	6AX4GT	0.95	12AT7	0.65	954	0.60
ECH35	1.70	PCC189	0.75	UCC84	0.75	6AX5GT	1.15	12AU7	0.60	955	0.70
ECH42	0.95	PCF80	0.95	UCC86	0.80	6B7	0.85	12AV6	0.80	956	0.60
ECH81	0.60	PCF82	0.70	UCF80	0.90	6BA6	0.50	12AX7	0.65	957	1.05
ECH82	1.20	PCF83	0.70	UCF81	0.90	6BB6	0.60	12B6	0.80	958	0.65
ECL80	0.70	PCF86	0.80	UCL82	0.85	6BG6G	1.15	12BE6	1.25	1629	8.85
ECL82	0.65	PCF200	1.05	UF41	0.90	6BH6	0.95	12BH7	1.10	2051	1.20
ECL83	1.40	PCF201	1.05	UF80	0.60	6BJ6	1.25	12C8	0.85	5763	4.40
ECL85	0.75	PCF801	1.05	UF85	0.70	6BQ7A	0.70	12E1	4.95	5842	7.50
ECL86	0.75	PCF802	0.75	UL41	1.20	6BR7	2.70	12J5GT	0.95	5933	3.80
EF22	3.40	PCF805	2.10	UL54	0.85	6BV6	5.19	12K7G	0.70	6057	1.05
EF37A	1.70	PCF806	0.95	UMB0	0.70	6BW7	1.15	12K8GT	0.80	6060	1.05
EF39	3.30	PCF808	2.05	UM84	0.70	6C4	0.70	12Q7GT	0.65	6064	1.05
EF40	0.80	PCH200	0.95	UY82	0.65	6C6	0.70	12SC7	0.85	6065	1.40
EF41	0.85	PCL81	0.70	UY85	0.60	6CH6	7.50	12SH7	0.85	6067	1.15
EF80	0.75	PCL82	0.75	VR105/30	2.15	6CL6	1.70	12S7J	0.65	6080	4.90
EF83	1.10	PCL84	0.80	VR150/30	1.45	6C5	1.15	12S7J	0.75	6146	4.95
EF85	0.55	PCL86	0.80	X66	1.05	6DS	0.85	12Y4	0.55	6146B	5.20
EF86	0.90	PCL805/85	X61M	1.70	6EA8	3.20	1306	0.70	6360	2.30	
EF91	1.30	0.85	XR1/6400A	6F6GB	0.85	1457	1.15	6550	6.60		
EF92	0.85	PD500	4.35	82.90	6F8G	0.85	19AQ5	0.80	6870	14.00	
EF95	0.95	PFL200	2.80	Z759	9.00						
EF183	0.85	PL300	0.95	Z800U	3.45						
EF184	0.80	PL81	0.85	Z801U	4.00						
EFB04	2.30	PL82	0.60	Z803U	3.90						
EFL200	0.95	PL83	0.60	Z900T	2.55						

VIDECON TUBE TYPE P863B

English Electric - £20

VALVES AND TRANSISTORS

Telephone enquiries for valves, transistors, etc., retail 749 3934; trade and export 743 0899.

PRICES MAY VARY

TELUROMETER MRA3 DISTANCE MEASURERS
LOW RESISTANCE HEADPHONES TYPE CLB £1.50.
40p postage. VAT 15%.

CONTINUANCE TELEPHONE TUC00433
HIGH VACUUM VARIABLE CAPACITORS - ceramic envelopes - UC 1000A/20/150 - VM/MHC 1000 60-1000F, 20kv-150A RF max=27MHz.
TEST SET FT2 for testing Transmitters A40, A41, A42 and CPC26.

UNIVERSAL WIRELESS TRAINING SET No 1 Mk 2 YA 6316 to train 32 operators simultaneously on key and phone. Complete installation consists of 3 kits packed in 3 special transit cases.
HARNESS "A" & "B" CONTROL UNITS "A" "R" "J1" "J2" Microphones No 5, 6, 7 connectors, frames, carrier sets etc.
DRUM CABLE continuous connection YC 0D433.

COLOMOR (ELECTRONICS LTD.)

170 Goldhawk Rd., London W.12

Tel. 01-743 0899

Open Monday to Friday 9-12.30, 1.30-5.30 p.m.

KELSEY K102M TRANSFORMERLESS BALANCED LINE MICROPHONE AMPLIFIERS

Specifications	
Direct P.C.B. mounting	
Supply Voltage	±15V
Maximum Gain	43 dB
Gain Control Range	38 dB
Gain Reduction in Unbalanced Mode (Input to Terminal +)	10 dB
Maximum Input Level (Unbalanced Mode, Input to Terminal +)	+15 dBV
Input Impedance (Each Input Terminal to Ground)	5 KOhm
Optimum Source Impedance	200 ohm
Maximum Output	+20 dBV
Frequency Response	± 0.5dB Ref. 10Hz to 50KHz
Slew Rate	Better than 10V/microsec
Harmonic Distortion	Better than 0.03% Ref 1KHz
	Typically 0.02%
Common Mode Rejection Ratio	Better than 80 dB
Equivalent Input Noise (Unweighted)	Better than -125 dBV (Din/Audio band weighted)
Recommended Output Loading	10 KOhm
Dimensions	40mm x 40mm x 20mm
Weight	48 grams

KELSEY ACOUSTICS LTD 28 POWIS TERRACE, LONDON W11. TEL: 01-727 1046

WW - 063 FOR FURTHER DETAILS

NEW YEAR SPECIAL OFFERS

SCOPES - SCOPES - SCOPES

OVER 75 SCOPES EX-STOCK NOW
FROM £25.00 UPWARDS
RING OR CALL FOR DETAILS

BULK BUY SEMICONDUCTOR SAVINGS

Type	Per 100	Per 1,000	Type	Per 100	Per 1,000
2N3702	£9.00	£70.00	2N6447	£10.00	£75.00
2N3704	£9.00	£70.00	2N6449	£9.00	£70.00
TIS92	£18.00	£150.00	8C337	£9.00	£70.00
TIS93	£22.00	£200.00	BF60	£33.00	£200.00
MJ1000	£45.00	£400.00	MC1458	£35.00	£300.00
MC14013	£38.00	£310.00	TIL119	£30.00	£275.00
LM709	£33.00	£280.00	1544	£2.00	£14.00
TIL209	£8.00	£65.00	1N4148	£2.00	£16.00

All devices full spec. Mostly by Texas, no remarks. All prices + carriage and VAT.
1,000s OF BARGAINS for callers in our walk-round warehouse situated 200 yards from Thornton Heath Station



Dept. W.W., 64-66 Melfort Rd., Thornton Heath, Surrey. Telephone: 01-689 7702

MAIL ORDER INFORMATION

Unless otherwise stated all prices inclusive of VAT. Cash with order. Minimum order value £20.00. Prices and Postage quoted for UK only. Where post and packing not indicated please add 30p per order. Bona Fide account orders minimum £10.00. Export and trade enquiries welcome. Orders despatched same day where possible. Access and Barclaycard Visa welcome.

WW - 077 FOR FURTHER DETAILS

SPECIAL VALVES

4CX 1000A	YL 1430	BR 189
4CX 5000A	YL 1440	CV 6131
BM 25L	GXU 6	GMU 2
BW 153	CV1597	TY4-500
DM 25LB	CV 2116	BK485/5552A
YL 1420	4CX 1500B	MIL 5948/1754

INTEGRATED CIRCUITS

SN7401N	0.32	SN74L73N	0.38	SN76033N	1.95
SN5402N	0.28	SN7474N	0.30	MC6800P	8.20
SN5410F	0.32	SN7485N	0.95	MC68800P	9.80
SN5470F	0.48	SN74L85N	1.10	MC14511B	2.95
SN54196J	1.20	SN7491AN	0.32	B1702AL	4.30
SN7407N	0.28	SN74123N	0.42	MM6300-1J	3.80
SN7408N	0.16	DM74123M	0.58	MCMB610AP	3.40
SN7445P	0.65	SN15836N	0.26	6340-1J	3.60
SN74453P	1.10	SN760013N	1.80	MC945-5D	0.28
SN7453N	0.18	SN76003N	1.80	MC936-5D	0.22

36" AERIAL MASTS consisting of 6 sections 6' 8" x 2 1/4" dia

Appointments

Advertisements accepted up to 12 noon Friday, February 1st for March issue, subject to space being available.

DISPLAYED APPOINTMENTS VACANT: £10.00 per single col. centimetre (min. 3cm).
LINE advertisements (run on): £1.50 per line, minimum three lines.
BOX NUMBERS: 70p extra. (Replies should be addressed to the Box Number in the advertisement, c/o Wireless World, Dorset House, Stamford Street, London SE1 9LU.)
PHONE: Neil McDonnell on 01-261 8508
 Classified Advertisement Rates are currently zero rated for the purpose of V.A.T.

DESIGN & DEVELOPMENT ENGINEERS

Are you seeking an opportunity to work on sophisticated test gear employing the latest analogue and digital techniques?

If so, join Rediffusion and work on a number of exciting projects associated with the design and development of equipment for production line testing of our future colour TV receivers.

Effective testing plays an important part in ensuring that the finished product reaches the high quality levels necessary for success during the 1980's. To increase the scope and flexibility of our testing, new equipment will be microprocessor controlled. Even if you only have limited knowledge of digital techniques this opportunity will enable you to learn the mysteries of microprocessors and their application to testing complex electronic sub-assemblies.

Applications are invited from engineers with a creative ability to work in a congenial and stimu-

lating environment at our Engineering Centre at Chessington, Surrey. We have vacancies at senior and intermediate levels offering opportunities for career advancement. Salaries are obviously commensurate with qualifications and experience, but will be extremely attractive to those engineers whose test equipment background is such that they can make a significant contribution to the performance of our test gear team.

The usual big company benefits, such as pension scheme, free life insurance, 4 weeks holiday with choice of leave period, sports facilities and assistance with relocation expenses are offered for these posts.

If you are interested in these challenging positions and would like more details or wish to discuss the matter in depth, please write or telephone:-

Mr. H. Brearley,
 Head of Technical Services,
 Rediffusion Consumer Electronics Ltd.,
 Fullers Way South,
 Chessington, Surrey. KT9 1HJ.
 Telephone: 01 397 5411

(10020)



REDIFFUSION

LEVER (AUDIO) LTD

Audio and Electronic Equipment Manufacturers

LOUDSPEAKER DESIGNER

Experienced in the design and manufacture of loud-speaker systems. The applicant must have had several years experience in the industry and be familiar with the design of driver units.

We are an established expanding Company with 90% export to over twenty different countries.

An exciting opportunity exists for someone with a practical outlook to see the product of their endeavours.

Salary is negotiable, subject to experience.

Apply in writing with a brief c.v.a.
 The Managing Director, 29 Heathfield, Stacey Bushes,
 Milton Keynes, Buckinghamshire. MK12 6HR. (10Q12)

ELECTRONICS/CONTROL ENGINEER SENIOR MECHANICAL DESIGN ENGINEER ELECTRONICS TECHNICIAN

URGENTLY REQUIRED TO EXPAND OUR R. & D. TEAM WORKING IN MEDICAL REHABILITATION ENGINEERING.

Stimulating and rewarding work with excellent pay offered by a long-established Company specialising in the development and supply of Artificial Limbs and Aids for the disabled.

Senior Mechanical Engineer:

Experience in bio-mechanical engineering, light engineering or aerospace design, preferably with experience of electro-mechanical or plastics design work. Responsible for design and project management from concept to manufacture on lightweight mechanisms, limb structures and motorised manipulators.

Electronics / Control Engineer:

To be responsible for all product development and liaison with sub-contractors. Experience in design of low power, low noise analogue is essential. Familiarity with digital and electro-mechanical systems would be advantageous.

Electronics Technician:

Experience with development of prototype electronic circuit breadboards. The range of work is varied and the ability to work from initial design diagrams, in close liaison with an engineer and with the minimum supervision, is essential.

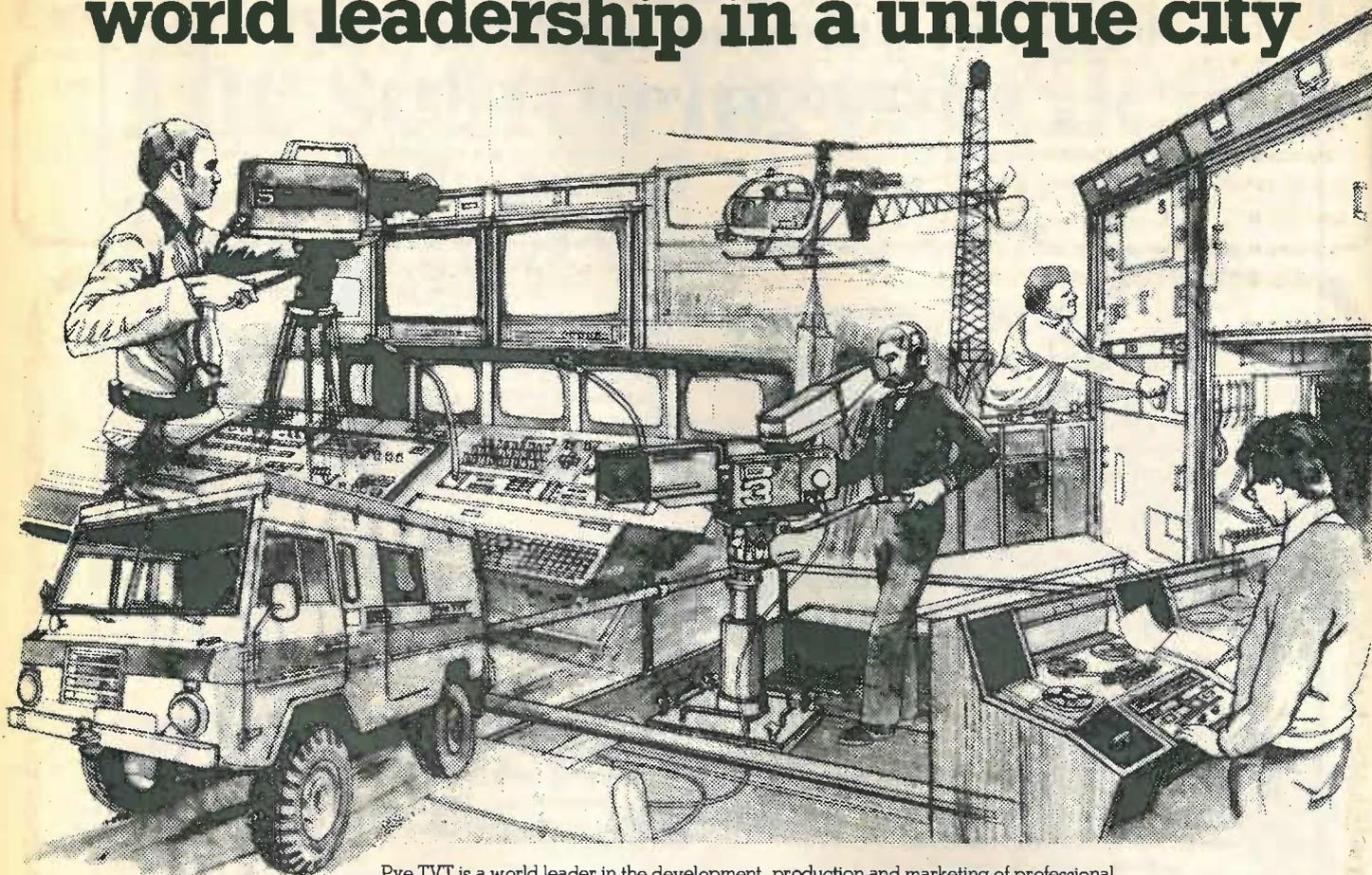
Applicants for the senior posts should possess a Degree or equivalent or have a proven record of achievement.

Written applications / telephone calls to

Mrs. Kay Cole
 HUGH STEEPER LTD.
 237 Roehampton Lane
 London, SW15 4LB 01-788 8165

(10000)

Pye TVT~The challenge of world leadership in a unique city



Pye TVT is a world leader in the development, production and marketing of professional broadcast equipment. We export 90% of our production and our sales have grown rapidly in the last five years, with some notable recent successes. We are situated in Cambridge, and have been closely associated with its commercial and cultural activities for many years. There are good schools, historic buildings and large, green, open spaces. We are only 65 minutes away from London and an hour or so from the coast. We need enthusiastic electronic engineers to work in the following areas:

Customer Service Engineering

We are looking for an enthusiastic and self-motivated engineer who is able to work (after equipment training) on complex broadcast equipment with the minimum of supervision. The work involves the investigation and correction of technical problems arising on equipment, including cameras, telecine and vision mixers, both in Cambridge and in the field. The job also includes customer liaison, worldwide travel and a very high level of job responsibility. It would ideally suit someone looking for variety and a strong element of problem-solving.

Studio Installation

This is another position that offers the applicant the opportunity of an independent and exciting life, coupled with the responsibility of a highly technical and important job. It involves the installation and commissioning of our studios and associated equipment worldwide. This equipment includes a variety of TV cameras, the latest video tape recorders, outside broadcast vans and sound studios. The job would probably suit a young engineer who wishes to gain a greater knowledge of TV systems.

Test Engineering

This opening is for an engineer to work with transmitter co-axial equipment. The overall purpose of the job is to test and align a broad range of co-axial combining and switching equipment. We're looking for someone who is able to operate independently and work to schedules, with a strong background of work on co-axial lines, wave guides or antennae.

Quality Assurance

Our Quality Department plays an integral part in a complex, technical, yet highly commercial environment, auditing the safety and performance of our equipment for adequate quality levels. Our reputation depends on their judgement, expertise and instincts.

We are either looking for a young graduate in electronic engineering, who has gained 2 or 3 years experience in industry, or someone with a solid background in electronic quality assurance, who qualifies for membership of I.Q.A. Our industry is being revolutionised by the advent of microprocessors, and the person we are looking for must be able to cope with these changes. He or she will be involved, from the quality point of view, in the design and development of new equipment, as well as being concerned with the production process.

Transmitter Development

Our continued success in the transmitter field worldwide, means we now have attractive openings in this department at all levels. We're looking for people with the ability to take responsibility for all aspects of design in TV, FM and AM sound broadcast transmitters. Applicants should be qualified to at least H.N.D. level with a minimum of around two years development experience — but the most important qualities are the interest and enthusiasm to become part of this highly successful team.

Studio Development

We are looking for people to join a highly-skilled development group, specialising in the design and development of studio equipment. As we are constantly initiating new developments, including a range of digital products used in signal processing and control, we would like to meet adaptable young engineers who can contribute to this fascinating and continually changing area. They would take responsibility for all aspects of digital equipment design for broadcast TV applications. Qualifications to degree standard are required for these posts.

We are offering generous relocation expenses, very good salaries and excellent working conditions for all of these positions. For further information or application forms, please contact **David Barnicoat on Cambridge (0223) 45115**.



Pye TVT Limited

PO Box 41 Coldhams Lane Cambridge England CB1 3JU
Tel: Cambridge (0223) 45115. Telex: 81103

(9964)

Radio Technicians Work in Communications R&D and add to your skills

At the Government Communications Headquarters we carry out research and development in radio communications and their security, including related computer applications. Practically every type of system is under investigation, including long-range radio, satellite, microwave and telephony.

Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, testing, and maintaining our equipment. In performing these tasks you will become familiar with a wide range of processing equipment in the audio to microwave range, involving modern logic techniques, microprocessors, and computer systems. Such work will take you to the frontiers of technology on a broad front and widen your area of expertise — positive career assets whatever the future brings. In the rapidly expanding field of digital communications, valuable experience in modern logic and software techniques will be gained.

Training is comprehensive: special courses, both in-house and with manufacturers, will develop particular aspects of your knowledge and you will be encouraged to take advantage of appropriate day release facilities.

You could travel — we are based in Cheltenham, but we have other centres in the UK, most of which, like Cheltenham, are situated in environmentally attractive locations. All our centres require resident Radio Technicians and can call for others to make working visits. There will also be some opportunities for short trips abroad, or for longer periods of service overseas.

You should be at least 19 years of age, hold or expect to obtain shortly the City and Guilds Telecommunications Technician Certificate Part I (Intermediate), or its equivalent, and have a sound knowledge of the principles of telecommunications and radio, together with experience of maintenance and the use of test equipment. If you are, or have been in HM Forces your Service trade may allow us to dispense with the need for formal qualifications.

Registered disabled people may be considered.

Pay scales for Radio Technicians start at £3900 per annum, rising to £5530, and promotion will put you on the road to posts carrying substantially more; there are also opportunities for overtime and on-call work, paying good rates.

Get full details from our **Recruitment Officer, Robby Robinson, on Cheltenham (0242) 21491, Ext 2269**, or write to him at **GCHQ, Oakley, Priors Road, Cheltenham, Glos GL52 5AJ**. We will invite suitable applicants (expenses paid) for interview at Cheltenham.



Recruitment Office

Government Communications Headquarters

Oakley, Priors Road, Cheltenham GL52 5AJ

(9813)

CHelsea COLLEGE
University of London

ELECTRONICS WORKSHOP

DEPUTY SUPERVISOR (Grade 6) and ELECTRONICS TECHNICIAN ENGINEER (Grade 5) required for interesting work for Electronics and Physics research and teaching. Includes prototype instrument design, development and construction and the servicing and repair of commercial electronic equipment.

Experience and qualifications in Electronics at an appropriate level are essential. Generous holidays. Inclusive salaries (under review):

Grade 6: £5023 to £5848 per annum
Grade 5: £4480 to £5100 per annum.

Further details and application forms from: **Mr. M. E. Cane (EW), Chelsea College, Pulton Place, London SW6 5PR.**

(9974)

ELECTRONIC ENGINEERS

NEEDED IMMEDIATELY

Trec Video is expanding its Broadcast facilities at its new premises close to Waterloo Station.

Applications are invited for Engineers interested in working in the following areas:

- A) Outside Broadcast
- B) Broadcast Video Tape Recorders
- C) General Equipment Servicing

Please ring, or write to:

**Mr. Derek Oliver
Chief Engineer
TREC CONSULTANTS
LIMITED
1-7 Boundary Row
London, S.E. 1
Tel: 01-633 9494.**

(9996)

ROYAL COLLEGE OF ART

An

ELECTRONICS TECHNICIAN

is required in the Department of Environmental Media to assist students in the creative use of equipment, and control all aspects of maintenance. This is a broad-based Department using Sony video facilities (1/2" open reel and U-Matic), sound recording equipment, film and slides, cameras and projectors.

Applicants should have at least the equivalent of a City & Guilds Certificate (Part II) and some practical experience.

Starting salary on scale £4767-£5592 (£5026-£5901) from 1.4.80).

Write, giving full details of age, qualifications and experience, to: Assistant Registrar (Staff), Royal College of Art, Kensington Gore, London, SW7 2EU. (10011)

THE POLYTECHNIC
OF CENTRAL LONDON
Division of Engineering

ELECTRONICS TECHNICIAN

Grade 5

Salary: £4479-£5100 increasing to £4707-£5364 on 1 April, 1980
These figures include £780 London Allowance

Technician required as computer supervisor to oversee the day-to-day operation and hardware maintenance of a PDP 11/40 installation with associated peripheral equipment.

Applicants should have minicomputer, hardware and/or operating systems experience.

The following qualifications are required: ONC, OND with 7-9 years' experience (inclusive of training) or the equivalent and/or appropriate industrial experience.

Application form and job description from the **Establishment Officer, PCL, 309 Regent Street, London W1R 8AL (Tel: 01-580 2020 ext. 212).**

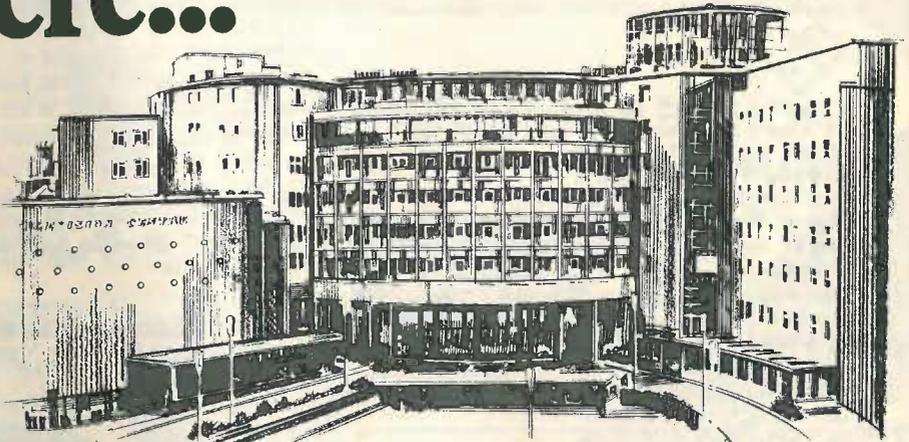
(9984)

Television Engineers

The search for excellence starts here...

Standards of BBC broadcasts are higher now than they have ever been—and the excellent quality of our transmissions is due largely to the expertise of our Engineering teams. We want to expand those teams, and for men and women who make the grade, the possibilities are endless.

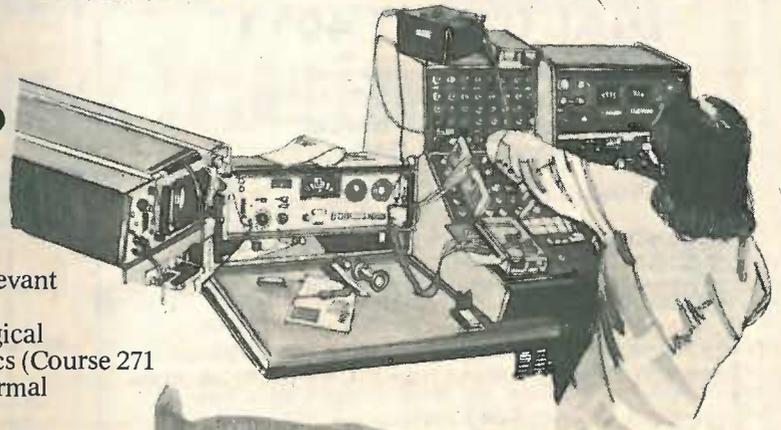
Our Engineers are closely involved with production staff in the making of programmes, either by providing the facilities required or by operating equipment.



and here...

They are also responsible for the technical standards of our broadcasts and for the maintenance of our technical equipment.

You should have a degree in Electrical or Electronic Engineering, Applied Physics or a relevant science subject, an HNC/HND or higher TEC certificate or diploma, or a C & G Full Technological Certificate in Telecommunications or Electronics (Course 271 or 281); a strong interest in broadcasting, and normal colour vision and hearing.

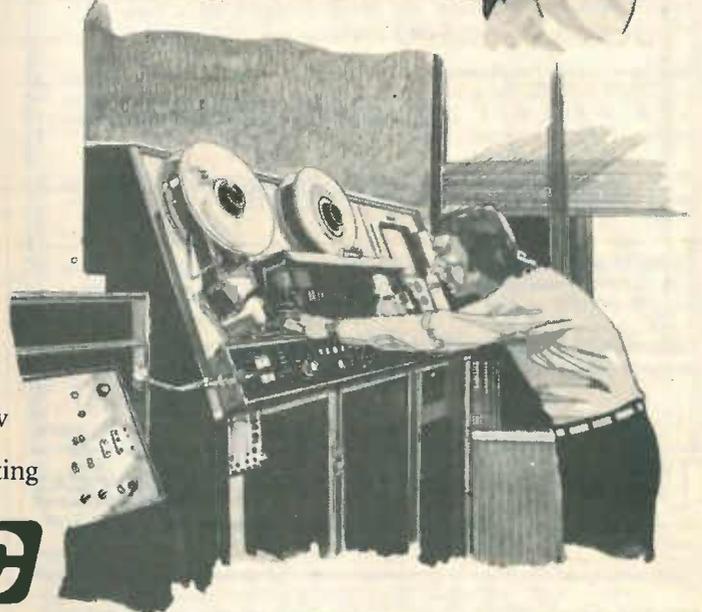


and here...

Salaries, to be reviewed in April, range from £5760 to £6260 including shift allowances and the jobs, which are based mainly in the West London area, also carry such benefits as a pension scheme, social clubs and staff restaurants.

Opportunities for personal development through training and promotion are good.

If you are interested please complete the coupon below and then return the whole advertisement to The Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA, quoting reference no. 79.E.4156/WW.



Name _____ Mr/Mrs/Miss Address _____

Tel. No. _____

Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA.

79.E.4156/WW.

(9988)



ROHDE & SCHWARZ MÜNCHEN

We are a leading German electronics company in Munich. Our reputation is based on the manufacture of high-precision measuring instruments and communications equipment.

Our German translators need the help of a British graduate.

Electronics Engineer

qualified to give the master touch to their English translations of data sheets, catalogues and manuals on electronic measuring and communications equipment.

His/her knowledge of German should be such that after about six months he/she can also do translations.

The applicants should be willing to work for some years in our translation department in Munich where he/she will find a friendly atmosphere and British fellow-workers.

Starting salary will be in the region of £8,000 to £10,000 p.a., holiday 26-29 days depending on age. Along with the usual benefits of a large company we offer flexitime, subsidised canteen and travel costs for those living far from the office.

If you are interested, please send your application together with full curriculum vitae to **ROHDE & SCHWARZ**, Personalabteilung P176.

**ROHDE & SCHWARZ GMBH & CO. KG : MÜHLDORFSTR. 15
8000 MÜNCHEN 80 : TEL. (089)4129-2403 : W. GERMANY**

(9978)

DIAL 01-741 4011

Think of the Op Amp and the NAND Gate and your are through to:

CHARLES AIREY ASSOCIATES

4 Hammersmith Grove

London W6 ONA

CURRENT VACANCIES INCLUDE:

Chief Control Engineer for multi-million pound company engaged in the manufacture of roof tiles. Managerial ability as important as the ability to create a new generation of process automation products. Surrey. Excellent salary.

Young Entrepreneurial Engineers to join a multidisciplinary company with interests in: radio-controlled target systems, range finders, aerospace products, etc. Good microprocessor hardware/software experience. Wilts. Salary good.

Microprocessor Hardware/Software Engineers to design systems and supply modules for a very wide range of applications. Experience in either: M6800, R.P.A. 1802, GM 1650 or INTEL 8085. Berks. Salary — "What 'es worth."

INTEL Microprocessor Engineers for message switching systems based on a minicomputer and the INTEL 8080/85/86. Surrey — to £9,000.

Digital Engineers for exceptionally advanced technology associated with an MPU control system for shipborne aeriels or early warning radar. To £9,000. Berks.

Computer Engineers for either technical support, field service, permanent site or systems test. Vacancies throughout the U.K.

For further details, please contact:

(9940)

Charles Airey Associates

4 Hammersmith Grove, London W6 ONA. Tel: 01-741 4011

"PROBABLY THE BEST KNOWN SUPPLIER OF ELECTRONIC ENGINEERS IN THE COUNTRY" -Financial Times.

Piccadilly Radio require a

BROADCAST ENGINEER

grade 1.L.R. 2 to be involved in all aspects of station engineering. Preference will be given to people having experience in this field.

Apply: **Phil Thompson**
Chief Engineer
Piccadilly Radio
P.O. Box 261
Manchester M60 1QU



(9993)

CAPITAL APPTS.

FREE LISTS

101 Design/Development
'and Test Jobs

Permanent and Contract

To **£8,500**

(8782)

637 5551 day: 636 9659 eve.

29 Windmill St.

London, W.1.

Chief Electronics Technician II

We are seeking a person who holds an HNCElectronics or equivalent qualification. The post holder (male/female) will be responsible to the District Engineer for the maintenance of very sophisticated Electronic and Bio Medical Equipment within this Health District. As well as day-to-day maintenance the operation and extension of a planned preventive maintenance scheme is also required.

A pleasant manner and the ability to advise and instruct operators on safety, and technical use of equipment is an important aspect of the post.

Salary: £5945-£7316 p.a. incl.

Job description and application form available from the District Personnel Department, Lewisham Hospital, High Street, SE13 6LH. Tel: 01-690 4311 ext. 344.

Closing date: 8 February, 1980.

ewisham

Health District

(9981)

Radio Communications Electronics Engineers and Software Designers

Mid-Sussex—S.W. London

Salaries up to £8,000

To join our expanding R&D Laboratories covering a wide range of R.F. spectrum, from L.F. to V.H.F. Equipments include transmitters and receivers for marine- and land-based use, radio nav aids and radio monitoring remote computer-controlled systems.

Electronics Engineers should have experience in transmitter or receiver design, analogue or digital circuit design, microprocessor applications. Software Designers should be experienced Programmers with an interest in control, signal processing or navigational software.

Attractive salaries are complemented by excellent prospects and generous benefits.

Contact: **David Bird, Redifon Telecommunications Limited, Broomhill Road, Wandsworth, London, S.W.18. Phone: 01-874 7281 (reverse charges).**

(9938)

How to get the second interview

without hitting the first hurdle

Second interviews are where it all happens.

You meet the decision-makers and you know they're interested.

Let Lansdowne save you from all the drudgery of the first-interview rat-race. Just send for our 'First Interview' form and fill it in in the comfort and privacy of your own home.

It will say as much about you as any first interview ever can and we can match it against positions in over 3,000 companies, large and small.

Where there is a position that might suit you, we send your form straight to senior management.

If they're interested, they get straight in touch with you. We don't get in the middle.

As you'd expect from Britain's most professionally respected register, we maintain total confidentiality throughout.

And you can specify those companies to whom you do not want your details sent.

Stop going to first interviews, just put yourself straight onto the shortlists.

Send us the coupon now.

Our clients would like to meet Sales Engineers in any of the following categories - (please tick where appropriate)

- Test Engineers
 Calibration Engineers

Name _____

Address _____

**Lansdowne Appointments
Register, Design House,
The Mall, London W5 5LS
Tel: 01-579 2282**

(24 hour answering service.) WW16/1

Lansdowne

**Lansdowne Appointments Register, Design House, The Mall,
London W5 5LS Tel: 01-579 2282 (24 hour answering service).**

Land a good job

**Your
Radio Officer's
qualifications
could mean a lot
here onshore**

If you're thinking of a shore-based job, here's where you'll find interesting work, job security, good money, and the opportunity to enjoy all the comforts of home where you appreciate them most - at home!

The Post Office Maritime Service has vacancies at Portishead Radio and some of its other coast stations for qualified Radio Officers to undertake a wide variety of duties, from Morse and teleprinter operating to traffic circulation and radio telephone operating.

To apply, you must have a United Kingdom Maritime Radio Communication Operator's General Certificate or First Class Certificate of proficiency in Radio-telegraphy or an equivalent certificate issued by a

Commonwealth Administration or the Irish Republic. Preferably you should have some sea-going experience.

The starting pay at 25 or over will be about £5381; after 3 years' service this figure rises to around £7087. (If you are between 19 and 24 your pay on entry will vary between approximately £4229 and £4937). Overtime is additional, and there is a good pension scheme, sick-pay benefits, at least 4 weeks' holiday a year, and excellent prospects of promotion to senior management.

For further information, please telephone Kathleen Watson on 01-432 4869 or write to her at the following address: ETE Maritime Radio Services Division (), ET17.1.1.2, Room 643, Union House, St. Martins-le-Grand, London EC1A 1AR.

Post Office Telecommunications

(9741)

Air traffic Engineers

The Civil Aviation Authority has vacancies for men and women as Air Traffic Engineers Grade 2 in its Telecommunications Division offering a variety of work on a wide range of electronic systems and specialised equipments.

Air Traffic Engineers Grade 2 are involved in the installation and maintenance of radio, radar, air navigational and landing aids, and data processing systems. Staff are employed at Air Traffic Control Centres and some Civil Airports and other locations throughout the U.K. but at present most of the vacancies are likely to be in the South of England with some in Scotland and Shetland.

Qualifications and Experience

You should be at least 20 years of age and have obtained either the ONC (ENG) with an electronic bias or C & G Telecommunications Technician T3 Certificates or T.E.C. Telecommunications Certificate with Radio options or other similar technical qualifications.

You should also have had skilled working experience in radio, radar or data processing.

Salary

Salaries are on the incremental scale £4777-£7472. Posts in the London area attract an additional allowance (Inner London £831 - Outer London £347) Grade 1 posts (maximum salary £8980) are normally filled by promotion from Grade 2.

For full details and an application form, complete and send the coupon to:
CAA Tels Staff Management (ATE2),
Room K206, CAA House,
45/59 Kingsway, London WC2B 6TE.

Name _____

Address _____

(WW2/80)

(9965)

the Long Arm of the Law needs its voice . . .

Dorset Police Force depends upon its communications system to direct its varied operations, from crime fighting to law enforcement, so its voice must be heard. As

Assistant Communications Officer

it will be your job to see that it is, by assisting the Communications Officer in the maintenance of an efficient communications system throughout the area. This will entail you in inspecting all Force owned equipment concerned with the computer based command and control system and instructing both the Police and civilian personnel in its use. You will also be expected to supervise the installation of telex and teleprinter equipment, emergency radio and telephone links and oversee the manufacture, alteration and installation of specialist electronic and electrical apparatus. This is a highly responsible and specialised post and while we realise that it will be difficult for someone to meet our exact requirements, we would prefer you to have extensive G.P.O. experience and technical training qualifications, such as a Radio Officer's Certificate, Civil Aviation Standard with relevant experience on the most modern communications equipment.

We would be interested in hearing from you when you have completed your service with the Force and we will give you training in areas that you lack experience.

We offer excellent conditions, a salary of £5,067 inclusive, an essential 'Car User' Allowance and a generous assistance car purchase scheme.

If you'd like to find out more and help the long arm of the law really roar, then please contact the Chief Constable, Police Headquarters, Winfrith, tel. Bindon Abbey (0929) 462727, ext. 254 for further details and an application form.

Closing date for completed applications: 22nd February, 1980.

PROJECT ENGINEERS

We need two Engineers to work in our Engineering Projects group and assist us with a major programme of expansion and re-equipment.

Duties within this small group include the design and construction of specialised equipment, the appraisal and acceptance testing of new equipment and the planning of system installations.

A thorough knowledge of digital techniques or modern television colour cameras would be an advantage.

Applicants should ideally be qualified to at least HND or equivalent standard and have had several years relevant training and experience in television broadcasting.

Starting salary up to £7500 depending on qualifications and experience.

Applications in writing to:

Personnel Executive Yorkshire Television Ltd
The Television Centre Leeds LS31JS


**YORKSHIRE
TELEVISION**

Member of the Trident Television Group (10003)

GEC Medical Equipment Limited

East Lane, Wembley, Middlesex

We are the largest British manufacturer of diagnostic medical equipment and wish to expand our Research, Development and Design teams engaged in X-ray and Ultrasound fields. In particular we wish to recruit:

**Electronic Development
Engineers
Designers
Draughtsmen
Technical Illustrators
Test Engineers & Technicians**

Persons, male or female, who have experience in any of the above and are seeking a career move are invited to contact our Personnel Manager to arrange initial, informal interviews. Tel: 01-904 1288.

GEC
Medical

(10013)

Electronics in the Leisure Industry

MAM Inn Play Limited is a major national supplier of fruit machines, juke boxes, background music and video games. The technology of our industry is undergoing a rapid change and this has created the need for a small number of Senior Engineers, to be based at our service departments throughout the U.K. and who will be responsible for specialist workshop repairs, training and the co-ordination of new projects.

Applicants, qualified at OND/HND level or equivalent, should have practical experience in a micro-processor environment. Experience as an instructor will be an advantage.

These are career appointments which offer attractive salaries and cars for private and business use.

Telephone in confidence: Brian Withers, Group Technical Manager, MAM Inn Play Limited, Theale, Berks. Telephone: Reading (0734) 302621. (10016)



MAM INN PLAY LIMITED

TESTERS, TEST TECHNICIANS, TEST ENGINEERS. Earn what you're really worth in London working for a World Leader in Radio & Telecommunications. Phone Len Porter on 01-874 7281, or write: **REDFON TELECOMMUNICATIONS Ltd., Broomhill Road, Wandsworth, London, SW18.** (9856)

SMALL EXPANDING COMPANY requires young electronic engineer for development and pre-production work. HNC or similar preferred but good practical ability essential. Salary negotiable with excellent future prospects. Tel. 01-868 0443 for appointment. (10008)

Success is simply a matter of Luck — ask any failure — Earl Wilson.

Digital Engineers — get lucky in
FIELD SERVICE

To register for wide choice of field service positions—

Ring **01-464 7714**
Ext. 502, 24 hours

LOGEX

ELECTRONICS RECRUITMENT SERVICE
309 HIGH ROAD, LOUGHTON, ESSEX, IG10 1TD.
01 502 1589/0937 01 464 7714 EXT 502 (9927)

HNC Level Engineers~

(Electrical or Electronic)

Train for the future as a Broadcast Transmission Engineer

Through our network of over 500 transmission stations the IBA is responsible for the transmission of all Independent Television and Local Radio services. With a steadily increasing number of stations, the preparations for the fourth television channel and more local radio stations now underway we are taking on increased responsibilities.

We take great pride in the fact that our system is one of the best in the world and great importance is placed on maintaining the efficiency of the service. To do this we have teams of highly trained and experienced engineers all over the country.

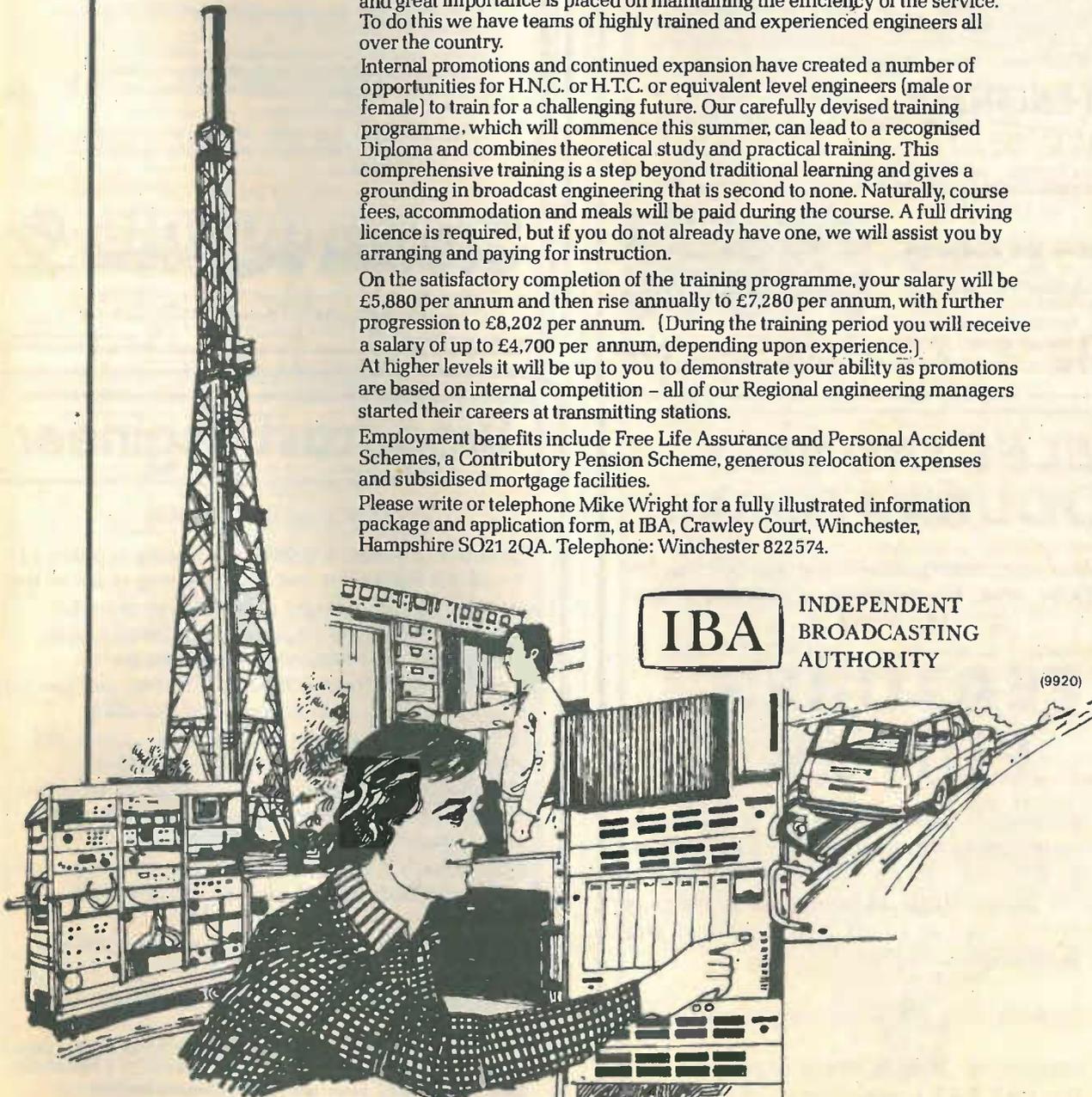
Internal promotions and continued expansion have created a number of opportunities for H.N.C. or H.T.C. or equivalent level engineers (male or female) to train for a challenging future. Our carefully devised training programme, which will commence this summer, can lead to a recognised Diploma and combines theoretical study and practical training. This comprehensive training is a step beyond traditional learning and gives a grounding in broadcast engineering that is second to none. Naturally, course fees, accommodation and meals will be paid during the course. A full driving licence is required, but if you do not already have one, we will assist you by arranging and paying for instruction.

On the satisfactory completion of the training programme, your salary will be £5,880 per annum and then rise annually to £7,280 per annum, with further progression to £8,202 per annum. (During the training period you will receive a salary of up to £4,700 per annum, depending upon experience.)

At higher levels it will be up to you to demonstrate your ability as promotions are based on internal competition - all of our Regional engineering managers started their careers at transmitting stations.

Employment benefits include Free Life Assurance and Personal Accident Schemes, a Contributory Pension Scheme, generous relocation expenses and subsidised mortgage facilities.

Please write or telephone Mike Wright for a fully illustrated information package and application form, at IBA, Crawley Court, Winchester, Hampshire SO21 2QA. Telephone: Winchester 822574.



IBA

INDEPENDENT
BROADCASTING
AUTHORITY

(9920)

**BRIGHTON POLYTECHNIC
LEARNING RESOURCES
THREE VACANT POSTS
GOOD SALARIES OFFERED
ELECTRONIC ENGINEER**

To work with a team of experienced engineers and technicians developing colour television and other audio/visual facilities throughout the Polytechnic. The systems developments range from simple sound and TV production equipment to video recording and editing to near broadcast standards.

The Electronic Engineer will apply digital and analogue techniques to develop and install new equipment, up-grade existing facilities and assist with its maintenance. Formal training to Degree or equivalent standard will be expected but proven ability and experience in electronic design and construction (preferably including television) will be rated even more highly.

**VIDEO RECORDING AND
STUDIO ENGINEER**

To lead the work of staff in a newly equipped recording and editing area (using state of the art techniques, including Plumbicon colour technique and a wide range of VTRs — some to broadcast standard) and to contribute to the engineering development of the systems of the area. Also to supervise the two adjoining studios, containing systems with colour corrections and multi-track sound.

Operational experience of sound and colour video systems (preferably in a broadcasting or educational institution) and a degree or equivalent qualification are desirable.

VTR ENGINEER

Unique opportunity to work in the forefront of helical vtr developments; using new 1" high band, broadcast 3/4" and all consumer formats, requiring a qualified engineer to work to broadcast standards but interested in working with all vtr formats.

Further details and application forms from the Personnel Officer, Brighton Polytechnic, Moulsecoomb, Brighton BN2 4AT. Tel. 0273 693655 Ext. 2536. Closing date 30th January, 1980.

(9977)



East Sussex

**ELECTRONICS
JOURNALISM**

Electron, the weekly technical magazine for designers and managers in electronics, requires a

**FEATURES
EDITOR**

We're looking for someone with a good all-round knowledge of electronics to commission features articles. Experience of technical writing or publishing, although preferred, is not essential, but a good command of the English language is important.

Salary: £6464 plus £210 reading allowance.

Telephone: **Barrie Nicholson on
01-261 9111 extension 257**
for an application form

**Brunei
Training Officer
(Teleprinter)**

**Department of Telecommunications
Tax free salary up to £8,100**

As part of its continuing expansion and improvement programme the Department of Telecommunications requires a Training Officer (Teleprinter).

Candidates should be over 35 years of age and have at least ten years' experience in telecommunications with a minimum of five years in a supervisory capacity. They must have a sound knowledge of teleprinter servicing and overhaul of either the CREED 444 or SIEMENS T100 machines.

The successful candidate will be responsible for the training of local staff both formally and in the field on all aspects of the discipline.

The tax free salaries include a special allowance and attracts a 25% gratuity.

Benefits include free passages, leave allowance, subsidised housing, education allowances, children's holiday visit passages, interest-free car loan and outfit allowance. Contract 3 years.

For full details and application form telephone Anne Eames 01-222 7730 ext 3231 or write quoting reference number MT/310/WD.



The Crown Agents for Oversea Governments and Administrations, Recruitment Division,
4 Millbank, London SW1P 3JD.

(9982)

Broadcast Engineer

TEST AND SERVICE

Seltech Equipment Limited is a leading supplier of broadcast equipment and its increasing share of the market requires a major expansion programme involving a move to larger modern premises and employment of additional engineering staff.

The position offered will involve testing and servicing a full range of broadcast products including switching, pulse generation, time code, clock and audio systems, utilising the latest technology.

The successful applicant will probably be qualified to HND level but broadcast related experience is of prime importance.

The position is based in the company's new premises at Bourne End, Bucks. Limited travel will be required.

Salary and conditions will be in keeping with the position offered.

In the first instance apply to: D. Craddock, General Manager.



SELTECH EQUIPMENT LIMITED
Rose Industrial Estate, Cores End Road,
Bourne End, Bucks, SL8 5AT
Tel: Maidenhead (0628) 36315
or Bourne End (06285) 29131 (9999)

ENGINEERS & TECHNICIANS

**1980 —
The Decade to Develop
your future**

If you want a real professional challenge and the rewards your efforts deserve, then

ARAMCO

could be the employer you need.

Aramco are the world's largest oil producers with a massive scale of operations in Saudi Arabia. You will be working with modern equipment in a highly professional team on some of the most challenging projects.

The Communications Department of

ARAMCO

require Engineers and Technicians in the following disciplines:

COMMUNICATIONS ENGINEERS & TECHNICIANS ELECTRICAL & ELECTRONIC ENGINEERS

Salaries are high, as you would suspect with a world leader. Engineers can earn up to **£16,900** per contract year, Technicians up to **£13,700** — after tax.

Contracts are single status and renewable with air-conditioned accommodation and free medical care. Married men receive 14, 14, 25 days' leave after each 4-month period, single men 30 days after 12 months.

A valid U.K. Driving Licence is required.

Find out more about the opportunities with Aramco. Please write, giving brief career details, quoting ref. WW/1/1 to:



MANAGEMENT SERVICES LIMITED

INTERNATIONAL RECRUITMENT

5, East Parade, Harrogate, North Yorkshire HG1 5LF.

COMMUNICATE NORTH

Development of North Sea installations has increased the need for advanced technology in the field of communications and computer controlled oil production systems. This area offers challenging opportunities and career security throughout the 80's and beyond.

Our client, a leading communications company, expanding to meet the needs of its clients within the oil industry, invite applications from suitably qualified persons for the positions outlined below:

Communications Engineer Gross Salary £9,000 + p.a.

In addition to a varied workload at onshore locations, responsibility will also include troubleshooting, repair and maintenance, and the installation of communications equipment on offshore platforms. It will be necessary to have experience of Broad-band systems, multiplex and telephone exchanges, HF/SSB/ISB Systems, VHF/FM Transceivers, portables and teleprinters. Candidates should hold an H.N.C. or B.Sc. in a relevant discipline or an equivalent Forces qualification i.e. Foreman of Signals.

Communication Technician Gross Salary £7,000 + p.a.

This position is workshop based but provides a varied and interesting workload with a commitment to offshore and field work on an ad hoc basis as and when required. A minimum of 5 years experience in installation and repair of radio and telecommunications equipment, with competence in the operation of associated test equipment. Full City and Guilds Telecommunications, ONC or equivalent Forces qualifications would be regarded as suitable.

Computer Service Engineer Gross Salary £9,000 + p.a.

This is an extremely interesting position for highly qualified engineers who will be working on projects both on and offshore. Projects include the installation of telemetry, supervisory and computer aided oil production systems. Engineers should have broad digital experience in computer and peripheral maintenance and have the potential to develop systems for clients. Applicants should possess an HNC or B.Sc. in a relevant discipline and have previous supervisory experience.

Due to the fact that engineers and technicians are required to work both on and offshore it is necessary for them to live in the Aberdeen area. Personnel staff will provide expert help and advice for those wishing to relocate and generous allowances are given to cover relocation costs.

Please contact Margaret Duthie at Aberdeen (0224) 28921 for an application form.

GTS Personnel Services



29 York Place, Aberdeen. Telephone: (0224) 28921

Employment Agency Licence No. SC 324.

(10007)

COMPUTER

**Vermont Research
Limited**

CIRCUIT DESIGN ENGINEER

- ★ Do you want to join a fast growing international company manufacturing sophisticated computer disc and drum systems.
- ★ Do you want involvement, responsibility and job satisfaction.
- ★ Do you prefer discrete component advanced circuit design.
- ★ Do you want to earn **£6,000-£7,000.**
- ★ The above position is available to further develop our advanced disc systems incorporating high technology servo and data channel electronics.

Telephone: Mrs. Amery on Leatherhead (03723) 76221

**Or apply in writing to: Vermont Research Limited
Cleeve Road, Leatherhead
Surrey KT22 7NB**

(9992)

PERIPHERALS

**IMPERIAL WAR MUSEUM
LONDON**

Audio Technician

The Museum illustrates and records all aspects of the two world wars and all other military operations involving Britain and the Commonwealth since 1914.

This post is in the Department of Sound Records, where the technical operations are based on a Sound Suite incorporating Leavers-Rich E200 and Revox tape machines, disc reproducers, a Neve BCM 10/2 mixing desk and ancillary facilities. It carries responsibility for regular servicing of all the audio equipment, dubbing operations and training and supervising an assistant to carry out transfer operations. Duties include some location recording, control of public listening facilities, production of programme material for the Museum's public and educational services and supervising the production of copy tapes.

Candidates should preferably have an ONC, C & G, TEC/SCOTEC or equivalent qualification in Engineering or other relevant subject, but those with special experience will be considered.

All candidates must have an aggregate of at least 8 years' recognised training (e.g. apprenticeships) and experience (which may include up to 3 years' relevant full-time study), and be experienced audio equipment technicians.

Salary (under review) starting at £5760 rises to £6330. Non-contributory pension scheme.

For further details and an application form (to be returned by February 5, 1980) write to Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours). Please quote ref: T/5272.

UNIVERSITY OF ST. ANDREWS

Department of Chemistry

Applications are invited for a post of

ELECTRONICS TECHNICIAN

Grade 5

to design and maintain electronic equipment in the Department of Chemistry. Candidates should have an O.N.C., City & Guilds Ordinary Certificate or equivalent qualification.

Salary at appropriate point on scale £3700 to £4320 per annum (under review).

Applications with the names of two referees should be sent to the Establishments Officer, The University, College Gate, St. Andrews, Fife, by 31st January, 1980.

(9985)

Thames Television

We have a vacancy for a

TELECINE ENGINEER

based at our Euston Studios

The post involves the operation and maintenance of Flying Spot and Photoconductive machines.

Applicants without practical experience must have a theoretical knowledge of Telecine operations and should possess an ONC qualification or equivalent.

Salary is on a scale from £5500 per annum to £7480 per annum, dependent upon experience, for a 38-hour week.

There are 21 days holiday, Company Pension Scheme and subsidised meal facilities.

For an application form please telephone or write to:-

Ms Pat Evans, Staff Relations
Department, Thames Television Ltd.
Teddington Lock, Middlesex.
Telephone: 01-977 3252, Ext. 325.



(10010)

KING'S COLLEGE, LONDON

ELECTRONICS TECHNICIAN

This post in the Department of Electronic and Electrical Engineering requires experience in the construction, modification and repair of electronic equipment. Salary according to age and experience on scale £4480 p.a. to £5100 p.a. (£4706 p.a. to £5364 from 1.4.80) inclusive (under review). 5 weeks' annual holiday. Superannuation scheme. Interest-free loans for annual rail season tickets.

Apply in writing with full details to: The Head Clerk (Ref: 221751/WW), King's College, London, Strand WC2R 2LS.

(9971)

ELECTRONIC SERVICE ENGINEER

We are looking for an engineer to take charge of the maintenance of our U.K. computer centre. This position will require good digital electronics background with particular experience in computer peripherals. It will be necessary to travel to the U.S.A. for training courses and liaison with service engineers in our Canadian and North American centres. A company car will be supplied after full training. Our company offer a realistic bonus and free medical schemes.

Salary offered £7,500 p.a. negotiable depending upon experience in computer systems

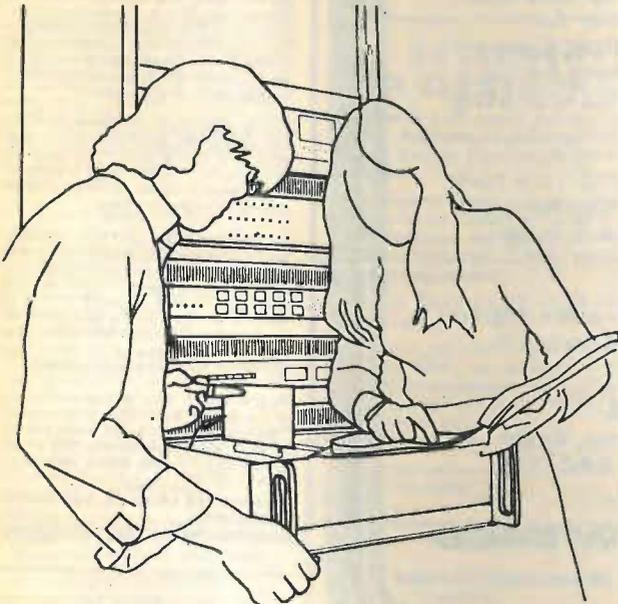
Please apply to:



**Roy Self
SEFEL GEOPHYSICAL (UK) LTD.
Turriff Building
Great West Road
Brentford
Middlesex
Telephone: (01) 568 3273**

(10014)

Professional Careers in Electronics



All the others are measured by us...

At Marconi Instruments we ensure that the very best of innovative design is used on our range of communications test instruments and A.T.E. We have a number of interesting opportunities in our Design, Production and Service Departments and we can offer attractive salaries, productivity bonus, pension and sick pay schemes together with help over relocation. If you are interested to hear more, please fill in the following details:-

Name	_____			Age	_____
Address	_____				
Telephone Work/Home (if convenient)	_____				
Years of experience	0-1	1-3	3-6	Over 6	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Present salary	£2,500- 3,500	£3,500- 4,500	£4,500- 5,500	over £5,500	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Qualifications	None	C & G	HNC	Degree	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Present job	_____				

Return this coupon to John Prodger, Marconi Instruments Limited, FREEPOST, St. Albans, Herts, AL4 0BR. Tel: St Albans 59292

**Marconi
Instruments**

A GEC MARCONI ELECTRONICS COMPANY

(9200)

DEVELOPMENT ENGINEER

To work on the design of new broadcast TV studio products. Applicants should have some knowledge of television studio techniques and be qualified to HND or Degree level.

TEST ENGINEERS

At senior and intermediate level to work on our range of advanced broadcast television studio products, including colour and monochrome television studio cameras.

Applicants should have an up-to-date knowledge of digital and linear circuit techniques gained from experience working on television studio equipment, radar equipment or similar sophisticated products and qualified to HND, HNC or equivalent level.

SYSTEMS ENGINEER

You would be involved in all stages of product management on the design and building of studio and mobile TV systems and should be prepared for occasional world-wide travel. The appointment requires someone with a background in this type of work, or in the operational side of television with the ability to take charge of people and deal with problems in the field on your own initiative.

Employment benefits include excellent salary, generous holidays, free life and health insurance, pension scheme, subsidised meals and relocation expenses.

Please apply for further details and application forms to Jean Smith at the address given below.



**Advanced
Broadcasting
Equipment**

LINK

ELECTRONICS

Link Electronics Limited,
North Way, Andover,
Hants, SP10 5AJ.

Telephone: (0264) 61345

(9968)

Electronics Design Engineers

Rank Research Laboratories are looking for young engineers who are keen to tackle analogue and digital electronic design for thermal imaging systems and the application of microprocessors. This work will attract engineers with ability in digital and analogue design and keenness to exploit the power of electronics in creating new systems in the fields mentioned.

Good salaries will be offered to suitable candidates and it is a Rank Organisation policy to assist professional career development. The company has a contributory pension fund and non-contributory life assurance scheme.

Men and women with a few years' R & D experience and a degree or equivalent in electronic engineering or physics are invited to phone or write for an application form to the

Administration Manager, Rank Research Laboratories, P.O. Box 33, Phoenix Works, Great West Road, Brentford, Middlesex TW8 9AG. Tel. 01-568 9766, extn. 26.

RANK RESEARCH LABORATORIES

(10019)



Opportunities for Test Engineers

If you've experience in thyristor control drives, digital logic techniques, computer systems, or microprocessors, then you could be the test engineer we're looking for.

We need several engineers to work on a wide range of electronic control equipment.

Ideally, you will have served an apprenticeship in the electrical industry, and be qualified to ONC or HNC standard, although experience could well take the place of formal qualifications.

If you're interested, apply to our Personnel Officer on Rugeley 5151 or write to him at:

THORN THORN AUTOMATION

THORN AUTOMATION LIMITED
P.O. Box 4, Rugeley
Staffordshire, W15 1DR

Applications are welcome from both men and women.

(10023)

UNIVERSITY OF ST. ANDREWS
Department of Psychology

TECHNICIAN GRADE 5 (ELECTRONICS)

Applications are invited for the above post in the Electronics Workshop of the Psychology Department. Applicants should have a good electronics background together with practical experience in the development and construction of digital equipment and the design of computer interfaces.

The person appointed will work together with other members of the technical staff on the development of on-line experimental facilities using the Department's Data General computers and DEC GT40 Graphics Display Terminal. There will also be work with the Department's dedicated microcomputer systems (Cromenco, Minc-11). Experience with small digital computers and a knowledge of programming languages is desirable. The duties will also involve the use and maintenance of other electronic equipment in the Department.

Salary at appropriate point on scale £3700-£4320 (under review). Applications, with full details of career to date, and the names of two referees, should be sent to the Establishments Officer, The University, College Gate, St. Andrews, Fife by 31st January, 1980.

(9970)

THE INNER LONDON EDUCATION AUTHORITY
THE LONDON COLLEGE OF PRINTING

TELEVISION TECHNICIAN/ENGINEER

Candidates should be conversant with 1/2", 3/4" and 1" black and white colour equipment and be capable of electronic maintenance. Experience in professional broadcasting would be an advantage, as well as an interest in experimental video work. The successful applicant will be expected to assist in the running studio productions, and video tape editing.

Salary scale £4,436.64-£6,509.64 inclusive (ST1/2).

Application form, returnable within 14 days, obtainable from the College on 735-8484, Ext. 227

(9937)

THE UNIVERSITY OF LEEDS, SCHOOL OF CHEMISTRY, ELECTRONICS TECHNICIANS Grade 5, required to work with a team on a wide variety of challenging and interesting work for research and teaching. A wide range of electronic experience (minimum 7 years) is required, preferably including analogue and digital circuitry. Minimum qualifications, O.N.C. or equivalent (H.N.C. or Full Technological certificate preferred). Grade 3, this post involves the construction, modification, maintenance and repair of electronic equipment. Applicants should have 3 years' relevant experience and have obtained O.N.C. or equivalent qualifications. Salaries in the range: Grade 5 £3700-£4320 pa rising to £3926-£4584 from 1st April 1980. Grade 3 £3122-£3553 pa rising to £3313-£3770 from 1st April 1980, salaries subject to further review from 1st October 1979. Applications to: Mr J. E. Farish, Supervisor Electronics Workshop, School of Chemistry, The University, Leeds LS2 9JT. (3890)



CAPITAL APPOINTMENTS LTD.

FREE JOBS LIST

for
FIELD SERVICE ENGINEERS
BASIC SALARIES TO
£8,000 + CAR

(9879)

30 Windmill Street, London, W1
01-637 5551

TOP JOBS IN ELECTRONICS

Posts in Computers, Medical, Comms, etc. ONC to Ph.D. Free service.

Phone or write: **BUREAUTECH AGY, 46 SELVAGE LANE, LONDON, NW7. 01-959 3517.**

(8994)

ELECTRONICS TECHNICIAN

The School of Chemical and Physical Sciences requires a technician to be responsible for an electronics teaching laboratory associated with physics area. Equipment includes oscilloscopes, signal generators, oscillators, various power supplies etc. The technician will be expected to work unassisted if necessary and make all preparatory arrangements in conjunction with course supervisors. Day release available.

T2 salary range £3975-£4383 inclusive.

Application forms from Assistant Registrar (Personnel), Kingston Polytechnic, Penryn Road, Kingston upon Thames. 01-549 1366.

(9982)

SITUATIONS VACANT

CAPACITY AVAILABLE

**UNIVERSITY OF BRISTOL
DEPARTMENT OF ELECTRICAL &
ELECTRONIC ENGINEERING**

**TECHNICIAN
GRADE 5**

A vacancy exists for a technician to work in the electronic research and teaching laboratories and in a small workshop attached to these laboratories. The work includes the use of general workshop skills for the design and construction of electronic and other equipment. In addition, responsibility will be taken for supporting students in the electronic teaching and research laboratories and for maintaining the electronic equipment.

In addition to applications from candidates who have experience appropriate to this post, applications will also be considered from candidates who are sufficiently versatile to benefit from training in electronic skills provided that they have suitable educational qualifications and, preferably, an engineering apprenticeship.

Commencing salary will be within the range £3700-£4320 per annum (scale under review).

Applications should be sent to Professor B. M. Bird, Department of Electrical and Electronic Engineering, University of Bristol, University Engineering Laboratories, University Walk, Bristol BS8 1TR. (9969)

**LONDON BOROUGH OF BRENT
WILLESDEN COLLEGE OF
TECHNOLOGY**

Principal: A. K. Barnard, BSc, PhD, CChem, FRIC

**Department of Electrical
Engineering**

Applications are invited for the post of

**LECTURER I
IN ELECTRONICS**

to teach both theory and practice on TEC Electrical Engineering and City and Guilds Electronics Servicing courses.

Applicants should have good practical experience preferably in servicing/maintenance and possess at least an appropriate final C & G Technical/Craft qualification.

Salary Scale: £3,954 to £6,466 inclusive.

Further particulars and application forms (SAC) are available from the Chief Administrative Office, Willesden College of Technology, Denzil Road, LONDON NW10 2XD (Tel: 01-459 0147) returnable within 14 days.

Relocation assistance available in approved cases. (10017)

University of London Reactor Centre

**ELECTRONICS
TECHNICIAN
GRADE 5**

Required for an establishment engaged in research and teaching based on a nuclear research reactor. Must be capable of constructing and maintaining a variety of electronic equipment as found in a nuclear establishment but previous experience in this particular field is not essential. A knowledge of digital circuitry would be an advantage. Applicants should have several years' experience and an appropriate qualification is desirable.

Salary in the scale £3,700-£4,320. Under review 1.10.79 with a further minimum increase of £226-£264 from 1.3.80. Post is supernumerary: Generous sick pay scheme; working week 37½ hours. 5 weeks' annual holiday plus several days in addition to public holidays at Christmas and Easter.

Applications to: Reactor Supervisor, University of London Reactor Centre, Silwood Park, Sunninghill, Ascot, Berks. SL5 7PY. Tel. Ascot 23911 (STD 0990), Ext. 272. (10004)

KING'S COLLEGE, LONDON

**TELEVISION
TECHNICIAN**

Applications are invited for this post which offers interesting and varied opportunities in the mobile unit and studio of the Faculty of Education. Closed circuit experience and current driving licence essential. Salary on scale £4480 p.a. to £5100 p.a. (£4706 p.a. to £5364 p.a. from 1.4.80) inclusive (subject to further review). 5 weeks' annual holiday. Superannuation scheme. Interest-free loans for annual rail season tickets.

For further details and application form write to: The Head Clerk (Ref: 221752/ww), King's College, London, Strand WC2R 2LS. (9972)

ARTICLES FOR SALE

GWM RADIO LTD., 40/42 Portland Road, Worthing, Sussex. Tel: 0903 34897 for surplus supplies. AVO 8 £43. Model 7 MK II £32 inclusive P x P receivers. Eddystone 730's Atlanta Marine. B40 ex-Govt. 40ft pneumatic masts by Seam Clark. Type 76 telephones. Quantity of Microwave Test Equipment. S.a.e. for details. 50 micro-amp AVO movements. All types of radio telephones, large or small quantities bought and sold, many one off items in stock. No lists, we are worth a visit, wholesale and retail.

LAB CLEARANCE: Signal Generators; Bridges; Waveform, transistor analysers; calibrators; standards; millivoltmeters; dynamometers; KW meters; oscilloscopes; recorders; Thermal, sweep, low distortion true RMS, audio FR, deviation. Tel. 040-376236. (9250)

VHF MONITOR RECEIVERS, Air or Marine band from £50. FM Business bands from £90. For leaflets send 50p P.O., not stamps. Radio Communications Ltd, 13 Clos du Murier, St Sampson, Guernsey, Channel Isles. (9874)

SPECTRUM ANALYSER Polarad 641-1 with digital memory 0.01 to 18 GHz (40 GHz with ext. mixer not supp.), full service manual, hardly used, mod. 2nd L.O. out at 5dBm. No VAT. £6,250 o.n.o. Tel. (0244) 813491 ext. 42/20199 eves. (10001)

'AA' SIZE 500MAH nicads, £1 each, inc. VAT, from: SMC Ltd., S.M. House, Osborne Road, Totton, Southampton SO4 4DN. Tel. (0703) 867333. Telex 477351 SMCOMM G. Dealer enquiries invited. (10002)

SOLATRON 436 double beam scope, good working order. First £60 secures. Telephone 021-444 1280.

TEK 575 semiconductor test set, £500. Hewlett Packard 7123 chart recorder, £500. Keithley 414 picoammeter, £150. — Tel. Rickmansworth 76382. (9995)

500 WATT Boozy & Hawkes amplifier. 16 and 30 watt paging amplifiers. Creed teletype No. 78. Tel. (0622) 50350. MKS, Upper Stone St., Maidstone, Kent. (9442)

TELEPHONE ANSWERING machine available for outright purchase. — Telephone Burton-on-Trent (0283) 47427. (9809)

EX-GOVT. TAPE RECORDERS: E.M.I., Ferrograph, Tandberg, Uher, Vortexion, etc. S.a.e. for details. A. Wright, 'Sunningdale', Broadheath, Worcester. (9831)

UNUSED BARREL PRINTER MECH. Ribbons, hammer drivers included. £150 ono. — Ring Bracknell 50491 after 6 p.m. (9978)

SERVICES

ELECTRONIC DESIGN SERVICES. Wide engineering experience available for the design of basic circuits to complete systems. Analogue DC to 1GHz and Digital. Write or phone Mr Anderson, Andertronics Ltd, Ridgeway, Hog's Back, Seale (Nr. Farnham), Surrey. Runfold 2639. (9140)

REPETITION SHEET METALWORK on Wiedemann turret press. Long/short runs. Highly competitive. Quick deliveries commission for introductions. — EES Ltd., Clifford Rd., Monks Rd., Exeter. 36489. (8060)

SHEET METAL WORK fine or general front panels chassis, covers, boxes, prototypes. 1 off or batch work fast turnaround. 01-449 2895. M. Gear Ltd. 179A Victoria Road, New Barnet, Herts. (9908)

TECHTRON INDUSTRIAL & COMMERCIAL ELECTRONICS

PCB AND SYSTEMS ASSEMBLY · LARGE AND SMALL BATCHES · BACK PLANE, PROTOTYPE AND PRODUCTION WIRING TO SPECIFICATION · PROMPT QUOTATIONS AND DELIVERIES

Park Farm-Hoxne-Diss-Norfolk- Tel: Hoxne 520

PCBs Production runs or prototypes

- ★ Assembly to sample or drawings
- ★ Design Service if required
- ★ Quick response to demand
- ★ Expert hand soldering
- ★ Nothing too large or too small

Telephone or write:

SEAHORSE ELECTRONICS LTD.

Unit 2, Picow Farm Road
Service Industry Estate
Runcorn, Cheshire

Tel. Runcorn (09285) 75950 (9950)

K.A.H. ELECTRONICS LTD.

CONSULTANTS · DESIGNERS
ASSEMBLERS

SPECIALISTS IN MICRO-BASED SYSTEMS

50 Flitton Road
Urmston, Manchester
Tel: 061-748 3878 (9919)

PRINTED CIRCUITS BOARDS.

Quick deliveries, competitive prices. Quotations on request, roller thinning, drilling, etc. Speciality small batches. Larger quantities available. Jamieson Automatic Ltd., 1-5 Westgate, Bridlington, North Humberside. For the attention of J. Harrison (0262) 74738 or 77877.

ELECTRONIC DESIGN SERVICE. Immediate capacity available for circuit design and development work, PC artwork, etc. Small batch and prototype production welcome. — E.P.D.S. Ltd., 93b King Street, MAIDSTONE, Kent. 0622-677916.

KIBMORE for printed circuits, rapid prototype to production runs, also panel printing design, layout, artwork and photographic services. — Kibmore Circuits Ltd., Redhill, Surrey. Tel. Reigate 41010. (9973)

SERVICES

EURO CIRCUITS

Printed Circuit Boards — Master layouts — Photography — Legend printing — Roller tinning — Gold plating — Flexible films — Conventional fibre glass — No order too large or too small — Fast turnaround on prototypes. All or part service available NOW. (9630)

EURO CIRCUITS TD.

Highfield House
West Kingsdown
Nr. Sevenoaks, Kent. WK2344

DESIGN SERVICE. Electronic Design Development and Production Service available in Digital and Analogue Instruments, RF Transmitters and Receivers for control of any function at any range. Telemetry, Video Transmitters and Monitors, Motorised Pan and Tilt Heads etc. Suppliers to the Industry for 16 years. Phone or write Mr. Falkner, R.C.S. Electronics, 6 Wolsey Road, Ashford, Middlesex. Phone Ashford 53661. (8341)

DESIGN DEVELOPMENT MANUFACTURE. We can offer a high quality, professional service, covering all aspects from original design to small batch production. Digital/Analogue prototypes welcome. For competitive pricing and quick delivery phone Mr. Flower, Digitalis Ltd., 9, Milldown Road, Goring-on-Thames, Oxfordshire. Tel: 049 14 3162. (9925)

ELECTRONIC and light precision engineering, design, prototype, small batch production. First-class work. — Hine Electronics. Tel. Bradford 583210. (9975)

I.H.S. SYSTEMS

Due to expansion of our manufacturing facilities we are able to undertake assembly and testing of circuit boards or complete units in addition to contract development.

We can produce, test and calibrate to a high standard digital analogue and RF equipment in batches of tens to thousands.

Telephone to arrange for one of our engineers to call and discuss your requirements, or send full details for a prompt quotation.

TEL. 01-253 4562

or reply to Box No. WW 8237 (8237)

CIRCOLEC

for Electronic/Electro-Mechanical Assembly. We offer the following versatile and quality service for small to large batches.

PCB and Final Assembly, Repairs and Servicing, Inspection and Functional Test, Prototypes and Associated Services, and modifications.

For competitive prices and fast turnaround, contact Circolec. Tel: 01-767 1233; 1 Franciscan Road, Tooting, S.W.17. (9889)

PCB ARTWORK DESIGN SERVICE with component notation masters and assembly drawings. PADS Electrical Ltd, 01-850 6516, 45 Southwood Road, New Eltham SE9.

SMALL BATCH productions wiring assembly to sample or drawings. Specialist in printed circuits assembly. Rock Electronics, 42 Bissipfield, Harlow, Essex 0279 33018.

ELECTRONIC ASSEMBLY. High quality. Quick turn around for all your needs: Prototypes, Batch, PCB Hardwiring, Testing, Wandtronic, Frogmore, Wandsworth, London SW18. 01-870 6585. (10015)

**TEST EQUIPMENT
CALIBRATION
AND REPAIR**

Quick turn round, attractive rates, ring for details on Southampton (0703) 431 323

DUTCHGATE LTD.

94 Affrinton Gardens, Sholing
Southampton (9385)

SMALL BATCH

Productions assembled from Sample or Drawings. Quick deliveries. Competitive prices. Design Service also available. Write or telephone:

SYNERGY BRITON ELECTRONICS LIMITED

BRITON HOUSE, 62 RAILWAY ROAD
DOWNHAM MARKET
NORFOLK PE38 9EL
Telephone (036 63) 5222 (9942)

PRINTED CIRCUIT MANUFACTURE. Very fast, reliable service. Lowest prices. Prototypes welcome. Inhouse photography. Phone 06474-573 for instant quote or write to AKRONICS Ltd., 42/44 Ford Street, Moretonhampstead, Devon. (9857)

SMALL BATCH PCB's produced from your artwork. Also DIALS, PANELS, LABELS. Camera work undertaken. FAST TURNAROUND. — Details: Winston Promotions, 9 Hatton Place, London EC1N 8RV. Tel. 01-405 4127/0960. (9794)

ARTICLES FOR SALE

TO MANUFACTURERS, WHOLESALERS & BULK BUYERS ONLY

Large quantities of Radio, T.V. and Electronic Components.
RESISTORS CARBON & C/F 1/8, 1/4, 1/2, 1 Watt from 1 ohm to 10 meg.
RESISTORS WIREWOUND. 1 1/2, 2, 3, 5, 10, 14, 25 Watt.
CAPACITORS. Silver mica, Polystyrene, Polyester, Disc Ceramics, Metalamite, C280, etc.
 Convergence Pots, Slider Pots, Electrolytic condensers, Can Types, Axial, Radial, etc.
 Transformers, chokes, hopts, tuners, speakers, cables, screened wires, connecting wires, screws, nuts, transistors, ICs, Diodes, etc., etc.
 All at Knockout prices. Come and pay us a visit. Telephone 445 2713, 445 0749.

BROADFIELDS & MAYCO DISPOSALS

21 Lodge Lane, N. Finchley, London, N.12. 5 mins. from Tally Ho Corner (9461)

RCA SOLID STATE COS/MOS MEMORIES

MICROPROCESSORS AND SUPPORT SYSTEMS DATA BOOK
 by RCA Price: **£5.75**

H/B OF ELECTRONICS CALCULATIONS FOR ENGINEERS & TECHNICIANS

by M. Kaufman Price: **£14.70**
ELECTRONIC DESIGNER'S H/B
 by K. Hemingway Price: **£13.25**

ACTIVE FILTERS FOR COMMUNICATIONS & INSTRUMENTATION

by Bowron P. Price: **£7.00**
DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS
 by H. M. Berlin Price: **£6.45**

DESIGN OF PHASE LOCKED LOOP CIRCUITS WITH EXPERIMENTS

by H. M. Berlin Price: **£6.45**
Z80 ASSEMBLY LANGUAGE PROGRAMMING
 by L. A. Leventhal Price: **£5.75**

LOGIC & MEMORY EXPERIMENTS USING TTL IC'S BK I

by D. G. Larsen Price: **£7.60**
TELETEXT & VIEWDATA
 by S. A. Money Price: **£6.00**

THE EUROPEAN CMOS SELECTION

by Motorola Price: **£7.75**

* ALL PRICES INCLUDE POSTAGE *

THE MODERN BOOK CO.

Specialist in Scientific & Technical Books
19-21 PRAED STREET LONDON W2 1NP
 Phone 402-9176
 Closed Sat. 1 p.m.

THE SCIENTIFIC WIRE COMPANY

PO Box 30, London, E.4.

ENAMELLED COPPER WIRE

SWG	1lb.	5oz.	4oz.	2oz.
10 to 19	2.65	1.45	.75	.60
20 to 29	2.85	1.65	.90	.70
30 to 34	3.05	1.75	1.00	.75
35 to 40	3.40	1.95	1.15	.84
41 to 43	4.55	2.65	1.95	1.30
44 to 46	5.05	3.05	2.15	1.70
47	8.00	5.00	3.00	1.80
48	15.00	9.00	6.00	3.30

SILVER PLATED COPPER WIRE

	1lb.	5oz.	4oz.	2oz.
14 & 18	4.50	2.25	1.44	.90
20 & 22	5.00	2.85	1.74	1.08
24 & 26	5.70	3.31	2.00	1.22
28 & 30	6.67	3.86	2.35	1.44

Prices include P&P and VAT.
 SAE brings list of copper & resistance wires.
 Dealer Enquiries invited. (9063)

TRANSFORMER PROBLEMS?

1VA-1KVA Prototypes in 7-10 days.
 Phone Vince Sellar on 06076-66716.

TRENT TRANSFORMERS LTD.
 26 Derby Road
 Long Eaton, Nottingham (8363)

TEK 545 B mainframe	£80
TEK 547 mainframe	£150
TEK 151 Sampling plug in	£100
1 L10 Spectrum analyser plug in	£450
TEK 422 15 MHz portable	£350
RACAL 9913 200 MHz counter	£150
SYSTEM Donner 5008 500 MHz sweeper	£495

POLYSKOP 1 400 MHZ	£350
POLYSKOP 2 1200 MHZ	£850
POLYSKIP 3 110 MHZ	£600
FLUKE 8300 DMM AC/DC/OHMS	£195
BRADLEY 233 post generator	£250
PHILIPS PM 6505 television analyser	£100

MARCONI TF 144 H sig/gen	£195
MARCONI TF 868/1 LCR bridge	£85
MARCONI TF 1370/9 oscillator	£100
MARCONI TF 2162 attenuator	£85
MARCONI TF 2201 30 MHz scope	£195
MARCONI TF 2169 pulse modulator	£195
HP 3200 B VHF oscillator	£395
HP 211A square wave gen	£75
HP 400H voltmeter	£75
HP 140 A mainframe	£175
HP 1416 A swept freq ind	£300
HP 8694 A 8-12.4 GHz sweeper plug in	£400

HP 8694 B 7-12.4 GHz sweeper plug in	£400
HP 8693 A 3.7-8.3 GHz sweeper plug in	£400

HP 1403 vertical plug in	£75
HP 1420 horizontal plug in	£75
SINTEL Capacitance bridge	£150
ADVANCE DVM5	£75
BPL C2 960 component comparator	£175
AVO 7	£30
AVO 8	£50
TELEQUIPMENT S 51 E oscilloscope	£95
TELEQUIPMENT S 52 scope	£110
TELEQUIPMENT S 61 A scope	£185

All + 15% VAT

ALL EQUIPMENT WORKING & CALIBRATED

DUTCHGATE LTD

94 ALFRISTON GARDENS
 SHOLING, SOUTHAMPTON
 SOTON (0703) 431323 (9875)

INVERTERS

High quality DC-AC. Also "no break" (2ms) static switch, 19" rack. Auto Charger.



COMPUTER POWER SYSTEMS

Interport Mains-Store Ltd.
 POB 51, London W11 3BZ

Tel: 01-727 7042 or 0225 310916 (9101)

MSF CLOCK

NEW! Gives ABSOLUTE TIME, always correct, never gains or loses, auto-reset after power failure, 8 digit LED shows date, hours, minutes and seconds, also parallel BCD output, receives Rugby 60KHz time signals, only 5x8x15cm, built-in antenna, 1000Km range for navigation, £48.80.

V.L.F.? 10-150KHz Receiver **£10.70.**
 Each fun-to-build kit includes all parts, printed circuit, case, postage, etc. Money back assurance so SEND off NOW.

Cambridge Kits, 45 (WB) Old School Lane, Milton, Cambridge. (9979)

COLOUR, UHF AND TV SPARES

(miniature size 4 1/2 x 3 1/2 x 2 1/2). New Saw Filter IF Amplifier plus tuner (complete and tested for sound and vision, £28.50, p/p £1.

TELETEXT, Ceefax and Oracle in Colour, Manor Supplies "easy to assemble". Teletext kit including Texas Tifax XM11 Decoder. External unit aerial input, no other connections to set. Wide range of facilities in colour include 7-channel selection, Mix, Newsflash and Update. (Price: Texas Tifax XM11 £130, Auxiliary Units £88, Case £14.80. p/p £2.50). Demonstration model at 172 West End Lane, NW6. Also latest Mullard Teletext 610LVM module available. Call, phone or write for further information.

COMBINED COLOUR BAR AND CROSS HATCH GENERATOR KIT (MK 4) UHF aerial input type. Eight pal vertical colour bars, R-Y, B-Y, Grey scale etc. Push-button controls £35 p/p £1; Battery Holders £1.50; Alternative Mains Supply Kit £4.80; De Luxe Case £4.80; Aluminium Case £2.60. Built and tested (battery) in De Luxe Case £58, p/p £1.20.

CROSS HATCH KIT, UHF aerial input type, also gives peak white and black levels, battery operated £11 p/p 45p. Add-on Grey scale kit £2.90 p/p 35p; De Luxe Case £4.80; Aluminium Case £2 p/p 85p. Built and tested in De Luxe Case £23.80 p/p £1.20.

UHF SIGNAL STRENGTH METER KIT £18.80, alum. Case £1.50, De Luxe Case £4.80 p/p £1.

CRT TEST AND REACTIVATOR KIT for Colour and Mono £20.80, p/p £1.30; TV 625 IF Unit for Hi-fi amps or tape rec. £6.80, p/p 75p. Surplus Bush IF panels, A816 £2.80, TV312 (single IC) £5. BC5600 (Exp) £5, A823 (Exp) £2.80 p/p 85p. Bush A823 (A807) Decoder panel £7.50 p/p £1. A823 Scan Control panel £3.50, blue lat, 75p. Philips G6 single standard convergence unit £3.75 p/p 90p. GEC 2040 ex rental panels, Decoder £5, Time Base £5 p/p 90p. Thorn 3000 ex rental panels, Video, Decoder, frame, IF £5 p/p 90p.

Colour Scan coils, Plessey £6, Yoke £3.50, blue lat, 76p (Mullard also available). Mono Scan coils Philips/Pye £2.80. Thorn £2.80 p/p 85p.

Philips G8 Decoder panels, salvaged for spares £3.80 p/p 90p. Varicap UHF tuners Gen Instruments £3.50, ELC 1043 £4.50, ELC1043/05 £5.50; Philips G8 £5.50 p/p 35p. Salvaged UHF Varicap tuners £1.50 p/p 35p. UHF/VHF ELC2000S Varicap tuner £8.50 p/p 65p. Varicap control units, 3 pos. £1.20, 4 pos. £1.50, 5 pos. £1.80, 6 pos. (special offer) £1.80, 7 pos. £3.80 p/p 45p. Touch Tune control unit Bush 6 pos. 5p p/p 75p. UHF transd tuners, rotary incl. slow motion drive £2.50, 4 pos. push button £2.50, 6 pos. push button £4.20 p/p £1. (Thorne, GEC, Bush, Decca, etc., special types available, details on request). Delay Lines DL20, DL5 £3.50, DL1 80p p/p 65p. Remote Control Thorn-type Transmitter, receiver £2 pair p/p 45p. Large selection of lopts, triplers, mains droppers, and other spares for popular makes of colour and mono receivers.

MANOR SUPPLIES, 172 WEST END LANE, WEST HAMPSTEAD, LONDON NW6, SHOP PREMISES, EASILY ACCESSIBLE, WEST HAMPSTEAD-BAKERLOO, JUBILEE TUBE, and BRITISH RAIL N. LONDON (RICHMOND-BROAD ST.) and ST. PANCRAS-BEDFORD. BUSES 28, 159, 2, 13. Callers welcome. Thousands of additional items available at shop premises not normally advertised. Open daily all week including Saturday (Thursday half-day). MAIL ORDER: 64 GOLDERS MANOR DRIVE, LONDON NW11 9HT. Tel. 01-794 8751. All prices subject to 15% VAT.

ENCAPSULATING, coils, transformers, components, degassing, silicone rubber, resin, epoxy. Lost wax casting for brass, bronze, silver, etc. Impregnating coils, transformers, components. Vacuum equipment low cost, used and new. Also for CRT regunning met allising. Research & Development. Barratts, Mayo Road, Croydon, CR0 2QP. 01-684 9917. (9878)

EXCLUSIVE OFFER

RACK MOUNTING CABINETS HIGHEST QUALITY 19"

Ref	Ht"	width"	Depth"	Price
PE	10	21	13	£10.00
LL10	54	21	18	£20.00
SL	54	25	26	£45.00
TL	71	25	26	£60.00
ST	85	22	24	£70.00
Rack cabinets for RA-17/117				£30.00
Uniframe, double				£30.00
Uniframe, single				£40.00
Uniframe, triple				£50.00

Over 60 types available from 12" to 90" high. Also twins, triples and consoles. Above are only a few types. Please send for full list.

AUDIO AND INSTRUMENTATION-TAPE RECORDER-REPRODUCERS

- * Ferrograph YD 2 track 1/4" / EMI RE-301
- * Ampex FR1300 7 track 1/2" UHER 4000 1/4"
- * Consolidated 2800 7 track 1/2"
- * Plessey 1D33 Digital Units. 7 track 1/2"
- * Plessey M5500 Digital Unit. 7 tracks 1/2"
- * Ampex FR-100. 6 speeds, stereo 1/4"
- * Ampex FR600. 4 speeds, 7 track 1/2"
- * D.R.I. RC-1. 4 speeds, 4 tracks 1/4"
- * Min-com CPM-100. 6 speeds, 7 tracks 1/4", 1/2", 1"
- * Ampex 351 2 speed 2 tracks 1/4"
- * 3M. H. 4 speeds 14 track 1"

Prices of above £70 to £500
 Also Transport Decks only available

We have a large quantity of "bits and pieces" we cannot list - please send us your requirements. We can probably help - all enquiries answered.

All our aerial equipment is professional MOO quality

- * Marconi HR-23 T.S.B. Receivers £320.00
- * K.B. Discomatic Juke Boxes £85.00
- * RCN 625 Mine Detectors in chests £40.00
- * Marconi TF/868 Universal Bridges £110.00
- * Hewlett Packard 400H VT Metres £95.00
- * Hewlett Packard 211A Sq. Wave Gen £80.00
- * Astrodata & Ikor Meteorological Equipment
- * Ion Pump E.H.T. Power Supplies £60.00
- * Haynes D.W. 500W Cased Transformers 240/1115V £18.00
- * Racal RA66 Adaptors £130.00
- * Racal MA 1350 Synthesizers £125.00
- * G.B. Kalea Flutter Meters. Model 17400/A £90.00
- * Telegroup C.I. Oscilloscope Calibrators £90.00
- * Tektronix 551 Scopes £270.00
- * Tektronix 555 Scopes £300.00
- * Teleonic VR2M Sweeps £250.00
- * Hell Schriber RC-28 £95.00
- * Lenkurt Model 26D Data Sets £115.00
- * Panoramic SB 15A Analysers £125.00
- * Aerial Multipliers from £25.00
- * Marconi TF 1168 Disc Oscillators £140.00
- * Hughes Memoscopes £170.00
- * Nems Clarke 1306 VHF Receivers £280.00
- * Telefunken Surveillance Receiver £175.00
- * Helix Aerials 11" & 18" and Reflectors £26.00
- * Textronix 543A Oscilloscopes CA. Plug-ins £210.00
- * Textronix 545A Oscilloscopes D. Plug-ins £140.00
- * Textronix 561A Oscilloscopes 80. Plug-ins £220.00
- * Marconi TF 2200A Oscilloscopes £280.00
- * Solatron 1016 Oscilloscopes £90.00
- * Simon Mobile 80 foot Tower Hydraulic 80ft extended, 12" B" closed. Mounted on 4 wheel drive Bedford Truck, self levelling, raised and lowered in 10 minutes. Used for servicing dish aerials. P.U.R. £170.00
- * Racal RA-17 P Receivers (new) £950.00
- * Eddystone 770/U VHF Receivers £170.00
- * Collins KWT 6 Transmitter Receivers SSB P.U.R. £190.00
- * Roband RO 50A Oscilloscopes £180.00
- * B & K 2407 Electronic Voltmeters £180.00
- * Winston "5" Band Spectrum Analyser P.U.R. £130.00
- * Airmec 352 Sweep Generators D £45.00
- * Advance Transistor Testers TT-1 S £140.00
- * Marconi TF 329 Magnification Meters £390.00
- * Marconi TF 1066B FM Signal Generators £220.00
- * Marconi TF 801/D/1 AM Signal Generators £150.00
- * Ferranti 7.5kVa Auto Voltage Regulators £240.00
- * Manson TFM-101 Multipliers £130.00
- * Servomex 2kw Auto regulators P.U.R. £115.00
- * 125ft. Lattice masts, 26" sides £18.00
- * 30ft. Lattice Masts, 15" sides £18.00
- * 10ft Light Lattice Sections, 6" sides £40.00
- * EMI 1/4" Audio Tape 3600ft. 10 1/2" nab. New £4.50
- * D.R.I. Model RC-1 Professional Tape Recorder-Reproducers. 4 tracks 1/4" 4 speeds. 1 1/4", 3 1/4", 7 1/4" & 15". 4 amplifiers Monitor Scope. All rack mounting & Transistorised £250.00
- * SE4/28 C.R.T.s £18.00
- * SE5/2A C.R.T.s £19.00
- * 3AZP/2 (DMN-9) C.R.T.s P.U.R. £14.00
- * AVO CT 471A Electronic Multimeters £75.00
- * EMI R301 Tape Recorders £50.00
- * Stonorett L Tape Recorders £29.00
- * Uniselectors. 10 Bank 25-watt £3.50
- * 40ft. Sectional Aluminium Masts, complete £85.00
- * Multi-purpose Trolleys with Jacks 19 x 17 £16.00
- * Advance 3KVA CV Transformers £150.00
- * Metal V.D.U. Tables 30" x 36" x 30" £24.00

MANUALS

We have a quantity of Technical Manuals and Periodicals of Electronic Equipment, not photostats. 1940 to 1960. British and American. No lists. Enquiries invited.

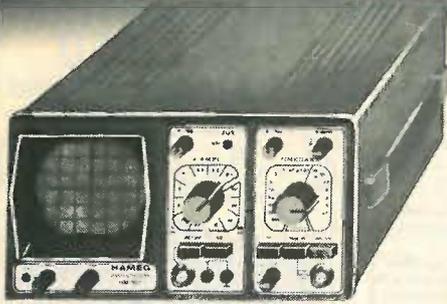
- * Data Efficiency Respoalors 240v £28.00
- * Belling Lee 100 Amp Interference Filters £78.00
- * Oscilloscope Trolleys from £18.00
- * Racal MA1978 pre-Selectors £65.00
- * Rack Mounting Operator Tables £10.00
- * 75ft. Aluminium Lattice Masts, 20" sides £400.00
- * Racal MA-175 L.S.B. Modulators (new) £45.00
- * Tally 5/8 Track Tape Readers Track Spooling £65.00
- * Racal RA-63 SSB Adaptors, new £70.00
- * Racal RA 298 I.S.B. Transistorised Adaptors (new) £120.00

We have a varied assortment of industrial and professional Cathode Ray Tubes available. List on request.

PLEASE ADD CARRIAGE AND V.A.T.

P. HARRIS ORGANFORD, DORSET, BH16 6BR
 (0202) 765051

ELECTRONIC BROKERS/HAMEG OSCILLOSCOPES



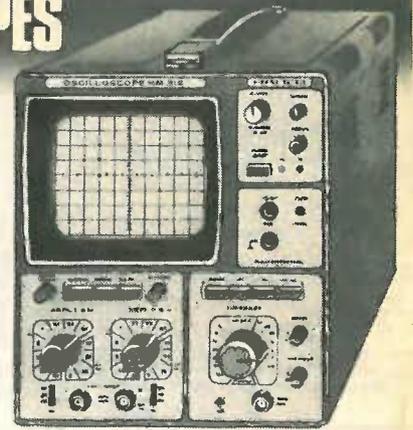
Brand New —
Top Quality Performance & Value

HM 307
Single Trace DC-10
MHz, 5mV/cm.
Plus built-in
Component Tester.

£149

HM 312
Dual Trace DC-20 MHz,
5mV/cm. Sweep Speeds
40 ns-0.2 s/cm 8x10
cm Display.

£250



**ELECTRONIC
BROKERS LIMITED**

49-53 Pancras Road, London NW1 2QB.
Tel: 01-837 7781. Telex: 298694.

Other models up to 50MHz bandwidth available. Prices
and full specs on request. Full demonstration at our
premises. Quick delivery.

Prices do not include VAT (15%) or Carriage.

WW — 053 FOR FURTHER DETAILS

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 126-143

	PAGE		PAGE		PAGE
A.E.L. Crystals	24	G.E.C. MO Valve	8	Olson Electronics	20
Aero Electronics	22	Hall Electric Ltd	10	Powertran Electronics	97, 102, 103
Ambit International	29, 123	Hameg Ltd	4	Precision Petite Ltd	6
Anders Electronics Ltd	22	Harris Electronics (London) Ltd	26, 30	Pye Unicam	90
Antex (Electronics) Ltd	32	Hart Electronics	100	Pype Hayes Radio	122
Aspen Electronics Ltd	99	Henry's Radio	95, 105, 110	Quantum Electronics	7
Astra Elec. Comps.	108	H.H. Electric Ltd	13	Radio Components Specialists	101
Avo Ltd	30, 114	H.L. Audio (Newtronics)	21	Radio Shack Ltd	99
B. Bamber Electronics	111	H.H. Audio	113	R.C.S. Electronics	100
Barnet Metal	26	Hilomast Ltd	6	R.S.T. Valves	91
Barrie Electronics Ltd	105	I.L.P. Electronics Ltd	23, 88, 89	Sabtronic International	75
Bauch, F. W. O. Ltd	109	Impex Electrical	22	Safgan Electronics Ltd	105
Bell & Howell	92	Industrial Tape Applications	87	Samsons Electronics	106
Bi-Pak Semiconductors Ltd	93	Interport Mains		Science of Cambridge	76
Boss Industrial Mouldings Ltd	107	J.D. Electronics	112	Scopex Instruments Ltd	11
Cambridge Learning	120	K.A.C. Electronic Investments Ltd	109	Service Trading	20
Carston Electronics Ltd	18, 19	Keithley Instruments Ltd	17	Sescom	20
Case Systems	27	Kelsey Acoustic	124	Shure Electronics Ltd	14, 15
Chiltmead Ltd	118	K.G.M. Electronics Ltd	9	Sonic Sound Audio	12, 110
Codespeed	108	Kirkham Electronics	2	Sota Communications	108
Colomor (Electronics) Ltd	124	Langrex	91	Special Products Ltd	112
Communication '80	120	Lascar Elec	24	Star Devices	94
Compec Europe '80	121	Leevers-Rich Equip. Ltd	22	Sugden, J. E. & Co Ltd	28
Computer Appreciation	122	Levell Electronics Ltd	3	Surrey Electronics Ltd	108
Comtek	114	Lowe Electronics Ltd	8	Swanley Electronics Ltd	109
Continental Specialists Corp	65	Maclin-Zand Electronics Ltd	5	Switchgear	109
Crimson Elektrik	12	Maplin Electronic Supplies	cover iii	Tandy Corporation	16
Cropico Ltd	110	Martin Associates	23, 28	Technomatic Ltd	119
Crouchcliff	122	Marshall, A. & Sons (London) Ltd	98	Tektronix (Tequipment)	Cover ii
Dalston Elec	109	Microcircuits	5	Teleradio Electronics	110
Datong	28	Millbank Electronics (M.I.L.)	31	TMEC	26
Display Electronics	124	Milward, G. F.	110	Vero Speed	30
Dominus	109	Monogram Professional	28	Vero Systems Ltd	8
Drake Transformers Ltd	112	Monolith Electronics Co	20	Wellbury	124
Edicron	24	Multicore Solders Ltd	Cover iv	West Hyde Developments Ltd	104
Electro-Tech Comps	96	Newbear Computer Stores	99, 104	Wilmslow Audio	25
Electronic Brokers Ltd	115, 116, 117, 144	Newnes-Butterworth	98	Z. & I. Aero Services Ltd	24, 106
Elonhurst Ltd	27	Northeast Audio Ltd	66		
Faircrest Eng Ltd	108				

OVERSEAS ADVERTISEMENT

AGENTS:
France & Belgium: Norbert Hellin, 50 Rue de Chemin Veat,
F-9100, Boulogne, Paris.

Hungary: Mrs Edit, Bajusz, Hungexpo Advertising Agency,
Budapest XIV, Varosliget.
Telephone: 225 008 — Telex: Budapest 22-4525
INTFOIRE

Italy: Sig C. Epis, Etas-Kompass, S.p.a. — Servizio Estero. Via
Mantegna 6, 20154 Milan.
Telephone: 347051 — Telex: 37342 Kompass.

Japan: Mr. Inatsuki, Trade Media — IBPA (Japan), B.212,
Azabu Heights, 1-5-10 Roppongi, Minato-ku, Tokyo 106.
Telephone: (03) 585 0581.

United States of America: Ray Barnes, IPC Business Press,
205 East 42nd Street, New York, NY 10017 — Telephone:
(212) 689 5961 — Telex: 421710.

Mr Jack Farley Jr., The Farley Co., Suite 1584, 35 East
Wacker Drive, Chicago, Illinois 60601 — Telephone: (312)
63074.

Mr Victor A. Jauch, Elmatex International, P.O. Box 34607,
Los Angeles, Calif. 90034, USA. — Telephone (213) 821-
8581 — Telex: 18-1059.

Mr Jack Mentel, The Farley Co., Suite 650, Ranna Building,
Cleveland, Ohio 44115 — Telephone: (216) 621 1919.
Mr Ray Rickles, Ray Rickles & Co., P.O. Box 2028, Miami
Beach, Florida 33140 — Telephone: (305) 532 7301.
Mr Tim Parks, Ray Rickles & Co., 3116 Maple Drive N.E.,
Atlanta, Georgia 30305. Telephone: (404) 237 7432.
Mike Loughlin, IPC Business Press, 15055, Memorial Ste 119,
Houston, Texas 77079 — Telephone (713) 783 8673.

Canada: Mr Colin H. MacCulloch, International Advertising
Consultants Ltd., 915 Carlton Tower, 2 Carlton Street, Toronto
2 — Telephone: (416) 364 2269.
*Also subscription agents.

MAPLIN



A 63-key ASCII keyboard with 625-line TV interface, 4-page memory and microprocessor interface. Details in our catalogue.



Our catalogue even includes some popular car accessories at marvellous prices.



A 10-channel stereo graphic equaliser with a quality specification at an unbeatable price when you build it yourself. Full specification in our catalogue.



These are just some of the metal cases we stock. There are dozens of plastic ones to choose from as well. See pages 52 to 57 of our catalogue.



A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components, this is the one catalogue you must not be without. Over 280 pages - some in full colour - it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.



Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue.



A digitally controlled stereo synthesiser the 5600S with more facilities than almost anything up to £3,000. Build it yourself for less than £750. Full specification in our catalogue.



A superb range of microphones and accessories at really low prices. Take a look in our catalogue - send the coupon now!



An attractive mains alarm clock with radio switching function and battery back up! Complete kit with case only £18.38 (incl. VAT & p & p) MA1023 module only £8.42 (incl. VAT).

MAPLIN

ELECTRONIC SUPPLIES LTD

WW-002 FOR FURTHER DETAILS

Post this coupon now for your copy of our 1979-80 catalogue price 70p.

Please send me a copy of your 280 page catalogue. I enclose 70p (plus 37p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.35 or ten International Reply Coupons. I enclose £1.07.

NAME _____

ADDRESS _____

WWW 280 _____



A superb technical bookshop in your home! All you need is our catalogue. Post the coupon now!



A hi-fi stereo tuner with medium and long wave, FM stereo and UHF TV sound! Full construction details in our catalogue.



Add-on bass pedal unit for organs. Has excellent bass guitar stop for guitarists' accompaniment. Specification in our catalogue.

All mail to:-
P.O. Box 3, Rayleigh, Essex SS6 8LR.
Telephone: Southend (0702) 554155.
Shop: 284 London Road, Westcliff-on-Sea, Essex.
(Closed on Monday).
Telephone: Southend (0702) 554000.

Even if tin prices stabilised, a change from 60/40 alloy to Savbit Solder could save you £100/tonne, ensure a better job...

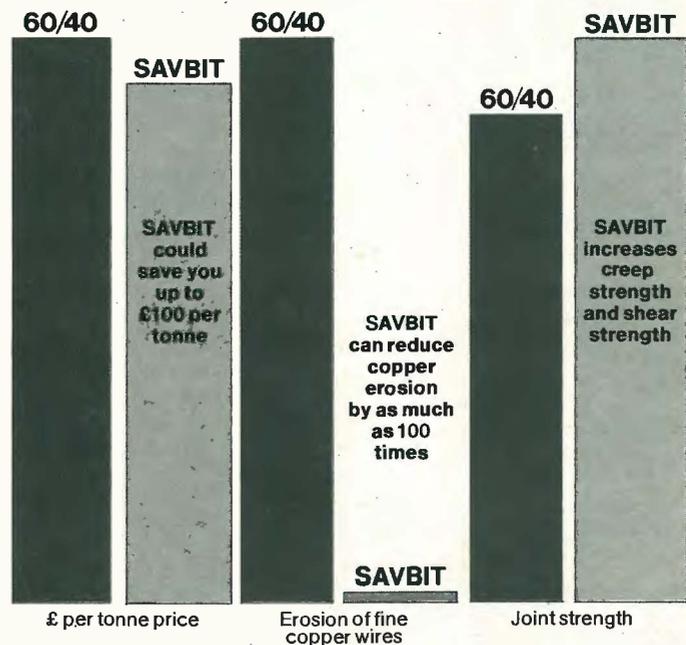
The reason is that Multicore Savbit not only solves the problem of fine copper wires and thin foils deteriorating during soldering, but also contains less tin than 60/40 alloy. **We make both so we are just offering to alleviate your rising metals costs.**

During normal soldering, a dissolving action causes the wire to weaken and embrittle – often to break during subsequent field use.

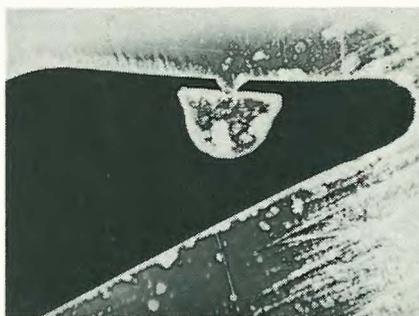
Savbit, however, is a rosin based, 5-core wire solder comparable in joint quality to standard high performance alloys, but capable of dramatically inhibiting the copper dissolving action.

As this diagram shows,* compared with a 60/40 alloy, Savbit can reduce the dissolution of copper by as much as 100 times. Yet wetting rate, flow, conductivity and capillary force are almost identical – with creep strength and shear strength actually increased.

*Indicative of product advantages only; not to scale)



...and more



Cracked iron-plated bit, after 40,000 simulated operations using 60/40 Solder.

Some people think Savbit alloy is only usable with plain copper soldering iron bits, but this isn't true.

As these photographs illustrate dramatically, Savbit also saves significantly on the cost of iron-plated soldering iron bits, which have a copper core. This is exposed through cracks in the plating.



Cracked iron-plated bit, after 40,000 simulated operations using SAVBIT Solder.

Add this advantage to the increased reliability and joint quality Savbit offers, and you'll understand why more and more 60/40 users are making the change – and profiting. The Ministry of Defence have given a special new Approval No. DTD 900/4535A for Savbit alloy with ERSIN 362 flux to be used in lieu of Solders to B.S. 219 and B.S. 441.



For full information on Savbit or any other Multicore products, please write on your company's letterhead direct to:

Multicore Solders Limited,
 Maylands Avenue, Hemel Hempstead, Herts. HP2 7EP.
 Telephone: Hemel Hempstead 3636. Telex: 82363.