PRACTICAL WIRELESS

APRIL 1975

30p

REACTION TIMER

QUIZ MONITOR

also:- The 'IC+2' Receiver

The 'EASYBUILD' Electronic Organ-Part 2

PRACTICAL WIRELESS

VOL. 50 NO. 12
ISSUE 818
APRIL 1975

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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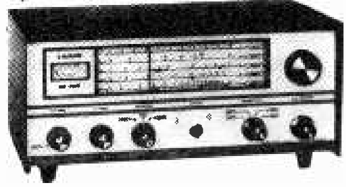
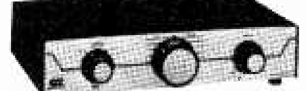
We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Practical Wireless* and *Television* only can be published in our CQ Column.

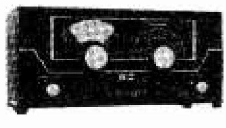
NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

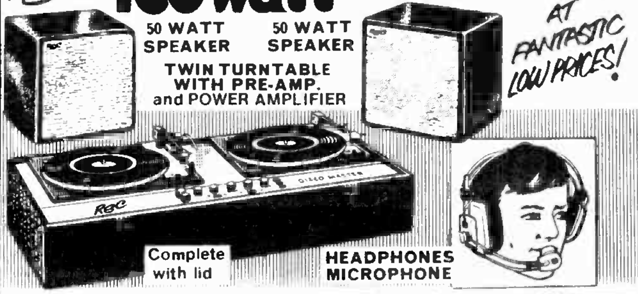






RSC 100watt DISCO SYSTEM

AT FANTASTIC LOW PRICES!



Units listed below
(a) DISCOMASTER TWIN TURNTABLE CONSOLE with integral 100W amplifier
(b) PAIR OF HI-FI HEAD-PHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" × 18" × 8"
(a) (b) (c) & (d) Carr. £3·00 **£159·95**
DEP. £19·95 & 18 fortnightly payments of £9·11 (Total £183·93).

STEREO VERSION OF ABOVE SYSTEM
Or DEP £29·95 and 18 fortnightly pymts. £11·11 (Total £229·93) **£199.95** Carr. £3·50

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £9·00 and 18 fortnightly pymts. £4·61 (Total £91·98) **£79·95** Carr. £1·50

TD2S STEREO VERSION OF ABOVE SYSTEM
Terms. Dep. £15·00 and 18 fortnightly payments £6·51 (Total £132·18) **£115·00** Carr. £1·60

DISCOMASTER TWIN TURNTABLE POWER CONSOLE £109·95

Carr. £2·50
Garrard SP25 or McDonald MP60 turntables. Sonotone or Acos cartridges with diamond stylii. Facilities as TDI Console but with built-in 100 watt Power Amplifier, complete with lid. Or Deposit £12·95 and 18 fortnightly payments £6·31 (Total £126·53)

STEREO DISCOMASTER **£145** or DEP. £20 and 18 fortnightly pymts £8·15 (Total £166·70). Carr. £3

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C38 40-50 WATTS Incorporating three exceptionally efficient 8" speaker units. Terms: Dep. £2·95 and 8 monthly payments £2·87 (Total £25·91) Carr. 65p. **£21·95**

TYPE C3/70 70 WATTS. Fitted three 12" 25 watt Highly sensitive high flux speakers with high power voice coils. Size approx. 54" × 14" × 11". Dep. £5·11 & 8 mthly pymts. £5·11 (Total £45·99) Carr. 85p **£39·95**

FANE ULTRA HIGH POWER SPEAKERS & KITS

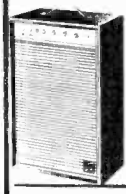
All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE High flux ceramic magnets. ALL CARRIAGE FREE.

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt	15" 60 Watt	12" 50 Watt
14,000 gauss	14,000 gauss	13,000 gauss
8/15Ω	8/15Ω	15Ω
£29·95	£16·95	£12·95
Dep: £3·80 and 8 mthly payments £3·80 (Total £34·20)	Dep. £2·17 and 8 monthly payments. £2·17 (Total £19·53)	Terms for pairs Dep £3·90 & 8 mthly pymts £3·16 Total £29·18

FOR BASS GUITAR, ELECT. ORGAN, ETC.
PAIR SUITABLE ALL PURPOSES

ALL RSC PRICES INCLUDE VAT

INTEREST on Credit Purchases REFUNDED settled in 3 months

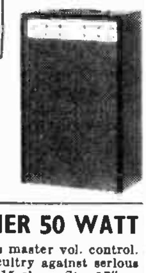


SUPER MINSTREL GUITAR AMP.

Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 10 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity.
Terms: Deposit £6·73 and 8 monthly payments £3·00 (Total £30·73) Carr. free **£26·73**

FANE CRESCENDO SPEAKERS

FULL RANGE AVAILABLE AT ALL BRANCHES



'POP' 25/T 12" 25W.
Dual cone. 15 ohm Imp. (Not for Bass Guitar use) **£8·95**

PH50 HIGH POWER TWEETER
Rating 50 Watt Imp 8Ω
with 2 to 4 mfd. Non elect. filter available 55p **£5·95**

MODEL D40 FULL RANGE 40 WATT SPEAKER KIT £19·99

Consisting of 12" 40 watt Bass Unit HPX1 200w Cross-over and PH50 Tweeter Rating 40w R.M.S. Imp. 8 ohms. Terms: Deposit £3·99 and 8 mthly payments £2·50. (Total £23·99).

FAL MAESTRO

COMBINED 30W AMP. AND 12" SPEAKER **£47·88** Carr. Free

For Lead Guitar, Mic, Gram, Radio, Tape (Not for use with Bass instruments) Inc. 3 inputs and 2 vol controls plus Treble & Bass, TREMOLO with associated controls. Attractively finished in black with silver-finished fascia. Compact size Fitted carrying handle. Deposit £7·88 and 8 mthly payments £5·75 (Total £53·88)

RSC 'PHANTOM 50' Rating 50 watts. 3 inputs, 2 vol. controls. Bass, Treble, Presence **£55·00** Carr. £1·50
Terms: Deposit £8·00 & 8 mthly. pymts. £6·76 (Total £62·08).

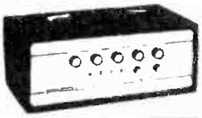
HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE VYNIDE AND VYNAIR FINISH

L12/2 50 WATT Fitted pair of 12" 30 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£39·95**
Or deposit £5·11 and 8 monthly payts. of £5·11. Total £45·99

L12/25G 12" 25 WATT 13,000 lines 15 ohms Terms for Pairs. Dep £3·32 & 8 mthly pymts £3·32 (Total £29·88) **£12·95** Carr. 55p.

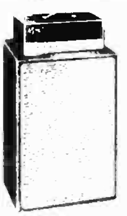
L12/10 10-15 Watt Veneered cabinet 12" unit 8-15 ohm. Approx. 14" × 14" × 9". Carr. 65p. Terms for Pairs. Dep. £2·05 & 8 mthly pymts £2·05 (Total £18·45). **£7·95**



FAL PHASE 50 Mk. III AMPLIFIER 50 WATT

Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 8 to 15 ohms. Size 17" × 7" × 7¼". 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £7·88 & 8 monthly payments £5·75. Total £53·88. Carr. Free **£47·88**

NOW AVAILABLE I.S.E. CA 127 JINGLE MACHINES £79·95



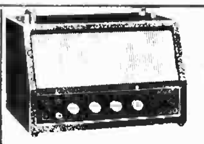
REGENT 50X 50 WATT AMP.

A powerful high quality unit for lead, rhythm guitar, vocalists, gram, radio, tape. 50w Peak O/P rating. Not for Bass Guitar.
★Two Fane heavy duty high flux 12in. spkrs.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls. Send S.A.E. for leaflet. Credit Terms: Deposit £9·95. & 18 fortnightly payments of £4·15 (Total £84·65). **£74·95** Carr. £2·50

REGENT 50B for Bass Guitar and general purposes. Or Dep. £10·95 & 18 fortnightly payments £4·73. (Total £96·09). Carr. £2·50 **£84·95**

FAL DISCO PRE-AMPLIFIER

T/Table mixing inputs. Headphone Monitoring. Mic. Jack & Tape inputs. Independent Vol. Control. Std. 200-250v A.C. Mains operation **£18·50**



GP30 AMPLIFIER

For Guitar, Vocal or Instr. Group, Gram, Radio or Tape. 4 inputs. 2 Vol. Controls. Current Valves. Peak o/p rating. Strong Vynide covered cabinet with carrying handles. Black/ Silver Facia. Neon Indicator. For 200-250v A.C. For 3 or 15 Ω speakers. Send SAE for leaflet. Terms: Dep £5·58 & 8 mthly pymts £3·58 (Total £34·22) **£29·95** Carr. 75p

REGENT '50' AMPLIFIER

As supplied with Regent 50x or 50B. Terms: Dep. £5·11 & 8 mthly pymts £5·11 (Total £45·99) **£39·95** Carr. £1

LIQUID WHEEL PROJECTORS from £24·75

COMPLETE PULSAR 'SOUND TO LITE' SYSTEM £99·95

AT A WORTHWHILE SAVING ON INDIVIDUAL UNITS purchased separately.
Terms: Deposit £11·48 and 18 fortnightly payments £5·74.
(Total Credit Price £114·80). Super SL Unit. 1000 watt per channel. Manual override buttons, 2 spotbanks with 6 bulbs (3 sep. colours) 5 yd and 10 yd leads, fitted plugs. Units sold sep.

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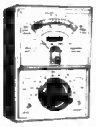
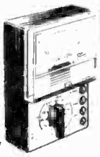
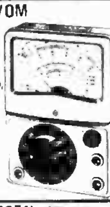
Build yourself a quality 20000 opv multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges 0/0.6/6/30/120/600/1200V D.C. 0/6/30/120/600/1200V A.C. Current: 0/0.6/6/60/600mA. Resistance: 0/10/100K/1/10 Meg ohms. Decibels −20 to +63db. Size 90 x 150 x 35mm.
OUR PRICE £7.95 P&P 30p

AUDIOTRONIC Model ATM1

Top value 1,000 opv pocket multimeter. Ranges:— 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistance: 0/150k ohms. Decibels: −10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.
OUR PRICE £3.25 P&P 15p

MODEL C1092

Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC. (2500 opv). 0-6/30/300/600V DC. (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. −10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.
OUR PRICE £3.95 P & P 20p

HIOKI 720X VOM

A versatile, accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10/50/250/1000V AC. 0—50uA/250mA. 0—20k/2 Megohms.
OUR PRICE £5.97 P&P 30p

MODEL C7202EN

20,000 o.p.v. DC. 10,000 o.p.v. AC. Mirror Scale. 5/25/50/250/500/1000/2500 V. DC. 10/50/100/500/1000 V. AC. DC Resistance x 10, x 1000 (30Ω centre scale) DC Current 50uA/2.5mA/250mA. −20 to +68 dB.
OUR PRICE £6.95 P & P 30p

MODEL PL436

20,000 opv DC. 8000 opv AC. Mirror scale. 6/3/12/30/120/600V DC. 3/30/120/600V DC. 50/600µA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. −20 to 46 dB.
OUR PRICE £6.97 P&P 30p

HIOKI 730X

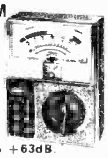
30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/µA/30mA/300mA. 2K/200K/2 Meg Ohm. −10 to 63dB.
OUR PRICE £7.50 P&P 30p

U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance x 10, x 100, x 1,000, x 10,000 (50Ω. 500Ω. 5kΩ. 50kΩ centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £8.00 P&P 30p

U435 MULTIMETER

20,000opv. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.
OUR PRICE £8.75 P&P 30p

MODEL C7208FM

30,000 opv DC. 15,000 opv AC. 6/3/15/60/300/600/1200 V. DC. 6/30/120/600/1200 V. AC. DC Resistance x 1, x 10, x 100, x 1000 (50Ω centre scale) DC Current 30uA/3/30/600mA. −20 to +63dB.
OUR PRICE £8.95 P & P 30p

U4324 MULTIMETER

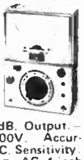
High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistance: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: −10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £9.85 P&P 30p

U91 Clamp VOLT AMMETER

For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £14.00 P&P 30p

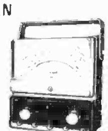
U4312 MULTIMETER

extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £10.75 P&P 50p

HIOKI 750X VOLT-OHM-MILLIAMETER

43 ranges: 0—0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0—3/6/15/30/60/120/300/600/1,200V AC. Current: 0—30/60uA/1.5/3/15/30/150/300 mA/6/12A. Resistence 0—3/300k/3/30Mohms. Decibels: −10 to +17dB. Output. 0—3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size 57 x 102 x 153mm.
OUR PRICE £11.95 P&P 40p

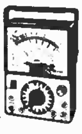
TMK MODEL TW50K

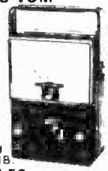
46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistence: 10k/100k/1 Meg/10 Meg ohms. −20 to +81.5dB.
OUR PRICE £12.50 P&P 20p

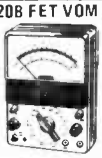
MODEL C7080EN

Giant 6" mirror scale. 20,000 opv. 0/0.25/1/2.5/10/50/250/1000/5000V DC. 0/2.5/10/50/250/1000/5000V AC. 0/50uA/1/10/100/500mA/10A DC. 0/2k/200k/20 Meg. −20 to +50dB.
OUR PRICE £19.95 P&P 35p

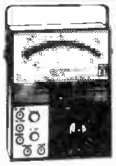
MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £13.95 Carr. paid

HIOKI MODEL 700X

100,000opv. Overload protection. Mirror scale. 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/500mA/6/12A DC. 2k/200k/2M/20MOhms. −20 to +63dB.
OUR PRICE £14.95 P&P30p

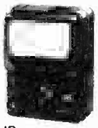
MODEL AS.100D VOM

100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10µA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. −20 to 17dB.
OUR PRICE £17.50 P&P 30p

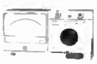
KAMODEN HM720B FET VOM

Input impedence 10 Megohms. Ranges:— 0/.25/1/2.5/10/50/1000V DC. 0/2.5/10/50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms.
OUR PRICE £21.00 P & P 40p

KAMODEN 360 MULTIMETER

High sensitivity. DC 100kohm/V AC 10kohm/V. 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. Decibels −20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.
OUR PRICE £17.50 P & P 40p

Model HT100B4 MULTIMETER

Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence' 0—20/200k/2/20 Meg. ohms. DC current:— 10/250uA/2.5/25/250 mA/10A. AC current: 0—10A. −20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £17.50 P&P 40p

370WTR MULTIMETER

Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: −20 to +62dB.
OUR PRICE £19.95 P&P 30p

U4317 MULTIMETER

High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Overload protection. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: −5 to +10dB. Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.
OUR PRICE £17.00 P&P 40p

KAMODEN 72.200 Multitester

High sensitivity tester. 200,000 opv. Overload protected. Mirror scale. Ranges:—0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. −20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £22.50 P&P 30p

MODEL AF.105 VOM

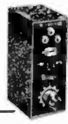
50,000 opv. Mirror scale. Meter protection. 0/3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30µA/6/60/300 mA/12 Amp. 0/10K/1m/10m/100 Meg Ohms. −20 to 17dB.
OUR PRICE £12.50 P&P 30p

TMK MODEL 117 FET ELECTRONIC VOLTMETER

Battery operated. 11 Meg input, 26 ranges. Large 4¼" mirror scale. Size: 149x117x60mm. 0.3—12000V DC. 3—300V RMS AC. 8—800V P-P. DC current 0.12—12mA. Resistence up to 2000MOhms. Decibels: −20 to +51dB. Supplied complete with leads and instructions.
OUR PRICE £18.50 P&P 20p

TMK 100K LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv DC. 5k/V AC. DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/100/2.5/10A. Resistence: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: −10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.
OUR PRICE £19.95 P&P 30p

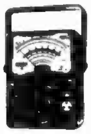
L84 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE £4.50 P&P 20p

KAMODEN TT35 TRANSISTOR TESTER

High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.
OUR PRICE £17.50 P & P 40p

U4341 Multimeter & Transistor Tester

27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £11.00 P&P 30p

S100TR MULTIMETER TRANSISTOR TESTER

100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/60/0/12/300mA/6/12A DC. 0/10k/1 Meg/100 Meg. −20 to +50dB. 0.01—0.2 MFD. Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.
OUR PRICE £19.95 P&P 25p

SWR METER Model SWR3

Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.
OUR PRICE £4.25 P&P 30p

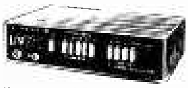
CI5 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1—25; HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3—25. Preset triggered sweep 1—3000usec. Free running 20—200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115—230V AC.
OUR PRICE £44.00 Carr. paid

ALL PRICES EXCLUDE VAT

Also see following pages

SINCLAIR DM2 DIGITAL MULTIMETER



Will measure AC and DC volts, AC and DC current, and resistance in a total of 20 ranges. The large light emitting diode display will read up to 1999 and automatically indicate polarity. Indication of positive and negative overload is also provided. The instrument is fitted with a combined carrying handle and bench stand and sockets are provided for the connection of an external power supply.

RANGES:
DC VOLTS. 1v, 10, 100v, 1000v
AC VOLTS 1v, 10v 100v, 1000v.
DC CURRENT 1mA, 10mA, 100mA, 1000mA
AC CURRENT 1mA, 10mA, 100mA, 1000mA
RESISTANCE 1k, 10k, 100k, 1000k

OUR PRICE £59.95 P & P 50p

RUSSIAN C116 DOUBLE BEAM OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

MODEL TE15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.

OUR PRICE £17.50 P&P 30p

TRANSISTORISED L.C.R A C BR/8 MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges 0 1 ohm-11 1 megohm ± 1% Inductance: 6 ranges. 1 microhenry-111 henries ± 2% Capacity 6 ranges, 10pf-1110 mfd ± 2% Turns Ratio: 6 ranges 1 1/1000-1 11100 ± 1% Bridge Voltage at 1,000cps Operated from 9-volt battery 100 micro-amp meter indication. Size 7¾" x 5" x 2"

OUR PRICE £27.50 P&P 30p

TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.

OUR PRICE £8.97 P&P 30p

TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated Variable R F attenuator audio output, Xtal socket for calibration 220 240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm

OUR PRICE £19.95 P&P 50p

ARF 300 AF/RF SIGNAL GENERATOR

All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P.P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

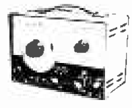
OUR PRICE £37.50 P&P 50p

MODEL TE20 RF SIGNAL GENERATOR

Six bands, 120kHz–260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105–125V, 220–240V AC. Size 193 x 265 x 150mm. Complete with test leads etc.

OUR PRICE £18.95 P&P 50p

TE22 SINE SQUARE WAVE AUDIO GENERATOR



Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.

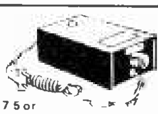
OUR PRICE £24.95 P&P 50p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.

OUR PRICE £52.00 P&P 50p

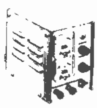
DT 124 POWER UNIT



220 240V AC Input Output 6, 7 5 or 9V DC 400 mA

OUR PRICE £2.20 P&P 50p

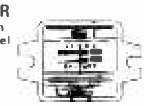
PS200 Regulated POWER SUPPLY UNIT



Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

OUR PRICE £19.95 P&P 50p

BATTERY/LEVEL PANEL INDICATOR



250 uA 18mm 18mm Panel mounting

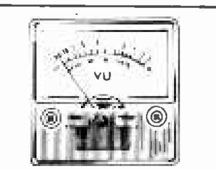
OUR PRICE 75p

P&P 15p Discounts for quantity

NEW GOLDRING G102 KIT

Belt-drive 2-speed turntable in kit form complete with pick up arm and head shell

OUR PRICE £16.95 P&P 75p



VU METER TYPE 3

Size 33mm 20mm

£1.25 P&P 15p

SDH8V MONO/STEREO HEADPHONES

Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug.

OUR PRICE £4.97 P&P 30p

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.

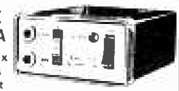
OUR PRICE £5.95 P&P 30p

T.T.C. SPRITE STEREO HEADPHONES

Feather weight (5 oz) Dynamic stereo headphones providing high quality reproduction at a budget price. Soft removable ear pads and adjustable headband. Speaker size 28mm Impedance 8 ohms Frequency response 30 13000 Hz.

OUR PRICE £1.95 P&P 30p

UNIPEX NT 100A



The unipex NT100A is a compact portable transistorised PA amplifier. This versatile unit has a maximum output of 10 watts RMS and operates on any 10 16V DC source, negative or positive ground and uses only 1 5A at rated output. Supplied complete with mounting brackets etc. plus full installation and operating instructions.

OUR PRICE £21.75 P&P 50p

EA41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beau-walnut cabinet. 184 x 77 x 108mm.

OUR PRICE £7.50 P&P 30p

RANK AUDIO RA 210T STEREO AMPLIFIER

7½ 7½ watts rms Inputs for magnetic phono, tuner, tape and aux. Separate base, treble, balance and volume controls. Headphone socket. Teak case. Unrepeatable offer

OUR PRICE £17.50 P&P 50p

VHF 105

This unit will give instant reception of the ground-to-air, air-to-ground waveband. Simply place beside any AM or FM Radio, covering 535 1605kHz, 88 108 MHz no conversion or connection required. This converter is self powered by one 9-volt (PP3 Type) battery and comes complete with a full set of instructions and battery.

OUR PRICE £3.50 P&P 50p

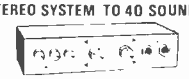
Just arrived – the sensational WIEN ET1008 CASSETTE! RECORDER

A highly recommended cassette recorder at this really low Laskys price

ONLY **£8.95** P&P 50p

FANTASTIC VALUE!

SPECIAL OFFER! CONVERT YOUR STEREO SYSTEM TO 4D SOUND



This clever unit enables you to add 4D sound to your existing system. Complete with simple connection details. Use this converter (together with 2 extra speakers) to achieve the fantastic 4D quadrophonic sound! The effect of being immersed within the music becomes a thrilling new experience (2 year guarantee).

OUR PRICE £3.95 P&P 50p

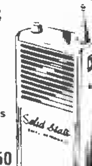
FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.

OUR PRICE £8.95 P&P 20p

Stereo Multiplex Adaptor £5 95 extra

WALKIE TALKIES

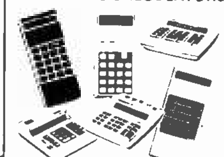


SKYFON NV7 Super low cost transmitter receivers 100MW with call buzzer and on off volume control 7 transistors Telescopic rod antenna

OUR PRICE £31.50 per PAIR P & P 50p.

NOT LICENSABLE IN THE U K

ELECTRONIC CALCULATORS



We carry a tremendous range of both pocket and desk calculators from as little as **£8.90**. Owing to the demand it is not possible to include them in this advertisement, so send for our latest price list or call into any branch

MINIATURE ORGAN MUSIC MASTER AM100

Spanning nearly two octaves, including semi tones. This instrument will give hours of enjoyment to all the family. Beautifully finished. The Keyboard range can be adjusted to be in tune with any instrument. Operates from internal 9V battery. Fitted with on off switch, vibrato switch, earphone socket and external 9V D C socket

OUR PRICE £7.95 P&P 50p.

BINATONE DIGITAL CLOCK

Attractive ivory case. Large clear numbers for hours, minutes and seconds. A C 240V operation. Size approx 6¼ x 3 x 3½ inches

OUR PRICE £4.50 P&P 50p

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER

complete with printed circuit mounting board

OUR PRICE £1.50 P & P 15p.

SINCLAIR Project 80 Modules

Z40 Power Amp	£5 95	P & P 15p
Z60 Power Amp	£7 45	P & P 15p
Stereo 80 Pre-Amp	£13 95	P & P 15p
Active Filter Unit	£7 45	P & P 15p
FM Tuner	£13 95	P & P 15p
Stereo Decoder	£8 95	P & P 15p
PZ5 Power Supply	£5 95	P & P 30p
PZ6 Power Supply	£8 95	P & P 30p
PZ8 Power Supply	£8 45	P & P 30p
Transformer for PZ8	£4 05	P & P 50p

SINCLAIR Project 80 Packages

2xZ40 Stereo 80 PZ5 £25 44
2xZ40 Stereo 80 PZ6 £27 84
2xZ60 Stereo 80 PZ8 £29 84
P & P 35p each

TE1021 Stereo Listening Station

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on–off slide switch, stereo headphone socket.

OUR PRICE £2.25 P&P 15p

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1 57	£3.00	£7.08
C90	£2.24	£4.25	£10.00
C120	£2.73	£5.17	£12.24

P&P 3p each 10 and over Post Free

MP7 MIXER-PREAMPLIFIER

5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

OUR PRICE £8.97 P&P 20p

AUDIOTRONIC AHA101 Stereo Headphone Amplifier

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.

OUR PRICE £8.50 P&P 30p

JOSTY KIT

HIGH QUALITY CONSTRUCTION KITS

WE ARE STOCKISTS AT Oxford Street, 142 & 257 Tottenham Court Road, 34 Lisle Street, 152, Fleet Street, 311 Edgware Road, CROYDON BIRMINGHAM KINGSTON LEICESTER NORTHAMPTON SOUTHEND TUNBRIDGE WELLS WOLVERHAMPTON branches, or by Mail Order

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£5 61
AF25 Mixer	£3 29
AF30 Mono pre amplifier	£3 20
AF35 Emitter amplifier	£2 42
AF80 0 5W mic amplifier	£4 86
AF305 Intercom	£7 67
AF310 2 Mono Amplifier	£7 55
M160 Multi vibrator	£2 18
M1302 Transistor tester	£8 33
M191 VU Meter	£5 37
M192 Stereo balance meter	£5 93
LF380 Quadraphonic device.	£8 42
AT5 Automatic light control	£3 75
AT30 Photo cell switch unit	£6 68
AT50 400W triac light dimmer/speed control	£5 18
AT56 2,200W triac light dimmer/speed control	£6 75
AT60 1 channel light control	£10 82
AT65 3 channel light control	£16 52
GU330 Tremolo unit	£8 10
HF61 Diode detector	£3 87
HF65 FM transmitter	£3 21
HF75 FM receiver	£3 66
HF310 FM tuner	£16 32
HF325 Deluxe FM tuner	£26 33
HF330 Decoder (HF310/325)	£10 55
GP310 Stereo pre amplifier for use with 2 x AF310	£22 98
GP312 Circuit board	£10 02
GP304 Circuit board	£5 33
HF380 Iw/vhf aerial amplifier	£6 02
HF395 broadband aerial amp.	£2 10
NT10 Stabilised power supply 100mA, 9V	£6 27
NT300 Stabilised p. supply	£13 16
NT310 Power Supply 240 V AC or 2 x 18 V D C at 2 amps	£5 64
NT305 Voltage converter	£5 64
NT315 Power supply 240V AC to 4.5/15V DC, 500mA	£12 06

Amateur Electronics by Josty-Kit, the professional book for the amateur – covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.

OUR PRICE £3.30 (No VAT)

P&P 25p plus VAT

AE1 100mW output stage	£1 55
AE2 Pre amplifier	£1 32
AE3 Diode receiver	£2 05
AE4 Flasher	£1 26
AE5 Astable multi vibrator	£1 14
AE6 Monostable multi vibrator	£1 11
AE7 RC generator	£1 08
AE8 Bass filter	£1 05
AE9 Treble filter	£1 05
AE10 CCIR filter	£1 05

Also see previous page

ALL PRICES EXCLUDE VAT

SEW PANEL METERS

SEW PANEL METERS ARE STOCKED AT OUR 3 LISLE ST., 311 EDGWARE RD., & 152 FLEET ST., BRANCHES or order by post.

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

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

50uA	£3 90	10V DC	£3 75
100uA	£3 85	20V DC	£3 75
200uA	£3 80	50V DC	£3 75
500uA	£3 75	300V DC	£3 75
50-0-50uA	£3 85	15V AC	£3 85
100-0-100uA	£3 80	300V AC	£3 85
1mA	£3 75	VU Meter	£4 00
5mA	£3 75		
10mA	£3 75		
50mA	£3 75		
100mA	£3 75		
500mA	£3 75		
1A DC	£3 75		
5A DC	£3 75		
10A DC	£3 75		
5V DC	£3 75		

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4 70	150V AC	£4 55
100uA	£4 60	300V AC	£4 55
500uA	£4 40	VU Meter	£5 00
50-0-50uA	£4 60		
100-0-100uA	£4 55		
1mA	£4 40		
1A DC	£4 40		
5A DC	£4 40		
20V DC	£4 40		
50V DC	£4 40		
300V DC	£4 40		

EDGWISE MODEL PE70
Size: 90 x 34mm

50uA	£4 25
100uA	£4 20
200uA	£4 15
500uA	£4 00
50-0-50uA	£4 20
100-0-100uA	£4 15
1mA	£3 95
300V AC	£4.05
VU Meter	£4 40

MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.

50uA	£8 70	20V DC	£7 80
100uA	£8 10	50V DC	£7 80
50-0-50uA	£8 10	300V DC	£7 80
1mA	£7 80	500mA/5A DC	£8 80
1-0-1mA	£7.80	5V/50V DC	£8 80
1A DC	£7 80	5V/15V DC	£8.80
5A DC	£7 80	1/5A DC	£8 80
5V DC	£7 80		
10V DC	£7 80		
15V DC	£7 80		

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm

50uA	£5 60	300V DC	£5 40
100uA	£5.55	15V AC	£5 45
200uA	£5 50	300V AC	£5 45
500uA	£5 40	S Meter 1mA	£5 35
50-0-50uA	£5 55	VU Meter	£5 70
100-0-100uA	£5 50	1A AC	* £5 35 *
500-0-500uA	£5 35	5A AC	* £5 35 *
1mA	£5 35	10A AC	* £5 35 *
1-0-1mA	£5 35	20A AC	* £5 35 *
5mA	£5 35	30A AC	* £5 35 *
10mA	£5 35		
50mA	£5 35		
100mA	£5 35		
500mA	£5 35		
1A DC	£5 35		
5A DC	£5 35		
15A DC	£5 35		
30A DC	£5 55		
10V DC	£5 35		
20V DC	£5 35		
50V DC	£5 35		
150V DC	£5 35		

CLEAR PLASTIC MODEL SD830
Size. 110 x 83mm

50uA	£4 40	10V DC	£4 20
100uA	£4 35	20V DC	£4 20
200uA	£4 30	50V DC	£4 20
500uA	£4 25	300V DC	£4 20
50-0-50uA	£4 35	15V AC	£4 30
100-0-100uA	£4 30	300V AC	£4 30
1mA	£4 20	VU Meter	£4 50
5mA	£4 20		
10mA	£4 20		
50mA	£4 20		
100mA	£4 20		
500mA	£4 20		
1A DC	£4 20		
5A DC	£4 20		
10A DC	£4 20		
5V DC	£4 20		

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm

50uA	£3 30	300V AC	£3 15
100uA	£3 25	S Meter 1mA	£3 05
200uA	£3 20	VU Meter	£3 50
500uA	£3 10	1A AC	* £3 05 *
50-0-50uA	£3 25	5A AC	* £3 05 *
100-0-100uA	£3 20	10A AC	* £3 05 *
500-0-500uA	£3 05	20A AC	* £3 05 *
1mA	£3 05	30A AC	* £3 05 *
5mA	£3 05		
10mA	£3 05		
50mA	£3 05		
100mA	£3 05		
500mA	£3 05		
1A DC	£3 05		
5A DC	£3 05		
10V DC	£3 05		
20V DC	£3 05		
50V DC	£3.05		
300V DC	£3 05		
15V AC	£3 15		

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm

50uA	£3 20	20V DC	£2 85
100uA	£3 15	50V DC	£2.85
200uA	£3 10	100V DC	£2 85
500uA	£2 90	150V DC	£2 90
50-0-50uA	£3 15	300V DC	£2 90
100-0-100uA	£3 10	500V DC	£2 95
500-0-500uA	£2 85	750V DC	£2 95
1mA	£2 85	15V AC	£2 95
1-0-1mA	£2 85	50V AC	£2 95
2mA	£2 85	150V AC	£2 95
5mA	£2 85	300V AC	£2 95
10mA	£2 85	500V AC	£3 10
20mA	£2 85	S Meter 1mA	£2 85
50mA	£2 85	VU Meter	£3 30
100mA	£2 85		
150mA	£2 85		
200mA	£2 85		
300mA	£2 85		
500mA	£2 85		
750mA	£2.85		
1A DC	£2 85		
2A DC	£2 85		
5A DC	£2 85		
10A DC	£2 85		
3V DC	£2 85		
10V DC	£2.85		
15V DC	£2 85		

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3 60	10V DC	£3 40
100uA	£3 55	20V DC	£3 40
200uA	£3 50	50V DC	£3 40
500uA	£3 45	300V DC	£3 40
50-0-50uA	£3 55	15V AC	£3 55
100-0-100uA	£3 50	300V AC	£3 55
1mA	£3 40	VU Meter	£3 75
5mA	£3 40		
10mA	£3 40		
50mA	£3 40		
100mA	£3 40		
500mA	£3 40		
1A DC	£3 40		
5A DC	£3 40		
10A DC	£3 40		
5V DC	£3 40		

POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm

50uA	£4 05	300V DC	£3 80
100uA	£3 95	15V AC	£3 90
200uA	£3 90	50V AC	£3 90
500uA	£3 85	150V AC	£3 90
50-0-50uA	£3 95	300V AC	£3 90
100-0-100uA	£3 90	500V AC	£4 00
500-0-500uA	£3 80	S Meter 1mA	£3 90
1mA	£3 80	VU Meter	£4 20
1-0-1mA	£3 80	1A AC	* £3 80 *
5mA	£3 80	5A AC	* £3 80 *
10mA	£3 80	10A AC	* £3 80 *
50mA	£3 80	20A AC	* £3 80 *
100mA	£3 80	30A AC	* £3 80 *
500mA	£3 80	50mA AC	* £3 80 *
1A DC	£3 80	100mA AC	* £3 80 *
5A DC	£3 80	200mA AC	* £3 80 *
10A DC	£3 80	500mA AC	* £3 80 *
15A DC	£3 80		
20A DC	£3 90		
30A DC	£3 95		
50A DC	£4 15		
5V DC	£3 80		
10V DC	£3 80		
15V DC	£3 80		
20V DC	£3 80		
50V DC	£3 80		
150V DC	£3 80		

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

50uA	£4 60
100uA	£4 55
500uA	£4 30
50-0-50uA	£4 55
100-0-100uA	£4 50
1mA	£4 30
1A DC	£4 30
5A DC	£4 30
20V DC	£4 30
50V DC	£4 30
300V DC	£4 30
300V AC	£4 40
VU Meter	£4 80

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm

50uA	£3 80	S Meter 1mA	£3 40
100uA	£3 60	VU Meter	£3 90
500uA	£3 45	1A AC	* £3 40 *
50-0-50uA	£3 60	5A AC	* £3 40 *
100-0-100uA	£3 45	10A AC	* £3 40 *
1mA	£3 40	20A AC	* £3 40 *
5mA	£3 40	30A AC	* £3 40 *
10mA	£3 40		
50mA	£3 40		
100mA	£3 40		
500mA	£3 40		
1A DC	£3 40		
5A DC	£3 40		
10V DC	£3 40		
20V DC	£3 40		
50V DC	£3 40		
300V DC	£3 40		
15V AC	£3 50		
300V AC	£3 50		

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5 40	300V DC	£3 90
50uA	£4 10	30V AC	* £3 70 *
100uA	£4 05	50V AC	* £3 70 *
500uA	£3 75	150V AC	* £3 70 *
50-0-50uA	£4 05	300V AC	* £3.70 *
100-0-100uA	£4 00	500V AC	* £3 70 *
500-0-500uA	£3 70	VU Meter	£4 20
1mA	£3 70	1A AC	* £3 70 *
1-0-1mA	£3 70	5A AC	* £3 70 *
5mA	£3 70	10A AC	* £3 70 *
10mA	£3 70	20A AC	* £3 70 *
50mA	£3 70	30A AC	* £3 70 *
100mA	£3 70	50A AC	* £3 70 *
500mA	£3 70	500mA AC	* £3 70
1A DC	£3 70	50mV DC	£3.85
2A DC	£3 70	100mV DC	£3 85
5A DC	£3 70		
10A DC	£3 70		
15A DC	£3 70		
30A DC	£3 70		
50A DC	£3.90		
5V DC	£3 70		
10V DC	£3 70		
15V DC	£3 70		
20V DC	£3 70		
50V DC	£3 70		
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10A	£33.75	£1.00
12A	£35.40	£1.00
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25A	£95.00	£1.50
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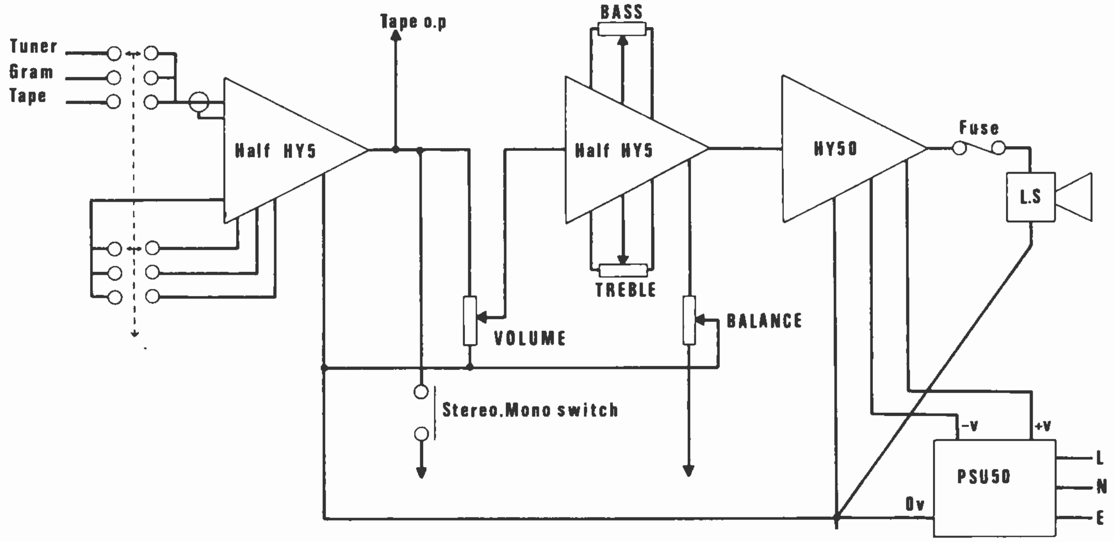
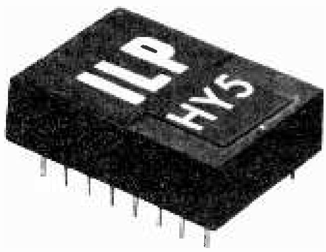
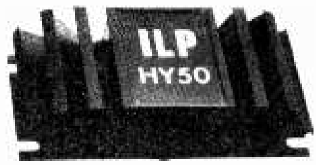
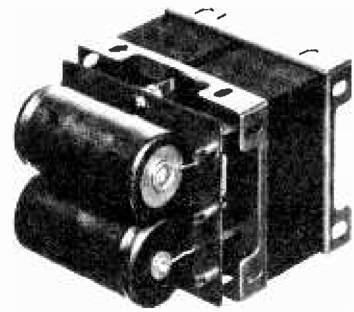


MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN







The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

TECHNICAL SPECIFICATION
Inputs: Magnetic Pick-up 3mV RIAA: Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxiliary 3–100mV; Input/Impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0·775V RMS). **Active Tone Controls:** Treble ± 12db at 10kHz; Bass ± 12db at 100Hz. **Distortion:** 0·5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ± 16–25V.

PRICE £4·50 + 36p VAT P. & P free

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

TECHNICAL SPECIFICATION
Output Power: 25W RMS into 8Ω. **Load Impedance:** 4–16Ω. **Input Sensitivity** 0db (0·775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0·1% at 25W typically 0·05%. **Signal/Noise Ratio:** Better than 75db **Frequency Response:** 10Hz–50kHz ± 3db. **Supply Voltage:** ± 25V. Size: 105 x 50 x 25mm.

PRICE £5·98 + 48p VAT P. & P. free

The PSU50 incorporates a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 50V (25-0-25V). **Input Voltage:** 210–240V.
Size: L.70. D.90. H.60mm.

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TRANSFORMERS

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In moulded case forming a 2 pin 5A mains plug.
2 metre output lead with 4-way mutiplug giving 2·1 and 2·5 mm sockets and 3·5 mm plugs.
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0–50 micro A.	1250	0–50 micro A.	1400
0-100 micro A.	580	0–100 micro A.	730
0–500 micro A.	170	0–500 micro A.	200
0–1 mA	170	0–1 mA	200
0–5 mA	170	0–5 mA	200
0-10 mA	6	0–10 mA	6
0–50 mA	0·5	0–50 mA	0·5
0–100 mA	0·5	0–100 mA	0·5
0-500 mA	0·5	0–500 mA	0·5
0–1 AMP	0·5	0-1 AMP	0·5
0–2 AMP	0·5	0–2 AMP	0·5
0–25 Volt	15K	0–25 Volt	15K
0–50 Volt	50K	0–50 Volt	50K
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C1001 MULTIMETER

Input Resistance 20,000 ohms per volt
Overload protection
150 μA movement, clear scale
Ranges—AC Volts 0-10, 50, 250, 1000V
DC Volts 0-5, 25, 125, 500, 2500V
DC Current 0–50 mA
Resistance 0–60 Kohms, 0–6 Mohms
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SAFETY ISOLATING

Prim. 120/240V. Sec. 120/240V. Centre Tap with Screen.

VA (watts)	Ref No.	Price Cased £	Price Plugs 2 Pin + 1 Earth	Price Open £	Post £
60	149	7·35	0·80	4·00	0·38
100	150	8·22	0·80	4·60	0·52
200	151	10·20	0·80	7·40	0·52
250	152	11·68	0·80	8·88	0·65
350	153	14·10	0·80	10·80	0·80
500	154	15·68	0·80	12·38	1·00
750	155	24·63	1·00	18·72	1·20
1000	156	32·19	1·00	26·50	1·20
1500	157	38·18	1·00	30·34	O.A.
2000	158	45·20	2·40	34·68	O.A.
3000	159	66·50	2·40	53·35	O.A.

12 & 24 Volts Prim. 200-240V.

Amps 12V	24V	Ref. No.	Price £	Post £
0·3	0·15	242	1·34	0·22
0·5	0·25	111	1·38	0·22
1	0·5	213	1·58	0·22
2	1	71	2·09	0·22
4	2	18	2·58	0·38
6	3	70	3·80	0·42
8	4	108	4·20	0·52
10	5	72	4·80	0·52
12	6	116	5·01	0.52
16	8	17	6·22	0·52
20	10	115	9·47	0·69
30	15	187	11·95	0·97
40	20	232	13·26	1·00
50	30	226	15·30	1·10

30 Volts

Prim. 200-240V. Sec. 12, 15, 20, 24, 30V.

Amps	Ref. No.	Price £	Post £
0·5	112	1·72	0·22
1	79	2·21	0·38
2	3	3·26	0·38
3	20	4·10	0·42
4	21	4·68	0·52
5	51	5·80	0·52
6	117	6·50	0·52
8	88	8·50	0·67
10	89	8·97	0·67

AUTO TRANSFORMERS

VA Watts	Ref. No.	Price Cased £	Price Plugs 2 & 3 pin	Price Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	3·00	0·15	1·55	0·30
Tapped at 115, 200, 220, 240 Volts					
150	4	5·80	0·15	3·98	0·39
200	65	6·40	0·15	4·50	0·40
300	66	7·27	0·15	5·28	0·52
500	67	9·99	0·15	8·29	0·67
750	83	12·56	0·75	9·76	0·82
1000	84	15·70	0·75	12·40	0·82
1500	93	19·88	0·75	16·58	1·50
2000	95	30·10	1·44	22·05	1·50
3000	73	43·58	1·90	32·00	1·90

50 Volts

Prim. 200–240V.
Sec. 19, 25, 33, 40, 50V.

Amps	Ref. No.	Price £	Post £
0·5	102	2·33	0·30
1	103	3·00	0·38
2	104	4·57	0·42
3	105	5·20	0·52
4	106	6·89	0·52
6	107	11·17	0·67
8	118	14·19	0·97
10	119	15·47	0·97

60 Volts

Prim. 230–240V.
Sec. 24, 30, 40, 48, 60V.

Amps	Ref. No.	Price £	Post £
0·5	124	2·08	0·38
1	126	2·96	0·38
2	127	4·63	0·42
3	125	6·84	0·52
4	123	7·94	0·67
5	40	8·86	0·67
6	120	10·15	0·82
8	121	13·58	1·00
10	122	18·15	1·00
12	189	16·00	1·10

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Volts Sec. 2	Milliamps Sec. 1	Milliamps Sec. 2	Ref. No.	Price £	Post £
3–0–3	—	200	—	238	1·23	0·10
0–6	0–6	500	500	234	1·30	0·10
0–6	0–6	1000	1000	212	1·98	0·22
9–0–9		100	—	13	1·23	0·10
0–9	0–9	330	330	235	1·43	0·10
0–8–9	0–8–9	500	500	207	1·75	0·22
0–8–9	0–8–9	1000	1000	208	2·30	0·30
15–0–15	—	40	—	240	1·23	0·10
0–15	0–15	200	200	236	1·30	0·10
20–0–20		30	—	241	1·23	0·10
0–20	0–20	150	150	237	1·30	0·10
0–15–20	0–15–20	500	500	205	2·47	0·38
0–20	0–20	300	300	214	1·72	0·22
0–20	—	3500	NO SCREEN	1116	3·00	0·40
20–12–0–12–20	—	700 (D/C)	—	221	2·31	0·30
0–15–20	0–15–20	1000	1000	206	3·22	0·38
0–15–27	0–15–27	500	500	203	2·73	0·38
0–15–27	0–15–27	1000	1000	204	3·52	0·38

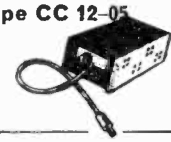
PLASTIC CASED SILICON BRIDGE RECTIFIERS

One Amp	Two Amp	Four Amp	Six Amp
50 P.I.V. 25p	50 P.I.V. 35p	100 P.I.V. 55p	50 P.I.V. 65p
100 P.I.V. 25p	100 P.I.V. 40p	200 P.I.V. 59p	100 P.I.V. 70p
200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
600 P.I.V. 30p	400 P.I.V. 50p	600 P.I.V. 75p	400 P.I.V. 90p

ADD 10p P & P PER ORDER

PLEASE ADD 8% FOR VAT

POWER UNIT Type CC 12–05



Output switched 3, 4·5, 6, 7·5 9 and 12 volts at 500 mA D.C. Operates from 240 V mains, suitable for Radios, Tape Recorders, Record Players etc Size 7·5 × 5·0 × 14·0cm. Price £3·95. Post 25p.

MINIATURE NEONS

6mm dia., 12mm length leads length approx. 20mm. Recommended ballast resistor 150K ohms for 240 Volt operation Price: Packet of 10 for 55p. Postage 10p.

A.S.P. LTD.

DEPT PW2, SIMMONDS ROAD, WINCHEAP, CANTERBURY, KENT. Tel: (0227) 52436

INVERTORS

240v—50Mz. from your 12v car battery.
25 watt—£3·90 + 30p p & p.
40 watt—£6·80 + 55p p & p.
75 watt—£9·96 + 75p p & p.
150 watt—£18·30 + 80p p & p.
30 watt (12v)—£28·80 + £1·05 p & p.
300 watt (24v)—£22·70 + £1·05 p & p
All above Invertors are in kit form but may be purchased built up & ready for use. Price list sent on receipt of stamped addressed envelope.

P.W. AUTOMATIC EMERGENCY SUPPLY

250v—50Hz—150 watt Invertor with built in battery charger. In event of power failure switches over automatically from battery charging to invertor operation. Cct. as appeared in Dec. 73 *P.W.* Complete kit of parts (excluding meter) £22·50 + £1·10 p & p.

COMPLETE FLUORESCENT LIGHT INVERTOR KIT

8 watt—12v—Fluorescent light, suitable for tents, caravans, houses, boats and secondary lighting for, factories, hotels etc. 12"—8 watt £2·90 + 25p p & p. 21"—13 watt. £3·30 + 30p p & p.

TRANSFORMERS & COILS

Both high volume & small order capacity available for Mains, R.F., & I.F. Transformers. Before you buy elsewhere let us quote you and see what you save.
V.A.T. at 8% included.

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ELECTRONI-KIT

". . . . educational kits of exceptional quality"
(AUDIO mag. Dec. 1974)

BUILD AND REBUILD ANY NUMBER OF TIMES:

Radios, microphones, burglar alarms, inter-comms, ferrite detectors, solar cell, photoelectric cell, voice relay, electronic cats, birds, guns, organs, illuminometers, voltmeters, meters of all types, etc., etc., plus your own circuit designs.

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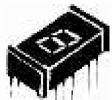
Satisfaction guaranteed.
ELECTRONI-KIT LTD, 408 St. John's Street, London, EC1. (01-278 4579)

Crescent Quality Components

BARGAIN CAPACITOR 2,200MFD at 63v. DC wkg.
Size = 2" × 1⅜" diameter. Tag ended. All new and unused. Our price 35p.

S. G. BROWN HEADSET
Finest quality British made Lightweight Headphones. Incorporates ceramic piezo electric transducers.
Specification:—
Frequency—20-17,500 CPS
Impedance—Predominantly capacitive, at ·001MFD per earpiece can be regarded as 150K at 1kcs.
Weight—3·5oz. (98 grams).
A bargain at £1·25 each set

JB11D STEREO JUNCTION BOX
The most popular stereo junction box. Facility for two pairs of headphones and two speakers. 3 position switch selects headphones, loudspeakers or both. A bargain at £2·50

LIGHT EMITTING DIODES

Til 209 (Red) With Clip	22p each
Til 209 (Green) With Clip	38p each
Til 209 (Yellow) With Clip	90p each
Mled 500 T092 Type	16p each

LED READOUTS
Litronix

DL707 .3 Character 14 Pin Dil.	£2·00
DL701 as above but ± 1	£2·00
DL747 ·6 Character	£2·62

Minitron

3015 7 Segment 16 Pin Dil	£1·18
3015G as above but ± 1	£1·18

Clock Chip
CT7001 MOS/LSI Digital Clock/Calendar Chip Plus full Circuits and Information leaflet £8·95
Circuits and Information Sheet 15p
Lit 704 Led Display for above £1·35
Or 4 for £5·25

WAFER SWITCHES
1 Pole 12 Way
2 Pole 2 Way
2 Pole 3 Way
2 Pole 4 Way
2 Pole 6 Way
3 Pole 4 Way
4 Pole 3 Way
22p each

POTENTIOMETERS
All types 1" and less diameter

Singles		Dual	
5K	Log or	5K	
10K	Lin Less	10K	
25K	Switch	25K	Less
50K	15p each	50K	Switch
100K		100K	45p each
250K	Double	250K	
500K	Pole	500K	
1M	Switch	1M	
2M	30p each	2M	

PRE SETS
Sub Miniature Skeleton Type 0·1 Watt Horizontal Mounting 100, 250 and 500 ohm, 1k, 2·5k, 5k, 10k 25k, 50k, 100k, 250k, 500k, and 1M ohm 6p each

MAINS TRANSFORMERS
Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1½" × 1¼" × 1¼" high
Fixing centres: 2⁵/₃₂".
TR1 20–0–20v 100 m/a
TR2 12–0–12 v 100 m/a — All
TR3 9–0–9 v 100 m/a — 240 Volt
TR4 6–0–6 v 100 m/a — Primary
TR5 3–0–3 v 100 m/a
Our Price £1·23 each

200/250v MAINS RELAY
Heavy duty contacts 2·500 ohm coil. All new and unused D.P.D.T. mains relays 50p, Carr. Free. Special quantity £40 per 100 off.

MINIATURE RELAYS
Brand new range of British made Relays, Size 1⅛" × 1" × ⅞". All two changeovers with 250v 1·5A contacts and suitable for fitting on ·1m Veroboard.

Type	Volts	Current	Ohms	
27/A	12v	17M/A	700	All
21/A	12v	28M/A	430	£1·30
12/A	6v	33M/A	185	each

MONO/STEREO MICROPHONE MIXER
9 volt. High impedance input. Gold finish with four black plastic chrome tipped level control knobs. On/Off switch and stereo/mono switch. 4 Input sockets.
SPECIFICATIONS:—
Input Imp = For XTAL Mics etc.
Gain = Approx 3.DB.
Max Input Sig = 1 volt
Max Output Sig. = 1·3 volt
Noise Ratio = —60DB
Supply = 9 volt
OUR PRICE = £5·25p

POWER PACKS
PP1 Switched 3 - 6 - 7½ - 9 volt 400M/A Transistor and Zener Stabilised On/Off Switch and Polarity Reversal Switch, in a black metal case £5·25 each.
PP2 Switched 6 – 7½ – 9 volt Battery Eliminator. Approx. size 2¾" × 2¼" × 3¼". Ideal for cassette recorders £3·25
PP3 Car converter. From 12v Pos. or Neg. to = 6 – 7½ – 9 volt. Easy to fit and transistor regulated £3·90

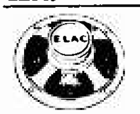
VEROBOARD

	·1	·15	Plain ·15
2½ × 3¾	32p	24p	15p
2½ × 5	34p	34p	18p
3¾ × 3¾	34p	34p	
3¾ × 5	39p	45p	
17 × 2½	1·06p	77p	60p
17 × 3¾	1·45p	1·16p	75p
17 × 5	1·85p		1·10p

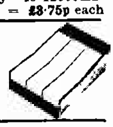
Pin insertion tool 72p
Spot face cutter 52p
Pkt. 36 pins (state ·1 or ·15) 25p

LOUDSPEAKERS
2¼" 8 ohm 50p
2¼" 40 ohm 50p
2¼" 80 ohm 50p
5" 8 ohm ceramic £1·25
6½" 8 ohm dual cone ceramic £2·50
10" 8 ohm dual cone ceramic £3·75
7" × 4" 8 ohm ceramic £1·60
8" × 5" 8 ohm Perman't Magnet £1·60
*EMI 13" × 8" 450 Kit
3 — 8 — 15 ohm £4·10
*EMI 13" × 8" 350 Kit 8 ohm £7·50

10 inch DUAL CONE L/S
Manufactured by "ELAC" to a very high standard these loudspeakers are a real bargain
SPEC:—Size = 10" Dual Cone.
Power = 10 Watts
Frequency = 40-12000Hz
Our Price = £3·75p each



MAINS KEYNECTOR
Keynector connects any Electrical Equipment to the mains supply in seconds. Ideal for bench, garage demonstrations, etc. Multi connections can be made (max. load 13A fused). £3·25p.



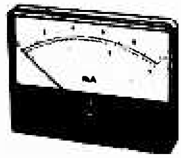
ALUMINIUM BOXES
Metal project boxes give your work a professional finish

	L	W	H	
AB7	2¼	5¼	1½	54p
AB8	4	4	1½	63p
AB9	4	2¼	1½	54p
AB10	4	5¼	1½	63p
AB11	4	2½	2	54p
AB12	3	2	1	45p
AB13	6	4	2	69p
AB14	7	5	2½	84p
AB15	8	6	3	99p
AB16	10	7	3	£1·35
AB17	10	4½	3	£1·02
AB18	12	5	3	£1·20
AB19	12	8	3	£1·50

ABS PLASTIC BOXES
Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.
1005 = 105mm × 73mm × 45mm = 51p
1006 = 150mm × 75mm × 47mm = 66p
1007 = 184mm × 124mm × 60mm = 96p
1021 = 106mm × 74mm × 45mm (sloping front) = 50p

BARGAIN BOARDS
Components galore for the experimenter Ex Computer boards with Resistors, Capacitors and useful Transistors—at least 4 transistors per board. Five boards £1·00.

CLEAR PLASTIC PANEL METERS
Size 59mm × 46mm × 35mm these meters require a 38mm hole for mounting.



ME6 = 0 to 50 micro amp Full Scale
ME7 = 0 to 100 micro amp Full Scale
ME8 = 0 to 500 micro amp Full Scale
ME9 = 0 to 1 m/a Full Scale
ME10 = 0 to 5 m/a Full Scale
ME11 = 0 to 10 m/a Full Scale
ME12 = 0 to 50 m/a Full Scale
ME13 = 0 to 100 m/a Full Scale
ME14 = 0 to 500 m/a Full Scale
ME15 = 0 to 1 amp Full Scale
ME16 = 0 to 50 volts
ME17 = 0 to 300 volts A.C. Full Scale
ME18 = "S" Meter
ME19 = "VU" Meter
OUR PRICE £3·00

ADD LUXURY TO YOUR CAR
with a motor driven car aerial
SPEC:- ★ 5 section
★ extended length 100cm
★ Length under fender 40cm
★ Cable length 120cm
Supplied complete with fixing bracket and control switch £7·50

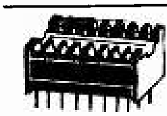
DECON DALO 33PC ETCH RESIST PEN
The Decon Dalo 33PC is a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board
OUR PRICE 80p

WIRE WOUND VOLUME CONTROL
250ohm Only 25p EACH. Approx 1" Diameter. Long standard spindle.

CABLE LESS SOLDERING IRON WAHL "ISO—TIP"
★ Completely Portable
★ Heats in 5 seconds
★ Solders up to 150 joints or more per charge
★ Recharges automatically in its own stand
★ No AC leakage or induced current to damage delicate components
★ Heats to 700 deg. F
★ Fine Tip for delicate and general purpose soldering
★ Only 8" long and weighs just 6 ozs.
OUR PRICE £9·75 (spare bits are available)

STOP PRESS

BHA0002	15 watt Amp Module	£2·50
NE555	Timer I.C.	78p
MC1310P	Stereo Decoder I.C.	£2·00
7805	Regulator	£1·49
TIP 29A		55p
TIP 30A		63p
BC107		10p
BC108		10p
BC109		10p



I.C. SOCKETS
D.I.L.
8 pin
14 pin 14p
16 pin

BARGAIN TRANSFORMERS
12-0-12 volt 500m/a
240 volt primary transformer bargain.
approx size =60mm x 40mm x 50mm
fixing centres = 75mm
Our Price =£1·20.

18 volt 500m/a
240 volt primary
approx size =60mm x 40mm x 50mm
fixing centres = 75mm
Our Price =£1·00.

LOW NOISE LOW PRICE CASSETTES
Good quality tape in well made screw type cassettes. Presented in single plastic cases.
C60 = 31p
C90 = 42p
C120 = 53p
10% Discount on ten or more cassettes of one type.

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COMPLETE STEREO SYSTEM

Scotland P & P Surcharge
System I £1·75
System 2 £3·50

System 1. £59·00

40 Watt Amplifier. Viscount III – R102 now 20 watts per channel.

* **System I** includes:

Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.

Specification

20 watts per channel into 8 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) – 58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.

Garrard SP 25 Mk III deck with magnetic cartridge, de luxe plinth and hinged cover.

Two Duo Type II matched speakers – Enclosure size approx. 17½″ × 10¾″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter. 10 watts handling.

Complete System £59·00

System 2. £82·00

Viscount III amplifier (As System I)
Garrard SP 25 Mk III deck (As System I)
Two Duo Type III matched speakers – Enclosure size approx. 27″ x 13″ x 11½″ Finished in teak veneer. Drive units 13″ x 8″ bass driver, and two 3″ (approx.) tweeters. 20 watts R.M.S., 8 ohms frequency range — 20 Hz to 18,000 Hz.

Complete System £82·00

PRICES: SYSTEM I

Viscount III R102 amplifier
£27·00 + £1·60 p & p

2 Duo Type II speakers
£14·00 + £3·50 p & p

Garrard SP25 with Mag. cartridge de luxe plinth and hinged cover
£21·00 + £2·80 p & p

total: £62·00

Available complete for only:
£59·00 + £5·50 p & p

PRICES: SYSTEM 2

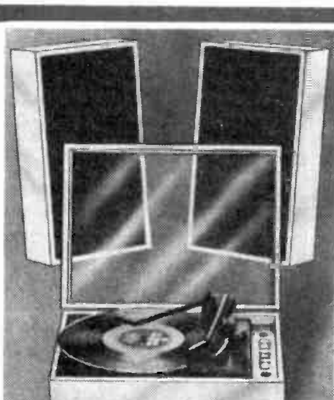
Viscount III R102 amplifier
£27·00 + £1·60 p & p

2 Duo Type III speakers
£39·00 + £6·40 p & p

Garrard SP25 with Mag. cartridge de luxe plinth and hinged cover
£21·00 + £2·80 p & p

total: £87·00

Available complete for only:
£82·00 + £6·50 p & p

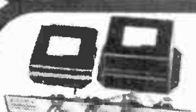


STEREO 21 * QUALITY SOUND FOR LESS THAN £20·00

Stereo 21, easy to assemble audio system kit. No soldering required.
The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.

Includes:– **BSR 3 speed deck**, automatic, manual facilities together with stereo cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications: For the technically minded:—
Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel.
Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx. 15½″ × 8″ × 4″. Complete deck and cover in closed position approx. 15½″ × 12″ × 6″.

Complete only **£19.95** + [illegible] p & p. **Extras if required**. Optional Diamond Styli **£1.37.**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**



BUILD YOUR OWN * STEREO AMPLIFIER

For the man who wants to design his own stereo — here's your chance to start, with Unisound — pre-amp, power amplifier and control panel. No soldering — just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only. **£7·64 + 90p. p & p** Also available with 2 speakers (7″ x 4″) £9 + 75p p & p

8 TRACK HOME CARTRIDGE PLAYER

*

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV Comparable unit sold eleswhere at £24.00 approx. **Yours for only**

£11.95 + £1·45p. p & p.

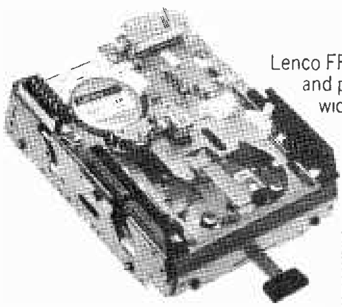
How to order the cassette unit for your Kempton or Ascot player.

As a reader of Practical Wireless, you can get the cassette mechanism for your car stereo player direct from Goldring.

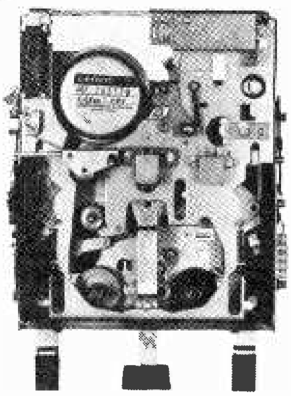
The units for both the PW Kempton and Ascot are made by Lenco and based on the famous STAAR design, with wow and flutter reduced to 0.3% max.

All you have to do is send the coupon to us, with a cheque or PO made out to Goldring Ltd. Be sure to state which unit you need. For the Kempton, it's Lenco FFR at £18.90; for the Ascot, it's Lenco CRV at £19.98. Prices include packing, carriage and VAT.

The units are also available from selected distributors.



Lenco FFR for the Kempton. Robust and precision engineered, it's widely used in industry and by Europe's largest car stereo manufacturer.



Lenco CRV for the Ascot. A record/replay unit made to hi-fi standards. Features of the Ascot Player include dynamic noise reduction, auto-stop and cassette ejection at end of play.

To: Goldring Ltd, 10 Bayford Street, Hackney, London E8 3SE.

Please send me: Lenco FFR at £18.90

Lenco CRV at £19.98

I enclose PO, cheque for £

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ADDRESS

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Imagine the thrill you'll feel! Imagine how impressed people will be when they're hearing a programme on a modern radio you made yourself.

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You build a modern Transistor Radio . . . a Burglar Alarm. You learn Radio and Electronics by doing actual projects you enjoy—making things with your own hands that you'll be proud to own! No wonder it's so fast and easy to learn this way. Because learning becomes a hobby! And what a profitable hobby. Because opportunities in the field of Radio and Electronics are growing faster than they can find people to fill the jobs!

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No matter how little you know now, no matter what your background or education, we'll teach you. Step by step, in simple easy-to-understand language, you pick up the secrets of radio and electronics.

You become a man who makes things, not just another of the millions, who don't understand. And you could pave the way to a great new career, to add to the thrill and pride you receive when you look at what you have achieved. Within weeks you could hold in your hand your own transistor radio. And after the course you can go on to acquire highpowered technical qualifications, because our famous courses go right up to City & Guilds levels.

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telephone: 01-883 3705

RECTIFIERS

V	1A		3A		6A		12A	
50	IN4001	6½p	IN5400	15½p			BYX61 - 50	£3.21
100	IN4002	7½p	IN5401	16½p			BYX61 -100	£3.48
200	IN4003	9p	IN5402	17½p	BYZ13	58p	BYX61 -200	£3.76
400	IN4004	9p	IN5404	22p	BYZ12	66p	BYX61 -400	£4.29
600	IN4005	11p	IN5406	26p	BYZ11	73p	BYX62 -600	£4.29
800	IN4006	13½p	IN5407	28p	BYZ10	85p		
1000	IN4007	16½p	IN5408	31p				

BRIDGES

V	1A	2A	6A
50	20p	35p	75p
100	20p	40p	78p
200	22p	45p	90p
400	25p	50p	£1.05
600	25p		£1.20
1000	38p		

TRIACS

	4A	
25v	2N6068	45p
50v	2N6069	52p
100v	2N6070	58p
200v	2N6071	63p
400v	2N6073	68p
600v	2N6075	£1.49

SOLDERING

Desolder Braid Reel 64p

Multicore
18 swg size 5 32p
22 swg size 15 36½p
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" " 12 £1.57

Adcola Invader
£2.88
L646 23 watt 3/16" bit £3.13

DIN CONNECTORS

Pins	Plugs	Sockets	Line Couplers
2	9p	7p	11p
3	10p	7p	11p
4	11p	7p	11p
5 (180)	11p	8p	11p
5 (240)	11p	8p	11p
6	11p	9p	11p
7	13p	9p	11p

4mm.

Available in seven colours
Terminals 15p
Plugs 13p

HEAT SINKS

Transistor covers
TO 3 10p
TO 66 10p

TV2 (TO66) 15p
TV3 (TO 3) 16p
TV4 (TO 126) 14p
TV5 (TO 220) 14p

5F (TO 5)
18F (TO18) 7½p

173 for SL414 SL415 18½p

AY-1-4 35p
100 N 400-4

U1(TBA800) 16p
U1(TBA810S) 16p
U2(TBA810AS) 16p
U2(TCA940) 16p
U3(TDA2020) 35p
47½p

CO-AXIAL

Plug - Screened 11p
- Plastic 9p

Sockets
Chassis 10½p
Surface 11p

Coupler 25p

PHONO

Sockets
1 way 5p
2 way 7p
3 way 7p
4 way 8p

Plugs:
Plastic Moulded 7½p
Chrome Screened 12½p
Coupler screened 15p

JACK

	Plugs	Sockets
2.5mm *	20p	12p
3.5mm*	20p	12p
standard *	25p	15p
stereo *	27p	21p
side entry standard	48p	

* screened

I.C. SOCKETS

TO5 Style
8 pin 31p
10 " 35p

Dual-in Line
8 pin 13p
14 pin 15p
16 pin 15p
24 pin 26p
28 pin 30p
36 pin 39p
40 pin 44p

I.C. PIN SOCKETS

I.C. pins in strips of 100.
Just snip off what you need.
65p per strip

P.C. CONNECTORS

0-1" pin centres 24 way + key supplied with ends 64p

Etch resist from a pen. Draw your own printed circuit, then etch it. 86p

SWITCHES

High Quality 250v 1A
S.P.S.T 25p
D.P.D.T. 45p

Rotary 2A Mains Switches 35p

Bulgin

Rendar Subminiature Toggle
S.P.D.T. 48p

push-to-make 25p

Slide
D.P.D.T. 12p

Erg Dil Switches
1 pole 8 way 99p
2 pole 4 way 85p
4 pole 2 way £1.24

Lorlin wafer switches 27p
1 pole 12 way; 4 pole 2 way
3 pole 4 way; 4 pole 3 way

POWER OUTPUT WATTS	Supply Volts	Load Ohms	Style	Power I.C. Amplifiers	Price	Pre-Amplifiers	Supply Volts	Style		
0.25	9	16	C	MFC4000B	78p	Dual Low Noise	±24	A	LM381	£2.16
0.5	9	8	E	MC1306P	68p	Dual Low Noise	±14	A	LM382	£2.19
1	9	8	F	TAA300	£1.76	Dual Pre-Amp	±13	A	MC1303L	£1.59
2	12	8	G	TBA820	74p	Dual Low Noise	±12	A	MC1339P	£1.31
2	18	8	A	LM380	£1.08	Dual Low Noise	±15	A	TBA231	88p
2½ + 2½	18	8	A	LM377	£2.91	General				
3	18	8	J	SL414	£1.72	D.C. Controlled attenuator			MFC6040	83p
5	24	16	J	SL415	£2.24	3 stage G.P. amp.		B	TAA263	80p
5	24	8	H	TBA800	96p	Tape Pre-Amp		F	TAA310	£1.34
7	16	4	H	TBA810S	£1.07	Bi-Fet		B	TAA320	97p
7	16	4	K	TBA810AS	£1.07	Hear/Aid Amp 1.3v		I	TAA370	£5.05
10	20	4	M	TCA940	£1.94	PPL stereo decoder(i)		A	MC1310	£2.14
15	30	3	O	BHA0002	£2.60	4 channel SQ " (ii)		A	MC1312	£2.42
35 driver	25	8	F	NE540L	£1.08	4 " pre-amp (ii)		16	MC1314	£4.05
20	±15	4	N	TDA2020	TBA	CBS SQ Logic (ii)		16	MC1315	£5.37

(i) & (ii) Separate leaflets available free only with purchases over £1

MAINS TRANSFORMERS

secondaries

6-0-6v, 100mA 97p ; 20-0-20v 1A £4.55
9-0-9v, 100mA 97p ; 24-0-24v ½A £2.48
12-0-12v, 100mA 97p ; 28-0-28 1A £6.18
18-0-18v, 200mA plus 0-24v 40mA 97p

	1A	2A	4A
0-9-17v	£1.95	£2.27	£2.64
0-12-15-20-24-30v	£2.48	£4.15	-
0-24-30-40-48-60v	£5.18	£7.02	-
	½A	1A	2A
0-19-25-33-40-50	£2.70	£3.40	£4.53

RENDAR INSTA-POWER

safe; inexpensive; quick, A.C. mains connector. A 13 amp plug top containing snap connectors £1.75

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2N3703	10p	BB109	18p	BFX29	33p
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ELECTROLYTIC CAPACITORS

Axial Lead

qF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	11	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	8p	8p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	—	—	26p	37p	41p	—	—
4,700	—	—	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

1975 is the year of challenge. Rather than sit back and wait for things to happen, we have produced our own policy to help stabilize price structure and maintain the services for which ELECTROVALUE are pre-eminent.

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as shown in our latest catalogue (No. 7, issue 3) will be maintained at least until March 31st next (except in cases of severe market fluctuation) and then held after review for further three-month periods instead of making day to day price change.

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CAPACITORS

DALY ELECTROLYTIC *In cans, plastic sleeved*
1000mF/25V **34p**
5000/100 **£3·56**
5000/25V **75p**
2000/50 **70p**
1000/100 **£1·00**
2200/100 **£1·91**
1000/50 **50p**
2000/50 **70p**
5000/50 **£1·44**

POLYESTER TYPE C.280. *Radial leads for P.C.B. mounting. Working voltage 250V d.c.*
0·01, 0·015, 0·022, 0·033, 0·047 ea. **3p**
0·068, 0·1, 0·15 ea. **4p**
0·22 **5p**; 0·33 **7p**; 0·47 **8p**; 0·68 **11p**; 1·0 **14p**; 1·5 **21p**; 2·2 **24p**

SILVERED MICA. *Working voltage 500V d.c. Tolerance 1% or 0·5pF*
Values in PFs—2·2 to 250 in 26, stages ea. **6p**
270-820 in 9 stages, ea. **7p**
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TANTALUM BEAD
0·1, 0·22, 0·47. 1·0 mF/35V, 1·5/20V, 3·5/16V ea. **16p**
2·2/16V, 2·2/35V, 4·7/16V, 10·6·3V ea. **16p**
4·7/35V, 10/16V, 22/6·3V ea. **21p**
10/25V, 22/16V, 27/6·3V, 100/3V, 6·8/25V, 15/25V ea. **23p**

POLYCARBONATE
Type B42540 Working Voltage—250V Values in mF:
0·0047; 0·0068; 0·01; 0·15; 0·22 ea. **4p**
0·018; 0·027; 0·033; 0·039; 0·047; 0·068; 0·082; 0·1; 100v/0·1 ea. **5p**
0·18; 0·22 **7p**; 0·27, 0·33 **9p**; 0·39, 0·47 **11p**; 0·56, 0·68 **16p**

CERAMIC PLATE
Working voltage 50V. d.c.
In 26 values from 22pf to 6800pF. ea. **2p**

POTENTIOMETERS

ROTARY, CARBON TRACK.
Double wipers for good contact and long working life
P.20 SINGLE linear 100 ohms to 4·7 meg ohms. each **14p**
P.20 SINGLE log. 4·7 Kohms to 2·2 megohms, each **14p**
JP.20 DUAL GANG lin. 4·7 Kohms to 2·2 megohms, each **48p**
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JP.20 DUAL GANG Log/antilog 10K, 22K, 47K, 1 megohm only, each **48p**
JP.20 DUAL GANG antilog 10K only **48p**
2A DP mains switch for any of above **14p** extra.
Decades of 10, 22 and 47 only available in ranges above.
Skeleton Carbon Presets, Type PR, horizontal or vertical **6p** each.

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Linear or log mono 4·7K to 1 meg. in all popular values each **30p**
STEREO, matched tracks, lin. or log in all popular values from 4·7K to 1 meg. **60p**
Escutcheon plates, mono, black or grey, each **10p**
Control knobs. blk/wht/red/yel/grn/blue/dk. grey/lt. grey, each **7p**

RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99 (see note below)	100 up
C	1/3	4·7-470K	1·3	1·1	0·9 nett
C	1/2	4·7-10M	1·3	1·1	0·9 nett
C	3/4	4·7-10M	1·5	1·2	0·97 nett
C	1	4·7-10M	3·2	2·5	1·92 nett
MO	1/2	10-1M	4	3·3	2·3 nett
WW	1	0·22–0·47Ω	16	14	11 nett
WW	1	0·56-3·9Ω	12	10	8 nett
WW	3	1-10K	9	8	6 nett
WW	7	1-10K	11	10	8 nett

Codes:
C = carbon film, high stability, low noise.
MO = metal oxide. Electrosil TR5 ultra low noise.
WW = wire wound, Plessey.

Values: All E12 except C ⅓W, C ¾W and MO ½W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, and their decades.
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Tolerances:
5% except WW 10% = 0·05Ω below 10Ω and ½W MO 2%

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.) Prices for 100 up in units of 100 only.

WAVECHANGE SWITCHES

1 pole 12 way; 2 pole 6 way; 3 pole 4 way; 4 pole 3 way each **33p**
TAG STRIP 28 way **11p**

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in lots of 100 each
4BA NUTS **31p**; 6BA NUTS **28p**
½" 4B Screws **30p** ½" 6BA Screws **24p**
Threaded pillars 6BA, ½" hexagonal **£1·35**
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3015F Seven segment filament compatible with standard logic modules. 0-9 and decimal point: 9mm characters in 16 lead DIL **£1·20**
Suitable BCD decoder driver 7447 **£1·15**
3015G showing + or — & 1 & dec. pt. **£1·20**

LEDS (Light Emitting Diodes) **25p**
Photo Cells, cadmium sulphide each **40p**

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C240 **£2·25** Spare bits **32p**
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TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS

Prr. 120/240 V Sec. 120/240 V Centre Tapped and Screened

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	P & P £	p
07	20	1	8	7·0 x 6·0 x 6·0	2·80	38
149	60	3	12	9·9 x 7·7 x 8·6	4·37	45
150	100	5	8	9·9 x 8·9 x 8·6	4·89	45
151	200	8	0	12·1 x 9·3 x 10·2	8·13	53
152	250	13	12	12·1 x 11·8 x 10·2	9·83	73
153	350	15	0	14·0 x 10·8 x 11·8	11·88	73
154	500	19	8	14·0 x 13·4 x 11·8	13·65	91
155	750	29	0	17·2 x 14·0 x 14·0	20 51	•
156	1000	38	0	17·2 x 16·6 x 14·0	29·15	•
157	1500	46	0	21·6 x 13·4 x 18·1	33·23	•
158	2000	60	0	21·6 x 15·3 x 18·1	37·07	•

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	P & P £	p
113	20	1	0	5·8 x 5·1 x 4·5	0-115-210-240	1·67	30
64	75	2	4	7·4 x 6·7 x 6·1	0-115-210-240	2·90	38
4	150	3	4	8·9 x 7·7 x 7·7	0-115-200-220-240	4·12	45
66	300	6	4	9·9 x 9·6 x 8·6	,,	5·82	53
67	500	12	8	12·1 x 11·2 x 10·2	,, ,,	8·82	67
84	1000	19	8	14·0 x 13·4 x 14·3	,, ,,	13·68	91
93	1500	30	4	14·0 x 15·9 x 14·3	,, ,,	18·31	•
95	2000	32	0	17·2 x 16·6 x 14·0	,, ,,	24·20	•
73	3000	40	0	21·6 x 13·4 x 18·1	,, ,,	35·09	•

CASED AUTO TRANSFORMERS

115V mains lead input and U.S.A. 2-pin outlets. 20VA £3·23 pp 38p 500VA £10·45 pp 80p 1000VA £17·51 via B.R.S.

TRANSFORMERS

PRIMARY 240-250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps. 12V	24V	Weight lb	oz	Size cm.	Secondary Windings	P & P £	p
111	0·5	0·25		8	4·8 x 2·9 x 3·5	0·12V at 0·25A x 2	1·47	23
213	1·0	0·5	1	4	6·1 x 5·8 x 4·8	0·12V at 0·5A x 2	1·74	30
71	2	1	1	12	7·0 x 6·4 x 6·1	0·12V at 1A x 2	2·29	38
18	4	2	2	12	8·3 x 7·7 x 7·0	0·12V at 2A x 2	2·86	38
70	6	3	3	8	8·9 x 8·0 x 7·7	0·12V at 3A x 2	4·12	45
108	8	4	5	8	9·9 x 8·9 x 8·6	0·12V at 4A x 2	4·56	45
72	10	5	6	4	9·9 x 9·6 x 8·6	0·12V at 5A x 2	5·14	53
116	12	6	6	12	9·9 x 10·2 x 8·6	0·12V at 5A x 2	5·52	53
17	16	8	8	12	12·1 x 9·9 x 10·2	0·12V at 8A x 2	7·28	60
115	20	10	11	8	14·0 x 9·6 x 11·8	0·12V at 10A x 2	10·39	73
187	30	15	15	8	14·0 x 12·1 x 11·8	0·12V at 15A x 2	13·59	85
226	60	30	32	0	17·2 x 15·3 x 14·0	0·12V at 30A x 2	16·83	•

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 x 5·8 x 4·8	0-12-15-20-24-30V	1·81	30
79	1·0	2	4	7·0 x 6·7 x 6·1	,, ,,	2·40	38
3	2·0	3	4	8·9 x 7·7 x 7·7	,, ,,	3·49	38
20	3·0	4	8	9·9 x 8·3 x 8·6	,, ,,	4·53	45
21	4·0	6	4	9·9 x 9·6 x 8·6	,, ,,	5·13	53
51	5·0	6	12	12·1 x 8·6 x 10·2	,, ,,	6·41	53
117	6·0	8	0	12·1 x 9·3 x 10·2	,, ,,	7·16	60
88	8·0	12	0	12·1 x 11·8 x 10·2	,, ,,	9·90	67
89	10·0	13	12	14·0 x 10·2 x 11·8	,, ,,	9·87	73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 x 6·4 x 6·1	0-19-25-33-40-50V	2·58	30
103	1·0	2	12	8·3 x 7·4 x 7·0	,, ,,	3·38	38
104	2·0	5	8	9·9 x 8·9 x 8·6	,, ,,	4·68	45
105	3·0	6	12	9·9 x 10·2 x 8·6	,, ,,	5·81	53
106	4·0	10	0	12·1 x 10·5 x 10·2	,, ,,	7·60	67
107	6·0	12	0	14·0 x 10·2 x 11·8	,, ,,	12·10	67
118	8·0	18	0	14·0 x 12·7 x 11·8	,, ,,	12·98	85
119	10·0	25	0	17·2 x 12·7 x 14·0	,, ,,	16·99	•

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 x 6·7 x 6·1	0-24-30-40-48-60	2·33	38
126	1·0	3	4	8·9 x 7·7 x 7·7	,, ,,	3·41	38
127	2·0	6	4	9·9 x 9·6 x 8·6	,, ,,	5·08	45
125	3·0	8	12	12·1 x 9·9 x 10·2	,, ,,	7·52	60
123	4·0	13	12	12·1 x 11·8 x 10·2	,, ,,	8·75	67
40	5·0	12	00	14·0 x 10·2 x 11·8	,, ,,	9·75	73
120	6·0	15	8	14·0 x 12·1 x 11·8	,, ,,	11·30	85
121	8·0	25	00	14·0 x 14·7 x 11·8	,, ,,	15·00	•
122	10·0	25	00	17·2 x 12·7 x 14·0	,, ,,	17·52	•
189	12·0	29	00	17·2 x 14·0 x 14·0	,, ,,	19·98	•

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	MA.	Weight		Size cm	VOLTS	P & P £	p
238	200		2	2·8x2·6x2·0	3-0-3	1·54	10
212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·84	30
13	100		4	3·9x2·6x2·9	9-0-9	1·41	13
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·56	19
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	1·92	30
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	3 30	38
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·43	19
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·93	30
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	2·17	38
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	3·46	38
203	500, 500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	3·00	38
204	1A, 1A	3	4	8·9x7·7x7·7	0-15-27, 0-15-27	3·85	38

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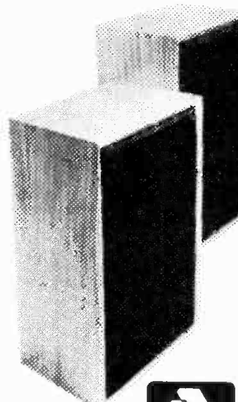

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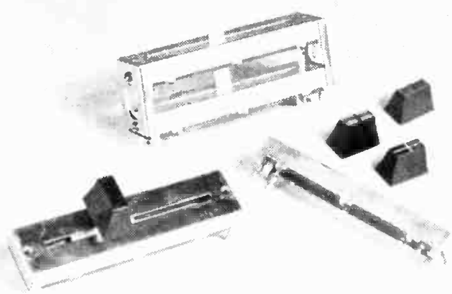
CARBON SLIDE POTENTIOMETERS



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7447 DRIVER	89p	74123	59p
7470 & 7472	29p	74141(&7441)	73p

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Price each		*MATCHING*	16p
AC127 & 128	16p	*INS.BUSH SET*	10p
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BC107 & 108	9p	TIP 3055	55p
BC109	10p	TIS43 *see 2N2646*	
BC147/8/9	10p	ZTX109&301	13p
BC157/8/9	12p	~~1N4001~~	~~4p~~
BC167/8/9	12p	1N4004 & 7	7p
BC177/8/9	18p	~~1N4148 & 914~~	~~4p~~
BC182/3/4*A&L*	10p	2N697	14p
BC212/3/4*A&L*	11p	2N706&8	11p
BCY70/1/2	17p	2N2646 UJT	32p
BD131 & 132	39p	2N2904 & 5	20p
BFR51		2N2926royg	9p
BFR50/51	23p	2N3053	17p
BFR50/51	23p	2N3055 115W	37p
BFR88 250V	29p	2N3563 & 64	16p
BFY50/1/2	15p	2N3614	49p
BSX19/20/21	16p	2N3702 & 3	9p
MJE2955	90p	2N3704 & 5	10p
MJE3055	65p	2N3706 & 7	9p
MPU131 PUT	49p	2N3708 & 9	8p
OA91 OA81	6p	2N3710 & 11	10p
OA81 & OA91	6p	2N3819E FET	16p
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1A 50V	20p	4A/400V	53p
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2½"x5" 29p 2½x3¾" 26p. 3¾x3¾" 31p. 3¾"x5" 31p 3¾x 17" £1.50
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TEXAS GOLD LOW PROFILE ea
8, 14, & 16 PIN 13p
SOLDERCON STRIPS: 100 PINS 50p. 1K £3.

THE NEW NELSON-JONES FM TUNER

PUSH-BUTTON VARICAP DIODE TUNING (6 Position)

('WW' JUNE '73)

Exclusive Designer Approved Kits

What are the important features to look for in an FM tuner kit? Naturally it must have an attractive appearance when built, but it must also embody the latest and best in circuit design such as:—

MOSFET front end for excellent cross modulation performance and low noise.
3 GANG tuning for high selectivity.
VARICAP tuning diodes in back to back configuration for low distortion.
CERAMIC filters for defined IF response.
INTEGRATED circuit IF amplifiers for reliability and excellent limiting/AM rejection.
PHASE LOCKED Stereo decoder with Stereo mute, see below
LED fine tuning indicators.
PUSH BUTTON tuning (with AFC disable) over the FM band (88-104)
IC STABILISED and S/C protected power supply.
CABINET double veneered against warp.

The Nelson-Jones Tuner has **all** of these features and many more, and more importantly the design is fully **proven** not just with a few prototypes but with many thousands of working tuners spread across the world.

Typ. Specn: 20 dB quieting 0·75uV. Image rejection −70dB. I.F. Rejection −85 dB.

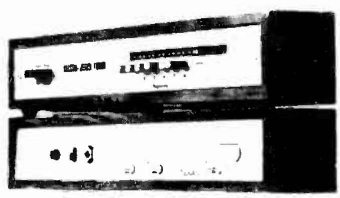
Basic tuner module prices start as low as **£12·96**, with **complete** kits starting at **£26·95** (mono) + P.P. 65p, and of course all components are available separately.

Our low cost **alignment service** is available to customers without access to a signal generator. Please send large **SAE** for our latest price lists which details all of the many options and special low prices for complete kits. All our other products remain available.

PORTUS AND HAYWOOD PHASE LOCKED DECODER (W.W. Sept. '70). Still the lowest distortion P.L. decoder available. THD typically 0·05% (at Nelson-Jones Tuner O/P level)! Supplied complete with Red LED.
Price **£7·02** when bought with a **complete** N-J tuner kit or **£8·29** if bought separately (P.P. 21p).

PLEASE NOTE. Existing tuners are readily convertible and kits/parts are available for this purpose.

TEXAN AMPLIFIER. We have designed the tuner case and metalwork to match the Texan amplifier (see photograph). Complete designer approved Texan kits are available at **£33·48** plus P.P. 65p including Teak Sleeve.



NEW LOW COST STEREO TUNER

Available as basic or complete kits

Basic stereo tuner **£15** post free.
Basic mono tuner **£12** post free.
6 position push button units with integral pots **£3·24**.

No alignment required. Mullard LP1186 front end module used with Ceramic IF and IC amplifier. Push button tuning (6 position) with **Interstation Mute**, restricted range **AFC**, single LED tuning indicator, phase locked IC decoder, and complete metalwork and veneered cabinet. Complete with IC regulated PSU and full assembly instructions. (Mechanically identical to N-J Tuner.)

TYP. SPECIFICATION
2μV for 30dB S/N
Image rejection 40dB
IF rejection 65dB

VAT at 8% is included in all prices

PRICE Complete stereo kit **£28·42**
Complete mono kit **£24·19**
P. & P. 65p

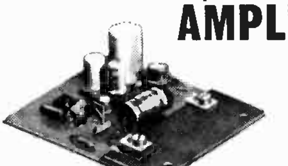
Access

INTEGREX LIMITED, P.O. Box 45, Derby, DE1 1TW Phone Swadlincote (028387) 5432 Telex 377106

- the lowest prices!

BI-PAK *QUALITY* COMES TO AUDIO!

AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f = 1KHz	0·25%
LOAD IMPEDANCE	—	8 – 16 Ω
INPUT IMPEDANCE	f = 1KHz	100 k Ω
FREQUENCY RESPONSE ± 3dB	Po = 2 WATTS	50 Hz – 25KHz
SENSITIVITY for RATED O/P	Vs = 25V. Rl = 8 Ω f = 1KHz	75mV. RMS
DIMENSIONS	—	3" × 2½" × 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8 Ω f = 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10. 3 watts RMS £2·50
AL 20. 5 watts RMS £2·85
AL 30. 10 watts RMS £3·20

POWER SUPPLIES

PS 12. (Use with AL10, AL20, AL30) 95p
SPM 80. (Use with AL60) £3·25
FRONT PANELS F.P. 12 with Knobs £1·10

PRE-AMPLIFIERS

PA 12. (Use with AL10, AL20 & AL30) £4·85
PA 100. (Use with AL60) £13·15

TRANSFORMERS

T461 (Use with AL10) £1·60 P & P 22p
T538 (Use with AL20, AL30) £2·30 P & P 22p
BMT80 (Use with AL60) £2·75 P & P 37p

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response—
20Hz – 50KHz (– 3dB)
Bass control—
± 12dB at 60Hz
Treble control—
± 14dB at 14KHz
*Input 1. Impedance
1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance
30 K ohms
Sensitivity 4mV

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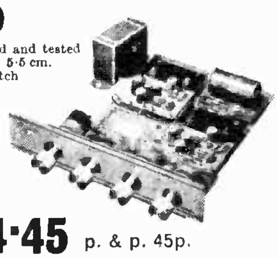
ALL PRICES INCLUDE V.A.T.

The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion Bass control ±12dB at 60Hz typically 0·25% at 1 watt. Treble con. ±14dB at 14kHz.

£14·45 p. & p. 45p.

TC20 TEAK VENEERED CABINET

For Stereo 20 (front board undrilled) size 10½" x 8¾" x 3", £3·95, plus 45p postage

SHP80 STEREO HEADPHONES

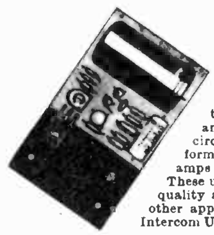
4-16 ohms impedance. Frequency response 20 to 20,000Hz Stereo/mono switch and volume controls £4·95

NOW WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £4.25

- Max Heat Sink temp. 90°c.
- Frequency Response 20Hz to 100KHz
- Distortion better than 0·1% at 0·1KHz
- Supply voltage 15-50 volts
- Thermal Feedback
- Latest Design Improvements
- Load—3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F enthusiast.

STABILISED POWER MODULE SPM80



SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·15 p. & p. 40p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100 which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz – 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	3·25 mV into 50K Ω
2. Radio, Tuner	75 mV into 50K Ω
3. Magnetic P.U.	3 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20 KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than – 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £14·25

MK 60 AUDIO KIT

Comprising: 2 x AL60, 1 x SPM80, 1 x BTM80, 1 x PA 100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets. Complete Price: £29·75 plus 45p postage

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16¾" x 11½" x 3½", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets etc. Kit price: £9.95 plus 45p postage

Giro No. 388-7006
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 11p. Overseas add extra for airmail. Minimum order 55p. Cash with order please.
Guaranteed Satisfaction or Money Back

Aiding and Abetting

A PERSON who aids, abets, counsels or procures the commission by another person of a summary offence is guilty of that same offence and may be tried for that offence, whether or not he is charged as a principal . . .

As a follow-up to our comments last month on the reception of priveleged transmissions, evidence exists which indicates that members of the public are quite openly being encouraged to break the law!

We refer of course, to advertisements that offer "walkie talkie radios" and "bugging devices" for which a licence is not available in the U.K.

These devices are currently being offered to members of the public and are often described for "fun and entertainment use". To invite members of the public to purchase these illegal devices is, in our opinion, a subliminal attempt to encourage the purchaser to break the law.

Purchasers of these devices could find themselves before the courts. Organisations or individuals that encourage others to break the law are aiding and abetting. Where does the responsibility lay? Is it the manufacturer, advertiser, publisher or retailer. Certainly, the purchaser will suffer if he breaks the law.

Heavy fines and the confiscation of equipment could result in conviction. What would the purchaser do then? Ask the supplier for his money back and reimbursement of fines and costs? Who is kidding who in these games that people are playing?

It is true that the small print invariably includes a statement to the effect that "a licence not available in the UK" or "a licence not generally available to members of the public".

Do not blame the Home Office if the equipment you purchase is not licensable in the UK—check first! Regulations exist on the allocation of frequencies to licensable equipment.

Our advice is simple: watch out for the small print in those advertisements. It could be the most important line in that advert! If in doubt, check with the Home Office Radio Regulatory Department, Waterloo House, Waterloo Road, London, SE1 8UA. You have been warned!

LIONEL E. HOWES—Editor.

We regret that due to pressure on Editorial space this month, Part 2 of "2 VHF Converters" has had to be held over. We hope to include this article in our May issue.

NEWS...

Eurovolts

THE International Union of Producers and Distributors of electricity has agreed a 230V standard for electrical supplies throughout Europe. This standard has a ±10% tolerance so the Continent can continue to operate on 220V and the U.K. on 240V.

This decision will now be made known to the International Electro-Technical Commission which hopes to produce a world standard voltage.

U.S. calculators

THE San Francisco based group National Semiconductors have launched a range of pocket calculators under the "Novus" brand-name. Prices range from £8 to £100.

Conference

THE Institute of Physics will hold a two day Conference on On-line Computers in Laboratory Use at Imperial College on 11-12 September, 1975. Residential accommodation will be available in Halls of Residence.

Papers will be presented under the following headings: General principals and techniques, Why use small computers?, Interfacing, Software, Systems Building and Data Presentation. Surveys of on-line computing applications in various branches of experimental physics. High energy physics, Plasma physics, crystallography, stress analysis, Space and atmospheric physics, Materials and Testing Atomic and Nuclear Physics, Low cost laboratory automation.

Specific examples of applications: Short contributions to come under the last heading are invited. Titles and short abstracts (200-300 words) should be sent to Dr. B. K. Penney, Department of Computing & Control, Imperial College, 48 Princess Gardens, London SW7 1LU by 21 June 1975.

Further details and application forms from *The Meetings Officer, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX.*

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

Good service

WHAT is believed to be a unique service has just been launched by SCS Components with the publication of two new catalogues. These catalogues, produced after a period of market research, list on the one hand the semiconductors of interest to the professional TV service sector and on the other hand those whose main interest will lie with the amateur small-order market.

The catalogues contain only a representative sample of the vast range of branded and guaranteed semiconductors offered by SCS Components at manufacturer's list prices. The only additional charge is 20p for post and packing and data sheets are free on request.

SCS Components is owned by one of the largest and most experienced distributors of semiconductors whose franchise agreements include the leading manufacturers. Thus SCS Components are able to make available a broad and deep stocking level backed by technical expertise that has not hitherto been available.

The range includes all discrete and integrated semiconductors from Mullard, Motorola, Signetics, General Instrument (Microelectronics), G.I. (UK), Ferranti, RCA, Monsanto and Mostek. In the near future passive components from Mullard, Seatronics and Centralab will be added to the range.

David Jackson (previously of RS Components) has been brought in as sales manager and he reports to Albert Shipton, marketing manager of Semicomps Ltd.

The catalogue is available, free of charge, from *David Jackson, SCS Components, 5c Northfield Industrial Estate, Beresford Avenue, Wembley, Middlesex, HA0 1SD. Telephone 01-903-3168.*

Lind-Air—Henry's

HENRY'S Home Entertainment Centres Ltd., a member of the Henry's Group of Companies, has now merged with Lind-Air Holdings Ltd. which trades as Lind-Air and Discount Audio. The new group has over 20 outlets in the United Kingdom and has recently opened its first European venture in Brussels with a 22,000 square foot showroom. The principal members of the board of the new group will be Henry French, chairman, David J. French, deputy chairman, Lionel G. Astor and Rafael Hyams, joint managing directors. The founder of Lind-Air, Mr. Bennie Linden still retains a material shareholding.

Henry's founded by Henry French over 30 years ago, and Lind-Air, both famous for their hi-fi centres which dominate the major London hi-fi areas of Tottenham Court Road and Edgware Road, now form a sizeable retail group of hi-fi specialised outlets.

R.F. Power Meter

A NEW r.f. Power Meter, TF2512, from Marconi Instruments Limited is aimed directly at the mobile radio manufacturing and servicing industries, where a reasonable accuracy of measurement is sufficient. (The meter costs about half as much as MI's range of high-accuracy d.c. to 1GHz power meters.) It is a robust and light instrument (2·75kg), entirely self-contained, needing no mains/battery supply.

High-power BBC

BBC Radio London's medium-wave service on 206 metres (1457kHz) is now transmitted from a new high-power transmitter at Brookmans Park, near Potters Bar.

Throughout the service area, reception should be improved and the area of good reception is expected to be extended southward to include Guildford, Godalming, Cranleigh, Horsham, Cuckfield, and Haywards Heath.

The v.h.f./f.m. transmissions of BBC Radio London on 94·9MHz continue unchanged.

Audio-Visual Show

EXTENSIVE car parking facilities, expansive exhibition areas and potentially high attendance feature in the first Midland Audio/Visual Show to be held on 11th, 12th 13th April 1975. The exhibition is already attracting some of the largest manufacturers of audio and audio visual systems and will include one Press/Trade day and two weekend days to enable members of the public from the highly populated Midlands area to attend.

Site of this exhibition will be the conference and exhibition complex at the National Agricultural Centre, Kenilworth, Warwickshire. Over seven million people are said to live within easy reach of this area.

Exhibitors products at the Midland Audio/Visual Show will encompass video tape equipment, video lighting effects, educational aids for schools, sales training work and business aids. In addition there will be the consumer items including cassette, radio, cartridge and record equipment.

South West transmitter

THE BBC brought a new transmitter into service at Redruth recently to broadcast the Radio 4 South West medium-wave service including 'Morning Sou' West', local news and weather reports. The new transmitter is located at the existing Redruth medium-wave transmitter site and transmits on 397 metres (755kHz). The daytime coverage extends to St Ives, Penzance, Helston, Falmouth, Truro, Newquay, Cambourne and Redruth.

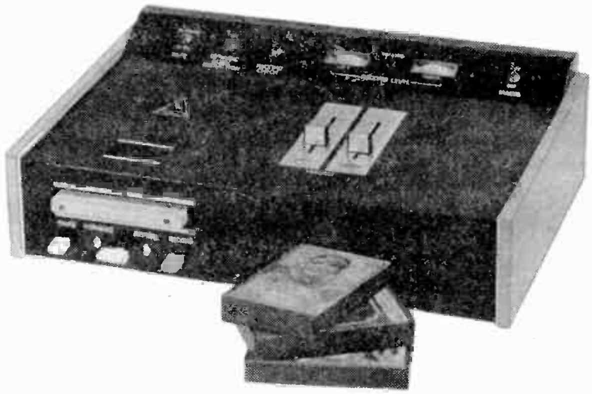
The existing Radio 4 service from Redruth on 330 metres (908kHz) continues as will the v.h.f. service on Radio 4 South West.

Barnstaple, Plymouth and Torquay already have transmitters radiating the local Radio 4 programmes in the medium-wave band. Others are planned for Exeter and Taunton.

PW 'ASCOT' STEREO CASSETTE DECK

PART 3

KEITH CUMMINS & TONY FRANCIS*

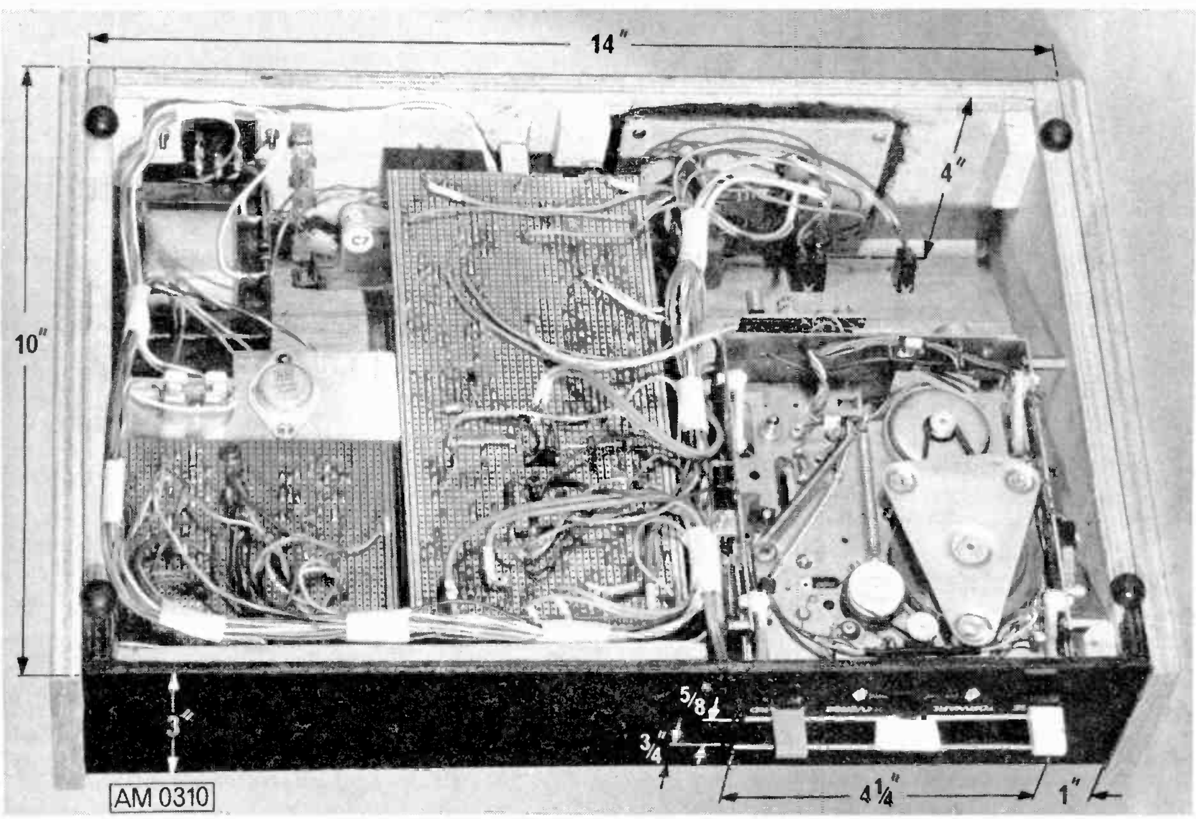


GENERAL CONSTRUCTION

The machine is built into a wooden cabinet, designed as shown in Fig. 9. Once the cabinet has been built up the deck and electronics can be fitted. It should be stressed that accuracy in construction is essential if the parts are to fit together correctly and if the equipment is going to operate properly electronically.

The illustrations show the layout of every part but mistakes can still be made and every care should be taken to avoid errors in construction. It is always much simpler to take care initially and so eliminate time-consuming, and possibly expensive, trouble-shooting later.

The main sections of the machine can be listed as follows:— cabinet, deck mechanism, power supply, recording and playback amplifiers. The power supply and amplifiers are built and fitted into the cabinet, along with the deck mechanism. The parts are then wired together as shown in Fig. 10. It is possible to lift out the circuit panels while the machine is operating. Wired connections are mostly made to the printed side of the panels so setting-up and service work is thereby simplified.



* Hamilton Electronics Ltd.

Fig. 9: Constructional information for the Ascot cabinet and cassette loading slot.

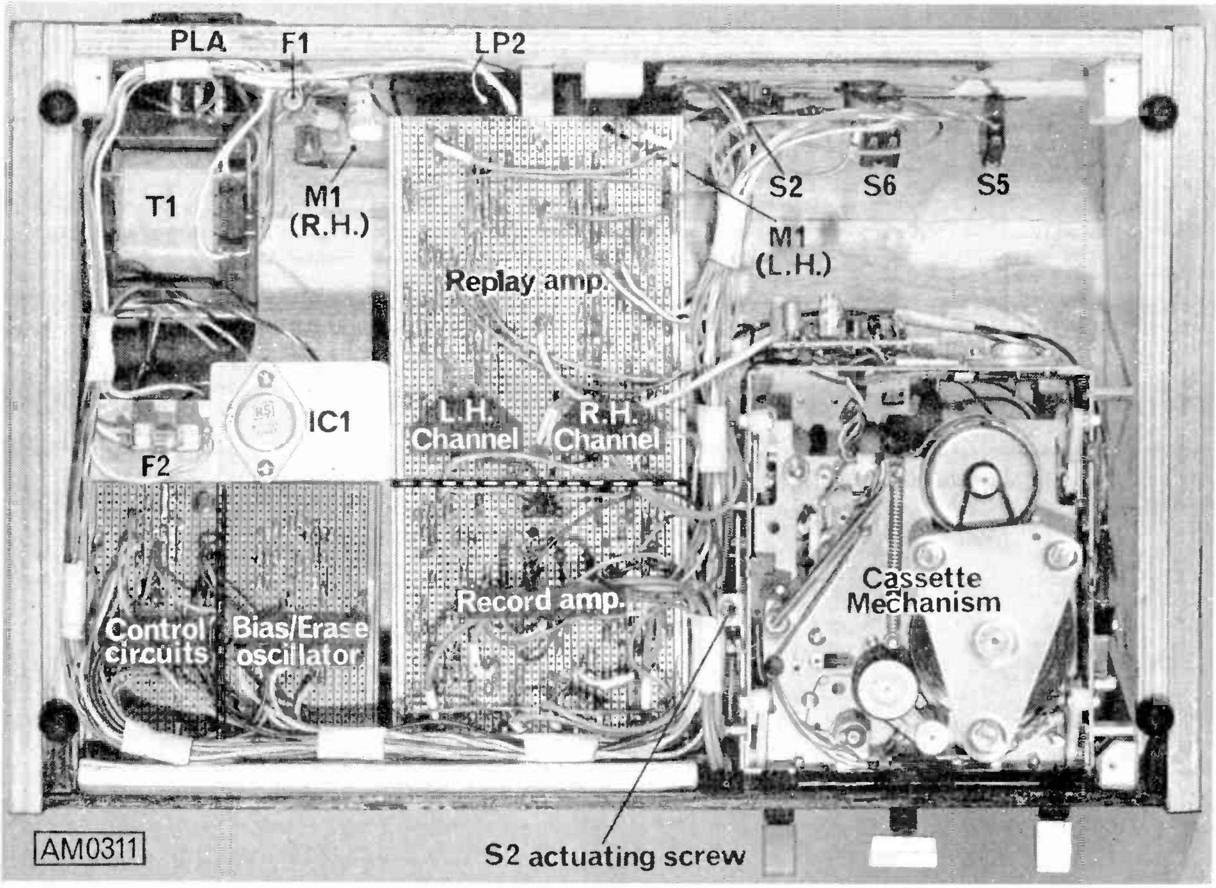


Fig. 10: Wiring guide between the circuit boards, deck mechanism and individual components.

We suggest that the following sequence of construction be followed, with careful reference to the diagrams at each stage:—

1. Build cabinet.
2. Fit slider controls, VU meters, lamps and switches.
3. Make up and fit supporting metalwork and transformer etc. to inside of cabinet.
4. Attach leads to heads, switch, control unit etc. of deck mechanism and mount deck mechanism in cabinet. The leads will be terminated later.
5. Build up electronic panels, Figs. 11 and 12, being particularly careful to check for accuracy of construction.
6. Fit panels to metalwork and observe that all parts fit accurately mechanically.
7. Connect panels to the remaining parts of the machine as shown in the wiring diagram, Fig. 10.

Once the machine has been completely constructed, **RESIST THE TEMPTATION TO PLUG IN AND SWITCH ON STRAIGHT AWAY!**

TESTING

Using a meter, check that no short-circuits are present on any of the supply rails A, B or C, Fig. 2. Likewise, check the supply line to the motor control circuit, which is taken off prior to the solid-state regulator. Having checked these points, fuses F1 and F2 may remain in while F3 is removed.

Power can now be applied to the deck mechanism. The motor should run when a cassette is inserted and +12V should be available at the supply side of F3 fuseholder. This being so, F3 can be inserted. Using a cassette which does not have any important material recorded on it, the machine can be switched on when the cassette compartment lamp should light. On pressing the record button the record lamp should light and the relay will operate. Releasing the cassette and re-inserting it should restore the machine to the play mode. Voltages on the supply rail A, B and C may now be checked. In the play mode, rail A should read just under 11V. When pressing the "check record" button, rail B should assume +12V. When "record" button is pressed, rail A should move to zero, while rail C assumes nearly 12V with rail B at about 11·5V.

When all the supply rail switching has been proved to be operating correctly the machine may be connected to an amplifier, and a preliminary check made, using a recorded cassette, to prove that the playback amplifiers are working. The pots VR4 for left and right channels, should be set to the half-way position for this test. If everything is working out well, results on playback at this stage should be quite acceptable, although the threshold level of the noise-limiting circuit will need to be finally adjusted. As the dual sliders of the slide controls double up as record level and variable line out potentiometers, they will have to be set correctly to provide the appropriate input level for the amplifier used. This approach has obviated the need for special arrangements to cope with the DIN and phono standards.

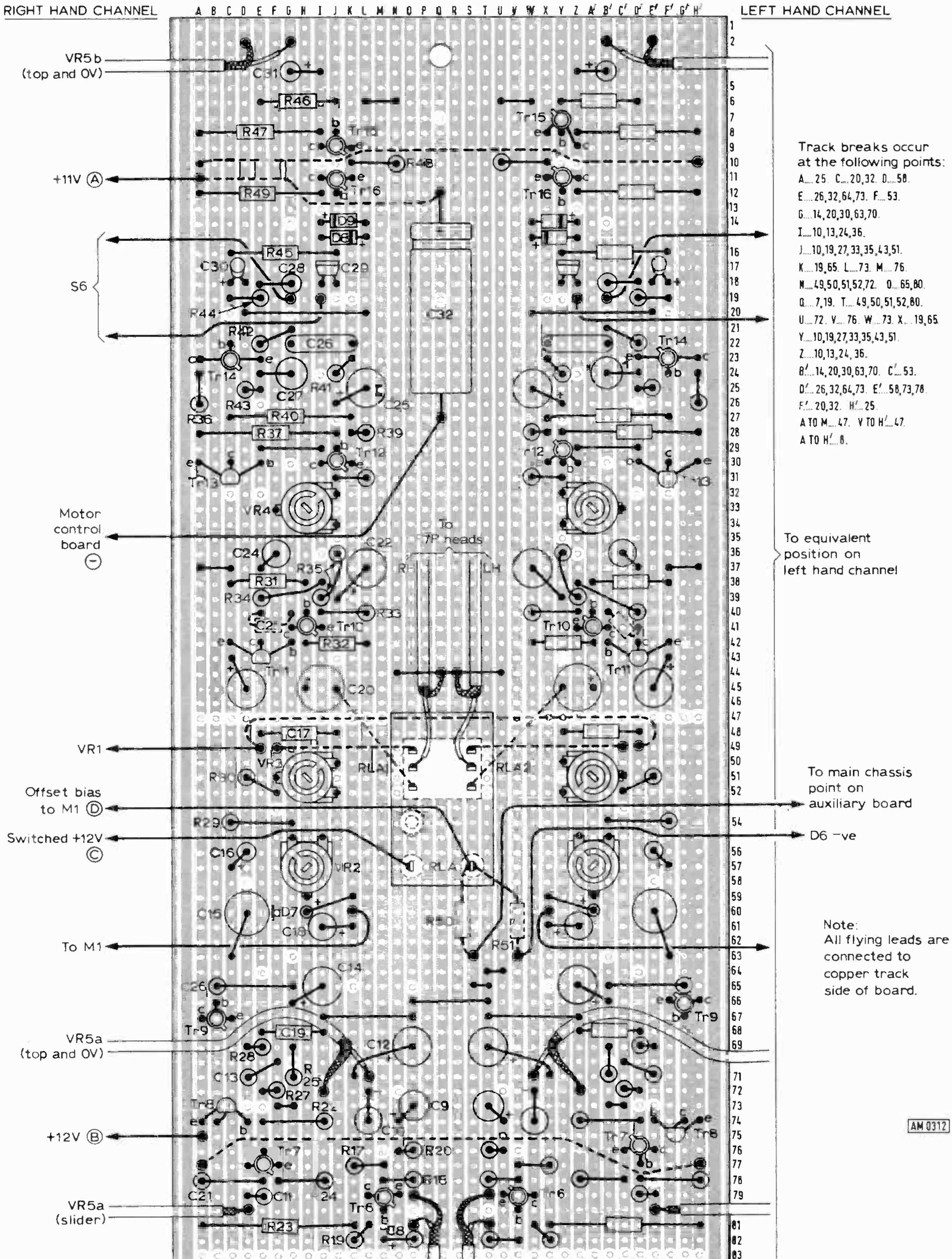
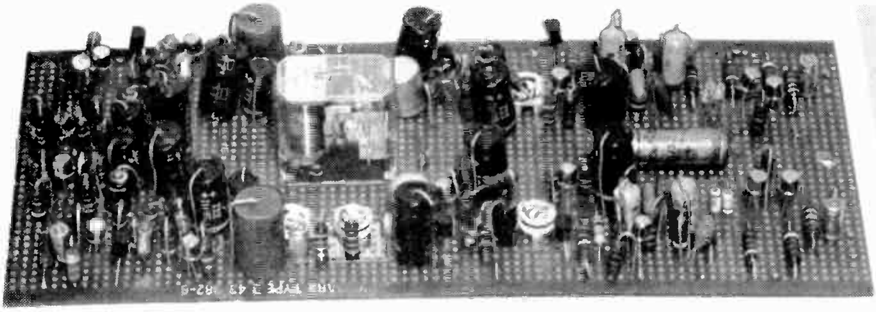


Fig. 11: Veroboard layout of main amplifiers. (viewed on component side)



Main circuit board and relay, shown in detail at left. Note that connecting leads are taken from the printed rail side of the board.

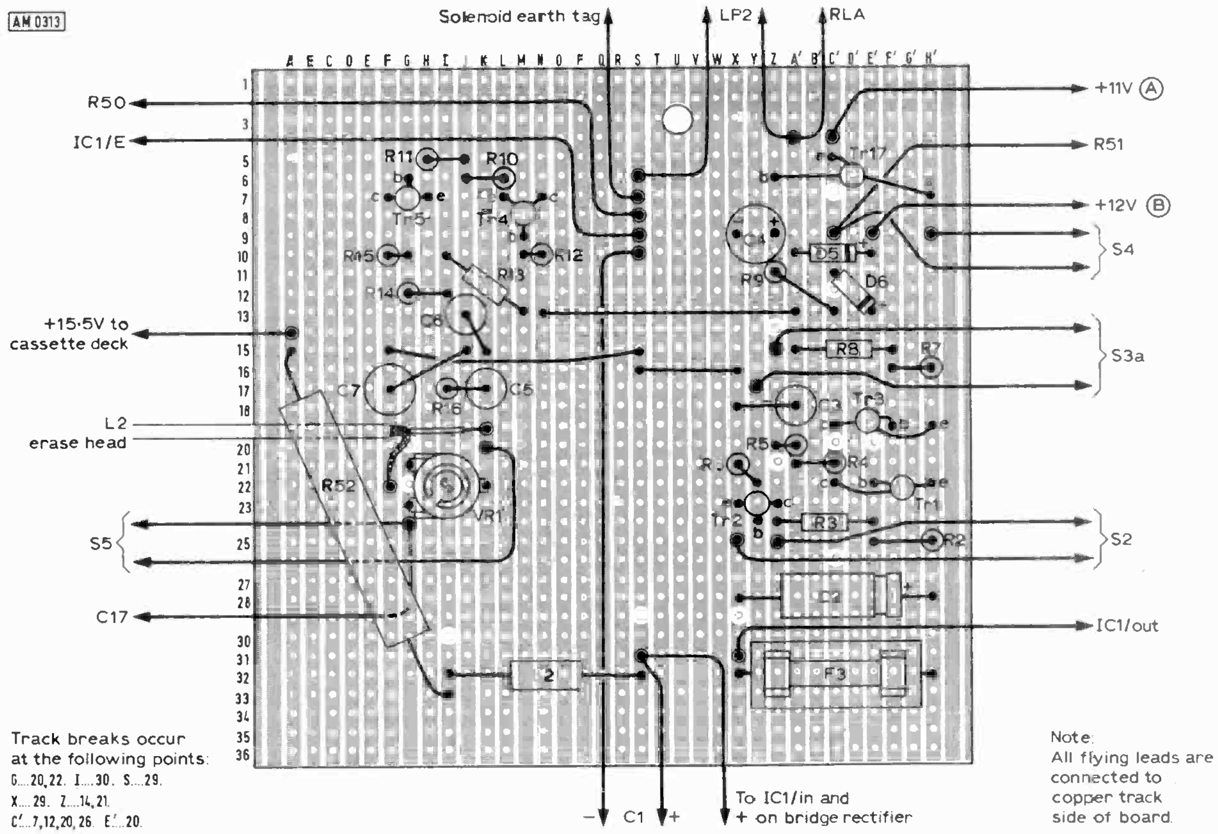
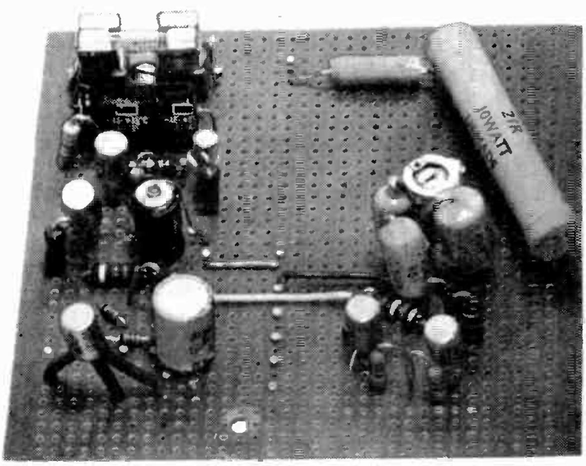


Fig. 12: Auxillary component board layout. The finished board is shown below. R52 and L1 are reversed for convenience, compared to Fig. 2, Part 1.



FINAL ADJUSTMENTS

There now follows the complete setting-up procedure. If any part of the setting-up cannot be achieved correctly a fault must exist in the machine which should be rectified before going any further. The first paragraph of the setting-up procedure repeats instructions already given. It is included to ensure that the overall instructions are complete.

1. Playback check. Switch to play, use pre-recorded tape if test tape not available, and with noise limiter off, adjust VR4 to minimum position (i.e. all track in circuit) and VR5 (slider control) to set satisfactory LINE out level for amplifier.
2. Adjust head position with azimuth screw to provide crispest top response.
3. Switch on noise limiter and turn up VR4 on each channel until best top response, consistent with minimum distortion, is obtained. Too much gain will overload the output stages.

4. Switch to record, and with no signal input, check that machine erases a previously recorded tape. If an oscilloscope is available, a 50V peak-to-peak sinewave should appear across the erase head.
5. Insert chromium dioxide (CrO_2) cassette, and by making repeated recordings at low input level, adjust pots VR3 for best quality of recording. If oscilloscope is available, adjust for 25V peak-to-peak signal (which corresponds to approximately 9V RMS).
6. Switch to standard tape (it does not matter if CrO_2 cassette is left in at this stage) and adjust VR1 for a 20 per cent reduction of bias voltage across record/play head. The oscilloscope or a multimeter can be used for this test.
7. Check recording quality on standard tape. An improvement may be achieved by repeated tests using different settings of VR1.
8. Make recordings using progressively greater inputs until distortion sets in. Back off to satisfactory position, then adjust pots VR2 until meters show peak readings at level 10. If oscilloscope and signal generator are available, inject 1kHz signal, adjust for 3V peak-to-peak at emitter of Tr9, then adjust VR2 for level 10 reading on VU meter.

Having set up the machine according to the foregoing instructions, it should be possible to record and play back. It is important to realise however, that the machine can be overloaded by excessive input. Ideally, the input level at LINE should be such that the slider level controls need to be set half way in order to obtain a peak level indication.

It is possible for the input stage itself to be overloaded by excessive signal, so that the input to the level control potentiometers is itself distorted. Obviously, the only adjustment possible under these conditions is the setting of the optimum level of an already distorted signal!

USING HEADPHONES

Should headphones be thought to be necessary then the circuit shown in Fig. 13 could be incorporated. This is one channel only, of course, but both channels could be built up on a small piece of veroboard and attached to the inside of the cabinet.

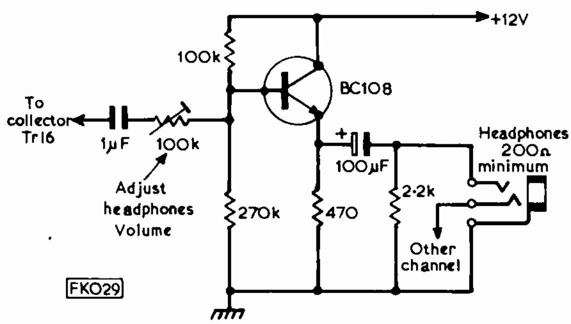


Fig. 13: Optional circuit to permit the use of headphones, one channel only being shown here.

The circuit as shown will operate on replay only although it might be possible to utilise the unused contacts on the relay to switch the input from the replay to the record amplifier so that both functions can be monitored on headphones.

MORE ON DISTORTION

After completing the setting-up procedure it was found that some distortion was evident on certain commercial pre-recorded tapes and this was traced to the noise limiter circuitry, Tr15/16. The circuit was modified by splitting R48 and adding a pre-set potentiometer as shown in Fig. 14. Adjustment of the pot allows additional emitter feedback to be applied without altering any DC condition.

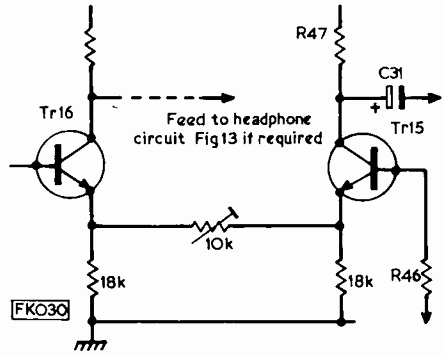


Fig. 14: Suggested modification to the noise limiter circuit, discussed in the text. Again, only one channel is shown.

Careful setting of the new pot and VR4 will enable optimum noise suppression to be obtained consistent with no overload condition. With the new pot set at mid position the gain of the stage approximates to unity while the noise should be down about 12dB, in theory.

NOTES

It has been the purpose of this series to provide details for constructing a tape recorder which will compare favourably with commercial models. The design approach was made bearing in mind the requirements, capabilities and facilities of the home constructor. As a result the machine does not represent an attempt to mimic commercially available apparatus.

Again we stress that care is needed at all stages. Impetuosity invariably leads to regrets and construction should be undertaken steadily and methodically. A couple of extra days spent on construction could well avoid a week's effort to rectify mistakes, besides avoiding expensive "blow-ups".

Every effort has been made in the design to ensure "repeatability" of the circuits. The frequent use of complementary transistor stages with heavy negative feedback is the most significant factor which guarantees that all the circuits will yield the same performance. If the setting-up procedures are accurately followed the performance specification attained will be:— Overall response 50Hz to 9kHz on standard tape, 50Hz to 11kHz on chrome tape. Typical signal to noise ratio 46dB although these are all conservative figures.

Standard tape is, of course cheaper, but chrome dioxide (CrO_2) tape will yield the best signal-to-noise ratio. It will be found that the top response of the chrome tape is higher than the standard tape,

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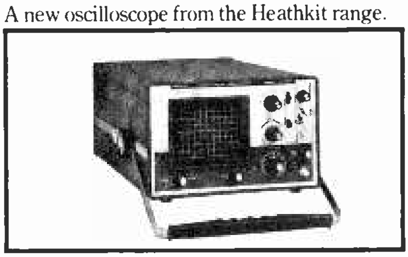

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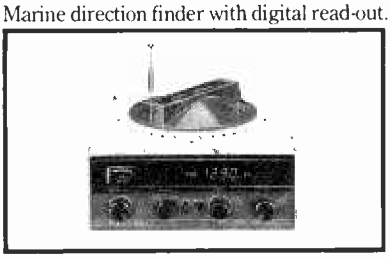

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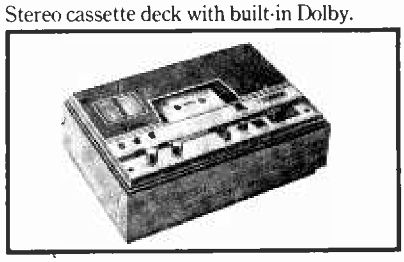

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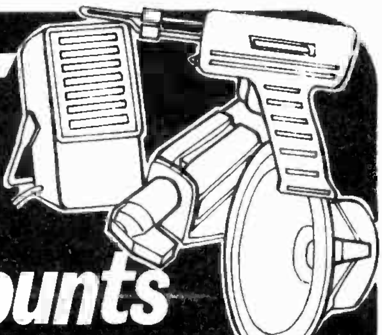

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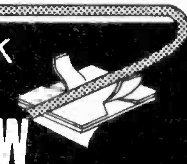

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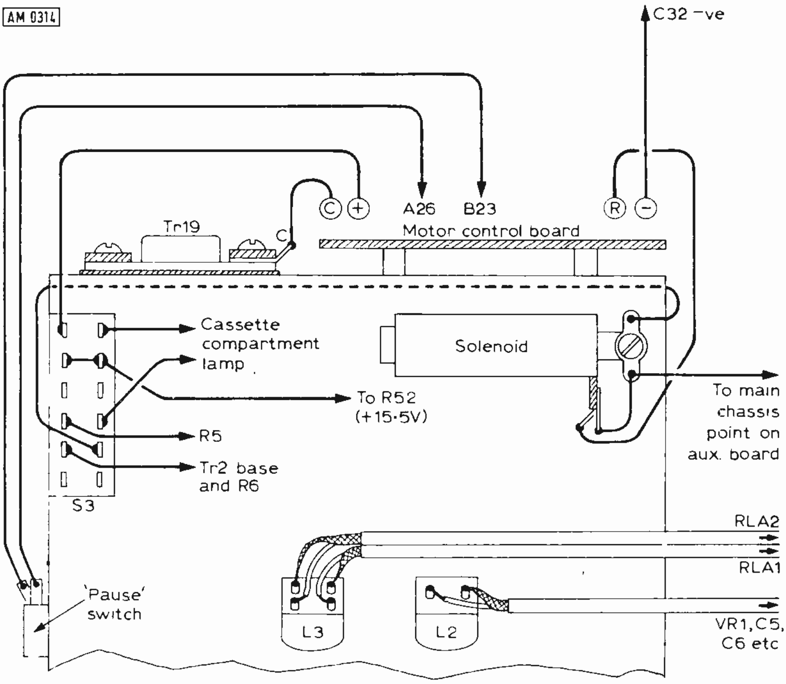


Fig. 15: The cassette deck mechanism used by the author was supplied to him complete with the motor control board etc. wired in. This diagram shows how the board of Fig. 8 and Tr19 are connected to the bare deck as now supplied. Microswitch S2 is mounted on a metal bracket fixed to the deck and cabinet. It is operated by the head of a 1¼in. 6BA screw attached to the drilled bracket on the 'Record' switch slide mechanism.

so that an improvement in signal-to-noise ratio is achieved by turning down the treble control on the amplifier when chrome tape is being used. The difference in performance is generally very noticeable. Use of the noise limiter circuit will depend upon the discretion of the user at any time, and will obviously be affected by the type of tape in use and the recorded programme material.

MAINTENANCE

No machine will run perfectly without occasional maintenance. The usual cause of trouble with cassette machines is dirty heads, which cause poor recording and playback, with weak top response. A non-uniform deposit on the heads will cause one channel to be affected more than the other. Once the head has suffered wear, it has to be replaced, so good quality tape should always be used as cheap tape usually has a rough surface which wears away the head besides depositing oxide on the heads, pinch roller and guides. Deposits are cleaned off using soft tissue paper soaked in methylated spirits.

Sometimes a defective cassette can cause difficulty. The take-up hub can jam, so allowing tape to spill over the pinch roller and capstan. A loop of tape can then wrap itself around the pinch roller or capstan shaft so that the tape winds off both parts of the cassette on to the roller or shaft until the machine jams completely. The only way to release the tape then is by careful removal and unwinding, cutting with a razor blade if necessary. The cassette itself is generally a write-off.

Jamming cassettes can sometimes be eased by giving them a healthy slap on one side against a fairly solid surface. This causes the tape to settle evenly. Uneven winding can cause the tape to jam against the sides of the cassette casing.

MOTOR QUERIES

Goldring-Lenco report that some readers constructing the Kempton or Ascot projects have complained to them that the motor in the cassette deck mechanism is marked 3·5V believing that it ought to be 12V. Some readers have even returned decks to Goldring-Lenco demanding correct replacements.

The motor as supplied is CORRECT! The motor control board, fed from a 12V line, ensures that the correct voltage, nominally 4 to 4·1V, is applied to the motor.

This inconvenience to Goldring-Lenco could have been avoided if readers had directed their queries to *Practical Wireless* in the normal manner.

Note:—
Fig.4 Part 1. Resistor R23 should be shown between C12 and R21 and not between R21 and the collector of Tr8. The circuit board of Fig.11 is correct.
Fig.5 Part 2. Resistor R36 should be shown between collector of Tr13 and C32. The circuit board of Fig.11 is correct.
Fig. 5 Part 2. The noise reduction switch marked S5 should be marked S6.
In the components list S5 should be given as a SPST miniature toggle switch and not as DPDT. Add to the components list:—S6 DPST miniature toggle switch.
Fig.7 Part 2. The 'Pause' switch is part of the cassette deck mechanism and is wired, via a 15kΩ resistor, between the left-hand contact of the commutating switch and the positive line. Connect the resistor between points A26 and C26, Fig.8, connect pause switch wires to A26 and positive line B1/B23.

HOTLINES ON RECENT DEVELOPMENTS

DIGI-WATCH

READERS of this page will doubtless remember my urging them not to be too eager to buy a digital watch, but to wait a while because I thought prices would come tumbling. I note that already, one company in the UK is offering a digital wrist watch with liquid crystal display (LCD) for less than £60. I still think prices will be lower before the end of this year so don't burgle those piggy banks yet.

MINI TV CAMERA

Fairchild has been kind enough to send me a photograph of the latest television camera. Difference is that it is entirely solid state (those charge-coupled devices again). Not only that, but it measures only 3in. in diameter and is just 1⅞in. deep. Power consumption is a miserly 1·5W. Whatever is coming next in tiny TV cameras?

Well, I'll tell you—there really is a smaller one, very much smaller! I've just heard of a TV device which can be safely slid along arteries and other internal organs allowing physicians to take a front seat look at the inside of humans. The lens part is a mere 4mm. in size and inside that is a tiny motor which drives a rotating mirror system. Information is scant at this time but more should be in by the time the next "Ginsberg" page comes round. Before departing, one thing that all this super-miniaturisation raises is; how on earth do you service it?

1A SOLAR CELL

I note with some satisfaction that North sea oil will be happily squelching ashore later this year—all part of beating the energy crisis. From the US comes news that one company has managed to manufacture a 3in. solar cell which can supply one amp (1A) of current. Could be interesting and I'll keep you posted as and when details are obtained.

ULTRASONICS

I've often thought that more use could be made of ultrasonic control. It isn't all that new in the realms of television since one or two companies already have ultrasonic channel changing; others also include volume, brightness, etc. control also.

ITT Semiconductors recently released details of two new ICs which are specifically intended for ultrasonics. Good thing is that ITT isn't doing things by halves, it's launched one chip which is a receiver and another for the transmitter. The first pair cater for fifteen channels. The transmitter chip requires only a fairly simple diode matrix, a few Rs and Cs plus, of course, the transducer and runs off 9V. The external crystal suggested is a 4·433MHz job and, obviously, these ICs have the TV market very much in mind. However, the Amateur constructor may well see a superb chance to do some ultrasonic control

Fairchild solid-state camera

for models which are, say, only used indoors or in a limited space where range isn't too great. Another pair (transmitter and receiver) of ultrasonic ICs from the same company caters for 30 channel usage.

For those still not enamoured with ultrasonics, let it be known that a great deal of research is being carried out in a number of areas. In the medical field alone a number of ideas are in the pipe line. One such application is to use ultrasonics to detect and measure hardened arteries but without puncturing the skin. The National Heart and Lung Institute of America recently gave publicity to this multi-million dollar idea and experimental ultrasonic scanners are well to the forefront in this scheme.

Nearer to home, the Plessey Company is known to be "getting its feet wet" in a scheme involving the Government to ultrasonically monitor the flow of water in tidal basins and, of course, in rivers.

BODY-END-SPOT

Remember those large 1W resistors where, instead of an all-band colour code it was body-tip-spot? Then came bands only for the vast majority But resistors are always getting smaller. Ever tried to read the colour code on a ⅛W or even a 1/16W in a hurry? Now take it a stage further and think of the poor old manufacturers of tiny "chip" capacitors. These are minute little blocks with a tiny conductive strip at each end by means of which they are bonded directly into the circuit. It's all very well you ordering 500 chip capacitors of a certain value, especially if they all come together in a small polythene pack. But can you imagine these little items getting mixed up?—after all, some of them measure barely 0·05in^2.

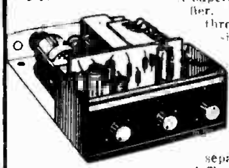
Not so for chip capacitor manufacturer Vitramon Inc. This company actually prints a letter of the alphabet in one of several colours on the chip capacitor itself. The letter plus colour forms a unique code which tells the capacitance of the chip in question. Please note all school teachers—A no longer stands for apple, it can mean 40pF 3V wkg.

FLOPPY DISCS!

I note that a number of US giants are now firmly into the CCD technology and not only at the drawing board stage either. Intel has just announced a 16,384-bit memory using this technique. It is thought by many that the CCD-type memories will replace the current "floppy disc" types. These are just what their name implies. A thin disc (about 0·005in. thick) is just under 8in. in diameter with a large (about 1·5in.) hole in the middle. The whole disc is housed in a plastic envelope, usually square and about ⅛-3/16in. thick. The plastic case is filled with some form of very soft material which permits the disc to revolve—at about 360 r.p.m. This disc might hold over 3 million bits of information.

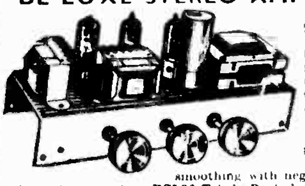
Ginsberg

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz-30KHz ± 3dB. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. **PRICE £12·50.** P. & P. 50p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:- 2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **£10·75.** P.&P. 50p.

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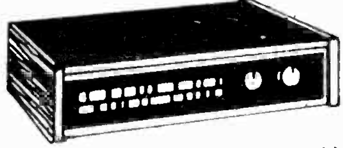

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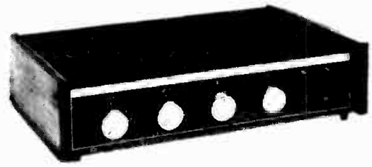

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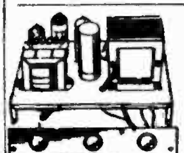

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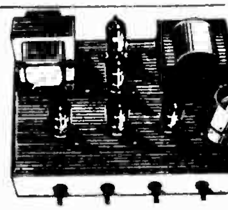

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ECL80 55p, ECL82 35p, ECL83 70p, ECL86 50p, EF36 65p, EF37A £1·20, EF40 75p, EF41 65p, EF80 30p, EF83 £1·25, EF85 35p, EF86 35p, EF89 30p, EF91 45p, EF92 50p, EF95 40p, EF183 35p, EF184 35p, EFL200 75p, EL33 £2·50, EL34 70p, EL36 60p, EL37 £1·80, EL41 80p, EL81 60p, EL82 55p, EL84 30p, EL85 60p, EL86 45p, EL90 45p, EL504 80p, EM31 60p, EM80 55p, EM84 40p, EM87 £1·00, EY51 45p, EY81 45, EY86 40p, EY88 50p, EZ40 70p, EZ41 75p, EZ80 30p, EZ81 30p, GY501 75p

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PY80 40p, PY81 40p, PY82 40p, PY83 40p, PY88 45p, PY500 £1·00, PY800 45p, PY801 50p, QQV03-10 £1·40, QQV06-40A £8·00, QV03-12 £1·10, R19 60p, SC1/400 £8·00, SC1/600 £5·00, SP61 75p, TT21 £5·00, U25 85p, U26 75p, U27 65p, U191 75p, U801 75p, UABC80 40p, UAF42 65p, UBC41 60p, UBF80 40p, UBF89 40p, UBL1 £1·00, UBL21 70p, UCC85 45p, UCF80 75p, UCH42 75p, UCH81 45p, UCL82 45p, UCL83 65p, UF41 70p, UF80 35p

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AC 128	AFZ 12	BYZ 16	OC 25	ZR 11	2N 3390
AC 176	ASY 26	CRS 1/10	OC 26	ZR 21	2N 3391
ACY 18	ASY 27	CRS 1/20	OC 28	1N 23A	2N 3730
ACY 19	ASY 28	CRS 1/30	OC 29	1N 25	2N 3731
ACY 20	BC 108	CRS 1/40	OC 35	1N 32A	2N 3819
ACY 28	BC 118	CRS 3/10	OC 36	1N 38A	2N 4038
ACY 39	BC 119	CRS 3/20	OC 42	1N 43	2N 4058
ACY 40	BC 136	CRS 3/30	OC 44	1N 70	2N 4061
AD 149	BC 137	CRS 3/40	O 45	1N 277	2N 4785
AD 161	BC 148A	CRS 25/C25	OC 70	1N 415C	2N 5295
AD 162	BC 172	GET 115	OC 73	1N 4148	3N 128
ADZ 11	BC 172A	GET 116	OC 78	2N 456A	3N 154
ADZ 12	BC 212A	GEX 66	OC 78D	2N 708	3N 159
AF 114	BCY 31	NKT 222	OC 81	2N 918	28 303
AF 115	BCY 33	OA 5	OC 82	2N 1304	404
AF 116	BCY 72	OA 47	OC 82D	2N 1305	2082
AF 117	BF 115	OA 70	OC 82DM	2N 1307	40250
AF 118	BF 167	OA 71	OC 83	2N 1309	40251
AF 124	BF 185	OA 73	OC 139	2N 2062	0668
AF 125	BFY 51	OA 79	OC 140	2N 2147	
AF 126	BFY 52	OA 91	OC 170	2N 2411	
AF 127	BFY 90	OA 200	OC 172	2N 2989	

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1R5 40p, 1S4 30p, 1T4 30p, 1X2A 60p, 1X2B 75p, 2D21 50p, 2K25 £9·00, 3A4 60p, 3D6 40p, 3S4 40p, 3V4 85p, 5B/254M £4·00, 5B255M £3·50, 5R4GY 90p, 5U4G 50p, 5V4G 55p

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6BG6G 90p, 6BJ6 65p, 6BQ7A 60p, 6BR7 £1·20, 6BW6 £1·00, 6BW7 £1·00, 6C4 40p, 6C6 50p, 6CB6 50p, 6CH6 £1·45, 6CL6 75p, 6D6 55p, 6EA8 85p, 6F7 £1·10, 6F8G 75p, 6F23 90p, 6F32 75p, 6F33 £3·50

6H6 35p, 6J4WA £1·25, 6J5 65p, 6J5GT 50p, 6J6 30p, 6J7 60p, 6J7G 40p, 6K6GT 80p, 6K7 55p, 6K7G 30p, 6K8GT 50p, 6K25 £1·00, 6L6 £1·25, 6L6G 40p, 6L7G 40p, 6SA7 50p, 6SA7GT 40p

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20P4 £1·10, 25L6GT 70p, 30C15 £1·00, 30C17 £1·00, 30C18 90p, 30F5 £1·00, 30FL1 £1·00, 30FL12 £1·10, 30FL14 90p, 30L15 95p, 30L17 95p, 30P12 £1·00, 30P19 £1·00, 30PL1 95p, 30PL13 £1·10, 30P14 £1·10, 35L6GT 75p, 35W4 50p, 35Z4GT 70p, 50C5 60p, 50CD6G £1·10, 75 £1·00, 75C1 75p, 76 75p, 78 70p, 80 75p, 85A2 75p, 723a/b £8·00, 803 £6·00, 805 £14·00, 807 65p, 813 £6·50, 866A £1·20, 931A £6·00, 954 50p, 955 50p, 956 50p, 957 50p, 1305 20p, 1629 70p, 2051 £1·00, 5933 £3·00, 6057 75p

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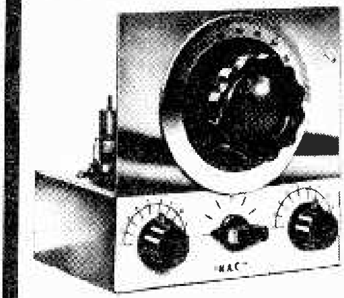

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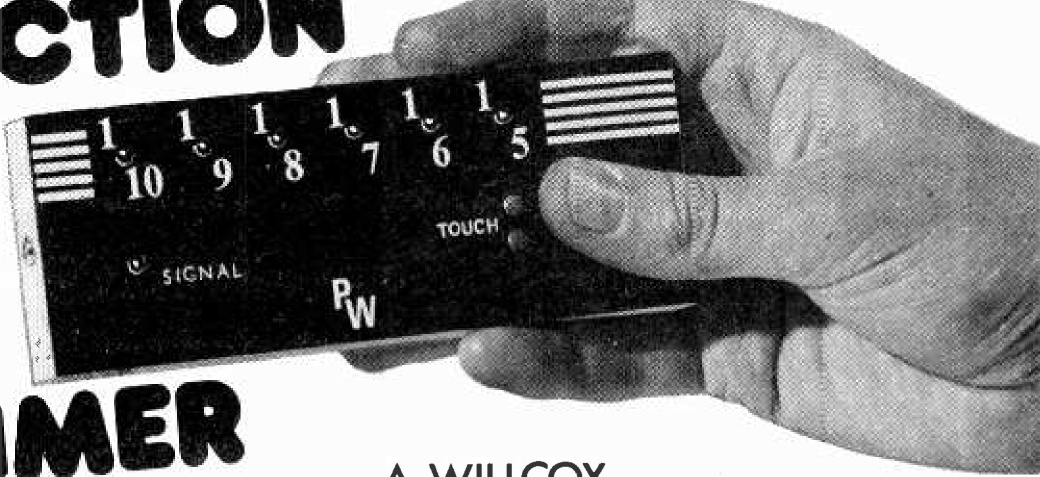
REACTION TIMER



A. WILLCOX

VARIOUS designs have been presented in the past for devices which measure the time taken for a person to react to a signal of some kind. Often a moving coil meter is used to display the individual's reaction time, usually by measuring the charge accumulated on a capacitor during the interval between the occurrence of the signal and the person's responding by pressing a switch.

THE DISPLAY ARRANGEMENT

In the present circuit the display takes the form of a series of six light emitting diodes (LED's), the illumination of each representing some discrete interval of time after the signal has been given.

A pair of contacts is provided which, when touched, halts the passage of light along the LED display, leaving one LED illuminated to give the reaction time.

The signal is provided by the switching off of another LED which is normally on. The LED's in the display then come on one after another. If no reaction is made before the last light goes off the signal light comes on again, and the cycle repeats automatically.

If, however, the contacts are touched in time the cycle is suspended, and the LED which indicates the reaction time remains illuminated until contact is broken.

ADVANTAGES

Obviously some accuracy is sacrificed by indicating time in discrete steps, but there are advantages in using this type of display.

First, the time interval measured by the display can be adjusted to cover the reaction times most likely to be encountered, whereas with a meter movement, if f.s.d. is arranged to indicate a suitable maximum time—say, 1/5 second—then the first half of the scale from zero to 1/10 second is redundant, because it would represent times which would not normally be achieved.

Also, with the LED display the light is stopped immediately contact is made. With a meter movement, however, there is a time lag before the meter pointer comes to rest. This is caused by the mass of the movement plus any damping, which prevents the meter from following faithfully the charge on the timing capacitor; a factor which would perhaps give the uninitiated a lack of confidence in the time indicated.

These points, together with the fact that a more robust and slimline construction was possible, seemed to justify the extra complications involved. The cost of a sensitive meter movement is certainly greater than that of the LED's and associated components, and so the choice is justified also on economic grounds.

CIRCUIT DESCRIPTION

The complete circuit is given in Fig. 1. Upon switch-on Tr3 conducts forward bias being provided by R3. Resistors R2 and R5 limit the collector current to 20mA. This current flows through the signal light LED D3 which is therefore illuminated.

About 3·6 volts are developed across R5, biasing on Tr6, and so providing a path for current which would otherwise be charging C2.

It is the charge accumulated on this capacitor that is later monitored to indicate the time interval. R2 has 2·4 volts developed across it, forward biasing Tr7 which in turn removes the bias for Tr8. Thus, the supply to the LED display via Tr8 is removed.

Resistor R2 is also the emitter resistor for Tr1, and so the 2·4 volts developed across it keeps Tr1 cut off while C1 charges via R1.

The time constant here is long, and only after six or seven seconds does the base of Tr1 become sufficiently negative for it to start to conduct. As it does so some of the bias current to Tr3 now passes to Tr1, and so the collector current of Tr3 starts to fall, reducing the voltage across R2 as it does so.

This further assists conduction of Tr1, and the net result is that Tr1 is turned fully on and Tr3 is switched off rapidly.

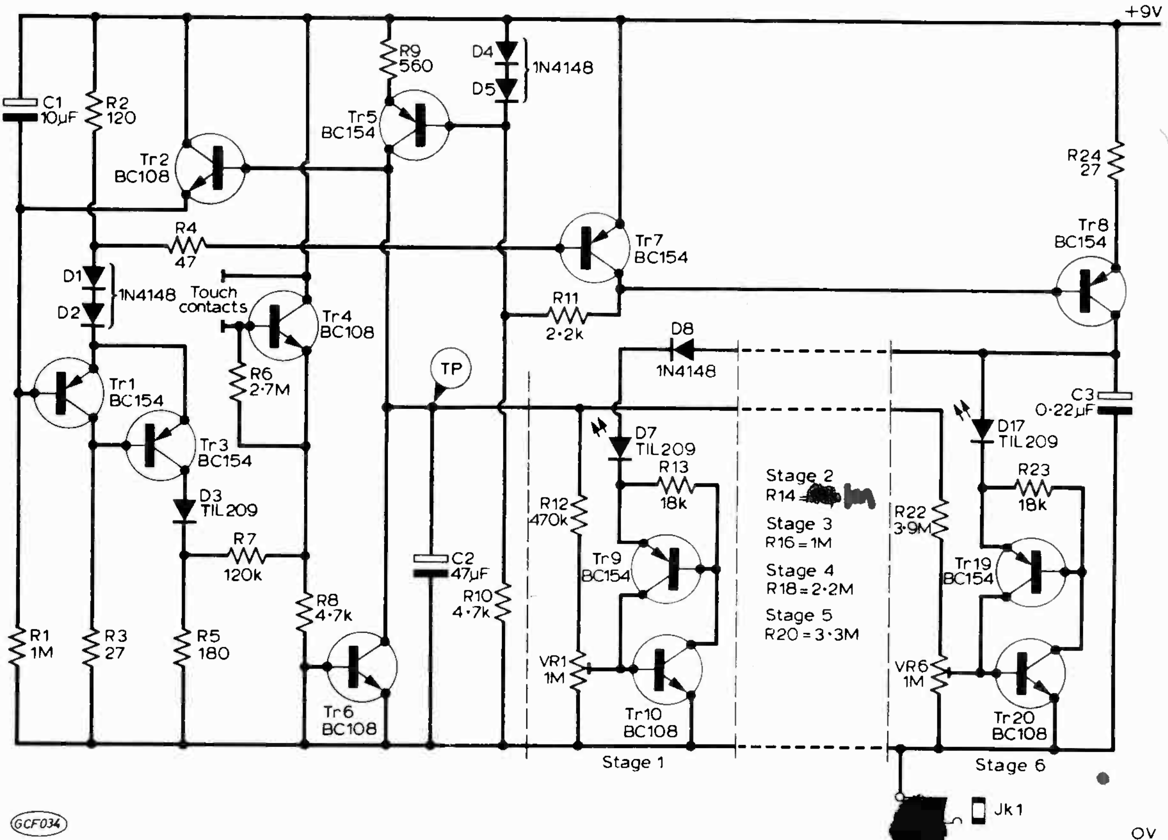


Fig. 1: Complete circuit diagram of the Reaction Timer. Only two stages of the display are shown, all being identical except for the resistor in series with the pre-set potentiometer. Values for the resistor are given.

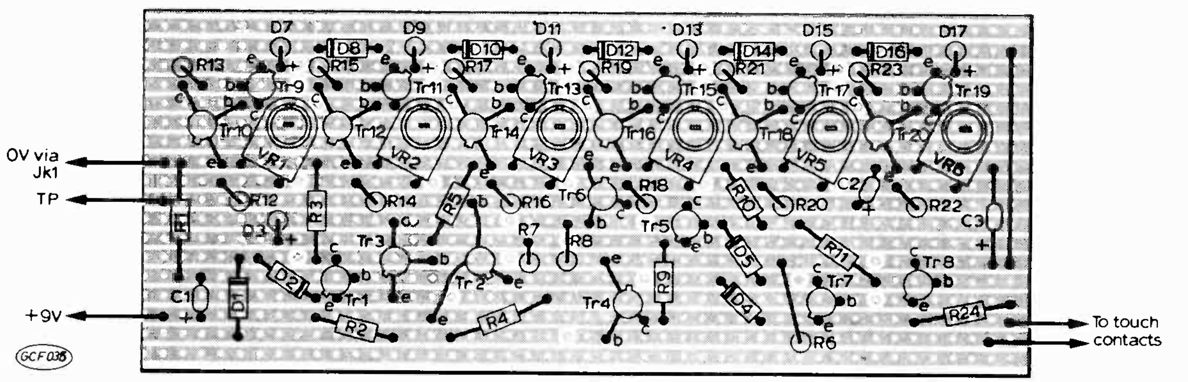


Fig. 2: Layout of the Veroboard with breaks in copper rails indicated. The cathode (+) of the TIL 209 is the longer lead.

LED D3 now extinguishes, providing the signal, and the bias for Tr6 is removed, so allowing the capacitor C2 to charge.

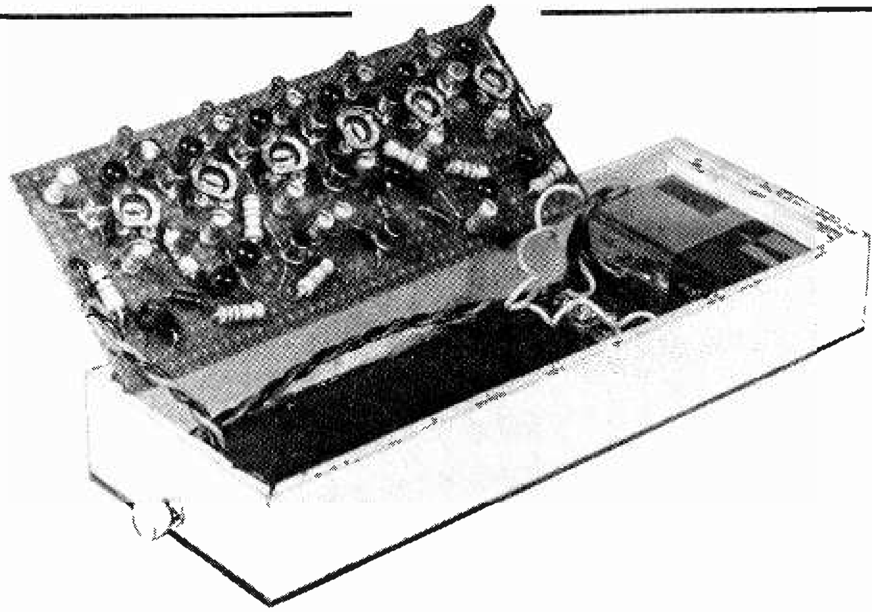
A constant charging current is provided by Tr5, its emitter voltage being fixed by the constant voltage (1·2V) across the diodes D4 and D5, and the value of R9 determining the current through the transistor: in this case 1mA.

By supplying the capacitor C2 with a constant current the voltage across it is a function of time, unaffected by any change in battery voltage. Also, the charge increases in a linear fashion, simplifying the calibration calculations.

DISPLAY DIODES

The voltage across R2 at this time is at a very low level because the current through it is now limited to 300 microamps by R3, and so Tr7 is turned off. Tr8, which supplies current to the display diodes, now receives bias from the forward voltage drop across D4 and D5 in common with Tr5. The current to the LED's is thus fixed by R24, whose value is chosen to provide 20mA.

Each LED in the display is driven by an n.p.n. and a p.n.p. transistor arranged so that they function as a sensitive thyristor. When the voltage on the base of the n.p.n. transistor exceeds 0·5V conduction starts. Each transistor then provides a bias path for the other, forming a rapid switch requiring only a minute current to activate it.



The completed board is fitted in the box with the LED's down against the holes in the panel, at the bottom in this photograph.

After a time interval of 1/10 second from LED D3 turning off, the voltage on C2 has reached 2·1 volts. If the slider of VR1 is in a position such that 0·5 volts appear on Tr1's base when 2·1 volts are present on C2, LED D7 will come on 1/10 second after D3 goes off, a path being provided through the diodes and Tr8.

When the time interval extends to 1/9 second the voltage on C2 has increased to 2·4 volts, and if the slider of VR2 is adjusted so that 0·5 volts appear on it when 2·4 volts are present at the top of R14, then LED D9 would come on and represent a time interval of 1/9 second. LED D7 is switched off in the process because the voltage at the junction of D8 and D9 is equal to the forward voltage of D9 only (typically 1·6 volts), and this is, of course, insufficient to cause D7 and D8 to conduct.

The process continues thus along the line, the illumination of each LED causing the cut-off of the one preceding it until the last LED, representing 1/5 second, is on.

TOUCH SWITCH

If in the meantime the contacts are touched a small current flows into the base of Tr4, and is amplified sufficiently to turn on Tr6 again and short out the timing capacitor C2.

Although the voltage to all of the presets is in this way removed, whichever of the LED's was on at the time the contacts were touched remains on due to the self-maintaining action of the thyristor configuration of the lamp drivers.

The LED remaining illuminated represents the response time. For instance, the 1/8 lamp would indicate a response time between 1/8 and 1/7 second.

When contact is removed the capacitor is allowed to charge again, and once the voltage across it exceeds its previous value, the remaining LED's go through their normal sequence until the last LED comes on.

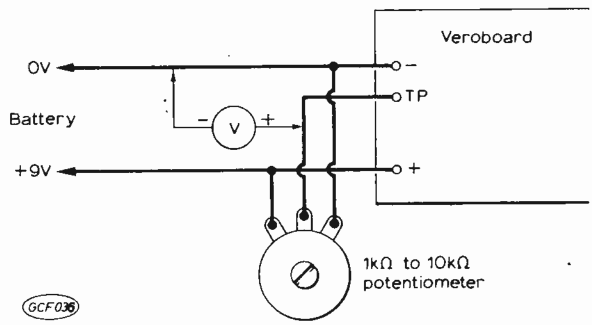


Fig. 3: Calibration circuit using a voltmeter and potentiometer.

RESET

Once the last LED is on, some means must be provided to turn it off and switch the signal light back on. This is done in the following way: When the charge on C2 reaches the battery voltage minus 1·2 volts—corresponding to a duration of 1/3 second —Tr2 is brought into conduction (the emitter voltage is reduced by the forward voltage drop of D1 and D2 to achieve this) reducing the charge on C1 and thereby turning off Tr1, so allowing Tr3 to turn back on.

We are now back where we started with the signal light back on. So, as described above, the supply to the display LED's is now removed by the action of Tr7, and the last remaining lamp is extinguished.

CONSTRUCTION

A suitable Veroboard layout is given in Fig. 2. The LEDs are best mounted last, as they are arranged

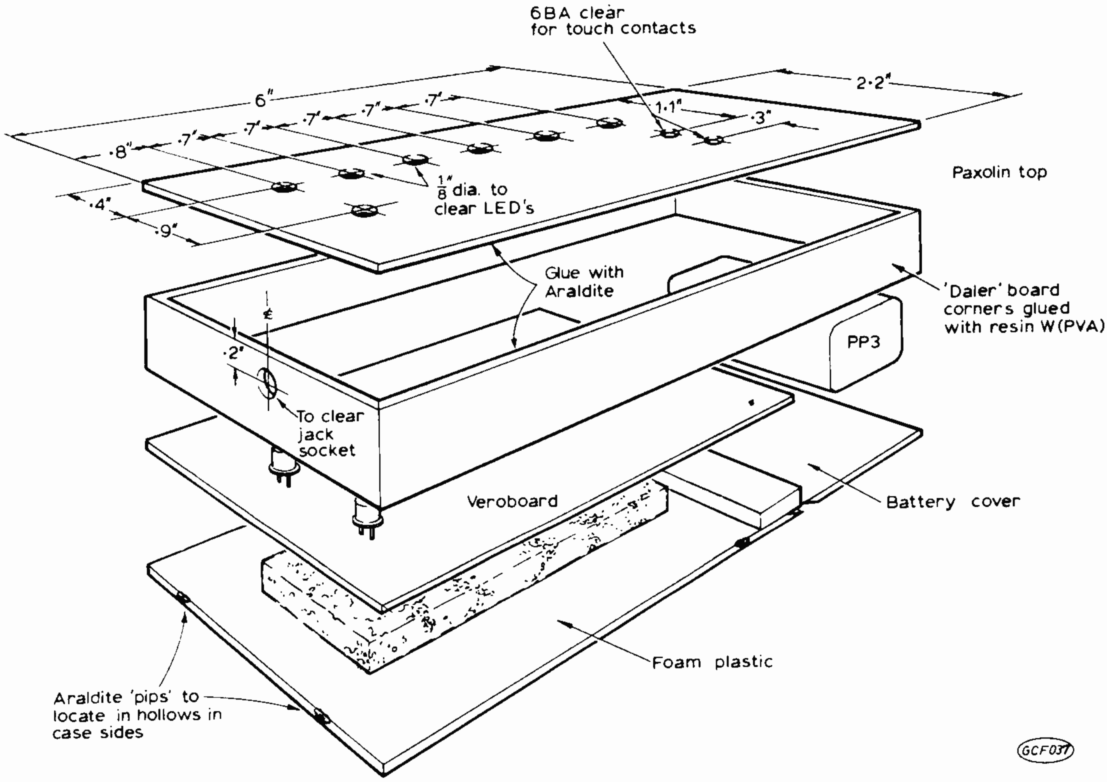


Fig. 4: Construction of the case, the sides and bottom being made from Daler board and the panel from paxolin.

★ components list

Resistors

R1	1MΩ	R13	18kΩ	
R2	120Ω	R14	1MΩ	
R3	27kΩ	R15	18kΩ	
R4	47kΩ	R16	1MΩ	
R5	180Ω	R17	18kΩ	
R6	2·7MΩ	R18	2·2MΩ	(All ¼ or
R7	120kΩ	R19	18kΩ	⅛W ±10%)
R8	4·7kΩ	R20	3·3MΩ	
R9	560Ω	R21	18kΩ	
R10	4·7kΩ	R22	3·9MΩ	
R11	2·2kΩ	R23	18kΩ	
R12	470kΩ	R24	27Ω	

VR1 to VR6 1MΩ miniature horizontal preset (6 off)

Capacitors

C1 10μF 6·3V tantalum
C2 47μF 6·3V tantalum
C3 0·22μF 35V tantalum

Semiconductors

Tr1, Tr3, Tr5, Tr7, Tr8, Tr9, Tr11, Tr13, Tr15, Tr17, Tr19 BC154 (11 off)
Tr2, Tr4, Tr6, Tr10, Tr12, Tr14, Tr16, Tr18, Tr20, BC108 (9 off)
D1, D2, D4, D5, D8, D10, D12, D14, D16 1N4148 (9 off)
D3, D7, D9, D11, D13, D15, D17 TIL209 (7 off)

Miscellaneous

Jk1 Subminiature jack socket and plug
B1 PP3 9V battery
Paxolin for case top
Daler Board for case
1k to 10k potentiometer for calibration

to sit above the other components so that they protrude through the front panel.

The circuitry associated with each LED in the display is identical, with the exception of the value of the feed resistors to the presets. These are chosen to bring the presets to mid-range for the times allocated to them.

The sides and removable base of the case were constructed from "Daler Board," which is available from art dealers. This material has a good finish and is easily cut.

The top of the case was cut from paxolin and fixed with Araldite to the case sides. Two 6BA screws, with their heads filed flat, were used for the touch contacts. Fig. 3 gives details.

Because of its small size, a sub-miniature jack socket was used for an on/off switch, a jack plug being inserted to **switch the unit off.** This socket could also be used to plug in an external power supply, although the total current consumption of only 22 mA is easily supplied by a PP3 battery.

CALIBRATION

Calibration is a simple matter, only a 1kΩ potentiometer and a voltmeter being required; the set-up is shown in Fig. 4.

All the presets are first turned fully anti-clockwise. The calibration potentiometer is also turned anticlockwise. The unit is switched on and the signal light allowed to go off. It will now remain off because the voltage on C2 is kept down by the calibration potentiometer.

The next step is to turn up the calibration control until the voltmeter indicates 2·1 volts. VR1 is now advanced slowly until D7 switches on. Now the cali-

continued on page 1130

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

It is good to report that letters are still coming in on the subject of running a competition in this column. Unfortunately no-one has yet come up with a method of confirming the reception of a station other than by the virtually impossible method of getting a QSL card, difficult often for the transmitting amateur himself, let alone the SWL! A tape recording was frequently suggested but then not everyone has a recorder, although one must admit that they are remarkably cheap these days. However I have concluded that this is possibly the only way out and I am in the process of formulating some rules based on recordings.

It is a pity that the log itself cannot be accepted but it is a fact of life today that it is all too easy to log stations as worked by, say, a local DX'er. Looking at the pile of logs I get, I'm afraid that this does happen, the listener not having actually heard the DX station involved. As I have said before, it is no use running any competition unless the competitors can be assured that the winners have indeed heard the stations submitted in logs.

John Porter (Baslow, Derby) lost half his long wire in the gales but managed to copy VQ9HCS in the Seychelles on 15m for a fairly rare one. **C. P. Bennett** (Slough, Berks) joins our ranks with a Codar CR70A and ditto preselector fed from a 10ft vertical or 100ft long wire. He lacks signals on the 10m band which is not an unusual moan, only to be expected at the bottom of the sunspot cycle. Nevertheless some of our SWL's do quite well and so the receiving set-up ought to be suspect. Receiver alignment or rather, misalignment, can be a contributory factor and an aerial designed for the band will help no end, as will bringing any existing aerial to resonance on 10m.

Roger Trett (Norwich) swears he will try to get up much earlier in the mornings to get some of that exotic DX that the lie-a-beds never hear! More from **John Porter** who is all agog at hearing a W8 and a W0 on CW on TWO METRES! Yes, very likely, now that amateur satellite Oscar 7 is in orbit, following its launching on November 15 last. The 432MHz to 144MHz repeater has already provided many trans-Atlantic QSO's. Strong signals from telemetry beacons on 435·1 and 145·98MHz are being heard. A second repeater from the 2m to the 10m band is also operational plus a telemetry beacon on 29·5MHz. All this should be an incentive for some of you to try your hand at 2m and down. John uses a Microwave Modules converter into his FR50B and an indoor dipole on 2m.

Regular **Alan Doherty** (Portrush) wanted some QTH's for the stations he had heard but generally I am unable to help in this respect. Can only suggest keeping an eye on the DX news in Short Wave Magazine or Radio Communication where the QTH's of the rarer DX stations are generally given. **Stephen Lawrence** (Market Harborough) had some blush-making comments to make on the column plus ideas for a contest involving a short contest period so that logs could be checked against each other. This would penalise the really good operator who might hear the odd weak DX station that nobody else hears, and this does happen. This is where the tape recording would prove invaluable.

Malcolm Sole (Lancaster) would like times quoted on reception reports but I'm afraid that the delay before the information gets into print makes such information useless. All we can hope to do is to indicate the unusual stations that have been active in recent times and leave it to the SWL to deduce from experience when he is most likely to be able to hear them on the particular band indicated. Malcolm has an AR88 and 300ft of wire in the loft . . . some loft! or too many zeros! I've asked Malcolm to elucidate.

Steve Cottis and **Nick Hunt** of the same street in Harrogate have very sensibly combined their energies and borrowed a receiver in order to get started in our exciting hobby. The set is fairly good but nevertheless they would like to get a set of their own, but as they say 'money is very important as we have not got much of it', and since they are aged but 13 this is very understandable. Congratulations chaps, and let's hope your initiative will be rewarded.

Tim Charles (Colchester) was still waiting for his new CR70A when he wrote from hospital where he was visiting his Mum. He managed to note VP1FF on 40m SSB and VR6AF on the same band on CW plus KS6AZ on 20m CW all worthwhile goodies by any standards. **Gary Edge** (Warrington) must have been laying down the law to his 9R59DS which came up with HZ1TA, VU2BX and FP8SPM on 80m SSB. Following my February compliments to 16-year-old John Martin I received an unsigned letter from an unknown address in Plymouth pointing out that Phillip Askey of the Plymouth Radio Club had passed his RAE at 14½! I gather that he is no less than G8JNN and I hope these startling revelations will not prove to be too much of an embarrassment! Outstanding entry from the log of **Max France** (Warrington) was VS6FB at

1543z towards the end of December on 80m. Round about our sunset I suppose, without looking up the tables, which would make the path ideal at the time.

Eric Carling (Lymington) persists with his request for a band/countries table each month but we again run into the problem of substantiating claims. **Alan Rae** (Glasgow) got money in lieu of goods at Christmas time and so is now looking for a receiver. Preference runs to Drake 2A, FR50 or 100 or the Trio series Jr310,500 or 160. Stanley Sharred's brother **David** A8312 has decided to join the act by sharing the equipment and submitting his own log. David likes 160m where he has heard no less than 33 countries in little over a year. He, like several other readers, sent me info on ST2AY which is much appreciated but so far nil QSO! Hoped to make it in the CQ WW 160m contest but in spite of working 20 countries the ST2 eluded me.

On getting QSL cards, **Bernard Hughes** BRS25901 (Worcester) reports a QSL card from Fiji as costing him 10p plus two IRC's plus an SAE! Which explains why we cannot demand cards as evidence in competitions! **John Burgess** (Birmingham) joins us with his Codar TRF receiver and 25ft outdoor wire and so far has concentrated on 20 and 80m. **Graham Wilson** (Blackpool) stuck with SSTV with his JR310 into a Spacemark monitor on 14230kHz to list nearly 100 stations. **Paul Barker** (Sunderland) is also happy on this mode plus some SSB catches. Paul comments on the excellent work done by VK6WC who acted as relay station in the first critical hours of the Darwin disaster.

Newcomer **Michael Adams** A8520 (Gosport) has a CR70A and finds it a delight to use. The 132ft of wire, preselector and ATU must help quite a lot too. A Microwave Modules converter puts him on 2m as an additional interest.

Keith Rawlings A8569 (Broxbourne, Herts) has begun his listening on 2m and 70cm, with converters into a PR40 fed from a 5 element job on 2m and a 46 element on 70cm rotated by an AR22. He has made up a preselector for the 70cm band which netted him F1AVG for a start. **Michael Green** (Northwich) has also been listening in to Oscar 7 with a converter into his HF arrangement of a QP166 front-end into a CR100 as an IF strip. As he says, further info on the Oscars can be heard on the RSGB broadcasts on about 3600kHz starting at 0930 on Sundays as well as on some VHF channels. The Oscar Net is on 3780kHz Sundays at 1015z. **John Martin** A8781 (Kingsbridge, Devon) joins us with a general log but is very concerned at the general noise on 80m. We all learn to live with it, in time! An enlarged log from **Tim Charles,** previously mentioned above, confirms reception of his new CR70A at long last! **Andrew Darragh** (Wetherby) is also gloating, this time over a FR50B, which he actually had to buy!

Log extracts

B. Hughes:—80m HZ1KE UA9VH/JT1 KG4DS XU1DX ZD7FT **20m** VQ9HCS VK8CE 4W1GM

M. Bennett:—80m HM5LV TG9YN **20m** FP8IZ VQ9B 5B4AV **15m** HC1AD 9Y5GA

D. Sharred:—160m EP2BQ OJ0MA PY1RO VS6DO 9G1AR **80m** FM7AB OY7K VP1FF ZL2BT 8P6ES **40m** HP1IW ZD7FT ZL2AMJ

A. Rae:—80m HI8LC HK3KT JY9GR KZ5EQ W7AZG 6W8AF 9Y4CP

E. Carling:—20m A2CCV (Botswana) BV2B ZS1ANT (Antarctica) **15m** CO2PZ HR3JJR **TG9YN** YN1GV **10m** A2CCY ZD7FT 9G1AR

S. Budd:—80m CP2BD HI8HA HK4BTY JA8LQ KG4DS PJ2CW SU1MA TR8AC **20m** VP2AYL XU1DX 8R1X (POB 164 Georgetown)

M. France:—80m FG7GF KG4OS VP1FF ZF1RD 3E1KC (Panama) 9X5PT

M. Sole:—40m F2JD/P/5U7 **20m** BV2B HM1AQ KG6SW VP8NP YJ8CS

J. Porter: 20m HI3XMV M1C VP8NP **15m** FY7AS HS4AFD KZ5DK **2m** A W8 and W0 heard on CW via Oscar 7

R. Trett:—20m VP2VPK (Tortola) **15m** A2CCY CT3AA PJ2VD

G. Wilson:—20m(SSTV) CT1EQ EA5IO HA6VK HB9NL JA7FS K2ONE OD5HC SV1CG VE3FCN VU2AIC VQ9R

M. Adams:—80m FP8FU VE7EL VP5BT ZL3GS **15m** KP4DLA 5T5AC

A. Doherty:—80m EP2VJ HI8XRG YN2DX **40m** JA1DSL TG9PW VP9CW **20m** TJ1TAF 5U7BA

M. Green:—80m XE3LK VP2SG **10m (from 2m via Oscar 7)** DC8BB G8AWS G8BCL **2m (from 70cm via Oscar 7)** DJ9DL F6CH G8AWS HB9RG I0SVS LX1DB LX1SI VE2BYG

T. Charles:—160m K8CCV WB8AJH 80m A4XVB **HP1SW** PZ5FB TI2JX VP2EEB (Anguilla) **15m** JY9CR PJ8AJA PZ1DR VQ9FCS

P. Barker:—20m (SSTV) HB9IT I2LOV OE1SF OK30ZAS SV1CD

A. Darragh:—80m FP8SPM HI8XRG **20m** DU1XKE HP1ZV 8R1X **15m** JY9CR PZ1DR TU2DV

All stations are SSB except those in bold which are CW.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Derek Bell

IN these days of the ever rising price it does my old bones good to be able to relate the story recently sent to me by **Andrew Toms** of Coventry. He wandered into a jumble sale in that neck of the woods and saw reposing there an old eight-band portable receiver, priced at ten pence. Bearing this home he found that it gave him:—

6055 at 2100 Radio Sweden from Horby
6065 at 1924 V.O.A. from Morocco
9540 at 1700 Radio Australia from Perth

All this when coupled to an ex W.D. tank aerial mounted ten feet in the air. Andrew asks for details of communications receivers suitable for general short wave listening. Well, OM, these would fill a book, but you seem well set up so I think it would be perhaps best to stay as you are.

CQ, CQ, **Rex Cooper,** you asked for details recently of FEBA from the Seychelles. In a recent band survey by the World DX Club (to whom my thanks for the gen) this station was reported on 11855 at 1800. While on the subject of band sweeping, acting on a recent letter reporting no traffic on 5MHz I did a bit of band surveying myself and came up with Ecos del Torbes, San Cristobal, Venezuela

—continued on page 1130

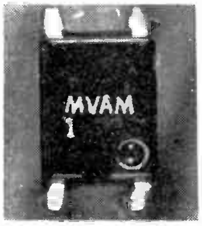
NEW!! the All Electric Wireless FIRST TIME PUBLISHED

IN NEXT MONTH'S PRACTICAL WIRELESS

PW APOLLO-series

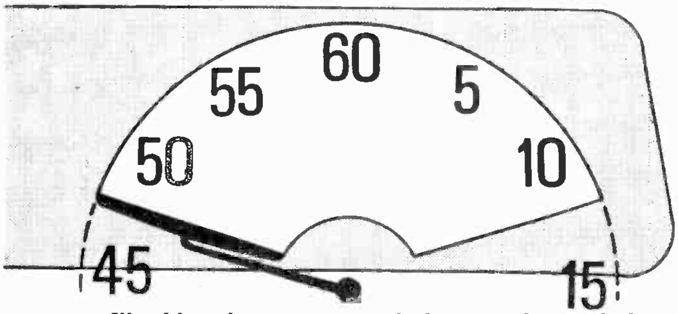
PART 1

TRIPLE VARICAP MEDIUM WAVE TUNER/RECEIVER



The very latest multiple Varicap is used in the Apollo series permitting the simultaneous tuning of several circuits at almost any distance by means of a simple potentiometer. The possibilities are tremendous! Protect your car radio by putting it in the boot and tuning it from the front seat! Comfortable armchair operation of your domestic radio . . . and remember, full tuning coverage is available in addition to the usual push-button facilities!

also: CAR WIPER DELAY UNIT



Clip this unit across your windscreen wiper switch and get single stroke operation at various controlled intervals to suit weather conditions.

MODEL TRAIN CONTROLLER

Simulate precisely the movements of real trains! Based on the cheap 555 IC the unit includes a mains power supply.

MANY OTHER CONSTRUCTIONAL ARTICLES, SPECIAL FEATURES AND REGULAR COLUMNS.

ON SALE IN APRIL

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

THE internal amplifier circuit shown in Fig. 5 uses the LM380 (IC17) in its simplest possible configuration. SK1 is a switched jack socket that allows a phono output to be taken before the internal amplifier and is so wired that the internal amplification system is disconnected when used with an outside amplifier. The output from IC17 is taken to both the internal speaker and to a headphone socket. This socket, when used, automatically cuts out the internal speaker. Should these jack sockets not be wanted the printed circuit board has two pairs of pins (A & A_1 and B & B_1) which can be shorted together and the jack sockets omitted. Maximum output power from IC17 is developed across an 8Ω loudspeaker but in practice it has been found that sheer power is not too important from the internal unit, consequently any medium impedance loud-

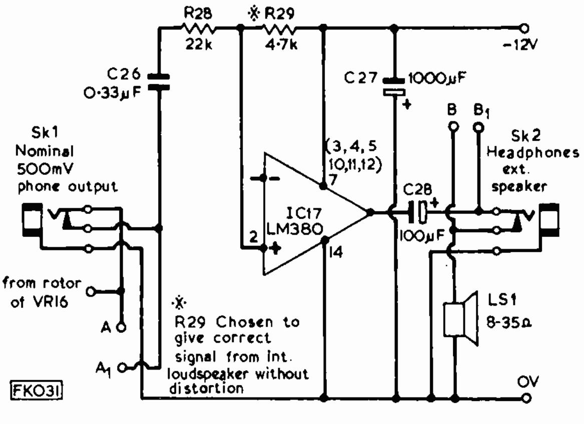


Fig. 5: Circuit of the simple audio amplifier incorporated in the organ.

speaker (8Ω-35Ω) of suitable dimensions can be used.

Apart from the keyboard resistors and the power supply, all circuitry is housed on one board. This includes all the manual controls and thus greatly simplifies the normal problems of interconnections. The second board houses the power supply, Fig. 6, and, as with the rest of the organ, it contains only essential components. A fairly reliable −12V rail is required, hence the zener D7 and the series regulator transistor Tr4.

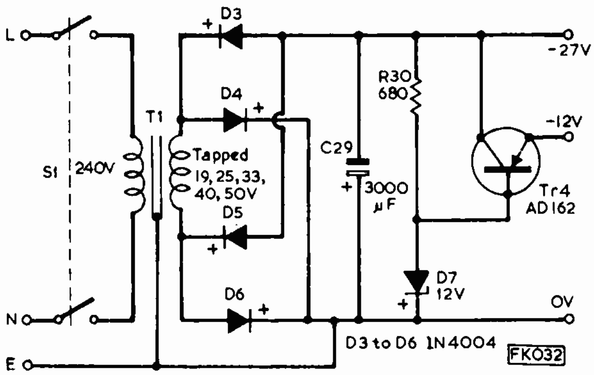


Fig. 6: Circuit of the power supply. Constructed on a PCB separately from the main organ PCB.

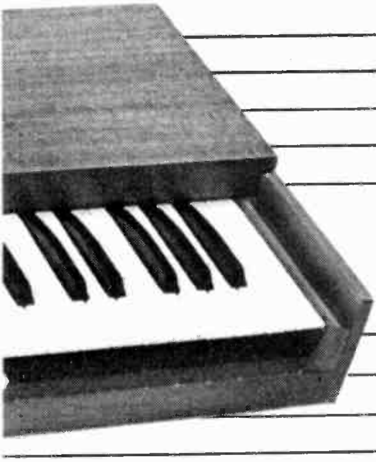
All smoothing and decoupling capacitors are mounted on the main board, with the exception of C29 which serves to provide a satisfactory −27V rail to feed the MOS devices.

NOTE

It is most important, before continuing any further, that the following points are read **before** even unwrapping the MOS integrated circuits (IC1 to IC13)!

In order to check the workings of the main board it is suggested that the power supply be assembled first. This board, Fig. 7, should be fabricated from fibreglass laminate as it will be used to support the mains transformer. Plenty of space has been allowed for transformers other than the MT50/½ but if using an unspecified transformer it is as well to check that it will fit before continuing. Using a pair of long-nose pliers form the component leads to exactly fit the hole spacing on the board, Fig. 8, ensuring that the diodes and the capacitor are inserted with correct polarity.

The tappings on the transformer should give an RMS output voltage of 18 or 19V, so if using the specified device it is suggested the supply be taken from the terminals marked 0V and 19V. On rectification this should give an off-load DC voltage of 26·6V across C29. Do not expect an exact voltage at this



PW 'Easybuild' ELECTRONIC ORGAN

MIERE

PART 2

point as it will be dependent on the loading of R30 and any eventual loading from the rest of the circuitry. Although the circuitry calls for a nominal −27V rail it has been found in practice that the circuits function adequately with this rail as low as −22V. On the other hand the −27V rail should not exceed −30V as damage to the IC's might result.

POWER SUPPLY TESTING

When the power supply board is assembled, connect up a temporary mains lead to the primary of the transformer (not forgetting the earth wire to the board) and then wind a few layers of insulating tape around the terminals for protection.

It is suggested that a power supply test be carried out before any of the circuitry is assembled into the cabinet. Connect up to the mains, and check the off-load output voltages. Relative to the OV (positive) rail should be something between −25 and −27V at the negative end of C30. If voltages wildly different from this are found check that the diodes are the right way round. If the voltage is just outside the above limits alter the output tapping of the mains transformer accordingly.

Having established a proper value for the nominal −27V rail go on to check that there is −12V at the emitter of Tr4. With the correct zener diode this should automatically fall within the range of 11·5 to 12·5V. If very different from this suspect the zener and replace it.

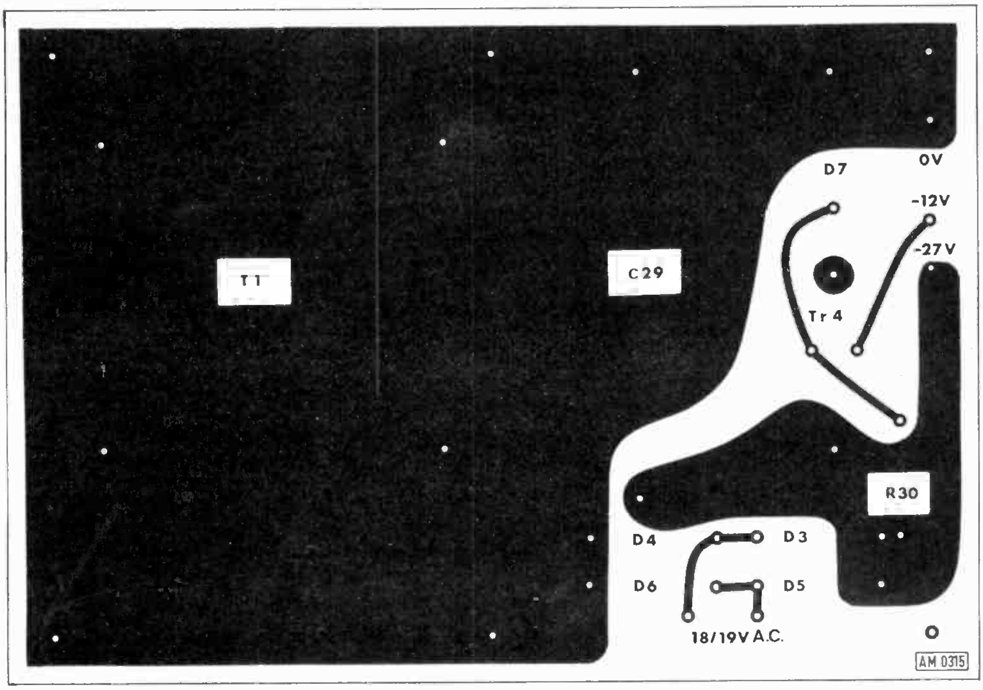


Fig. 7: Actual size layout for the PCB on which the power supply is built.

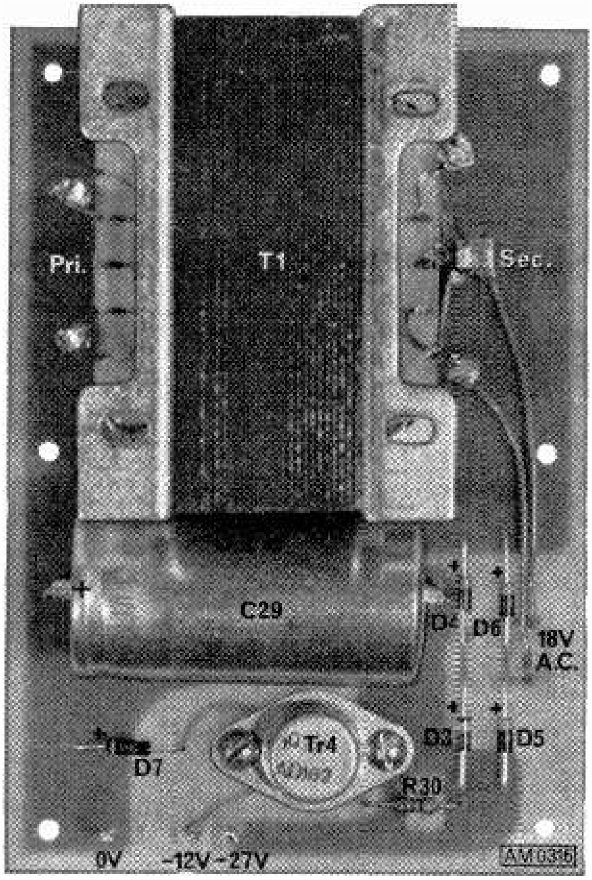


Fig. 8 : Location of components on power supply PCB. Observe correct polarity of diodes and capacitors.

MAIN PCB

By any standards this is a large circuit board (Fig. 9) and it has to carry a number of manual controls which rely on their soldered connections for mechanical rigidity. For this reason fibreglass laminate must be used. It is large because we have removed most of a conventional organ's complexity from the hands of the constructor and put it into the board. Whether the board is home-made or bought it must be thoroughly checked for quality. Make a test for possible hair-line cracks in the very fine conductors that run between the tone generator IC's and the lead-out lands on the edge of the board. At the same time check that none of these fine conductors are shorting to their neighbours, either from under-etching or a "smear" from the roller tinning process.

If the board is ready-made there should, of course, be no problem but it saves an awful lot of bother later to devote five minutes to this test. Should any discontinuity be found in any of these conductors "home in" on the break with testmeter probes and then carefully solder a single strand of wire (taken from some fine flex) across the offending area. Do not try to bridge the gap with solder, at best it will make a messy job and at worst it will introduce a doubtful connection which could cause trouble later. Short circuits can easily be cleared by running a sharp knife between the conductors until the "bridge" is felt when it can then be scraped clear.

MAIN BOARD ASSEMBLY

Start assembly with the nine slider potentiometers. The type specified will fit the lands on the circuit board exactly and will be self supporting. It is not recommended to use other types, but if it is unavoidable the contact positions may not coincide with those on the board. As a make-shift remedy carefully drill three holes in the correct position (without interfering with any of the printed wiring in that area) and attach the potentiometers in place on the top side of the board with Araldite. Connections to the lands can then be made on the underside of the board with insulated wire. This is an exceedingly messy job and should be avoided because it will be almost impossible to replace these components at a later date.

Make sure that all the tracks of the sliders are parallel with each other, a small latitude in positioning is afforded by the slight flexibility of their solder tags. When they are correctly positioned make sure that they are rigidly fixed with a generous amount of solder on each land.

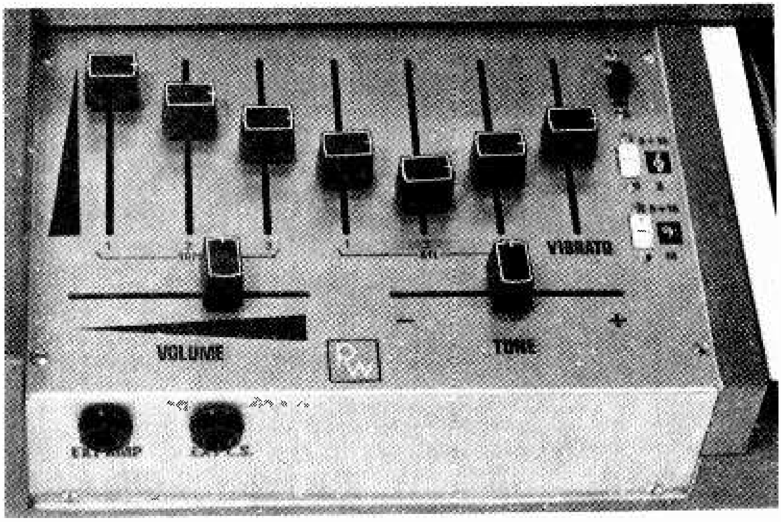
Now insert and solder-in the inductor, L1 and L2, after which the board can be turned upside down for subsequent soldering. The components already in place will act as legs to hold the board clear of the working surface. Because of the high density of printed wiring, little metal is left on the board for soldering lands necessitating extreme care with the soldering iron. A miniature iron must be used for this and all subsequent operations, one with a 3/32in. diameter bit or, at most, 1/8in. diameter. Ideally, the iron should be equipped with an earthing lead, for reasons which will be explained later, but if it has no earth connection do not worry unduly; it is certainly not worth rushing out to buy one specially! Use the minimum amount of solder for each joint and make sure that each connection is clean and bright before moving on to the next. Dry joints can be a great headache in this project!

OSCILLATOR AND VIBRATO STAGES

Now wire in all the topside conductor jumpers. These are cut from 22SWG tinned copper wire that has been work hardened to keep it straight. It is a useful tip to know how to harden wire for this, and other projects. First of all cut off about a yard of wire from the reel; it will, of course, have a tendency to curl. Firmly grip each end in a couple of pairs of pliers, a couple of twists around the jaws of the pliers helps maintain the grip, and then slightly stretch the wire by pulling apart on the pliers. Allow the wire to stretch for about 2 or 3 inches and when the pliers are removed the wire will remain straight.

Now cut off straight lengths, form the ends to fit the holes for the jumpers and solder them into position. Make absolutely sure that they are the right length so that there is no chance of them bowing and shorting together. Apart from the jumpers in the vicinity of IC2 to IC13 do not forget the two short links near IC15. Next insert and solder all the board pins into their correct locations.

Start assembly of the rest of the circuitry in the following sequence after which one can carry out a few tests to check progress. Begin with the master oscillator and vibrato stages by soldering in the resistors R1 to R11 (R5 and R6 are located near the slider pot VR2). Proceed with capacitors C1 to C7.



Close-up of the organ control panel and outlets for external amplifier or speaker. The first three vertical sliders at the left control the 16ft. pitch, the next three controlling the 8ft pitch.

The latter is a compression type and should be mounted on the top side of the board; use tinned copper wire to connect its two terminals to the corresponding holes in the PCB. Make absolutely sure that C6 is in the right holes and that the polarity is correct.

Solder in the semiconductors D1, D2, Tr1, Tr2 and Tr3. Be careful not to damage the plastic casing of the diodes, form the leads and make sure they are inserted the right way round.

Now the oscillator can be tested with the help of a medium-wave transistor radio. Temporarily connect the 0V and −12V rails of the power supply to the corresponding circuit pins on the main board (near the location for IC13), hook a length of insulated flex to the end of R10 nearest Tr3 and set VR1 to minimum vibrato, i.e. the slider should be furthest away from the edge of the board). Set VR2 to the centre of its range and switch on the radio, tuned to about the middle of the medium waveband. Place the insulated wire from R10 very close to the radio and switch on the organ's supply. Using a screwdriver, adjust C7 until a signal is picked up by the radio. If there is a station nearby you should hear a clear heterodyne whistle. A signal indicates that the oscillator is functioning.

If no signal is picked up at any setting of C7 then it is almost certain that there is a missed conection, or Tr3 or the diodes are the wrong way round. Proceed to check the tune control by tuning C7 for a clear heterodyne whistle at some position on the waveband and then try sliding VR2 across its travel. It should have much the same effect as tuning C7 except that the degree of control is much finer.

Finally, check the vibrato by listening to the whistle while advancing VR1. The whistle should start to "wobble" in frequency and eventually, as the control is advanced further, break-up altogether into a series of low frequency pulses.

TONE FORMING STAGES

However tempted one may be, **do not under any circumstances**, insert the MOS integrated circuits (ICs 1 to 13); this should be done at the very last stage in assembly. Instead, carry out assembly of the tone forming circuits and amplifiers.

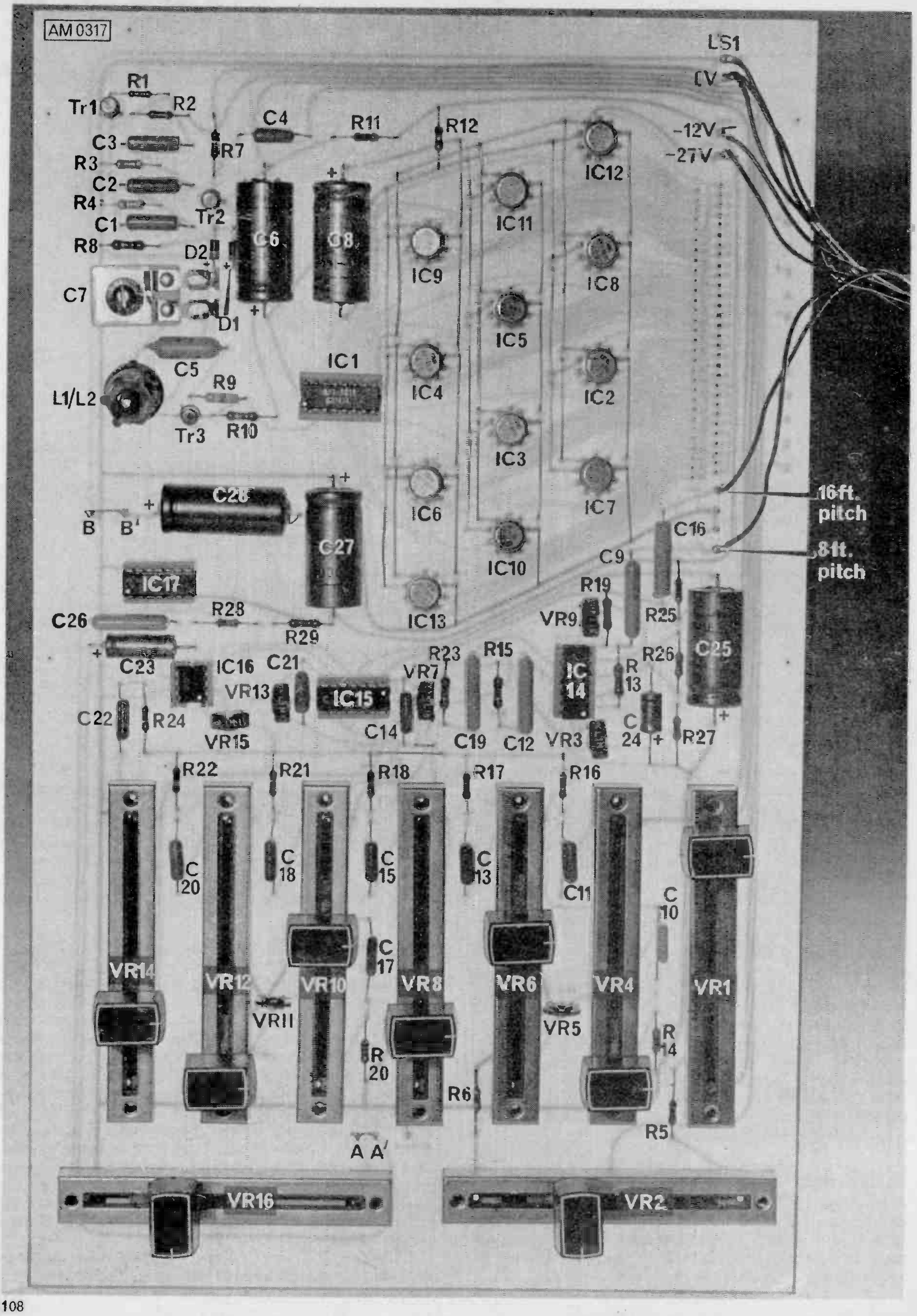
Start with all the IC sockets as this will help in locating the positions of other components. Complete the installation of the remaining passive components, R12 to R29, the seven pre-set potentiometers and C8 to C28. At the same time put temporary shorting links across the board pins. A and A_1, and B and B_1. The board has been designed for use with Mullard C280 capacitors but ample room has been left to accommodate other types. When using the C280 devices widen the distance between the lead-outs slightly; this should be done very carefully and the leads should **not** be bent too close to the plastic covering as they can sometimes break away altogether. It is best to hold the lead with a pair of long-nose pliers, very close to the case, and carry out the bending operation on the side of the pliers furthest from the case.

Integrated circuits IC14 to IC17 can now be inserted into their sockets ensuring that they are correctly orientated. Be careful in deciding which way round they go because the orientation mark is a very small indent in one corner of the top side. This should not be confused with the larger moulding mark which appears on some devices. Before proceeding to the final stage of board assembly set all the pre-set potentiometers to the centre of their adjustment.

MOS DEVICES

It only remains to insert the MOS devices. A reasonable amount of care is required for this operation because the devices, although protected to a degree, are subject to damage from high voltage static electricity, the type that can be induced on the body when one wears a pair of nylon overalls or a nylon sweater. To protect the devices in transit they are supplied with special packing. In the case of IC1 it will probably be sent in a plastic box, its pins pressed into a piece of black conducting foam rubber. It is quite safe to handle the device while its pins are thus protected but it would be a foolish man who did so immediately after combing his hair or stroking the cat, ideal ways of building up a high static charge on the body!!

Likewise, IC2 to IC13 are supplied with shorting devices, connected around the pins. Again the IC's


AM 0317
LS1
0V
-12V
-27V
Tr1
R1
R2
C4
R11
R12
C3
R7
R3
C2
R4
Tr2
C1
R8
D2
C6
C8
IC12
IC11
IC9
IC8
C7
D1
IC5
C5
IC1
IC4
IC2
L1/L2
R9
Tr3
R10
IC3
IC6
IC7
C28
B
B'
C27
C16
16ft. pitch
8ft. pitch
C9
IC10
IC17
R19
C26
R28
IC13
VR9
R25
C25
R29
R23
R15
C23
IC16
C21
VR7
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C11
C
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VR14
VR12
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VR16
VR2

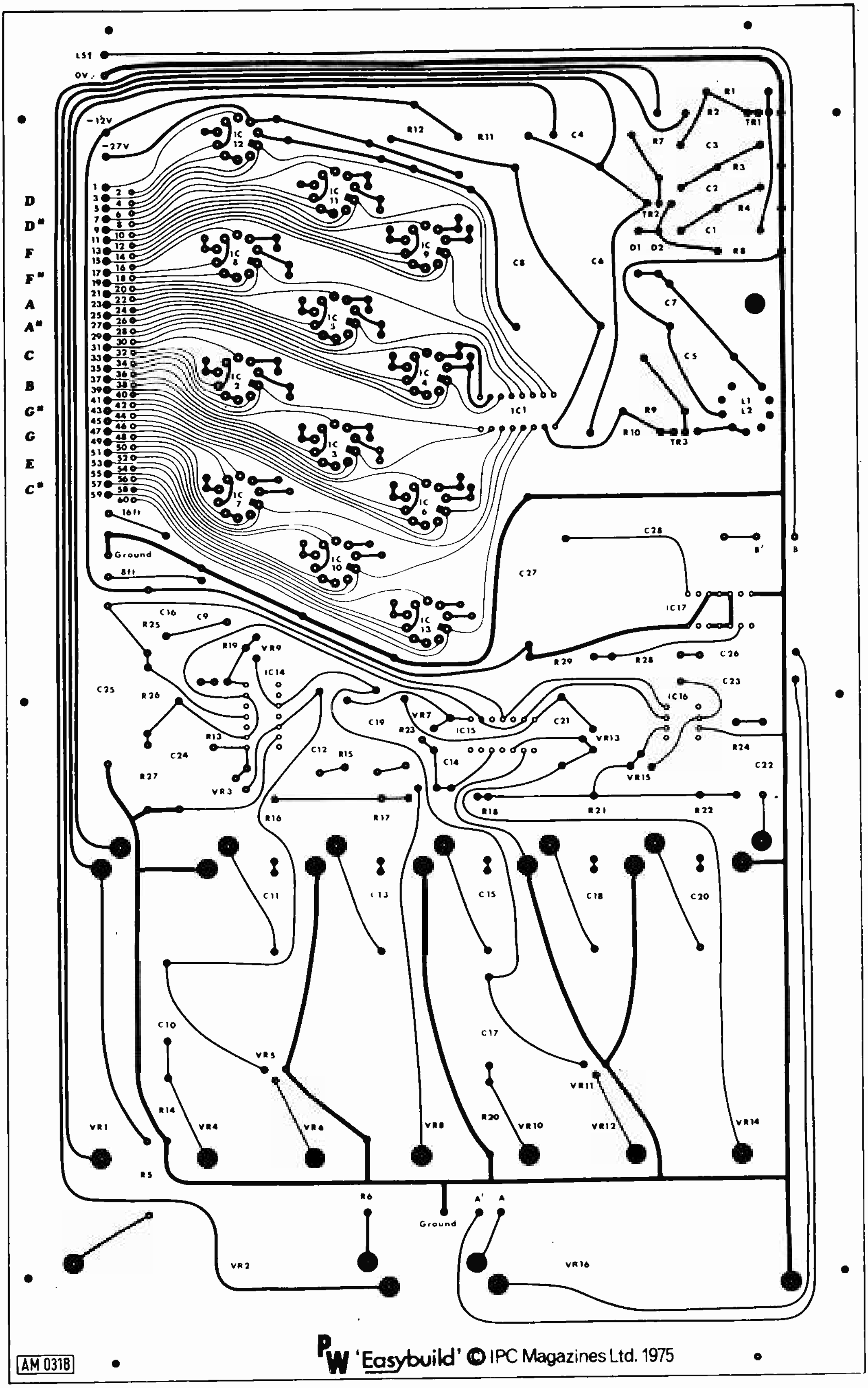


Fig. 9: Above, shows the main PCB layout, for reference purposes only. This is **NOT ACTUAL SIZE.** *The board size is 330 x 205 mm (13 x 8in.) Details on obtaining a full-size paper drawing of the PCB can be found in Part 1. The annotated photograph, facing page, is of the finished board, which will assist constructors to locate the components. The copper side of the board is underneath.*

may be handled with these in place, but eventually these protective measures have to be removed so that one can solder the devices into place. IC1 is a dual-in-line package and hence a socket can be used for it and soldering is not required.

The ten-lead TO-5 packages of ICs 2 to 13, however, present a problem because sockets for this type of package are extremely expensive, making their use unjustifiable. Remember however, that soldering these devices straight to the board will probably invalidate any guarantee from the manufacturer for free replacement in the event of failure. As the sockets are very nearly as expensive as the devices themselves it was felt the extra insurance was hardly good value for money, and in any case provided these instructions are followed in every detail there should not be any problems.

The main worry is static electricity and every possible precaution must be taken to prevent introducing a static potential difference between the pins of the IC's which can be caused by a body charge induced by wearing synthetic fibre clothing while sitting on PVC chairs, wearing insulated soled shoes, a charge on a formica working surface that is insulated from the ground by rubber feet and from a charge induced on an unearthed soldering iron. Static is enhanced by dry, hot conditions.

From the above it might seem that we are suggesting that you strip off all your clothes and go barefooted into the garden to do your assembly on the lawn on a wet cold winter's day! Fortunately one need not go to these lengths but it is necessary to do one or two apparently strange things to ensure complete protection.

The object is to try and keep everything at a uniform potential and to avoid aggravating problems, i.e. work on a wooden table and avoid PVC covered chairs, a good old fashioned wooden chair is safer. Take off those beautiful synthetic soled shoes and put on your oldest slippers. Prepare your working surface by covering it with a generous sheet of aluminium cooking foil and make sure that it covers all the area on which you intend to work. Put all your tools and the PCB on this sheet together with the soldering iron stand and connect a lead of fine wire between a cool metal part of the iron's case and this sheet. If the soldering iron is properly earthed this means that anything that comes in contact with your work surface will auomatically be earthed. While working on this part of the project, frequently touch the fingers on the foil. Alternatively roll up the sleeves so that the elbows frequently come into contact with the foil.

Tip out the IC's onto the aluminium foil and make sure that they have all come into contact with it. They can then be handled in the normal way without any further worries.

DIVIDER IC's

Inserting ten-lead devices through a drilled circuit board can be a bit of a problem. It is therefore advisable to trim the leads to different lengths making the lead immediately under the locating lug the longest. Then, working round the leads, trim each one a little shorter than its predecessor but do not overdo the trimming because it must end up with between $\frac{3}{8}$in. and $\frac{1}{2}$in. for the shortest lead!

The lead immediately under the lug of each of the twelve IC's should be inserted first into the hole which carries an identifying lug on the printed wiring side of the board. Then work round, carefully inserting each successively shorter lead in turn until the IC is in place. Push the circuit home making sure that the leads fan out gently without shorting against each other. Turn the board over and carefully solder the device into place with the maximum of care and the minimum of solder.

Proceed like this until all the TO-5 devices have been installed. Check that blobs of solder have not been dropped on the fine printed wiring and that there are no bridges between pads on the IC connection pattern. Finally insert IC1 into its socket, again making sure of its correct orientation, and the board is now compiete and ready for testing.

Solder temporary leads, each about 12in. in length, to the board pins as follows: one wire to pin LS1, two wires to that marked 0V and one wire each to −12V, −27V, 16ft, and 8ft. Now dispense with the static protection paraphernalia as once the IC's are in circuit there is little chance of them being damaged.

TESTING

Test the main board by connecting the leads 0V, −12V and −27V to the corresponding pins on the power supply PCB, and another lead from the 0V pin together with one marked LS1 to the loudspeaker (not yet in the cabinet). Set the knobs of all the sliders as follows: VR1 furthest away from the front of the board, VR2 mid-way, VR4, 6, 8, 10, 12 and 14 furthest away from the front of the board (i.e. to minimum signal) and VR16 to the furthest left position (minimum volume). Switch on the power when a "clunk" from the loudspeaker should be heard and nothing more. If nothing at all is heard check shorted points B and B_1 and similarly points A and A_1. Advance the volume control (VR16) to about mid-way and you could hear a gentle "singing" from the loudspeaker. This may only be a faint signal but is a good sign that things are as they should be.

Now for the great moment: advance VR6, (the square wave control at 8ft pitch), to maximum and touch the flying lead from the 8ft pin on to any of the lands numbered 1 to 60. There should be a loud clear tone from the loudspeaker for every land that is touched. Pin 1 should be the lowest octave tone for the note D, pin 2 should be one octave up on this, pin 3 another octave higher, pin 4 one more octave higher and pin 5 the highest octave for D. Pin 6 should be the lowest octave for D and so on. Keep the wire on one mid-frequency tone and check that its loudness can be controlled by VR6 and the volume control VR16.

Now leave VR6 at minimum level and check the "spikey" signal by advancing VR4. It should sound much thinner and, probably, will be of much lower amplitude. Advance the volume control to maximum and turn VR15 (preset) down until the sound is at a comfortable level, approximately 25% up from its lowest position. If the sound is weak at this setting go to the busbar preamplifier gain control (pre-set) VR3 and adjust this to give a comfortable level.

PART 3 NEXT MONTH CONTINUES WITH THE TESTING OF THE MAIN PCB, AND WIRING OF THE KEYBOARD.

IC+2 RECEIVER

R.H. LONGDEN

THIS receiver uses an integrated circuit which provides mixer, oscillator, IF, detector and audio driver stages, with a ceramic filter in the IF position. A complementary push-pull audio output stage follows, to operate the speaker.

CIRCUIT DESIGN

The switching and tuning arrangements adopted are of a somewhat simple nature and the way in which the three bands are obtained will be clear from Fig. 1. VC1/VC2 is the tuning capacitor with an integral ball drive. The band switch has three poles. On "M", for medium wave reception, L1 and L2 are in series and tuned by VC1. VC2 tunes the oscillator coil, with padder C4 in circuit. S1 also places C2 across VC2. In these circumstances, oscillator coverage is approximately 1165 to 2020kHz. As the receiver intermediate frequency is 455kHz, the oscillator operating HF of the signal frequency, coverage is approximately 710-1565kHz. No pre-set trimmer is required in the oscillator circuit because the panel trimmer VC3 allows for peaking of the aerial circuit throughout the band.

With the switch at "160" C2 remains in circuit, but the padder is changed to C3. Oscillator coverage is now approximately 2160 to 2600kHz. The oscillator is HF of the signal frequency as before so the receiver tunes about 1705-2145kHz which includes the 160m band (1800-2000kHz). L1 and L2 remain in series, but aerial tuning coverage is reduced by TC2 in series with VC1, to obtain a suitable band.

With the switch at "80" S1 shorts out the MW section L2 leaving only the short wave winding L1 in use. C2 is no longer across VC2 and TC3 is in series with C4. As a result, oscillator coverage is approximately 3045 to 3415kHz. The oscillator is now on the LF side of the signal frequency giving a band of about 3500-3870kHz for 80m reception. TC1 is in series with VC1 providing suitable coverage in the aerial circuit.

Alignment of these circuits is not particularly tricky as VC3 is present on all bands allowing manual trimming. It should be noted that there is not a great deal of latitude in capacitor values. Capacitor C4 is larger than the usual padder because the oscillator coil has to be set to a somewhat lower inductance than normal, which is easily within the core adjustment. The circuit allows effective bandspreading of 160m and 80m plus most of the usual MW coverage without the switching otherwise necessary to select alternative oscillator coils for the various bands.

CIRCUIT DETAILS

The pins of IC1 are numbered as seen from below, Fig. 2. The aerial coil point 5 goes to the mixer base pin 1. Pin 3 is for the mixer emitter circuit with emitter bias components R2, R3 and C9. Pin 4 is the input of the audio amplifier, with pin 5 for negative feedback from the output transistors, via R16. Pin 6 is the audio section output, driving Tr1 and Tr2. Pin 7 is the IC earth line.

Pin 8 is the audio output going to volume control VR1, and AGC bias via R4 and R5 to control the gain of earlier stages. Pin 9 is the IC positive supply point. Pins 10 and 11 are the IF amplifier input, with by-pass capacitor C8 on pin 11.

Pins 12 and 13 are collector and emitter circuits of the IC oscillator, and go to the oscillator coil. Pin 14 is the mixer output in conjunction with pin 2, which is earthed via C7.

The IC is effectively 14 transistors, the end occupied by pins 1 and 14 being identified as shown in Fig. 2.

External connections only for the CFT455C filter are shown, pins are bridged and connected to place the ceramic filter in series with the coupling windings.

The output transistors employ emitter resistors R14 and R15 to stabilise working conditions the circuit being satisfactory for a loudspeaker of 8 ohms or over. A speaker of up to 75 ohms may be used, though output falls off a little, and a somewhat

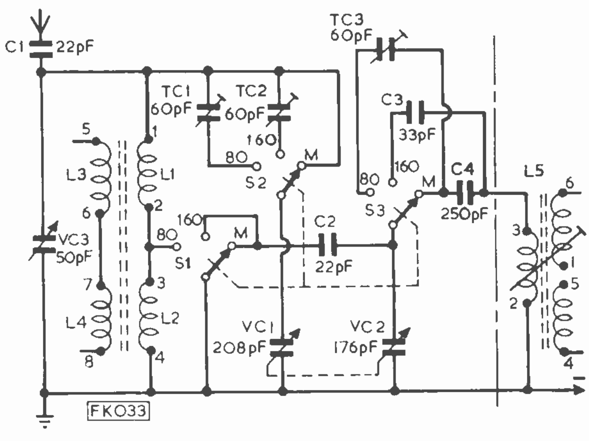


Fig. 1: Circuit diagram of the switching and tuning arrangements of the receiver. Connections to L3, L4 and L5 are shown in Fig. 2.

lower impedance (but not under 8 ohms) is more suitable. Low impedance phones may be plugged into the jack socket, for personnal listening.

CONSTRUCTION

The receiver, with speaker and battery, was constructed to fit a case $6 \times 3\frac{1}{2} \times 1\frac{3}{4}$in. internal dimensions, as a pocket set giving good 80m and 160m amateur band reception in addition to normal MW reception. The whole circuit of Fig. 2, with the exception of the aerial, VR1 and speaker, is assembled on 0·1in matrix plain Veroboard. In order that the components may be readily accommodated, it is most convenient to use the $\frac{1}{4}$ watt resistors sometimes listed as "miniature". The capacitors are also of small size, and except for the electrolytics, are mostly low voltage disc ceramic.

The board is approximately $4\frac{1}{4} \times 1\frac{5}{8}$in, and components can be located from Fig. 3. Holes are first drilled to take the pins of the oscillator coil, IF filter and for bolts to secure the two angle brackets which attach the board to the receiver panel and which also form the earth return connecting points. Tags are fitted for this purpose. In most places the wire ends of resistors and capacitors can reach between the connecting points. Where other connections are required, these can be 24SWG tinned copper or similar wire. Insulating sleeving is necessary on many leads and different colours can be used to identify various connections.

When soldering to the IC, the same care to avoid overheating should be taken as when soldering the transistors. With the latter, short pieces of green sleeving were put on the emitter leads with white on the collector leads, to avoid possible short circuits and provide easy identification of connections. Flying leads are provided from R7, for VR1 centre tag and from R6/C12, also for VR1. The remaining VR1 tag is wired to chassis. Leads from C18 positive and the positive line run to the speaker. A red lead from C14 positive is fitted with a positive battery clip.

The bridging connections on the IF filter should not be overlooked and connections must not touch unused pins. C3 and C4 are soldered to pin 3 of the oscillator coil and will go to S3. C10 has short leads to pins 8 and 9 of IC1.

A small soldering iron is necessary and care must be taken not to form very large joints or to bridge adjacent points with solder. The layout of components is quite compact though there is some free space.

★ components list

Resistors

R1	22kΩ	R8	27kΩ	R15	2·2Ω
R2	150Ω	R9	470Ω	R16	15kΩ
R3	820Ω	R10	10kΩ	R17	10kΩ
R4	8·2kΩ	R11	100Ω	R18	220kΩ
R5	8·2kΩ	R12	680Ω	R19	2·7kΩ
R6	390Ω	R13	47Ω		
R7	1kΩ	R14	2·2Ω		

All resistors are 5% ½ watt
VR1 5kΩ log. potentiometer with switch S4

Capacitors

C1	22pF	C8	0·047μF	C15	0·25μF
C2	22pF	C9	0·047μF	C16	0·01μF
C3	33pF	C10	0·047μF	C17	32μF 6·4V
C4	250pF	C11	10μF 6·4V	C18	320μF 6·4V
C5	0·047μF	C12	0·1μF	C19	100pF
C6	0·1μF	C13	320μF 6·4V	C20	680pF
C7	0·1μF	C14	220μF 10V	C21	0·047μF

VC1/VC2 208/176pF gang (Jackson Type 00 with slow motion)
VC3 50pF variable (Jackson Type C804)
VC4 20pF variable (Jackson Type C1604)
TC1/2/3 60pF compression pre-sets

Semiconductors

IC1 TAD100 Tr1 AC141 Tr2 AC142 Tr3 ZTX108 or similar

Miscellaneous

Ferrite rod aerial (Denco 5in. with MW winding only). Oscillator coil L5 (Denco TOC1). Filter F1 CTF455C (Ambit). Switch S1/2/3 3 pole 3 way rotary wafer. S5 slide switch. Speaker 8 ohm 2½in. but see text. Insulated jack socket 3·5mm. Veroboard, see text. Knobs.

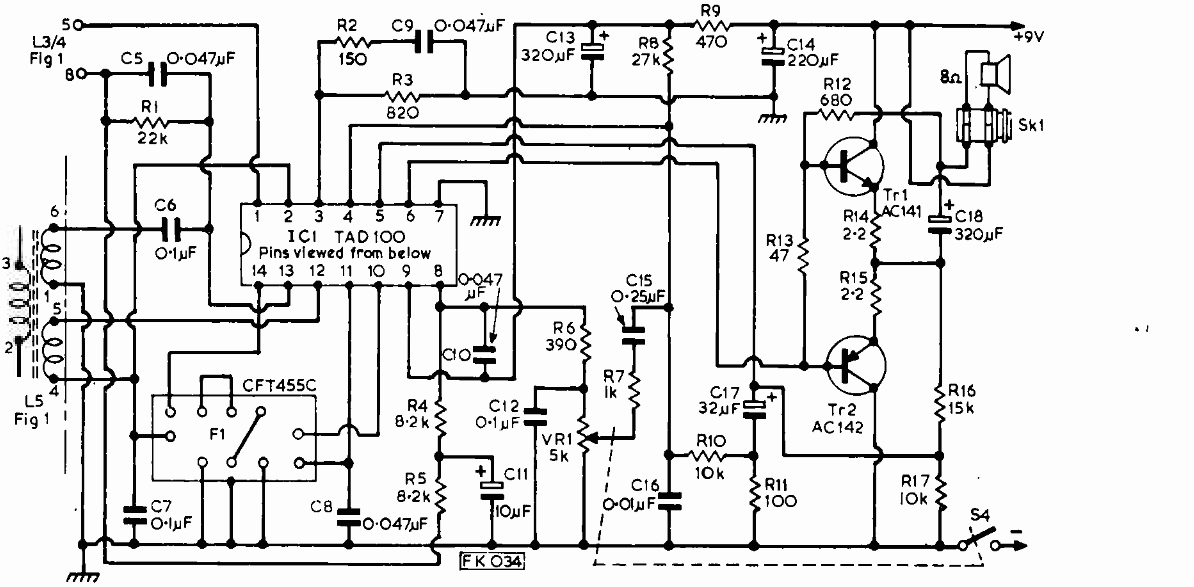


Fig. 2: Circuit diagram of the receiver and amplifier sections of the 'IC + 2'

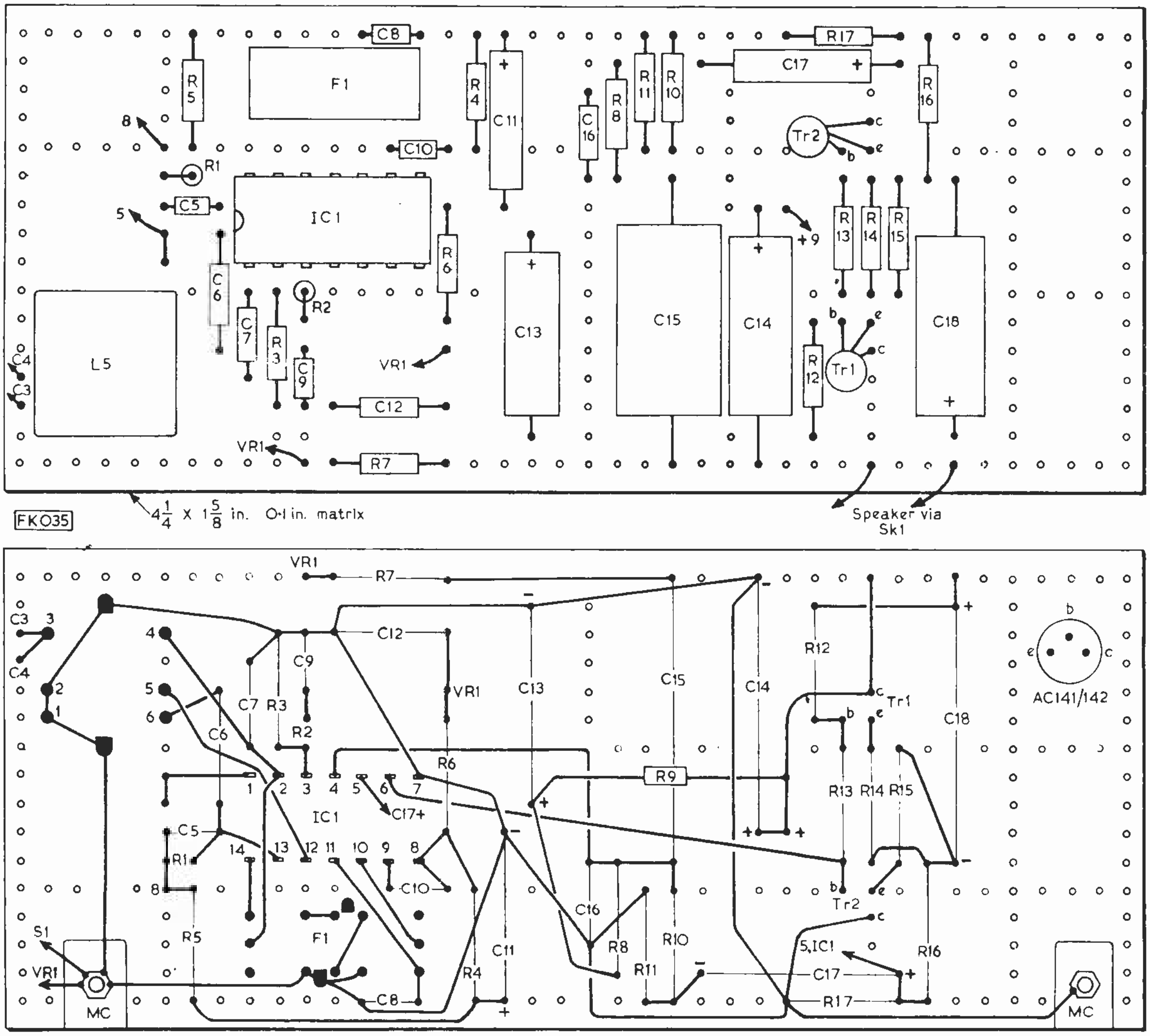


Fig. 3: Component layout on the perforated board. Use insulated wire for the underside wiring.

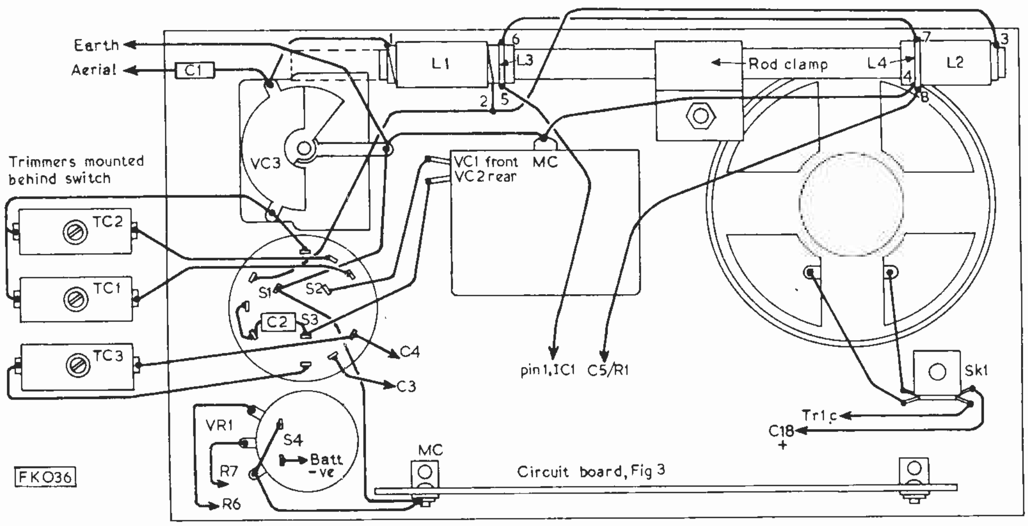


Fig. 4: Front panel component location and interwiring. Capacitors C3 and C4 are mounted between the board and the front panel.

The whole receiver is assembled on the panel of the case, so that it can be tested and adjusted easily. Connections here can be seen from Fig. 4.

VC1/VC2 is fixed with three 4BA countersunk bolts and is set back a little by placing extra unts or washers between the capacitor and panel. If this is not done the control knob will project much more than necessary, since the spindle could, in any case, only be cut down very little, due to the integral reduction drive. VC1 is the front section, having most plates, and VC2 the rear section.

The rotary switch is wired as shown except for the trimmers. These are then mounted by using 18 SWG or other stout wire directly to VC3 and the switch tags. These three trimmers are directly behind the switch.

FERRITE AERIAL

A $1\frac{1}{2}$in 6BA bolt passes through the panel and a spacer or extra nuts allows the rod to be clamped as in Fig. 4, by passing a strip of stout card round it.

A strip of paper about 1in to $1\frac{1}{2}$in long is wound round the end of the rod, with a little adhesive, forming a tube which will allow L1/L2 to be slid along the rod. L1 begins at 1, and is 30 turns of 26SWG enamelled wire, close wound, ending at 2. L3 is two turns of any thin insulated wire, say 34 SWG, near L1.

As the MW section L2 is intended for use by itself 17 turns are unwound from its outer end. All the individual strands of the wire must be carefully cleaned and soldered together. This lead is 3, Figs. 1 and 4. L1 and L2 must be so phased that beginning at 1, continuing on to 2 and 3, and then to 4, all turns are in the same direction.

L4, already present with L2, is modified to leave only three turns. L3 and L4 must be in the same direction, as explained for L1 and L2. It is worth noting that the receiver can be tested on medium waves only by connecting L2, unmodified, to VC1 and chassis, and L4 to C5 and 1, IC1. Position the winding on the rod so that VC3 peaks up signal throughout the range.

ALIGNMENT

This can be greatly simplified by using a signal generator or second receiver, but in any case efficiency is not lost provided VC3 can be rotated to peak up signals and is then not fully closed or fully open. However, band coverage does depend considerably on the trimmers and oscillator core setting.

If a calibrated receiver is available, place an insulated lead from its aerial socket near VC2. Switch to medium waves and close VC1/2. Unscrew the core of the oscillator coil until the oscillator frequency is 1165kHz, as shown by the receiver. If the receiver is not a type with a tuning indicator or BFO, the oscillator signal or carrier will be located only as a reduction in background noise, as when tuning in a station carrying no programme. The core can then be left in this position. Otherwise, unscrew the core a little, checking reception, until the MW band obtained is about 710-1565kHz. Any integral trimmers on the ganged capacitor should be left fully unscrewed.

Signals near the HF band end should peak up with VC3 about one-third closed. Position L2 on the rod so that VC3 is best in a similar position near the LF end of the band (VC1/2 nearly closed). With the switch at 160, coverage depends on C3, and no other adjustment is provided. If 1·8 to 2MHz cannot be tuned, the oscillator coil core is probably wrongly set. There is some latitude, this range being about 1705 to 2145kHz. TC2 is adjusted so that the aerial circuit coverage is suitable, shown by VC3 not needing to be fully open for best volume.

When the switch is at 80, oscillator coil coverage is adjusted with TC3. There is not much latitude here, though a little over 3·5 to 3·8MHz can be tuned with the full swing of VC1/2. It is then necessary to set TC1 and if necessary also modify the position of L1 on the rod, until aerial coverage is similar, again as shown by VC3 peaking signals when rotated.

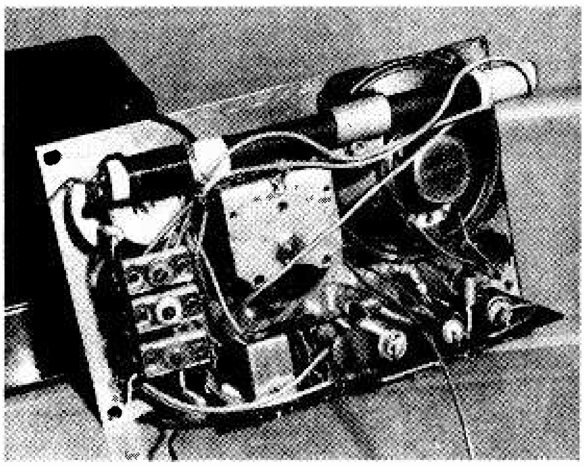
NOTES

MW reception will usually be by means of the internal ferrite rod, through an external aerial naturally increases range. The ferrite rod will give sufficient pick-up of strong local signals on the 80m and 160m bands. It may be necessary to make use of the directional effects of the aerial by turning the whole receiver. However, normally an external aerial will be provided for 80m and 160m.

This aerial increases range and signal strength so that more transmissions can be heard, even if it is only a relatively short indoor wire. The aerial lead goes to C1. If a very long aerial is available, a further small capacitor or preset of about 50pF maximum can be put in this lead. For best reception an earthed connection should also be available, as this can increase signal strength to a worthwhile extent.

The aerial and earth sockets are on the side of the case with thin flexible leads running to them. The phones socket must be of fully insulated type, or separately insulated from the metal panel.

The dial is $2\frac{3}{8} \times 2\frac{1}{4}$in with a scale marked 0-100. It is covered with a piece of thin Perspex of the same size, fixed with the bolt holding the ferrite rod mount, and a second bolt near VC3. A transparent cursor with a line marked on it can be drilled to be a tight fit on a small grommet, which firmly grips the $\frac{1}{4}$in. spindle. Alternatively, a metal pointer could be soldered on. A piece of metal is shaped to hold the battery against the end of the case, and is bolted inside the case.



Internal view of the 'IC + 2' receiver (without BFO).

OPTIONAL BFO

Broadcasts received on medium waves are AM or amplitude modulated and will be heard in the usual way. Some transmissions in the 160 and 80 metre bands are also AM. However, on the 80m amateur band in particular, a large number of single side-band and CW Morse transmissions will be present. A beat frequency oscillator is necessary to receive these and this can be assembled on the space provided at the end of the board, near the speaker. The BFO is **not** in use for the reception of AM signals, on any frequency.

Fig. 5 is the circuit of the BFO which is brought into operation by closing S5. The panel control VC4 allows fine adjustment of BFO frequency.

As the BFO pitch control now occupies the hole used for the phone socket, this has to be moved to the side of the case. It is also necessary to position the battery immediately against the speaker, and near the ferrite rod, so as to clear VC4 and the coil.

The coil is wound with 38SWG wire, Fig. 6. L6 has 165 turns and L7 has 40 turns. The former is approximately 7mm in diameter with an adjustable core. Begin winding near the base of the former, this being point C. Wind L6 in a pile occupying about 8mm winding length, ending at D. Leave a space of about 1mm and begin at A, winding L7 in a pile occupying about 4mm and terminating at B. The windings can be secured with a little adhesive and the ends are left long enough to reach the various connecting points.

Components for this stage are positioned and wired as in Fig. 6. S5 is a miniature slide switch, fitted in a slot near the speaker. VC4 is also a miniature component, secured with its bush nut. As the spindle of the specified VC4 is not ¼in in diameter, it is necessary to obtain a knob with a small hole, or to cut and shape a small piece of metal to pack out the spindle diameter. Or drill a ½in length of plastic rod ¼in in diameter to fit the capacitor shaft.

No additional coupling into the receiver circuit was found necessary, other than that provided by stray capacitance and the unscreened coil.

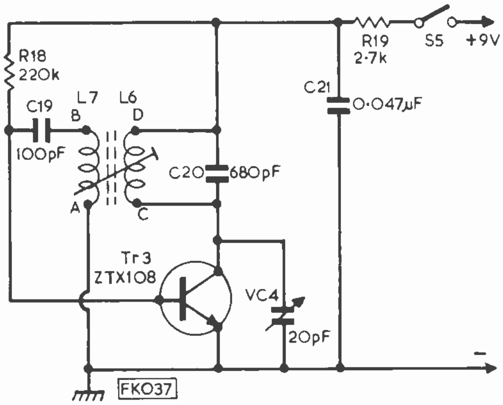


Fig. 5: Circuit diagram of the beat frequency oscillator.

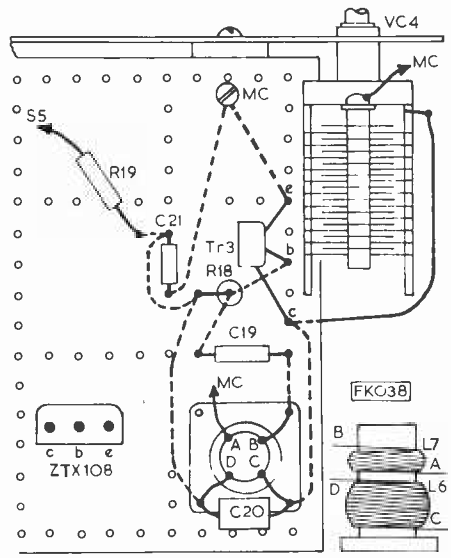
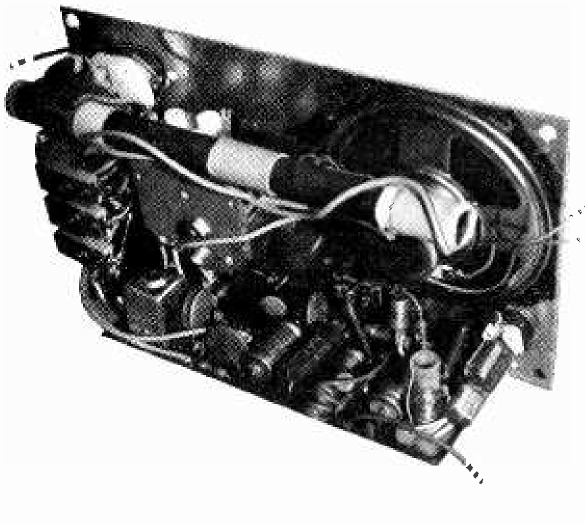


Fig. 6: Layout of the BFO components on the perforated board. The variable capacitor VC4 occupies the hole previously used for the jack socket.



The 'IC + 2' receiver with the extra BFO components added.

BFO ADJUSTMENT

The BFO can have no effect until it is adjusted to about the same frequency as the receiver intermediate frequency of 455kHz. To do this, half closeVC4 and rotate the core of L6 until a strong heterodyne accompanies any AM signal tuned in. This is probably most easily done on the MW band. Check with more than one station to make sure the heterodyne is not a harmonic reaching the aerial circuit.

To receive CW, close S5 and adjust VC4 for the best note. For SSB reception, very careful adjustment of receiver tuning and VC4 are necessary. When CW or SSB signals are very strong, the aerial trimmer should be set to reduce them in power, so that VR1 can be near maximum gain. In this way the carrier of the BFO has sufficient strength to allow proper detection. A little use will soon show how the BFO control is adjusted. PW

PRODUCTION LINES

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LED DIGITAL WATCH DISPLAYS

Litronix, the optoelectronic and semiconductor manufacturer, has added four new low-power LED displays to its range of semiconductor devices for electronic digital watches. These 4-digit displays are mounted on small ceramic substrates measuring only 0·75in. long x 0·21in. high. To minimize area requirements, the packages are provided with solder bump contacts designed for reflow solder attachment to a watch module. Designated the DL-5175 Series, the displays are available in four different types, each with colon between second and third digits:

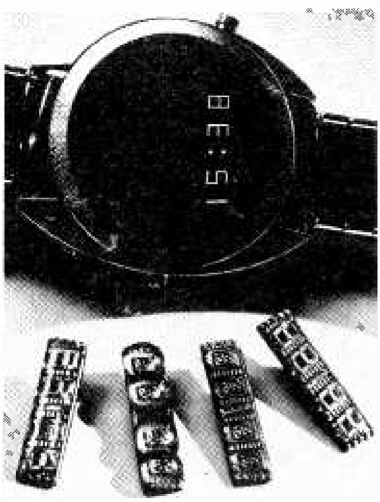
The DL-5175 is a 4-digit display of continuous-line monolithic digits 0·1 in. high.

The DL-5176 is a 3-1/2 digit hybrid display of characters 0·115in. high.

The DL-5177 is a 4-digit display in a monolithic package with digits magnified to create 0·1in. high characters.

The DL-5178 is a 4-digit version of the DL-5176 for a 24-hour watch. Prices start at £3·66 in quantities of 1000.

All displays are manufactured from specially selected high-brightness materials which minimize drive current requirements, and enhance visibility in high ambient light. In the case of the DL-5177 the use of a magnifying lens, which concentrates the emitted light into a narrow cone, makes it particularly suited to veiwing in bright sunlight.

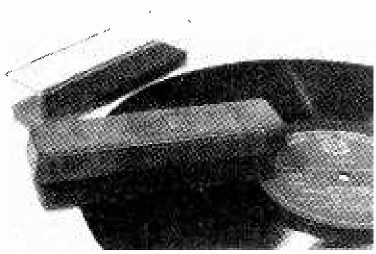


The pin-out configuration of the DL-5175 Series has been optimized to allow close spacing of associated integrated circuits, such as the Litronix LBC-1060 and LBC-1070 bipolar drivers.

For further information on these digital watch displays, contact *Bill Stott, Product Marketing Manager, Litronix, Bevan House, Bancroft Court, Hitchin, Herts, SG5 1LW.*

BIB RECORD DUST-OFF

BIB announce a new BIB Record Dust-off, for removing dust and dirt quickly and simply from gramophone records to reduce record and stylus wear.



Normally it is recommended that the Dust-Off is used dry, but it has been designed so that it can be used in a moist condition if records are excessively dirty. The BIB Dust-Off comes complete with a clear protective cover in which is included a foam pad which can be moistened with BIB liquid cleaner so that when the Dust-Off is inserted into the cover the velvet surface and absorbs the moisture from the foam pad evenly.

The handle of the BIB Dust-Off is moulded in a simulated teak finish and the cleaning pad is covered in a smart, special purpose, high quality red velvet.

Recommended Retail Price of the Dust-Off is 66p each, excluding VAT. *BIB Hi-Fi Accessories Ltd., P.O. Box 78, Hemel Hempstead, Herts. HP2 7EP.*

POCKET TEST METER

No bigger than a packet of cigarettes, the new ICE Microtest 80 test meter combines several unique features in one compact and accurate instrument.

Covering 8 fields of measurement and 40 ranges, the meter has a 20,000 ohm per volt sensitivity, with 2% accuracy on the a.c. and d.c. scales.

Design of the meter incorporates special automatic electronic regulation for zero ohms, and the movement is protected against on overload of 1,000 times in the ohmetric ranges before automatic cut out. Protecting the low ohmetric ranges is an internal fuse unit, easily repaired by winding on a fuse from a minute, internal bobbin.

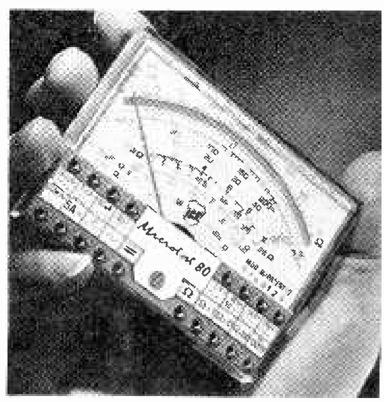
The shockproof movement, with a compensated magnetic core provides a closed magnetic circuit screened against all external magnetic fields. The 20 components are housed on a printed circuit board, making replacement of components fairly easy.

Power is from a special 1·35V mercury battery which, in normal usage, will last up to 3 years. A complete range of accessories is available with the meter to extend its performance.

Incorporated into the design of the Microtest 80 are the latest-type manganine and metallic film resistors giving high stability and precision of 0·5%, while the mirror scale gives clear and accurate reading.

Each test meter is supplied with a comprehensive instruction manual, and a protective case incorporating the leads. Size is 90mm x 70mm x 18 mm.

Meters or further information available direct from the sole UK importers, *Electronic Brokers Ltd., of 49, Pancras Road, London NW1 2QB,* the Microtest 80 is priced at £11·95 ex VAT with special terms for quantity purchases.



The Microtest 80 mini-meter.

HAM II ROTATOR

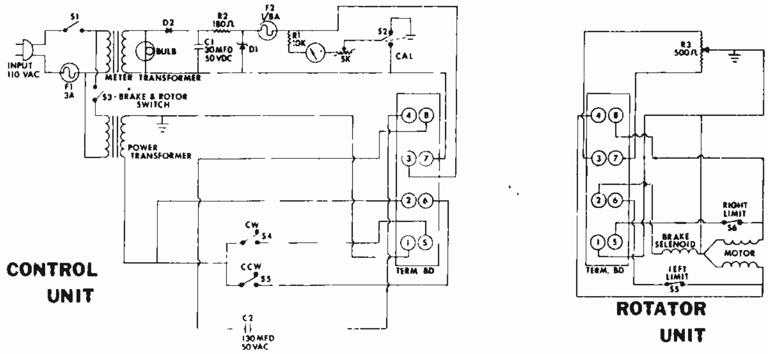
The Ham II rotator system, available from South Midlands Communications Ltd. is designed for Amateur aerial systems with a maximum of 7·5 sq. ft. It provides a full 360° range of rotation and aerial position is indicated on a meter scale.

The rotator motor, radial and thrust bearings, electrically-operated wedge brake, gear train and indicating sensing device are built into the bell-shaped aluminium housing.

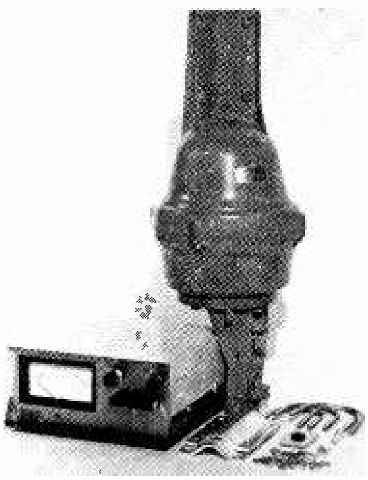
The control unit utilises two transformers. One supplies 30V a.c. for releasing the brake and operating the motor when the control levers are operated. Transformer overheating is eliminated by a thermal cut-out switch in the primary winding.

The meter transformer is energised as the on/off control is switched to the "on" position (see diagram). Rotator size is 8in diameter and 20in high. Brake torque is 3,500in./lbs. and an 8-core cable is required between control unit and motor. Rotator weight is 12¼lbs and power requirement 240V a.c.

These rotators are actually made in America but imported and retailed by *South Midlands Communications Limited* who will be pleased to supply details of prices etc. upon receipt of a stamped, addressed envelope. Their address is *S. M. House, Osborne Road, Totton, Southampton, S04 4DM.*



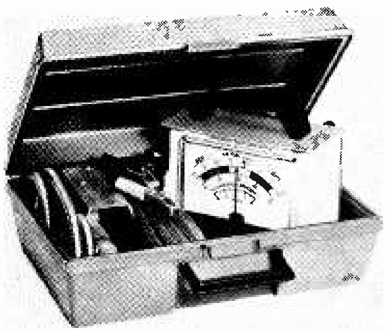
(Above) circuits (110V version) of the control unit and rotator unit
(Below) control unit and rotator.



EXHAUST GAS ANALYSER

With the new Heathkit CI-1080 Exhaust Gas Analyser, you can easily monitor exhaust output for minimum pollution and maximum efficiency. The CI-1080 will indicate relative combustion efficiency, air-fuel ratio and percentage of carbon monoxide from the exhaust emission of four cycle automotive engines. For best results, readings should be taken before and after an engine tune-up.

The CI-1080 consists of a large 4½in. meter and sensor which fit snugly inside the durable polystyrene carrying case. For operating power, the colour coded battery clips can be attached to any 6 or 12 volt car battery. The meter is designed to hang on a partially open car door window or sit on any convenient flat surface. Flexible stainless steel tubing diverts exhaust gas from the engine exhaust pipe to the sensor where thermal conductivity of the gas is measured. A sensitive bridge circuit built into the instrument translates this measurement into units of air-fuel ratio, combustion efficiency (%) and carbon monoxide (%). These readings indicate the proper interaction of carburetter and ignition settings.



Operation of the CI-1080 is simple. After warming the engine to normal operating temperature and connecting the battery clips, the meter is adjusted to the balance point using the balance control. The flexible tubing is then connected to the sensor and the other end inserted into the exhaust pipe. After the meter stabilizes, readings can be taken. The kit K/CI-1080 costs £34·60 or Assembled: A/CI-1080 £49·90. (Including 8% VAT and delivery within the United Kingdom). *Heath (Gloucester) Ltd., Bristol Road, Gloucester GL1 6EE.*

DIGITAL CAR CLOCK/ TIMER KIT

On the Heathkit GC-1093 digital electronic car clock/timer, hours and minutes are displayed in bright orange on 7 - segment Beckman planar gas discharge tubes—even visible in direct sunlight! When the sun goes in, the clock readout automatically dims so that the car driver won't be distracted while driving at night.

A quartz crystal time base and solid-state digital electronic circuitry combine to give the clock an accuracy of within one minute per month. The low - voltage clock memory is designed to maintain this accuracy even during battery-draining starting on cold mornings.

At the touch of a button on the front panel, the clock turns into a precise elapsed timer with a 20-hour capability. During the first ten minutes of elapsed timing, the digital readout is in minutes and seconds. Thereafter, readout is in hours and minutes for up to 20 hours. The clock readout can be recalled at any time without disturbing the memory of either the clock or the timer.

The GC-1093 kit is priced at £39·90 (this includes 8% VAT and delivery within the UK). *Heath (Gloucester) Ltd., Gloucester GL1 6EE.*

Please mention *"Practical Wireless"* when contacting manufacturers and suppliers whose addresses are given in "Production Lines".

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Forget slide rules and four-figure tables!
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sin and arcsin,
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$\log_{10}$, antilog_{10}, giving quick access to x^y (including square and other roots),
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All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our Service Department will back you throughout if you've any queries or problems.

Of course, we'll happily supply the Scientific or the Cambridge already built, if you prefer – they're still exceptional value. Use the order form.

Components for Scientific Kit (illustrated)

1. Coil
2. LSI chip
3. Interface chips
4. Case mouldings, with buttons, windows and light-up display in position
5. Printed circuit board
6. Keyboard panel
7. Electronic components pack (diodes, resistors, capacitors, etc)
8. Battery assembly and on/off switch
9. Soft carrying wallet
10. Comprehensive instructions for use

Assembly time is about 3 hours.

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7. Keyboard panel
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9. Battery clips and on/off switch
10. Soft wallet

Assembly time is about 3 hours.

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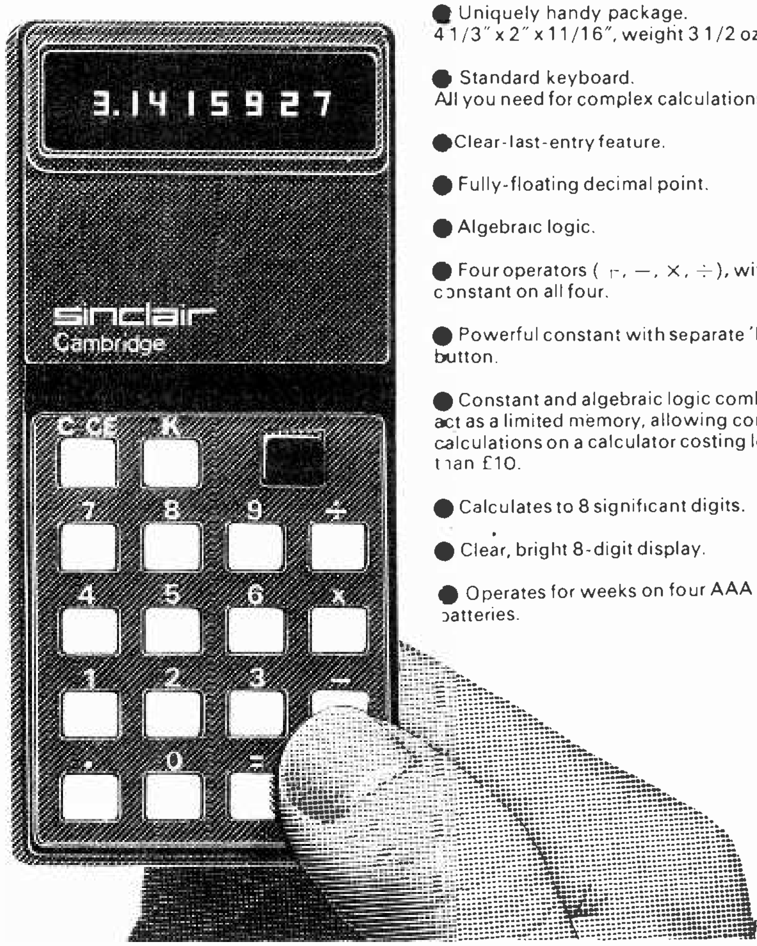

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QUIZ MONITOR

A. FOWELL

ANYONE who has ever attempted to organise a quiz, either between friends or within the family, will no doubt have watched with envy the smooth running of such television programmes as University Challenge, Top of the Form, etc. In the home quiz, however, a free-for-all situation arises where a question is asked and whoever shouts first is allowed to answer! The difficulty here being in deciding who shouted first! In the TV programmes already mentioned the problem is solved using a buzzer system.

The quiz monitor described in this article was designed with a view to recreating a "University Challenge" atmosphere by providing each player with a button. The first button pressed turns on a corresponding light on the main console and sounds a buzzer. Once this has happened all other players are automatically excluded, and, although the buzzer stops upon releasing the button, the light remains on until cancelled by the quiz master.

Circuit

The complete circuit of the quiz monitor for up to four players is shown in Fig. 1. At first sight the circuit looks rather complicated but its operation can be readily understood by considering the action of a similar circuit, but for two players only, Fig. 2.

PB3 is a normally closed push button, whilst PB1 and PB2 are normally open. The values of R1, R2, R3 and R4 are chosen so that on closing PB1, sufficient gate current flows to trigger TH1 into conduction and LP1 therefore lights up. The voltage on TH1 anode falls to about 1V under these conditions, so the cathode of D2 is firmly fixed at a potential of 1V. The junction of R5 and R6 cannot therefore rise above about 1·6V, even if PB2 is pressed. R6 and R7 are chosen so that under this condition there is insufficient drive to the gate of TH2 to cause it to conduct. The same arguments apply if the other button is pressed first.

Due to normal thyristor action LP1 will remain illuminated even when PB1 is released, and it can only be extinguished by momentarily reducing the current through TH1 to zero. PB3 is included in the circuit for this purpose and is under the control of the quiz master. The thyristors specified are sensitive gate types which necessitate the use of R4 and R8. These prevent premature firing of the thyristor

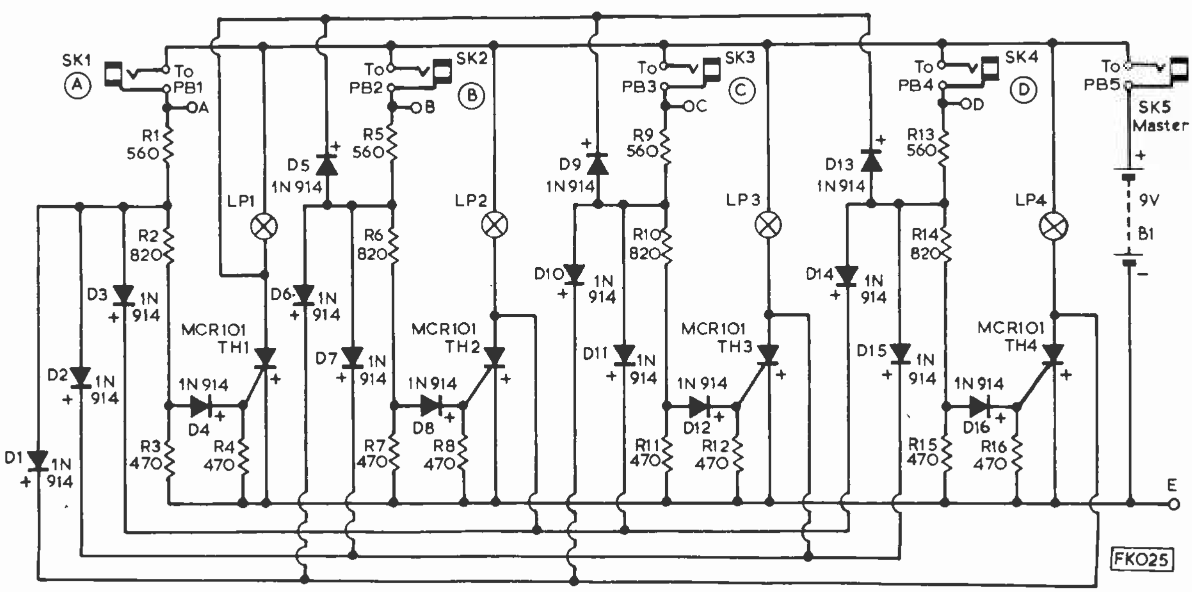


Fig. 1: Circuit diagram of the monitor proper the output being fed to the buzzer circuit of Fig. 3.

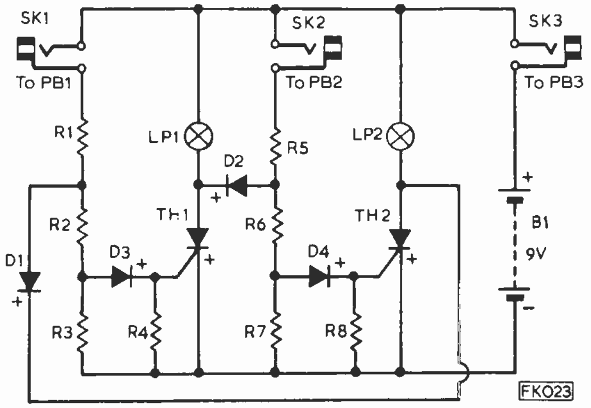


Fig. 2: A simplified circuit for two players only, to illustrate the operation of the monitor.

by providing a low impedance path to earth for any noise signals that may be present.

It is possible for the bulbs to light simultaneously if both buttons are pressed at precisely the same moment. In practice, however, this does not happen very often, but when it does it is reasonable to consider the situation as a draw. Diodes D3 and D4 are included in order to make the values of R2, R3, R6 and R7 relatively unimportant.

From this discussion it can be seen that from each stage of the circuit there must be one diode to every other stage. Thus for the four-channel circuit, Fig. 1, there are 12 diodes acting as feedback elements to other stages.

Audible Warning

Fig. 3 shows the buzzer circuitry. Diodes D17 to D20 act in conjunction with Tr1, R17 and R18 as a logic 'OR' gate, i.e. if any of the four buttons are pressed then Tr1 is turned on and the buzzer sounds. Diode D21 is essential to prevent high voltage spikes, due to the inductance of the buzzer coil, from damaging Tr1. C1 is included to minimise interference from the buzzers' contacts.

It will be noted that separate batteries are used for the main circuit and for the buzzer. The reason for this is twofold. First, the buzzer used only requires around 4·5V and it is difficult to design the rest of the circuit to work reliably off such a low voltage. Second, and more important, is the fact that the buzzer draws about 1A from a 9V supply. This causes a substantial voltage drop which can upset the operation of the main circuit.

Construction

The prototype was built into a plastic instrument case measuring approximately 6 x 4 x 4in, although any case of about this size will suffice. All of the electronics, including the buzzer, are mounted on a piece of 0·1in pitch veroboard about $5\frac{3}{4}$in x $3\frac{1}{4}$in. The copper tracks need to be cut at several points, and these are indicated, with the corresponding component layout, in Fig. 4. The veroboard required is slightly longer than the standard 5in length, but if the buzzer can be accommodated elsewhere within

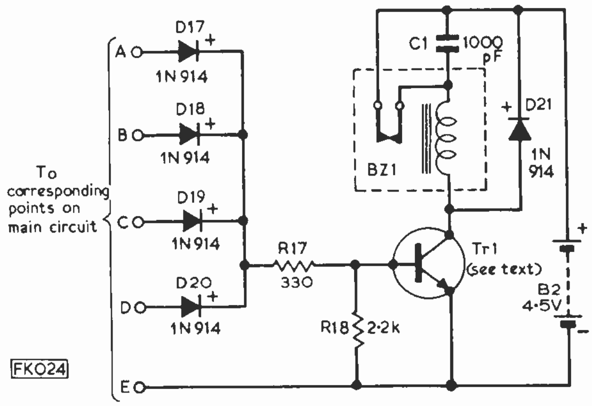


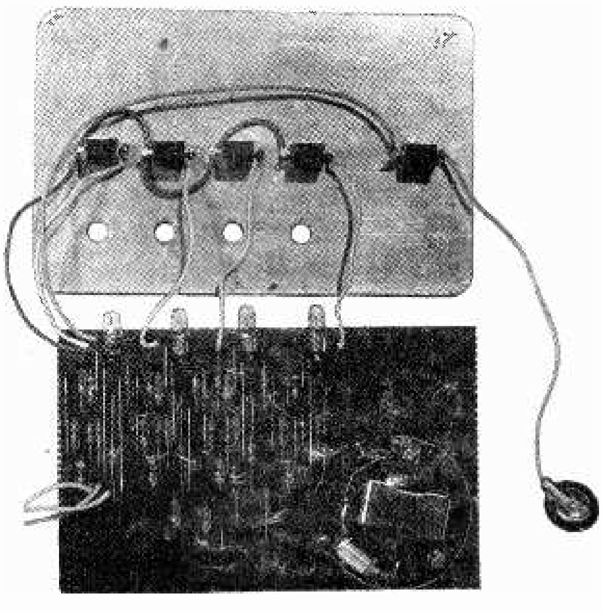
Fig. 3: Buzzer circuitry and input diodes fed from main circuit, Fig. 1.

the box, then the board dimensions can be reduced to 4 x $3\frac{1}{4}$in.

The 21 diodes can be any general purpose signal type but D4, D8, D12 and D16 must be silicon since the forward voltage drop of germanium, about 0·2V, is too low for this part of the circuit. It is also recommended that the specified type of thyristor is used since its operating conditions are quite critical. The bulbs are 12V Lilliput types, which, with the 9V supply, only consume about 50mA. Bulb holders were dispensed with, for cheapness, and the bulbs soldered directly to the veroboard. Provided the soldering operation is carried out quickly the bulbs should not be damaged.

PB1 and PB4 can be ordinary bell pushes which are readily available very cheaply. PB5, on the other hand, must be a normally closed type, and may be a little more difficult to obtain. Tr1 can be any silicon NPN transistor with a collector current rating of at least 500mA. The buzzer is a standard domestic type which is easily obtainable at most electrical retailers.

The instrument case used for the prototype has two sets of slots moulded into it. These are used to secure the veroboard and an aluminium plate, the same size as the circuit board, which holds the two



Finished circuit board wired to panel sockets. The lamps protrude through the holes in the panel.

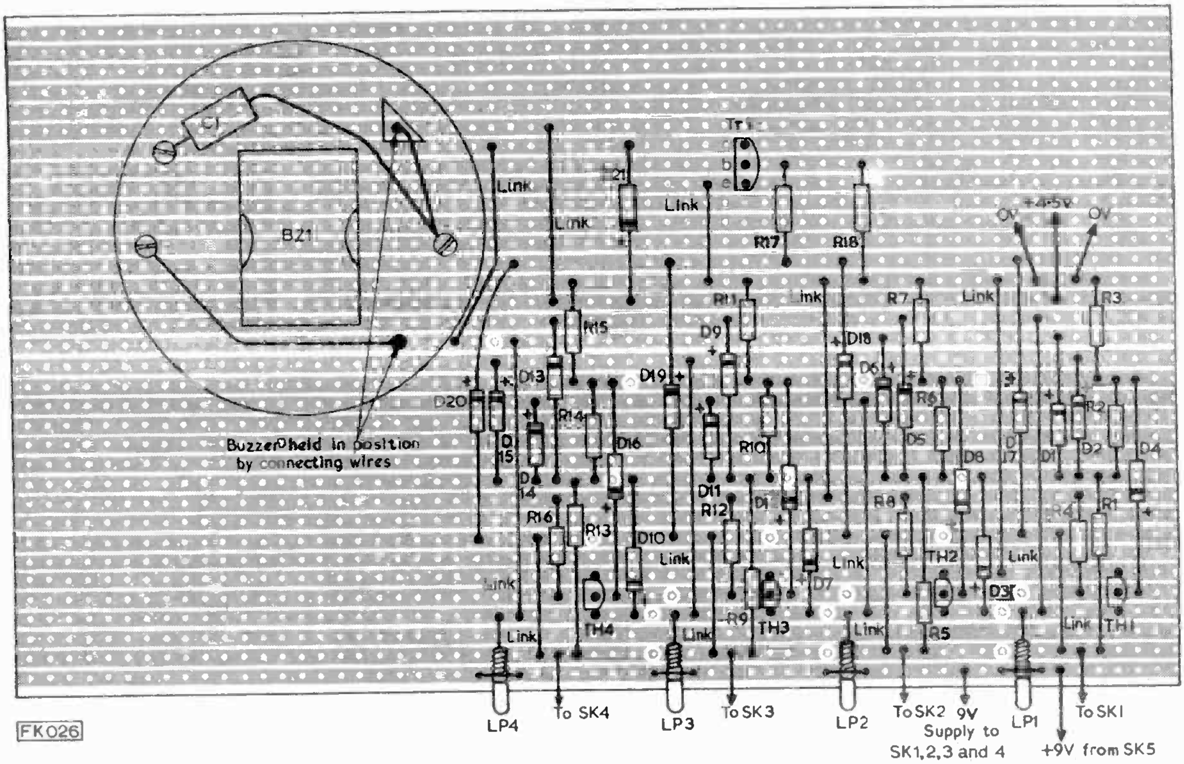


Fig. 4: Component layout on circuit board. Note carefully the breaks in the copper rails.

★ components list

Resistors

R1 560Ω	R10 820Ω
R2 820Ω	R11 470Ω
R3 470Ω	R12 470Ω
R4 470Ω	R13 560Ω
R5 560Ω	R14 820Ω
R6 820Ω	R15 470Ω
R7 470Ω	R16 470Ω
R8 470Ω	R17 330Ω
R9 560Ω	R18 2·2kΩ

All ¼ or ½W 10%

Capacitor

C1 1000pF 15V

Semiconductors

TH1, TH2, TH3, TH4 } Motorola MCR 101 (0·5A)

D1 to D21 1N914, 1N916 etc.

Tr1 2N3053 (Silicon NPN type with collector current rating of 500mA. min.)

Miscellaneous

Four normally open push buttons. One normally closed push button. Five 2·5 or 3·5mm jack sockets and plugs. Four Lilliput 12V bulbs. Friedland 'Mini buzzer' or similar. PP7 (9V) and 1289 (4·5V) batteries.

Constructors of this monitor will be interested in the Reaction Timer also described in this issue.

batteries. The front panel, again of aluminium, completes the case and holds the circuit and chassis in position, see photographs.

The five push-buttons are connected to the circuit by means of panel-mounted jack sockets and plugs. It will be noted that no on/off switch is included since, with the bulbs and buzzer off, the current taken is only the leakage current of the thyristors and Tr1, which is negligible. If the unit is to be left for any length of time the batteries can be disconnected.

No great difficulty should be encountered in the construction of this project but the following points may be helpful. Make sure that adjacent tracks on the veroboard are not shorted out by blobs of solder. This is easily avoided by the use of a soldering iron with a bit diameter of no more than ⅛in. Secondly, cut the veroboard track in accordance with Fig. 4 **before** mounting the components as it will be difficult to do so afterwards.

Testing

Having completed the unit, connect the batteries and press any one button. The corresponding bulb should light and remain lit upon releasing the button. The buzzer should also sound during the time the button is pressed. Pressing PB5 should extinguish the light. Repeat this test with each of the other three buttons. Now, press one button, bringing on the corresponding light, and press each of the other three buttons. The buzzer should sound each time but the original light only should be lit. If any part of these two tests fails then it is likely that one or more of the diodes is either not connected or is connected the wrong way round.

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⅛	MF	10–2M7	2	1·54	1·32	1·1	3x7
¼	MF	10–2M2	2	1·43	1·21	0·99	4·2x10·8
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16µF	40V	6½p	470µF	6·4	9p
22µF	25V	6½p	470µF	40V	20p
22µF	63V	6½p	680µF	16V	15p
32µF	10V	6½p	680µF	40V	25p
33µF	16V	6½p	1000µF	16V	20p
33µF	40V	6½p	1000µF	25V	25p
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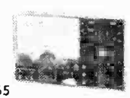
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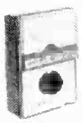
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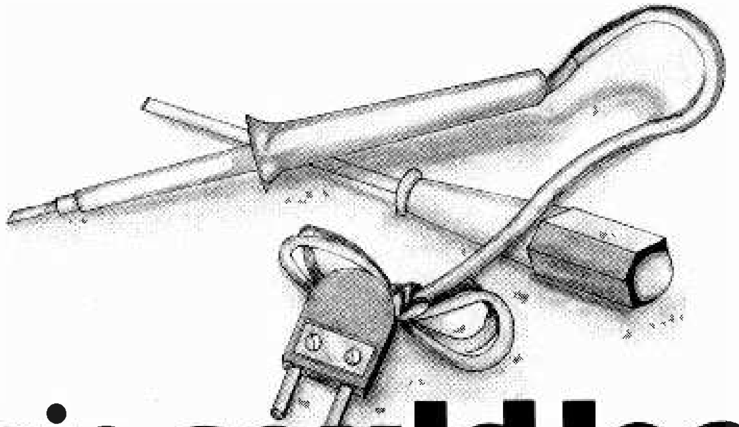

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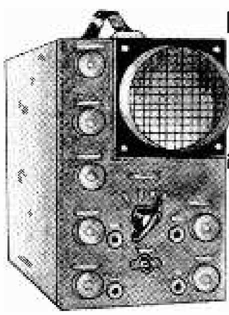

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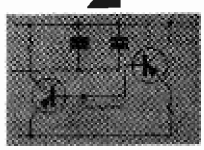

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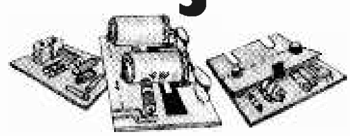

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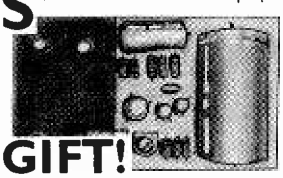

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THE UNITRON

A MAGNETIC FIELD-EFFECT TECHNOLOGY

DON RESCHEVSKY*

EVERY once in a while, some major breakthrough in electronics changes the whole face of the industry. Now that world patents have been officially filed and registered, Solitronix Inc. has released details of a new device—in fact a new technology; the Unitron.

This component has such application potential that it is impossible to overstress its impact on the electronics scene both in industrial/professional and military applications plus, of course, consumer electronics. It works on an old, established principle but only now that there are newer materials available is it possible to exploit the full potential. Materials currently under investigation in the laboratories promise even better devices.

The device

The Unitron is extremely simple, both in operation and manufacture—which means cheap devices. The heading shows simple magnets with north and south poles. Text books inform that *like* poles repel while *unlike* poles attract. Push two north poles together and they will oppose you, but make it one north and one south pole and they'll try to get together—you have to physically hold them apart.

Now let us come to the clever part. Let us lay down a large number of very tiny magnets close together such that the flux or magnetic field of each magnet couples with that of its neighbours. If we lay them so that they attract, then there will be a certain interaction between the poles of each adjacent magnet. Similarly, a certain repulsion will take place if adjacent magnets have like poles.

It is at this juncture that materials start to play an important role. Until recently, materials available would only allow a magnet structure such as that above which, in itself, is pretty useless. Research during the past two years has led us to a new magnetic material/substance which is synthetic (i.e. man made). The new substance is called Polyferro-samarium-bybutylcobalt. To the layman it is a bit of a mouthful but to us it spelt success. Abbreviated to PSB it has the strangest effect upon magnetism and it is this effect which gives rise to the Unitron which makes possible a whole new family of devices.

The material PSB takes the form of a scft, plastic ferrite with a crystalline structure. In its normal synthesised state it is not magnetised, i.e. it isn't a magnet and thus has no north or south poles and has no field surrounding it—it is magnetically inert. If we now bring another magnet close to the material it will suddenly magnetise forming a miniature magnet complete with poles. This effect may also be obtained by simply applying some form of voltage either a.c. or d.c. Taking away the source of power makes the material magnetically inert again. The rise and fall times of this induced magnetic effect can be less than a microsecond, however, the material stores some of the power which is released when the next "pulse" of power is applied. The power appears to be stored within the material itself as a series of minute magnets which are themselves composed of smaller magnets. This tiny atomic magnet structure has the combined power of all the tiny magnets locked within it, but the poles are set up in such a fashion as to make the net magnetic effect across the whole structure add up to zero—until the next signal pulse is applied.

Structure

A diagram of the device is shown in Fig. 1. The drawing is simplified to preserve clarity. For example, there are 100 tiny vertical magnets and in some devices the coupling magnets (the long ones top and bottom) are divided and cross-coupled. The sizes are given which shows just how tiny these structures are. The length of one magnet element is only 2μ wide by 4μ long.

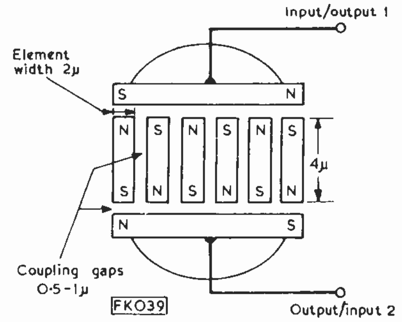


Fig. 1: Devices commonly have 100 elements on a 300μ x 10μ area. Only six are shown here for clarity. Note 1μ = 0·0000393in. or 1/1000in = 25μ.

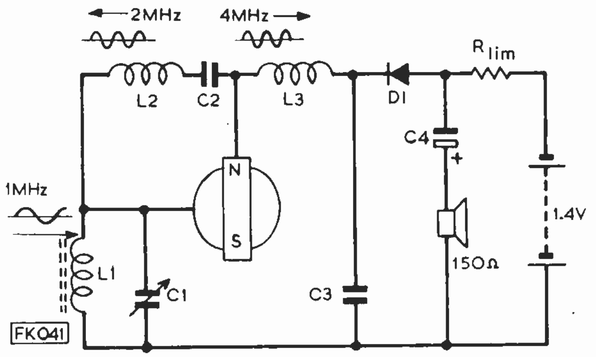


Fig. 2: M.W. receiver. The coil/capacitor combination L1/C1 tunes medium waves. (In example, we assume a 1MHz signal coming from the ferrite rod). L2/C2 tunes 2MHz and feeds signal back to input. L3/C3 tunes 4MHz and passes signal to D1, load R_{lim} and speaker.

* *Chief Design Engineer, Solitronix Inc. Anaheim, California.*

Device specifications in the semiconductor industry are commonly given in mils and to give some idea of the smallness of the elements in the Unitron it should be remembered that 1 mil is 1/1000in. which is equal to 25·4 microns. Thus even 25·4 microns (25·4μ) is only 0·001in. and thus 1μ is 0·001 divided by 25·4.

The Unitron structure is manufactured using similar techniques to those for making integrated circuits except that an electron beam is employed to trim the magnetic pattern.

First, a solid layer (less than 0·05μ for small signal devices and up to 7μ for power components) is deposited on a ceramic substrate. Then, a computer-controlled programmed laser beam cuts the devices into separate areas. Lastly, another computer programmed electron beam divides the areas into a series of minute islands each forming an inert, potential magnet made of PSB.

Operation

There is another peculiarity of PSB. The signal-induced magnetic field runs from input to output coupling magnets—a sort of magnetic ripple along the individual magnetic structures. However, immediately a signal is applied, a secondary magnetic surface wave streaks along the surface of the material, like a flat stone skimming across a millpond. Further, such a secondary field is exactly twice the speed, and therefore twice the frequency, of the induced field and lastly, it is very much larger. In other words, we have magnetic amplification. The degree of amplification is a function of two things—the type of field which caused it and the permitive index of the grade of PSB used.

Maximum gain obtained from a Unitron to date is 120dB. This is from an area less than 0·01in^2. For power devices the same order of gain is obtainable but a larger area is required because dissipation is higher within the device itself.

Perhaps the most startling thing about seeing a Unitron for the first time is that it has only two leads (although power devices may have their cases bonded to a heat sink to improve heat dissipation).

The Unitron does, of course, require a battery or some source of power. Efficiency is extremely high for small signal applications. For example, Fig. 2 shows the circuitry required for a small medium wave receiver running from a 1·4V power source. The resistor, R_{lim} is employed to act as a form of load, but also to limit the current taken by the device.

Thus if the output required (as shown in Fig. 2) is 250mW or ¼W and the Unitron was a grade 1 device (efficiency 85%) then one simply allows d.c. power equal to 115% to be applied i.e., 85% plus the 15% to make up 100% plus 15% for the loss. In the case of Fig. 2 and assuming 250mW required, then R_{lim} would be calculated for 0·1785A to flow. This is a simple calculation using only Ohms law viz; Volts x Current = Power which means 1·4V x 0·1785A = 250mW.

That's all there is to the design. Unitrons are classified and marked according to their frequency handling capability and power ability. Providing the frequency rating is greater than that for which the device is to be used, there are no problems. Power is simply a matter of Ohms law as explained i.e., the applied voltage multiplied by the current drawn by the device must equal a number which is less than the specified power rating of the particular device. Thus a 3PSB2 is a Unitron for use up to 3MHz (first figure) and must not dissipate more than 2W (last figure). Devices needing a heat sink are signified by the addition of the letter S after the last figure. If there is no S, then the dissipation is for free air.

A Unitron 3PSB1 (as used in Fig. 2) currently costs about one dollar on the US market, that's about 40p in English money. Already the consumer industry has placed orders for some 100 million devices and production lines are running flat out. The devices should find their way onto the US Amateur market by the third quarter of this year. By then, even better Unitrons will be available.

Some practical circuits are given in the remaining diagrams just to whet your appetite and show what can be achieved. Before closing the theoretical side, it is worth mentioning a spin off from the Unitron research program. Figure 3 shows a structure using only 3 magnets for simplicity. The complex build up of power i.e. stored field, in the PSB structure made us think. Isn't that just what a capacitor does—or even a coil?

To date, an electronic capacitor has been fabricated which could prove invaluable in the IC industry. There seems no reason why an electronic tuned circuit should not be manufactured using the Unitron technique. This would mean that complete receivers, transmitters, etc. could be manufactured on a single IC chip less than one hundredth of an inch square. The capacitor structure shown in Fig. 3 has allowed an electronic capacitance of 0·1μF at 3V working to be achieved in an area on 6μ by 10μ [1μ = 0·0000393in.].

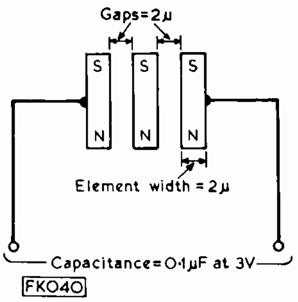
Applications

Radio Amateurs will be interested in the circuit shown in Fig. 4. Here, a single field effect transistor feeds a single Unitron. Although the f.e.t. v.f.o. needs to tune only one section of half the lowest band of interest (remember, the induced reverse surface wave is twice the frequency which induced it) then any higher harmonic can be tuned by simple selective tuned circuits. A signal coming in at, say, 3·5MHz would come out of the Unitron at 7MHz. Here, a simple 7MHz acceptor LC combination would either accept the signal and pass it to the next stage for amplification or could feed it back to the input. Here it would go back through the Unitron and emerge as a 14MHz signal and so on. Input impedance of the Unitron varies with frequency but even at 20MHz this is still several hundred megohms so there is virtually zero damping of tuned circuits.

The Unitron may be a bit of a disappointment physically because it looks very much like an ordinary transistor.

Since the Unitron is bi-directional i.e., the signal can flow either way thus input and output are interchangeable, no pip or case marking is required and lead identification is unnecessary. What could be simpler!

It will be interesting to see just how far the Unitron has progressed by this time next year—who knows, transistors and ICs as we know them, may well be obsolete. PW



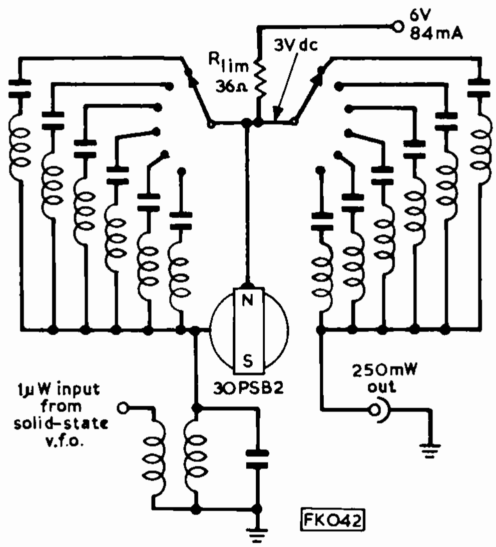


Fig. 3: (above) Electronic 0·1μF 3V wkg capacitor which takes up only 10μ x 6μ. An electronic coil can be fabricated (up to 86μH) but is more complex.

Fig. 4: (right) Single f.e.t. v.f.o. providing only 1μW can drive a single Unitron to give ¼W output on six bands, 1·8–30MHz.

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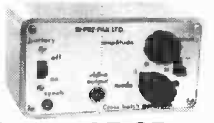

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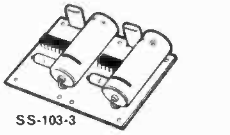

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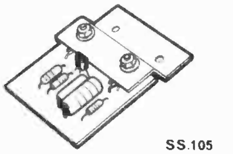

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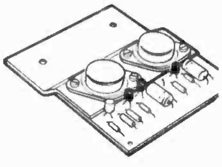

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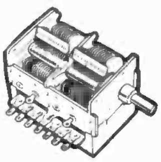

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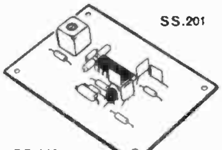

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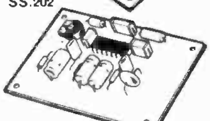

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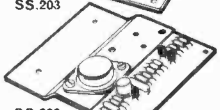

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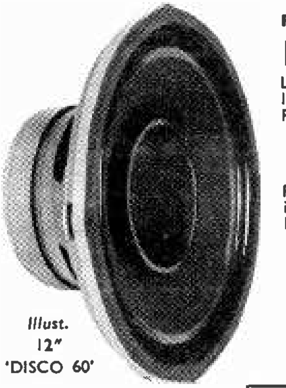

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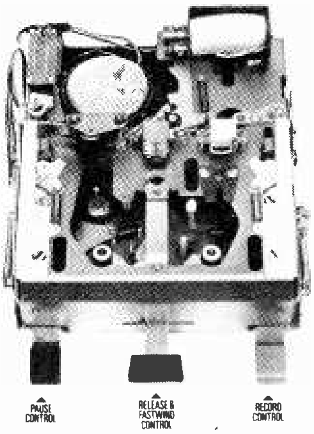

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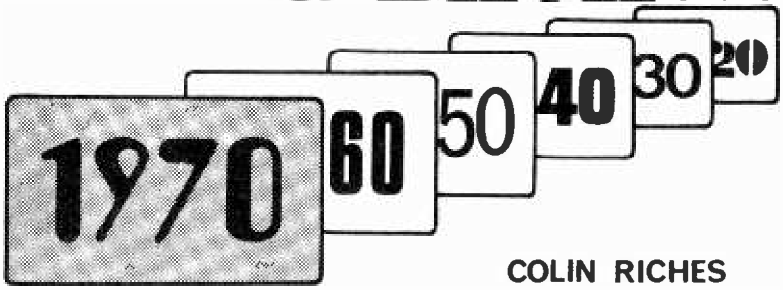


COLIN RICHES

MR. L. OWEN, 7 St. Richard's Road, Deal, Kent, writes to say that he used to have some small part in the manufacture of McMurdo Silver "15-17" receivers of about 1937-38. He says not many were made but, if anyone can help, he'd like to acquire one for old times' sake.

A photograph of the "R" type valves published a short while ago brought back two rather poignant memories to Mr. **R. J. Hall** of Penzance, Cornwall. He says that just after the First World War, he saw a shop window full of that type of valve for sale at 1d. each. Upon mentioning the fact to his elder brother who had been a radio operator in the R.N.A.S. on airships, he informed him that the "R" valves used by the Navy had filaments made of platinum wire—the filaments and lead-out wires being one single length of wire.

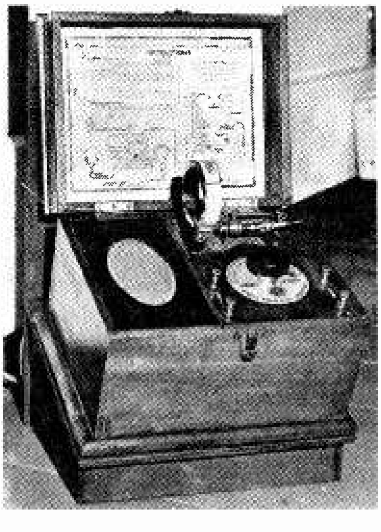
On hearing this, the young R.J.H. quickly returned to the shop to buy some but was promptly informed by the proprietor that he had disposed of the lot for a "a few shillings."

Mr. Hall's second recollection concerns an ex-Navy set which he had. It contained six "R" type valves all set in a row on the top of the set. Unfortunately a little accident occurred when H.T. and L.T. leads at the rear of the set were reversed. The valves lit up like arc lights for a few seconds, then were ruined forever.

Tempus fugit says **W. J. Swift** of 36 Pattenden Road, Catford, London SE6 4NQ, and this makes him less able to do the things he used to do. He has a book "Talks About Wireless" which contains some history of wireless pioneering. It is written by Sir Oliver Lodge and was published by Cassell in 1925. Another book in Mr. Swift's possession is "The Book of Practical Radio," by John Scott-Taggart. It has 163 diagrams and 63 plates and was published by The Amalgamated Press in 1925. If anyone would like to make him an offer for these two books, please contact him direct.

Gilbert Davey of Harrow tells me that he has a "Hezzanith" horn loudspeaker which dates from about 1926 and which he uses in conjunction with his O-V-2 battery-operated receiver with which it was originally supplied. The maker's name, inscribed on the speaker is Heath and Co. of New Eltham, London. He wonders if there is any connection with the firm of scientific instrument makers of that name with an address in the same area.

Unlike the Brown "H" horn speaker shown in the October issue of P.W., Mr. Davey's speaker has a large diaphragm fixed around the edge and held over two magnets with the usual speech current windings round them. A knurled knob underneath operates a screw system which brings the magnets nearer to or further away from the diaphragm. After 50 years, the magnets seem as powerful as they always were. The horn mounting is in the centre of the diaphragm just above the magnet system.



Mr. McAlister's modified crystal set.

Operating the speaker from the O-V-2 receiver, the quality is similar to that of a small, cheap transistor set. Mr. Davey stresses that speech is far better than music although he always enjoyed its rendering of Jack Payne and Henry Hall in the earlier days.

Wiltshire reader **George Southgate** (Fourways Cottage, Chilmark, Salisbury) tells me he has many items of vintage equipment for disposal—valves, phones, condensers, transformers, mains-energised speakers, etc. If any readers are interested will they please send a stamped, addressed envelope to him for details.

A million pirates

Even in January 1927 the Post Office were contemplating taking steps to discover unlicensed users of broadcast receivers so that disciplinary action could be taken against them. They stated that it was difficult to estimate even approximately the number of "pirates" in the country but a conservative figure would be a million!

Anyone help?

S. J. McAlister, the manager of Bord Na Mona, Derrygreenagh Works, Rochfortbridge, Mullingar, Co. Westmeath, has sent me a photograph of an old crystal set and wonders if anyone can give him some more information on it.

The set was manufactured by Service Radio Co. Ltd., London N.16, and Mr. McAlister thinks it is dated c. 1925. It has two plug-in coils (see picture) numbered 50 and 60 and signed John Nicols.

On the left of the set there is a space for a "Service" amplifier powered by accumulators of 4V for L.T. and 45V H.T.

The set is on display in Mr. McAlister's V.H.T. Radio Communications Workshop and to enable visitors to listen to it, he has fitted an audio amplifier, the speaker of which can be seen to the left of the unit. The set is in perfect working condition.

ON THE AIR

—continued from page 1102

on 4980 at 0230! (I must have been mad!) so for all those night owls here's one for the log book.

Thirteen year old **David Lovatt** of Cheadle, Staffs, wonders if anyone knows of Radio Malaya in the 49 metre band. Radio Malaysia, as it is now known, still has a service on 6100 and 6175 called the Voice of Malaysia. It is a 100kW transmitter from Kuala Lumpur.

Peter Kay from Maghull, Liverpool, sends a comprehensive list of QSL times that must have taken hours to type. The star prize goes to Voice of Vietnam via Radio Havana, Cuba, that came after nearly two years! It seems that Peter has not been able to latch on to some of the broadcasts that I have featured in the column, and to this I can only say that if the DX isn't running then even the most expensive set won't find it.

The ionosphere I once heard described as "like a moving bowl of custard", and when you ask for SINPO lists, Peter, you would find that they would be out of date, in some extreme cases, after two hours. I can help with your other request though, and to do this let us call on **David Gordon** whose QTH is in Salford. David sends info on three DX shows:—

R. Finland on 9500 at 1425 No Days given
R. Prague on 9605 at 1545 No Days given
R. Budapest on 9760 at 1615 Tues. and Fri.

Why not let me know of any DX shows you hear and then I will put together a week's list to ensure that you never miss any, thus keeping you glued to the set every spare minute.

When he has finished his days "collar feeling" policeman **James Walker** of Milton Keynes turns to feeling the tuning knob of his Heathkit SW717 with its 50ft long wire aerial. He has logged the following:—

VOA Greenville Mass. on 15430 at 1530
Vatican Radio on 11740 at 1500
R. Ghana on 21720 at 1500

James then goes on to tell me that R. Peking's 1975 calendar has arrived and that it is the traditional aspects of China painted by Chinese artists. This came, along with a huge collection of magazines and pennants, so here's your chance, pennant collectors, QSL Peking, and try your luck.

From the horse's mouth comes an answer to the recent query regarding a TV set that puts out the Deutsche Welle sign-on tune. **David Porter** is a BBC engineer at Sutton Coldfield and he explains that the sound carrier of a u.h.f. set is demodulated in an intercarrier sound detector and runs at 6MHz, this being the difference between the sound and vision carriers. Thus there are circuits in the set tuned to 6MHz followed by an a.f. amplification stage. Any local 6MHz signal tends to be picked up and amplified by these circuits. So there we are!

David Blair from Airdrie in Bonny Scotland logs WYFR on 11645 at 1700 and wonders what it is all about. This station used to be called Radio New York World Wide (WNYW) and it was sold a year or so ago to "Family Radio Ltd" a religious broadcasting company that owns many local US stations, particularly on v.h.f. The new company retained all the old WNYW frequencies but changed the programming from sweet music to general religious broadcasts.

From wild and woolie Wales, Holyhead to be exact, comes a plea from **John Higginbotham.** He would like to know the exact info that he should put on a QSL request. Many s.w. stations like the following, John:—

1. Date, time and frequency of broadcast heard.
2. Your type of radio and aerial.
3. SINPO of that particular broadcast.
4. Ten minutes of prog. content written out.

It always helps to comment on the type of programme and some stations require either IRCs or return postage, or both.

Martin Daft at his QTH in Mapperley, Notts, is bothered by interference from household electrical goods since buying an r.f. amplifier. This is purely a case of "amplify the signal, amplify the noise." Finally **Peter Roberts** of Pont Vaillant, Guernsey, very kindly says that it was this column that turned him on to DXing and that his Heathkit GR1 with its 35ft long wire has rewarded him with, among others:—

Tema, Ghana on 9545 at 2110
WINB Red Lion on 15185 at 2000
V. of Nigeria on 15270 at 0610 (another early bird)

One final note while on the transmitter subject, R. Finland is to start a service on 9620 with a new 100 watter and is seriously considering a service on the MW. Thus we say farewell to this months column and wish 73s to you and yours.

REACTION TIMER

—continued from page 1100

bration pot is turned up further until 2·4 volts is shown on the voltmeter, and VR2 is then slowly advanced until D9 comes on. At this point D7 will switch off.

The process is continued with the voltmeter indicating 2·7 volts for VR3 adjustment, 3 volts for VR4, 3·5 volts for VR5 and 4·3 volts for VR6. These voltages correspond to the charges that will be present on C2 after time intervals of 1/10, 1/9, 1/8, 1/7, 1/6 and 1/5 second from the signal light going off.

Calibration is now complete, and the meter and potentiometer can be removed.

For readers wishing to set the unit for intervals of time other than those given, the formula for the voltage on C2 is

$$V = \frac{It}{C_2}$$

where I is in microamps, C_2 is in microfarads, t is in seconds and V is in volts. In this unit $I = 1{,}000$ microamps, $C_2 = 47\mu F$, and so $V = 21{\cdot}3 \times t$.

The current through the presets VR1 and VR6 is minute in comparison with the 1mA charging current to C2, and is ignored in the calculations.

The total accuracy of the unit is determined mainly by the actual capacitance of C2. A common tolerance value for tantalum capacitors is 10 or 20 per cent, but one would be unlucky indeed to pick a capacitor at the edge of its tolerance.

If it is desired to increase the length of time that the signal light remains on, this is best achieved by increasing the value of C1. If a light dependent resistor is wored in series with R1 and placed behind a small aperture in the case, a random element will be introduced into the duration of the signal, due to changes in the light entering when the unit is mover, or time of day, etc. PW

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AB10	4"	5¼"	1½"	55p
AB11	4"	2½"	2"	65p
AB12	3"	2"	1"	50p
AB13	6"	4"	2"	77p
AB14	7"	5"	2½"	90p
AB15	8"	6"	3"	£1·16
AB16	10"	7"	3"	£1·32
AB17	10"	4½"	3"	£1·10
AB18	12"	5"	3"	£1·32
AB19	12"	8"	3"	£1·80

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AB20 8" Long 9" Wide 3½" High at back £2·20
2" High at front 6" Slope to front
With P.K. Screws
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SN7400	18p
SN7401	18p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	30p
SN7407	30p
SN7408	20p
SN7409	40p
SN7410	18p
SN7411	23p
SN7412	22p
SN7413	40p
SN7416	30p
SN7417	30p
SN7420	20p
SN7422	38p
SN7423	38p
SN7425	38p

SN7427	42p
SN7428	50p
SN7430	20p
SN7432	42p
SN7433	70p
SN7437	50p
SN7438	50p
SN7440	20p
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SN7442	75p
SN7443	£1·00
SN7445	£1·70
SN7446	£2·00
SN7447	£1·50
SN7448	£1·75
SN7450	20p
SN7451	20p
SN4753	20p
SN7454	20p
SN7460	20p

SN7470	30p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	55p
SN7476	45p
SN7480	80p
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SN7484	90p
SN7486	45p
SN7490	75p
SN7491AN	£1·00
SN7492	75p
SN7493	75p
SN7494	80p
SN7495	80p
SN7496	£1·00
SN7497	£2·25

SN74100	£2·00
SN74104	£1·45
SN74105	£1·00
SN74107	55p
SN74110	80p
SN74118	£1·90
SN74119	£1·90
SN74121	65p
SN74122	£1·35
SN74123	£2·00
SN74141	£1·00
SN74145	£1·50
SN74150	£1·35
SN74151	£1·10
SN74153	£1·35
SN74154	£2·00
SN74155	£1·55
SN74156	£1·55
SN74157	£1·80
SN74160	£1·60
SN74161	£1·60
SN74162	£1·60
SN74163	£3·40
SN74164	£2·75

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SN74166	£4·00
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SN74170	£4·10
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SN74180	£1·55
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120 watt module complete with built-in supply—extra heavy duty £22·50 Carr. 60p

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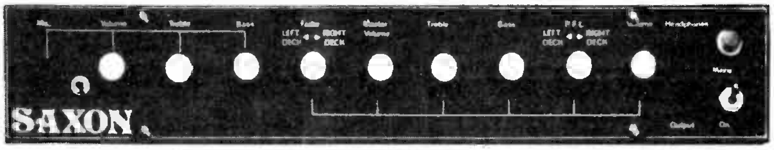
PS45	Suits 2 SA35 or 2 SA50 (4 ohm)	£4·45	Carriage free
MT45	Transformer for above	£3·50	Carriage 30p
PS70	Suits 2 SA100	£5·45	Carriage free
MT70	Transformer for above	£4·90	Carriage 40p

N.B. PS70 is not suitable for the SA50

Mk II STEREO DISCO MIXER £22·50

Carr. 30p

This well tried unit mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. May be used for mono and is mains operated. Fitted with sturdy screening case Controls: Mic vol, base, treble. Left/Right fade, deck volume, bass, treble, h/phone select. vol, Mains. Size 17½in × 3in × 4in deep.



DISCO MODULE £9·50 Carr. 20p

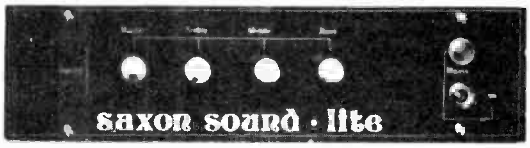
Thousands sold of this extremely popular mono version. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12½in × 3in × 2in deep.

3-CHANNEL SOUND-LITE £22·50 Carr. 30p

Only SAXON can supply such incredible value for money. This unit features 3kW power handling, full-wave control, bass, middle, treble AND master controls. Twin loudspeaker jacks for "through" connections. It may be used free standing or will panel mount next to either of the above. Also features unique CUT-BACK circuitry for extra wide range response. Size 12in × 3in × 2½in deep. Professional standards at a price you can afford!

SINGLE CHANNEL VERSION £7·50 Carr. free
Recently reduced in price due to increasing sales, handles 1kW. Full wave operation.

ADD 8% VAT TO ALL ORDERS

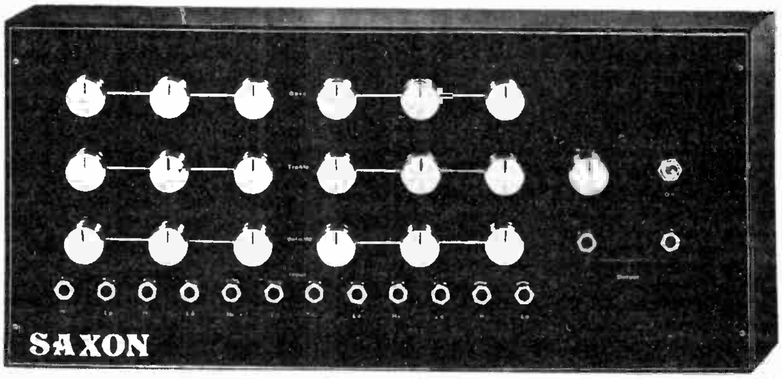


MULTI-PURPOSE MIXERS

M4HL £19·50 Carr. 50p
M6HL £29·50 Carr. 50p

Featuring multiples of our VA30 module, the M4HL and M6HL fulfil the requirements of all clubs, groups, etc. where a high quality mixer is required. Each channel has one high and one low impedance input, plus volume, treble and bass controls. Input impedances may, if required, be easily changed. The M4HL has four channels, and one output, and the M6HL six channels (12 inputs) and a master control and two outputs. Either unit may be used free-standing or panel mounted. These mixers will feed all types of amplifier. Recommended for their versatility and high performance, and excellent value for money.

VA30 CHANNEL MODULE £3·50 Carr. free
This is the basic channel module in the above mixers and may also be used for extra imputs on either the mono or stereo mixers. Fitted with volume, bass and treble controls, requires just a jack and supply (9–100V)



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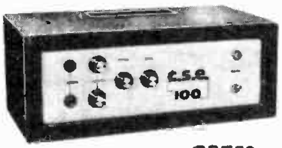
100W of speech and music—Two separately controlled inputs. Wide range bass and treble controls. Sturdy and attractive vynide case. Twin outputs. Ideal for groups, discos, etc. Fully tested and guaranteed. 50W version identical in appearance.



CSE50
£29·50 Carr. free

NEW ! !

SAXON MULTIMIX 100 £57-00 carr. free

100W rms four inputs *slider* controls *plus* master slider. Wide range bass and treble controls. Fantastic value, ideal for complete disco's, groups, clubs etc.

SAXON MULTIMIX 50—Exactly as above but 50W rms. **£45·00**

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Kef T15	£6·00
Kef B110	£7·25
Kef B200	£8·25
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Kef DN8	£2·00
Kef DN12	£4·95
Kef DN13	£3·30
STC4001G super tweeter	£6·19
Richard Allan CG8T 8"d/c r/surr.	£8·35
2½" 64 ohm, 70mm 80 ohm, 70mm 8 ohm	·65
2¼" 75 ohm	·50
7" x 4" 3 or 8 ohm	£1·40
8" x 5" 3 or 8 ohm	£1·50
10" x 6" 3, 8 or 15 ohm	£2·30

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Baker Major Module	each £10·75
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Goodmans DIN 20	each £9·75
Helme XLK 25	pair £22·00
Helme XLK 30	pair £14·95
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Kefkit 1	each £20·95
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Wharfedale Linton 2 kit	pair £19·25
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PA/DISCO AMPLIFIERS

(carr. and ins. £1)

Baker Major 100 watt	£49·75
Linear 30/40	£30·00
Linear 40/60	£35·00
Linear 80/100	£58·95
Linear 100 watt slave	£44·00

Eagle PA range in stock—ask for catalogue.

Free with speaker orders over £7—

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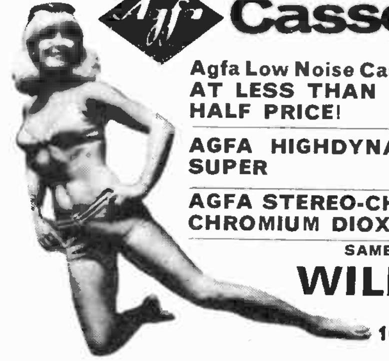

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	C90+6	68p	£3·35	£6·60
	C120	99p	£4·90	£9·80
AGFA STEREO-CHROM CHROMIUM DIOXIDE	C60	85p	£4·20	£8·30
	C90	£1·08	£5·35	£10·60

SAME DAY DESPATCH. P. & P. 15p per order

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(DEPT. PW)
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Wire Wound Resistors. Our selection of mixed values. 30 for **£1·50.** 100 for **£4·00.**

Audio Amplifier Module. Mullard LP1173, output power, nominal 10 watt, supply voltage +24 volt, with data and circuit, **£2·50.**

Ferguson Stereogram chassis Model 3357, all transistor, medium long, VHF/FM. 3 watts per channel S/M. with connection data, less tuning scale, **£20.** Post paid.

Crystals HC6U: 52·03333 MHz: 52·02500: 52·01667: 51·56667: 51·58330: 37·75250: 37·75000: 12·895·8: 12·891·6: 12·700·0: 9·458·33: 9·456·25: 9·455·55: 9·533·33: 9·531·94: 9·530·55: 9·090·62: 9·087·5 **50p** each.

Electrolytics. 32/32/32μF, 325v. 2"×1¼" **35p**: 80μF 150vt 1¾" x 1" **20p;** 2000μF 30v, 2¼"×1" **25p:** 2000μF 35v 3"×1" **30p:** 470μF 100v 3"×1¼" **25p:** 2000/2000μF 25v 2"×1¼" **35p:** 30,000μF 25v 4½"×2½" **50p:** 700μF 200v 3½"×1¼" **30p:** 16/16μF 275v 1¾"×1" **20p:** 40/40/20μF 275v 3"×1" **20p:** 4500/900/900μF 30v 2½"×1½" **50p:** 4000μF 35v 3"×1¾" **40p:** 4000μF 35vt 3"×1½" **35p:** 2500μF 40vt 2½"×15" **40p:** 4000μF 18v 2"×1" **20p:** 470μF 25v 1¼"×½" **15p.**

Matched pair of bookshelf speakers. Teak finish, size 12"×8"×5". 8×5 8" ohms ceramic, 5 watts RMS. Complete with cin leads. **£11·00 pair.**

Thorn TV IF chassis, 950 series (less valves), **£1 75.**

UHF 625 transistor push button tuner (NSF Telefunken) as used on Decca MS2400. Brand new and boxed, **£3·25.**

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Rank EVR Teleplayer colour translator panels, type and components on new panels listed as follows, **£2·50,** each panel. Z605—14 off BC148: 2 RCA ca3054 (ic): 1 crystal 4·433618 MHz—Z607—12 off BC148: 1 BC108: 1 BC158: 1 RCA ca3046 (ic), 1 RCA ca3045 (ic): Z608—23 off BC148: 2 BC158—Z612—12 off ME4103: 2 BC-251B: 1 BFY50.

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Edgewise Level meters, 200μA, size ⅝" overall, **50p.**

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Aluminium Chassis, 7½"×5½"×2¼" **70p:** 10"×7½"×2¼" **85p.** 11"×7½"×2¼" **95p.**

BSR P128, similar to HT70 single play, with heavy die cast turntable, less cartridge, **£11·00.**

Transistorised FM tuner head, with A.M. gang slow motion drive 88–108 Mcs, with circuit diagram, **£2·30.**

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15 ASSORTED SWITCHES £2.00. 50—3 way to 7 way TAG STRIPS, £1.25. ALMA REED RELAY TYPE DRH. 3 VOLTS. 55p.

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CARBON FILM

⅓W 1 Ω to 1M: 5%, IM2 to 10M: 10% E12
¼W 1 Ω to 10 Ω: 5%, IM2 to 10M: 10% E12 11 Ω to 910k: 5% E12 & E24 1p each

METAL OXIDE

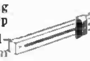
½W 10 Ω to 1M: 2% E12 & E24 4p each

WIREWOUND

3W 0·22 Ω, 0·27 Ω, 0·33 Ω, 0·47 Ω: 10%, 1 Ω 5% 17p each
1·2 Ω to 270 Ω: 5% E12 13p each
Other ranges stocked. See our catalogue for details.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades.
E24: 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades.

● POTENTIOMETERS

Rotary miniature carbon track ¼" spindle.
Values available: 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M.
Log. Single-gang 16p
Lin, Single-gang (+ 1K) 16p
Log. or Lin. Single-gang with switch 33p
Log. or Lin. Dual-gang without switch 49p



Slider 60mm track. Metal-cased: overall length 86·15mm (knob extra 7p)
Values available: 1k; 5k; 10k; 25k; 50k; 100k; 250k; 500k; 1M; 2M.
Lin. Single Gang 36p
Log Single Gang 38p
Lin or Log Dual Gang 45p

Presets: 0·1W Vertical or Horizontal.
100 Ω, 220 Ω, 470 Ω, 1K, 2k2, 4k7 10k, 22k, 47k, 100k, 220k, 470k, 1M 7p each

● CAPACITORS

Sub-miniature
Axial lead electrolytic

Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
1	63	6p	68	6·3	6p			
1·5	63	6p	68	16	6p			
2·2	63	6p	68	63	14p			
3·3	63	6p	100	4	6p			
4·7	63	6p	100	10	6p	470	6·3	6p
6·8	40	6p	100	25	6p	470	10	14p
6·8	63	6p	100	40	6p	470	25	16p
10	25	6p	100	63	16p	470	40	25p
10	63	6p	150	6·3	6p	680	6·3	14p
15	16	6p	150	16	6p	680	16	16p
15	40	6p	150	25	6p	680	25	25p
15	63	6p	150	40	14p	680	40	28p
22	10	6p	150	63	16p	1000	4	14p
22	25	6p	220	4	6p	1000	10	16p
22	63	6p	220	10	6p	1000	16	25p
33	6·3	6p	220	16	6p	1000	25	28p
33	16	6p	220	25	14p	1500	6·3	16p
33	40	6p	33	40	8p	1500	10	25p
47	4	6p	220	63	25p	1500	16	28p
47	10	6p	330	4	6p	2200	6·3	25p
47	25	6p	330	10	6p	2200	10	25p
47	0	6p	330	16	14p	3300	6·3	28p
47	63	6p	330	63	28p	4700	4	28p

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BC109	13p	SC146D	88p
BC109C	15p	T1843	28p
BC142	23p	W005	30p
BC143	26p	W04	33p
BC147	10p	1N914	4p
BC148	10p	1N4001	6p
BC149	12p	1N4002	6½p
BC168C	12p	1N4003	7p
BC169C	12p	1N4004	7½p
BC178	17p	1N4005	8p
BC182L	10p	1N4006	8½p
BC183L	12p	1N4007	9p
BC184L	12p	1N4148	4p
BC212L	14p	2N1302	20p
BC213L	15p	2N1303	20p
BC214L	18p	2N1304	30p
BCY71	22p	2N1711	24p
BD131	45p	2N2219	25p
BD132	54p	2N2646	45p
BD131/BD132 MP	£1·20	2N2905	33p
		2N2926 Or	10p
BD135	36p	Ye	12p
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BF258	35p	2N3055	49p
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BFX29	30p	2N5459	51p
BFX30	33p	7400	16p
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5–pin B (240°)	10p	7p
6–pin	10p	9p

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3·5mm Plastic Barrel 9p
3·5mm Metal Barrel 15p

JACK CHASSIS SOCKETS

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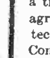

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A Full Scale Electronic Organ that you can Build to Your Own Specification.

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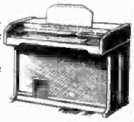

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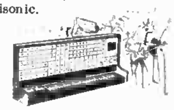

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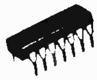




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£5·75 THE PAIR. Post 45p. (Available separately. Woofer £4·25; Tweeter £1·90).

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Impedance Standard 8 ohms
Maximum power 12 watts
Useful Response 25 to 18,000 cps
Bass Resonance 45 cps

SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£10·50** Post 75p

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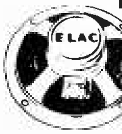

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts **£3·75**

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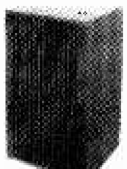

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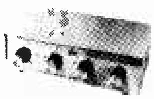

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4 inputs 2-way mixing. 2 outputs separate treble and bass controls. Ideal disco or p.a. amp.

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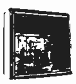

Teak veneered ½in thick wood cabinet. Size 18½in × 18½in × 8½in. Weight 23lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½inch Woofer. £7·50 Carr. 85p. Rosewood Version £8·50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

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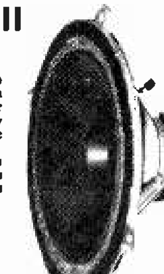
HIGH QUALITY — BRITISH MADE

REGENT
12in. 15 watts

An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.
Bass Resonance 45cps
Flux Density 12,000gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.

£7·75

DE-LUXE Mk II
12in 15 watts



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Flux Density 14,000gauss
Useful response 25-16,000cps
8 or 15 ohms models.

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SUPERB
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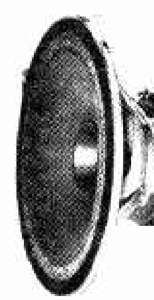

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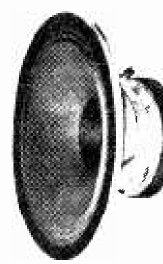
AUDITORIUM
12in. 25 watts



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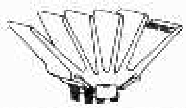

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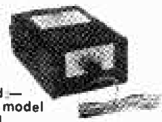

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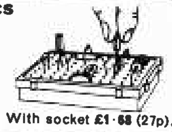

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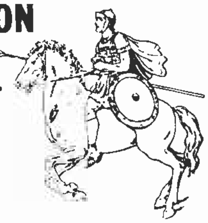

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TIP30a	0·57	7409	0·23	74141	0·90
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741C TO	0·38	7473/74	0·36		
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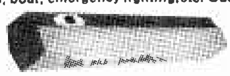

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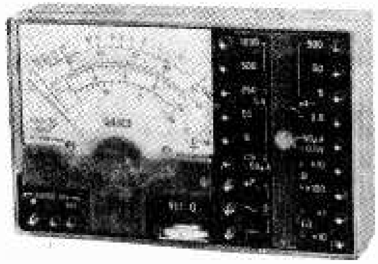

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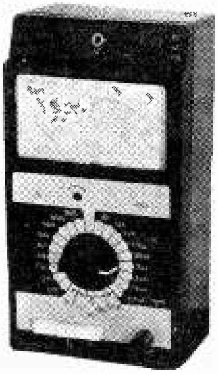

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130 LOVE

Henry's Radio

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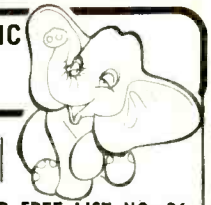

You can build the Texan and Stereo FM Tuner

TEXAN 20 + 20 WATT IC STEREO AMPLIFIER

Features glass fibre PC board, Gardners low field transformer 6–IC's, 10-transistors plus diodes, etc. Designed by Texas Instruments engineers for Henry's and, P.W. 1972. Supplied with full chassis work, detailed construction handbook and all necessary parts. Full input and control facilities. Stablised supply. Overall size 15½" x 2¾" x 6¾" mains operated. Free teak sleeve with every kit. **£31·00** (Carriage 50p). (also built and tested £37·50)

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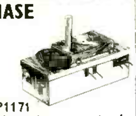

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Mullard type LP1179 and LP1171
These two modules together form a high quality AM/FM tuner covering the long, medium and VHF broadcast bands. Requires only 16 resistors and capacitors and a switch to complete. Supplied with circuits and spec. data

FM	Coverage	87-108 MHz
	Bandwidth	300 KHz
	Selectivity	36 dB
	Signal to noise at limiting threshold	40 dB
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	Built-in AGC	

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CAO38	9 volt 1½ + 1½ watts 8 ohms	6·95
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AM/FM Modules

Mullard LP 1186 FM tuner (front end) with data 10·7 MHZ O/P	4·85
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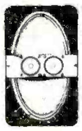

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*150 TC 10 watts 8 ohms twin cone **£2·20**
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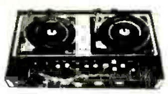

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