

# PRACTICAL WIRELESS

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1976

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PRI 240V, SEC. 12V, 100Ma Manul.: Hinchley  
Size: 36 x 45 x 40mm, F.C. 53mm.  
Price 1-65p, 100 50p ea. 1,000 50p ea. 10,000 40p ea. 8% VAT.

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1000pF Feedthrough capacitor 5p ea.  
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Wire wounds from 1 watt-100 watts. Please phone for prices, etc.  
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**ALUMINIUM BOXES IDEAL FOR VEROBOARD WITH BASE & P.K. SCREWS**

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# PRACTICAL WIRELESS

VOL. 51 NO. 12

ISSUE 830

APRIL 1976

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

## EDITOR

Lionel E. Howes, G3AYA

## ASSISTANT EDITOR

Eric Dowdeswell, G4AR

## ART EDITOR

Peter Metall

## PRODUCTION & NEWS EDITOR

Colin Riches

## TECHNICAL SUB-EDITOR

Bill Tull

## TECHNICAL ARTIST

Alan Martin

## SECRETARIAL

Karen O'Neil  
Jill Austin

## ADVERTS MANAGER

01-261 6275

Roy Smith

## CLASSIFIED ADVERTS

01-261 5762

Colin R. Brown

Advertisement correspondence and enquiries to the Advertisement Manager, Roy Smith, Practical Wireless, Kings Reach Tower, Stamford Street, London, SE1 9LS

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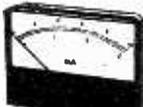
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- ME13 = 0 to 100 m/a Full Scale
- ME14 = 0 to 500 m/a Full Scale
- ME15 = 0 to 1 amp Full Scale
- ME16 = 0 to 50 volts
- ME17 = 0 to 300 volts
- A.C. Full Scale
- ME18 = "8" Meter
- ME19 = "VU" Meter



OUR PRICE £3.00  
+8%

## 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



27p each +8%

## SCOOP PURCHASE MW-LW-FM STEREO TUNER

We supply a MW-LW-FM-Stereo Tuner fully wired and aligned on a 6" x 4" x 1 1/2" printed board, plus the Ferrite Aerial and switch which you connect following our complete instructions. Now you only need a 9-12 volt D.C. supply and you can feed this tuner into any Stereo Amplifier.

FANTASTIC VALUE AT £7.00 + 25% VAT

## POWER SUPPLY UNITS + 8%



PP1 Switched 3, 4, 6, 7, 9 and 12 volts at 500 m/a, with on/off switch and pilot light. Size: 130mm x 55mm x 75mm.  
ONLY £4.00

PP2 Switched 6-7-9 volt Battery Eliminator. Approx. size 2 1/2" x 2 1/2" x 3 1/2". Ideal for cassette recorders £3.25 PP3 Car converter. From 12v Pos. or Neg. to -6-7-9 volt. Easy to fit and transistor regulated £3.90

## LOW VOLTAGE STEREO AMPLIFIER

8 Transistor Stereo Amplifier with Vol'e, Base, Balance and Tone Controls. Approx. 3 watts into 8 ohm per channel needs a 9/12 volt DC supply and is complete on a 2 1/2" x 7 1/2" P/C board.

Ideal for domestic record players, etc. A Bargain at £5 + 25% VAT.

## ABS PLASTIC BOXES + 8%

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.

- 1005 = 105mm x 73mm x 45mm = 55p
- 1006 = 150mm x 75mm x 47mm = 72p
- 1007 = 154mm x 124mm x 60mm = £1.28
- 1021 = 105mm x 74mm x 45mm (sloping front) = 55p

## TELESCOPIC AERIAL

Nine section fully swivelling telescopic aerial with 4BA single bolt fixing or two hole fixing bracket. Fully extended = 43" Fully closed = 7"

Our Price 50p + P/P + VAT @ 25%

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Good quality tape in well made screw type cassettes. Presented in single plastic cases.

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10% Discount on ten or more cassettes of one type.

## LOUDSPEAKERS + 25%

- 2 1/2" 8 ohm 60p
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- 2 1/2" 80 ohm 60p
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## BARGAIN PROJECT BOX.

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An ideal box to give a small project a professional finish SIZE (Internal) 81mm x 51mm x 28mm.

OUR PRICE 40p. + 8%



## MINIATURE RELAYS

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- | Type | Volts | Cur.  | Ohms | rent |
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| 27/A | 12v   | 17M/A | 700  |      |
| 21/A | 12V   | 28M/A | 430  |      |
| 12/A | 6v    | 33M/A | 185  |      |
| All  | £1.30 | each  |      |      |

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- ★ 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 + 8% (spare bits are available)

## FERRIC CHLORIDE

Anhydrous ferric chloride in double sealed one pound poly packs. Our Price 85p + P/P + VAT @ 8% per lb.40

## 3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel Base, Middle, Treble, Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed.)



£18.50 plus 75p P. & P. + 8%

## 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 + 8%

## P.C. ETCHING KIT

This kit contains all that the constructor will need to etch the circuits of his own design.

- Contents—Plastic etching dish. Sample copper clad board; Laminate Cutter; 1 lb Ferric chloride; Large Plastic Spoon; Etch Resist Pen; Full Etching Instructions.

Complete and Big Kit Value at £3.75p + 8%

## 10-INCH 8 OHM DUAL CONE

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 + 25%

# RSC DISCO SYSTEM 40 WATT



Consisting of 1 twin Turntable Console with Pre-Amp and built-in Power Output. Sep. vol. controls for each 1/2 table. H/phone monitoring facilities. Sep. Bass and Treble controls. Mic. Vol. control. Neon Mains Indicator. Plus Pair 12" Spkrs. in matching Rexine covered cabinets. Terms: Dep. £15.99 and 18 fortnightly paym'ts. £5.41. (Total £113.37)  
**AS ABOVE LESS SPEAKERS £79.95**  
Terms: Dep. £9.00 and 18 fortnightly payments £4.61 (Total £91.98). carr. £3

## MOBILE DISCO CONSOLE £59.95

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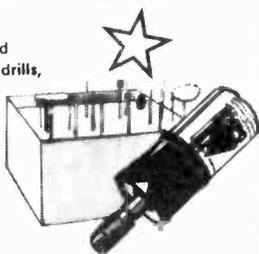
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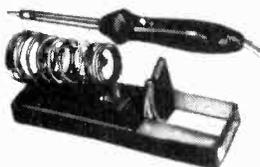
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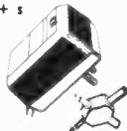
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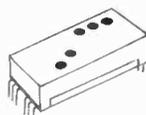
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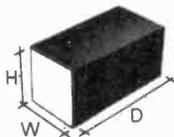
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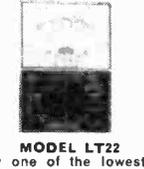
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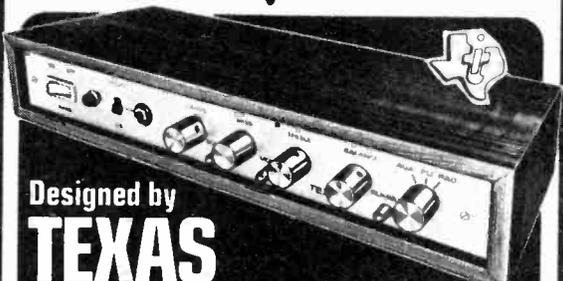
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- UT5 40 Zener diodes, 250 mW OA2240 range, average 50% good.
- UT6 25 Zener diodes, 1-1 1/2 watt top hat type, mixed voltages.
- UT9 40 NPN silicon planar transistors, of the 2N3707-11 range, low noise amp.
- UT10 15 Power transistors, PNP germanium and NPN silicon, mostly TO-3 but some plastic and some marked.
- UT13 15 Integrated circuits, experimenters pak, dual in line, TO-5, TTL, DTL, marked and unmarked, some definitely good but old type.

FOR FULL RANGES—SEE CATALOGUE

● Singles BRIDGE RECTIFIERS Plastic encapsulated

P.V.I.V.	50v	100v	400v
1 amp	25p*	35p*	45p*
2 amp	35p*	45p*	55p*
4 amp	45p*	50p*	80p*
6 amp	50p*	60p*	90p*

BY164 equiv. SKB2/02 400v 1.5 amp. 45p\*

FETs	18p
2N3919	20p
2N4416	

MOS F.E.T.s	50p
3N141/MEM616	

UNI-JUNCTION TRANSISTORS	65p*
2N2160	48p*
2N2846	31p*
TIS43	

P.U.T.s	50p
2N26027	

LEDs	18p*
TIL209—Red	33p*
TIL211—Green	

Also Power Diodes, Thyristors, Triacs, Diac Zener Diodes, Opto-Electronics, etc.

## POWER TRANSISTORS

Vce	Watts	1c Amps	Price
40P1	15	20	3 20p*
40N2	40	40	4 30p*
40P2	40	40	4 30p*
90N1	15	45	4 25p*
90P1	15	45	4 25p*
90N2	40	90	8 35p*
90P2	40	90	8 35p*

Many other types available from 3 to 115 watts

## INTEGRATED CIRCUITS

MM5314 Dual in line clock chip £3\*  
LMS380/SL60745 Dual in line 2w. audio amp. with data, etc. 75p  
Dual in line I.C. sockets 8 pin 14p, 14 pin 15p\*; 16 pin 16p\*

## Sundry

### SIGNAL GENERATOR

For MW and IF Covers 550 KHz to 1.6 MHz for MW and 400 to 550KHz for IF. Fully portable. (p/p 40p) £4.25

### POCKET SIGNAL INJECTOR

Fountain-pen type. Invaluable for finding faults £2.00\*

### EX-G.P.O. 5" SIDECUTTERS

Not new, but in perfect order, per pair 50p\*

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Not new, but in perfect order, per pair 60p\*

### MAINS TRANSFORMERS

MT6	6v 0.6v 100mA	£1.22*
MT12	12v 0.12v 50mA	£1.22*
SST9/1	9v 1amp	£1.67*
SST12/1	12v 1amp	£2.05*
SST18/1	18v 1amp	£2.50*
SST25/2	25v 2amp	£3.00*
SST30/2	30v 2amp	£4.25*
SST35/4	35v 4amp	£5.50*

### PC EDGE CONNECTORS

Type	Sizes	Pitch	
SSEC 6 way	1 1/2"	156"	32p
SSEC 10 "	1 1/2"	156"	50p
SSEC 12 "	2"	156"	60p
SSEC 16 "	2 1/2"	156"	75p
SSEC 18 "	3"	156"	85p
SSEC 22 "	3 1/2"	156"	1.00

### BOOKS

All free of V.A.T. We carry very large stocks of technical books by Babani & Bernard Publishers, by Newnes and Butterworth as well as reference books from the Common Market in English/German/Italian. All detailed in our catalogue.

## MONEY SAVERS FOR MOTORISTS

Our new "Super Spark" Capacity Discharge Ignition unit is instantly adaptable for pos. or neg. earth; can be switched back to conventional ignition instantly and incorporates anti-burglar immobilising switching. Rev. controlling adjustment. In totally enclosed strong metal box (p/p—50p) (S.A.E. for leaflet) KIT—£7.95\* READY BUILT £10.50\*

NEXT MONTH LOOK OUT FOR SOME EXCITING NEW

Stirling Sounds Audio Modules £10.50

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Check that your order is correct for description, quantity and price. Mention this journal when ordering if you don't want to cut out the coupon.  
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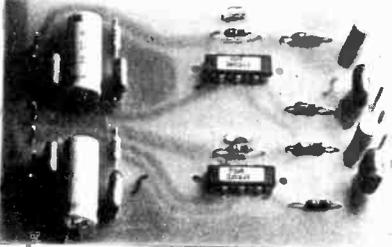
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# tecknowledgely in consumer ICs - and their applications.

## SGS Audio ICs



The much heralded TDA2020 is here. And just to make sure that you don't go wrong, so is the SGS application test circuit PCB for a stereo 15 + 15 (RMS) Hi Fi amplifier.

Prices :	IC	AUDIO	DISCRETES
TBA810AS	+HS 1.09	ZTX107/8/9	14p
TCA940E	+HS 1.80	ZTX413(LN)	17p
TDA2020	2.99	ZTX212/3/4	16p
FM LINEAR	ICS	BD 535 npn	7A/60v 52p
MC1350	0.70	BD536 pnp	53p
CA3089	+OC 1.94	BD377 npn	3A/50v 29p
TBA120	+OC 1.00	BD378 pnp	32p
MPX LINEAR	ICS	BD515 npn	2A/45v 27p
MC1310P	+LED 2.20	BD516 pnp	30p
CA3090AQ	+LED 3.75	BD609 npn	10A/90v 70p
		BD610 pnp	102p

## We've moved

To accommodate expanded R & D facilities, AMBIT has moved sales and administration to 25 High St. Brentwood. The existing 37 High Street premises are retained for the engineering activities.

One of the first products of this move has been the development of a TV sound tuner, from an "off air" system, using its own varicap UHF TV tuner, with ICIF amplifiers and block filters by TOKO. And then one of our best ever circuits - an electronic touch tuner, with scanning mode, and facilities for 6 preset stations. The unit is suitable for use with FM, and now AM of course, and offers a complete tuner system without any moving parts. Selection is by means of touch tuning in all cases, with manual scan and preset switching automatically interlocked.

Our R&D facilities are available for general consultancy to OEMs: further details on application. Standard project estimation fee, including project evaluation comment data is £15.00 payable in advance.

## Modules & Kits

### New modules:

8011	Totally touch tuned varicap controller built	£14.99
8005	Larsholt tunerset accessory unit, with pilot tone filter and audio stages, rectifier, IC stabilizer, meter driver circuits.	£4.99 (kit)
8001	55kHz low pass filter (mpx birdy filter)	£2.35 built £1.75 (kit)
2001	Stereo scratch and rumble filter, with continuously variable operating frequencies.	£5.80 (built) £4.60 (kit)
3000	Stereo control preamp - a wide dynamic range, low distortion AF preamp, with vol, bal, bass and treble controls.	kit £5.78
2020k	The TDA2020 stereo amp kit photographed on the left.	£7.85
7700	TV off air UHF sound tuner - built	£26.00 (4 preset stations)
9000 kit	AM/FM mpx tuner chassis, with mech. tuner	£17.50
7004 kit	MW/LW varicap tuner module, inc. ferrite rod	£9.95
7252	Hi-Fi MOSFET FM tuner module by Larsholt	£24.00
7253	Hi-Fi FET FM tuner module inc decoder	£24.00
5600	Hi-Q MOSFET varicap tunerhead by TOKO	£11.25
EC3302	FET tunerhead from TOKO	£5.00

Complete FM Tuner Kits, inc case, for use with the above modules: details SAE please. Prices range from £40 - £60.

Amongst our various accessories for entertainment electronics is a range of FM tuning, frequency and sig. strength meters with 12v, 50mA bulb. £2.50 ea.



**ambit international**  
 25 high street, brentwood,  
 essex. cm14 4rh. tel: (0277) 216029  
 tlx: 995194

Free price list with an SAE, catalogue of modules and parts 40p., including postage and VAT.

General Terms: CWO please, official bodies and companies please note min. invoice £7.50. PP for CWO orders 22p per order. (UK and Eire). Overseas customers please include sufficient for postage. VAT is not included, and must be added at 25%. In stock orders despatched within 48 hours.

## ADVANCED CLOCK KIT

Complete kit including attractive slim case for 6 digit alarm clock with beep alarm, snooze, high brightness driving of Jumbo LED displays, automatic intensity control—with optional add-ons of touch switch snooze control and crystal control/battery back-up. £27.31

## P.E. CAR CLOCK with Journey Timer

6 digit clock for use in any car with 12V battery, with an independent journey timer incorporated. Bright Jumbo LED display comes on with ignition—automatic intensity control. Complete kit of all parts needed including case, PCB's and all components. Full instructions. £39.50

Easy to Build E.E. DIGITAL CLOCK (Jan. issue). Kit of all components, including case etc., for this attractive clock with 12mm green display. Full instructions. £16.20

50 Hz Xtal Timebase Kit for clocks (incl. advanced kit above). £6.28

<b>CMOS ICs</b>	CD4029 0.94	CD4059 10.64	CD4511 1.28	<b>Displays</b>	5LT-01 5.80
<b>RCA MOT ONLY</b>	CD4030 0.46	CD4060 0.92	CD4514 2.56	DL704E 0.85	FND500 1.02
CD4000 0.17	CD4032 0.88	CD4062 7.33	CD4516 1.12	CD4518 1.03	Display Int.
CD4001 0.17	CD4033 1.14	CD4063 0.90	CD4520 1.93	SN75491 0.81	SN75492 1.02
CD4002 0.17	CD4034 1.55	CD4066 0.58	CD4527 1.30	7447 1.05	7448 0.95
CD4006 0.97	CD4035 0.97	CD4067 2.95	CD4532 1.16	MC14508 2.37	<b>Flat Cable</b>
CD4007 0.17	CD4036 1.82	CD4068 0.18	CD4532 1.16	MC14528 0.86	20WAY 1M
CD4008 0.79	CD4037 0.78	CD4069 0.18	CD4555 0.74	MC14534 6.04	100M for 8.50
CD4009 0.46	CD4038 0.88	CD4070 0.18	CD4556 0.74	MC14566 1.21	10WAY 1M
CD4010 0.46	CD4039 2.86	CD4071 0.18	MC14508 2.37	MCM14552	10M for 0.60
CD4011 0.17	CD4040 0.88	CD4072 0.18	MC14528 0.86	8.05	10M for 4.80
CD4012 0.17	CD4041 0.69	CD4073 0.18	MC14534 6.04	<b>Clock Chips</b>	<b>IC Socket Pins</b>
CD4013 0.46	CD4042 0.69	CD4075 0.18	MC14553 4.07	MM50253 5.60	100 0.50
CD4014 0.83	CD4043 0.83	CD4076 1.27	MC14566 1.21	MM50253 5.60	1000 4.90
CD4015 0.83	CD4044 0.77	CD4077 0.18	MCM14552	MM50253 5.60	3000 10.50
CD4016 0.46	CD4045 1.15	CD4078 0.18	MC14508 2.37	MM50253 5.60	
CD4017 0.83	CD4046 1.10	CD4081 0.18	MC14528 0.86	MM50253 5.60	
CD4018 0.83	CD4047 0.74	CD4082 0.18	MC14534 6.04	MM50253 5.60	
CD4019 0.46	CD4048 0.46	CD4085 0.59	MC14553 4.07	MM50253 5.60	
CD4020 0.92	CD4049 0.46	CD4086 0.59	MC14566 1.21	MM50253 5.60	
CD4021 0.83	CD4050 0.46	CD4089 1.27	MC14508 2.37	MM50253 5.60	
CD4022 0.79	CD4051 0.77	CD4093 0.66	MC14528 0.86	MM50253 5.60	
CD4023 0.17	CD4052 0.77	CD4094 1.53	MC14534 6.04	MM50253 5.60	
CD4024 0.64	CD4053 0.77	CD4095 0.86	MC14553 4.07	MM50253 5.60	
CD4025 0.17	CD4054 0.95	CD4096 0.86	MC14566 1.21	MM50253 5.60	
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CD4027 0.46	CD4056 1.08	CD4502 0.98	RCA1975 2.67	MM50253 5.60	
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ADD VAT at 8% (Higher rate does not apply to any of above).

15p P & P on orders under £2—Despatch is by 1st Class Post. Price list and data sent FREE with an order, or on request (an SAE helps). Official orders welcomed (written or phoned)—(Unives, Polys, Govt, Cos, etc. Export orders: no VAT, add 35p (Europe) £1 (overseas) for Airmail p & p.

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With the first printing sold out, Issue No. 2 is up-dated on prices, etc. 144 pages. New items. Opto-electronics. Diagrams of components, applications, I.C. circuits, etc. Post free 40p, including voucher for 40p for spending on order over £5 list value.

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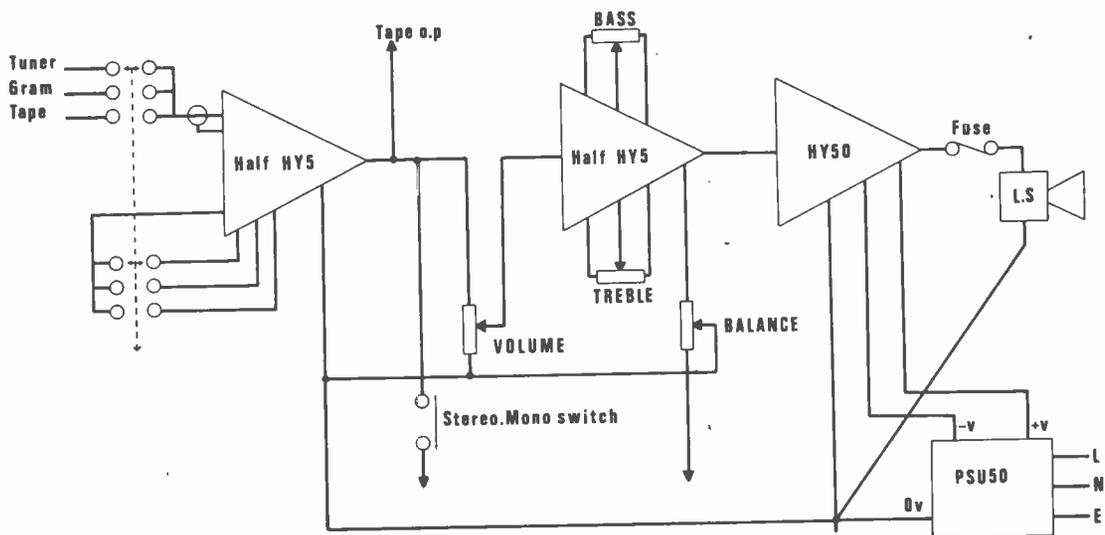
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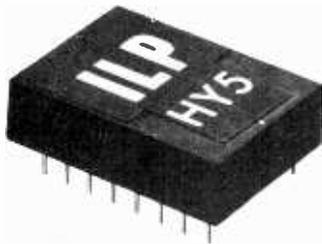


**I.L.P.** (Electronics) Ltd

# SHEER SIMPLICITY!



**MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN**



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

**TECHNICAL SPECIFICATION**  
 Inputs: Magnetic Pick-up 3mV RIAA; Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; 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.

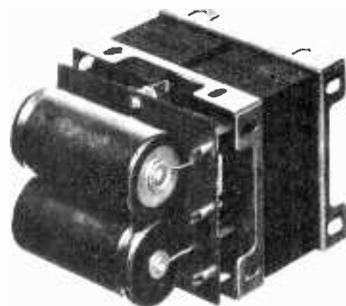
**PRICE £4.75** + £1.19 VAT



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 £6.20** + £1.55 VAT



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.

**PRICE £6.25** + £1.56 VAT

**I.L.P. Electronics Ltd.**  
**Crossland House,**  
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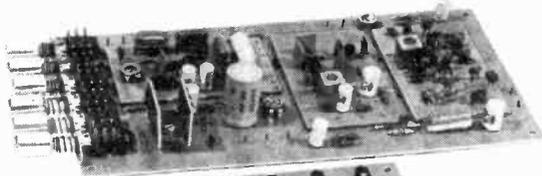
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# BI-PAK High quality audio



OUR PRICE ONLY

## £19.95

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, by simply changing the settings of the pre-set controls.

Used with your existing audio equipment or with the BI-KITS STEREO 30 or the MK60 Kit etc. Alternatively the PS12 can be used if no suitable supply is available, together with the Transformer T461.

The S450 is supplied fully built, tested and aligned. The unit is easily installed using the simple instructions supplied.



## STEREO FM TUNER

Fitted with Phase Lock-loop

- ★ FET Input Stage
- ★ VARI-CAP diode tuning
- ★ Switched AFC
- ★ Multi turn pre-sets
- ★ LED Stereo Indicator

**Typical Specification:**  
Sensitivity 3µ volts  
Stereo separation 30db  
Supply required 20-30v  
at 90 Ma max.

## STEREO PRE-AMPLIFIER PA 100



A top quality stereo pre-amplifier and tone control unit. The six push-button selector switch provides a choice of inputs together with two really effective filters for high and low frequencies, plus tape output.

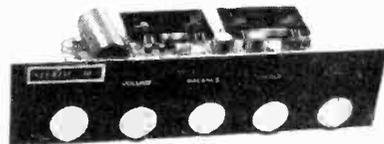
Frequency Response + 1dB  
20Hz-20KHz.  
Sensitivity of inputs:  
1. Tape Input 100mV into 100K ohms  
2. Radio Tuner 100mV into 100K ohms  
3. Magnetic P.U. 3mV into 50K ohms  
P.U. Input equalises to R1AA curve within 1dB from 20Hz to 20KHz. Supply 20-35V at 20mA.  
Dimensions—299mm x 89mm x 35mm.

**£13.50** P & P 45p

**MK60 AUDIO KIT:**  
Comprising: 2 x AL60's 1 x SPM80, 1 x BTM80, 1 x PA100, 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. **COMPLETE PRICE £27.55 plus 62p postage.**

**TEAK 60 AUDIO KIT:**  
Comprising: Teak veneered cabinet size 16 1/2" x 11 1/2" x 3 1/2", other parts include aluminum chassis, heatsink and front panel bracket plus back panel and appropriate sockets etc. **KIT PRICE £30.20 plus 62p postage.**

## STEREO 30 COMPLETE AUDIO CHASSIS



7 + 7 WATTS R.M.S.

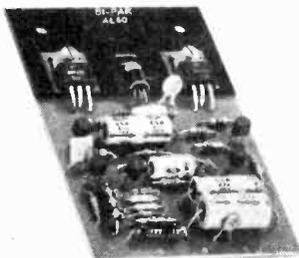
The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available. Ideal for the beginner or the advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty (can be installed

**TRANSFORMER £2.45** plus 62p p & p

**TEAK CASE £3.65** plus 62p p & p.

**£15.75**

P & P 45p.



## AL 60

25 Watts (RMS)

**VAT ADD 25%**

- Max Heat Sink temp. 90C.
- Frequency response 20Hz.
- Distortion better than 0.1 at 1kHz.
- Supply voltage 15-50v.
- Thermal Feedback.
- Latest Design Improvements.
- Load—3,4,5, or 16ohms.
- Signal to noise ratio 80db.
- Overall size 63mm. 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.

**ONLY £3.95**

## Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5A at 35V. Size: 63mm, 105mm, 30mm. Incorporating short circuit protection.

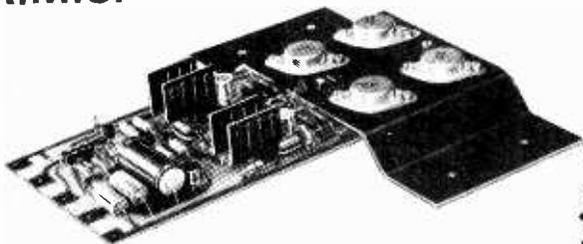
**INPUT VOLTAGE** 33-40V. A.C.  
**OUTPUT VOLTAGE** 33V. D.C. Nominal  
**OUTPUT CURRENT** 10mA-1.5 amps  
**OVERLEAD CURRENT** 1.7 amps approx.  
**DIMENSIONS** 105mm x 63mm x 30mm  
**TRANSFORMER BMT80** £2.60 + 62p. postage

**£3.00**

equipment mono and other modules for Stereo

# IT'S NEW! IT'S POWERFUL IT'S THE AL250

125 watts  
R.M.S.



## POWER AMPLIFIER

Specially designed for use in—  
Disco Units, P.A. Systems, high power  
Hi-Fi, Sound reinforcement systems

The module has a sensitivity of 450mV and a frequency response extending from 25Hz to 20KHz whilst distortion levels are typically below 0.1%. The use of 4, 115w transistors in the output stage makes the unit extremely rugged while damage resulting from incorrect or short-circuit loads is prevented by a four transistor protection circuit.

The unit is intended for use in many applications such as disco units, sound reinforcement systems, background music players, etc.

### SPECIFICATION:

Output Power: 125 watt RMS  
Continuous  
Operating voltage: 50-80  
Loads: 4-16 ohms  
Frequency response: 25Hz-  
20kHz Measured at 100 watts  
Sensitivity for 100 watts output  
at 1kHz: 450mV  
Input impedance: 33Kohms

Total harmonic distortion  
50 watts into 4 ohms: 0.1%  
50 watts into 8 ohms: 0.06%  
S/N ratio: better than 80dBs  
Damping factor, 8 ohms: 65  
Semiconductor complement: 13  
transistors 5 diodes  
Overall size: Heatsink width  
190mm, length 205mm Height  
40mm

**ONLY £15.95 +8% VAT**

## MPA 30



Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new Bi-Pak M.P.A. 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only. Used in conjunction are 4 low noise, high gain silicon transistors. It is provided with a standard DIN input socket for ease of connection. Supplied with full, easy-to-follow instructions.

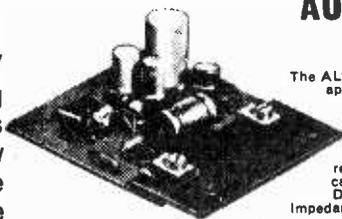
**£2.65**

**VAT  
ADD  
25%**

### POSTAGE & PACKING

Postage & Packing add 25p unless otherwise shown. Add extra for airmail. Min. £1.00

## AL10-20-30 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 home. Harmonic Distortion Po = 3 watts f = 0-25% Load

Impedance 8-16ohm

Frequency response  $\pm 3dB$  Po = 2 watts 50Hz-25KHz  
Sensitivity for Rated O/P—Vs = 25v. RL = 80ohm  
f = 1KHz 75mV. RMS. Size: 75mm x 63mm x 25mm.

AL10 3w R.M.S. **£2.30** AL2: 5w R.M.S. **£2.65** AL30 10w R.M.S. **£2.95**

**NEW PA12  
£6.50**

NEW PA12 Stereo Pre-Amplifier completely redesigned for use with AL10 20 30 Amplifier Modules. Features include on/off volume. Balance, Bass and Treble controls. Complete with tape output.  
Frequency Response 20Hz-20KHz. (-3dB)

Bass and Treble range  $\pm 12dB$   
Input Impedance 1 meg ohm  
Input Sensitivity 300mV  
Supply requirements 24V. 5mA  
Size 152mm x 84mm x 33mm

**PS12** Power supply for AL10/20/30, PA12, S450 etc. Input voltage 15-20v A.C. Output voltage 22-30v D.C. Output Current 800 mA Max. Size 60mm x 43mm x 26mm  
Transformer T538 **£2.30**

**£1.20**

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Ref. No.	VA (Watts)	£	p & p
07*	20	3.77	0.58
149	60	4.69	0.72
150	100	5.33	0.85
151	150	6.54	1.12
152	250	10.32	1.41
153	350	12.47	1.41
154	500	14.33	1.61
155	750	21.94	BR5
156	1000	30.57	BR5
157	1500	34.89	BR5
158	2000	38.92	BR5
159	3000	61.48	BR5

\* 115V or 240V Sec. only

## 12 and or 24 Volt

Ref. No.	Amps		£	p & p
	12v	24v		
111	0.5	0.25	1.54	0.28
213	1.0	0.5	1.86	0.58
71	2	1	2.41	0.58
18	4	2	2.97	0.72
70	6	3	4.43	0.72
108	8	4	5.09	0.85
116	12	6	5.50	0.85
116	12	6	5.80	0.97
17	16	8	7.48	0.97
115	20	10	10.91	1.61
187	30	15	14.20	1.41
226	60	30	17.67	BR5

## 30 VOLT RANGE

Ref. No.	Amps	£	p & p
112	0	1.90	0.58
79	0	2.52	0.72
3	2	3.77	0.72
20	3	4.70	0.85
21	4	5.56	0.85
51	5	6.73	0.97
117	6	7.52	1.12
88	8	10.20	1.25
89	10	10.36	1.41

## 50 VOLT RANGE

Ref. No.	Amps	£	p & p
102	0.5	2.71	0.58
103	1.0	3.55	0.72
104	2.0	4.95	0.85
105	3.0	6.10	0.97
106	4.0	7.98	1.12
107	6.0	12.71	1.25
118	8.0	16.63	1.61
119	10.0	17.75	BR5

## 60 VOLT RANGE

Ref. No.	Amps	£	p & p
124	0.5	2.48	0.72
126	1.0	3.68	0.72
127	2.0	5.33	0.85
125	3.0	7.90	0.97
123	4.0	9.19	1.41
40	5.0	10.24	1.25
120	6.0	12.07	1.41
121	8.0	15.75	BR5
122	10.0	19.40	BR5
189	12.0	20.25	BR5

## AUTO TRANSFORMERS

Ref. No.	VA (Watts)	£	p & p
113	20	1.15	0.51
64	75	3.05	0.72
4	150	4.33	0.75
66	300	6.11	0.85
67	500	9.36	1.25
84	1000	14.36	1.61
93	1500	19.02	BR5
95	2000	25.41	BR5
73	3000	36.84	BR5

## CASED AUTO TRANSFORMERS

Ref. No.	VA (Watts)	£	p & p
100VA	100	1.15	0.51
150VA	150	1.41	0.72
500VA	500	9.36	1.25
1000VA	1000	14.36	1.61
2000VA	2000	25.41	BR5

## SCREENED MINIATURES

Ref. No.	mA	Volts	£	p & p
138	200	3-0-3	1.62	39
132	1A	0-0-6	1.93	46
13	100	9-0-9	1.56	25
235	330	330 0-9-0-9	1.64	25
207	500	500 0-9-0-9	2.02	51
208	1A	0-9-0-9	3.07	58
236	200	0-15-0-15	1.56	25
214	300	0-20-0-20	2.38	58
221	700(DC)	20-12-0-12-20	2.38	58
206	1A	0-15-20-0-15-20	3.63	72
203	500	0-15-27-0-15-27	3.15	72
204	1A	0-15-27-0-15-27	4.14	72
5112	500	12, 15, 20, 24, 30	1.97	58

## HIGH VOLTAGE

Ref. No.	mA	Volts	£	p & p
138	200	3-0-3	1.62	39
132	1A	0-0-6	1.93	46
13	100	9-0-9	1.56	25
235	330	330 0-9-0-9	1.64	25
207	500	500 0-9-0-9	2.02	51
208	1A	0-9-0-9	3.07	58
236	200	0-15-0-15	1.56	25
214	300	0-20-0-20	2.38	58
221	700(DC)	20-12-0-12-20	2.38	58
206	1A	0-15-20-0-15-20	3.63	72
203	500	0-15-27-0-15-27	3.15	72
204	1A	0-15-27-0-15-27	4.14	72
5112	500	12, 15, 20, 24, 30	1.97	58

## BRIDGE RECTIFIERS

Ref. No.	VA	£	p & p
50V	2A	35p	
100V	2A	40p	
100V	6A	70p	
200V	2A	35p	
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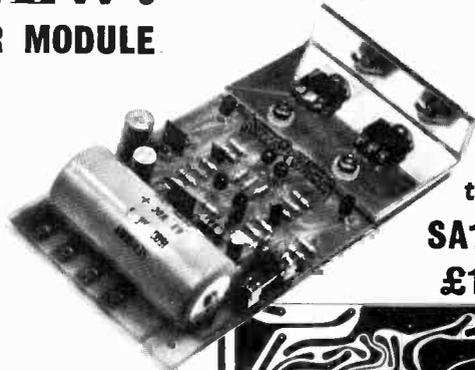
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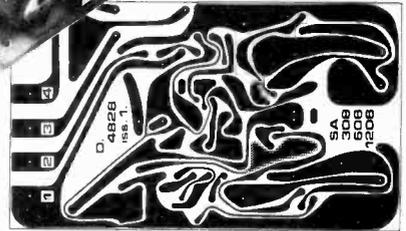
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- Mono or stereo versions
- Front and rear output terminations to suit style of usage
- Inputs for 2 ceramic cartridges/tape/microphone
- Autofade with depth and threshold controls
- Wide range treble and bass controls on both channels
- Individual deck controls AND left/right fader
- Low noise (—80dB) 20Hz — 50kHz  $\pm$  1dB
- Suits all Saxon amplifiers and most other makes
- † watt headphone monitor—five position switch with mute positions



- **CONTROLS**—L. to R.: Mic Vol./Treble Bass, Autofade depth, L/Deck Vol., R/Deck Volume, Tape Volume, Treble, Bass, Master, Monitor Volume, Monitor Selector-On-Off
- Variable autofade stainless steel panel

**MONO £34.50**    **STEREO £49.50**

## MODULAR DISCO MIXERS MONO & STEREO

Printed circuit sub-assembly version of the above mixers—ideal for those wishing to incorporate Saxon's superb specifications into their own systems—all the electronics are provided.

You require only plugs and sockets plus one switch to complete the wiring. All other controls are already mounted on the P.C.B. Comprehensive wiring instructions are supplied with circuit and very clear diagrams.



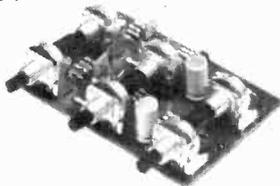
**MONO £18.50**

**STEREO £27.50**

## MULTI-PURPOSE MODULAR MIXERS—A SYSTEM 7000 BREAKTHROUGH—UP TO 20 CHANNELS MONO/STEREO

### ■ P.C.B. MODULES :

- Ready assembled with all controls
- Simple terminations—solder or edge connector
- Consumption 10mA at 18v



<b>INPUT MODULES</b>	<b>Mono 1M7001M</b>	<b>£5.50</b>
(up to 20 may be used)	<b>Stereo 1M7001S</b>	<b>£9.00</b>
<b>MIXING MODULE</b>	<b>Mono 1M7002M</b>	<b>£5.50</b>
(only 1 required)	<b>Stereo 1M7002S</b>	<b>£9.00</b>

Provides headphone output & mixes all inputs to output level.  
Suits all mixing requirements for groups—clubs discos etc.

### ■ COMPLETELY WIRED WITH STAINLESS PANEL:

Both modular and complete types offer same facilities

- Inputs for all sources inc mag. cartridge
- Wide range bass and treble controls
- Only one mixing module required
- Up to twenty channels
- †w monitor power
- Mono and stereo modules may be used together
- Feeds most amplifiers
- Modern low noise circuitry
- 20Hz — 30kHz  $\pm$  1dB
- Echo send/return facility
- Send for details
- Complete—ready to plug in or solder
- 5cm matrix—bold panel
- Individual monitor buttons

Mono input module	<b>£8.50</b>
Stereo input module	<b>£12.00</b>
Mono mixer module	<b>£8.50</b>
Stereo mixer module	<b>£12.00</b>



Power supply unit **£7.50**

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## New! TWO STROBES TO MEET ALL REQUIREMENTS

### SUPERSTROBE

- Built in Saxon reliability
- 1 flash/2 secs.—up to 20/sec.
- Compact black Bondene case
- Appearance matches other Saxon units
- Ideal for the mobile disco or smaller club



SUPERSTROBE £24.75  
PRO-STROBE £38.50

### PRO-STROBE

- Giant 80 watt tube
- Discharge energy up to 6 Joules
- External trigger—audio up to 240v
- May be used with Soundlite to obtain rainbow strobe
- Smart, tough Bondene case 8" x 8" x 5" approx (20cm x 20cm x 13cm)

## New! 150 WATT LIQUID WHEEL PROJECTOR

- Complete with wheel
- 150 watt tungsten lamp
- Wide range of extra effects may be attached
- Sturdy construction
- Adjustable feet



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Spare wheels £4.90

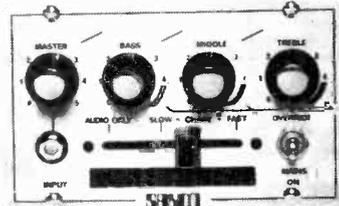
## TOTAL CONTROL WITH SYSTEM 7000 LIGHTING CONTROL UNIT

- Full control of 3KW of lights (1KW/channel)
- Audio control *plus* sequence *plus* override
- Variable speed sequence with slider function control
- Stainless steel two tone panel—matches mixer
- 13 transistors 8 diodes—advanced control circuitry
- High audio sensitivity—operates from any amplifier
- Attractive Bondene case—free standing or panel mounting
- Individual tone controls *plus* master audio control

This exciting unit offers the performance of units offered at nearly twice the price.

£38.00

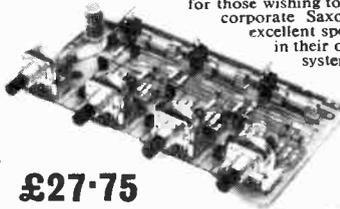
inc. case & plug—ready to use.



## SUPERFECT MODULE

- All features as the System 7000 lighting control unit
- Requires only panel and plug socket, etc.
- Slider control supplied
- Glass fibre P.C.B.
- 8 amp RCA triacs
- Complete light show in one unit with instructions

This P.C.B. sub-assembly of the System 7000 lighting control unit is recommended for those wishing to incorporate Saxon's excellent specs. in their own systems.



£27.75

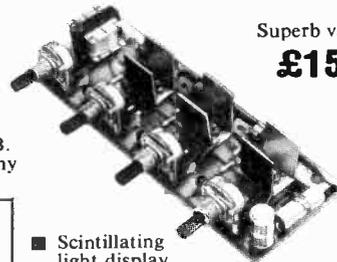
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Our outstandingly successful 3kw converter in module form

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- Individual tone controls
- Master control
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- Operates from any amplifier

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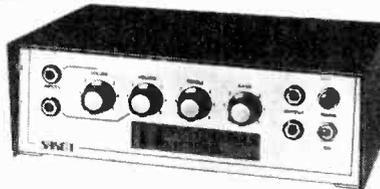
- Scintillating light display

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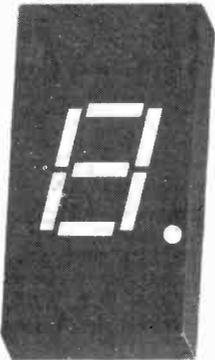


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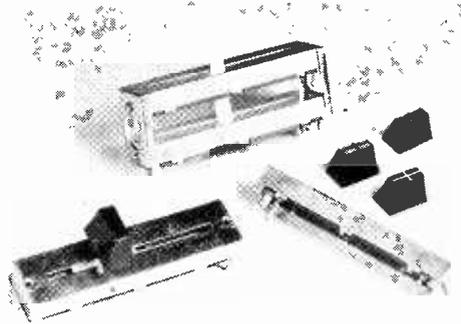
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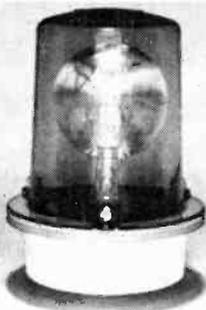
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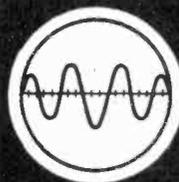
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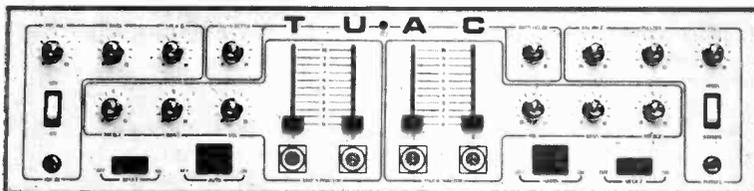
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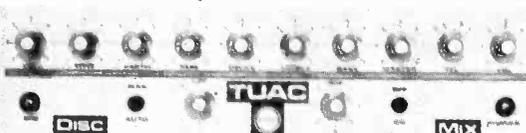
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# Frequencies for all

**T**HE Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3) was held in Geneva last autumn and, among other things, considered the frequency allocations on those bands and it is good to report that the UK seems to have come out of the affray quite well. In Europe and those African and Asian countries bordering on the Mediterranean the use of these broadcasting bands is at present governed by the European Broadcasting Convention and the Copenhagen Plan, negotiated in 1948. Delegations from 103 countries took part in the conference, the UK delegation including representatives of the BBC, the IBA and the Home Office.

The conference produced an Agreement and Plan which was signed by all but three of the delegations. Other member countries may accede later. The Plan is due to come into effect on 23 November 1978 and is intended to meet requirements for at least the following ten years. Charles Molloy has more to say about the frequency allocations in his Broadcast Bands column.

Let us hope that the radio amateurs will do as well in the World Administrative Radio Conference in 1979. It may seem strange to some that anybody should be worrying about a meeting that will not take place for some three and a half years. But a great deal of work must be done before the UK delegation can depart with a long list of the frequencies and other facilities that have been requested by every user of the radio spectrum in the UK. The radio amateur's case will, of course, be formulated by the Radio Society of Great Britain and every amateur here can be assured that they will do the best job possible in this respect.

Every amateur can help the cause by complying with his licence conditions, in particular by observing what should be normal good behaviour when on the air. There are those around who would be only too happy to snatch some of the amateur's frequencies in order to further their commercial interests. Bad behaviour on the air is playing straight into their hands.

It is a matter for regret that the number of licensed amateurs in the UK who belong to the RSGB is very much less than the ideal 100%. The answer surely must lie in the organisation of the Society. The present set-up should be reviewed and the sooner the better. If the planners of the new National Exhibition Centre saw fit to place the Centre outside London then the RSGB should take up its Headquarters and do likewise!

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The Editor, Practical Wireless—Television  
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## NEWS...

### Solar Energy Watch

**L**ASKYS have imported what is believed to be the world's first digital watch, incorporating a wrist-based calculator and powered by solar energy.

It is called the Uranus Time Computer and represents "the State of the Art" in digital integrated circuit technology.

The watch function displays, on command, hours, minutes, day of the month and seconds.

The calculator is four-function, +, ×, ÷, −, machine with an 8-digit display, full floating decimal and automatic stand.

The Time Computer contains a solar cell which draws its power from sunlight, daylight or artificial light. The batteries, therefore, never need replacing.

The heart of the Time Computer is a tiny encapsulated "chip" of silicon containing many thousands of transistors and other active electronic devices. (It is available to special order for £295 including VAT.)

The Uranus Time Computer is on special display at *Laskys 481 Oxford Street* store.

### Hold very tight please!

**T**HE passengers on the top decks of 30 buses operated by the Scottish Bus Group will be getting music-while-they-ride now. A firm called Sounds in Motion Ltd. have installed Pye auto-reversing cassette players to provide the music.

### Alexandra Palace

**A**S an alternative to the usual Woburn Abbey Rally, the Radio Society of Great Britain is arranging to hold an exhibition at Alexandra Palace, North London, on 30 and 31 July and 1 August, 1976.

The site has very adequate car parking and outdoor facilities. Full catering exists within the building.

*Practical Wireless, April 1976*

**Diary Dates**

- March 8-14.** Festival International du Son, Paris.
- March 9-11.** Electro-Optics/Laser International Conference and Exhibition, Metropole Convention Centre, Brighton.
- March 9-11.** Computermarket 76 Exhibition, Assembly Rooms, Edinburgh.
- March 16-18.** Computermarket 76 Exhibition, The Forum, Wythenshawe.
- March 18-28.** 23rd International Exhibition of Electronics, Nuclear Energy and Aerospace Technology, Rome.
- March 23-25.** CAD 76—Computer Aided Design Conference and Exhibition, Imperial College, London.
- March 23-25.** Computermarket 76 Exhibition, New Horticultural Hall, London.
- March 24-26.** Third Conference on Industrial Robot Technology and Sixth International Symposium on Industrial Robots, The University, Nottingham.
- April 5-10.** International Component Show, Paris.
- April 13-15.** All-Electronics Show, Grosvenor House, London.
- April 26-30.** IFSSEC 76—International Fire Security & Safety Exhibition and Conference, Olympia, London.
- April 27 to May 2.** Hi-Fidelity 76 Exhibition, Heathrow Hotel, London Airport.
- April 28 to May 6.** Hanover Fair, Hanover.
- May 3-7.** IEA 76—International Instruments, Electronics and Automation Exhibition, National Exhibition Centre, Birmingham.
- May 3-7.** Electrex 76—Electrical Engineering Exhibition, National Exhibition Centre, Birmingham.
- May 23-27.** International Home Electronics and Domestic Appliance Exhibition (AMDEA/BREMA), National Exhibition Centre, Birmingham.
- May 28-31.** Sound and Vision 76 TV and Audio Show, National Exhibition Centre, Birmingham.
- June 8-11.** Communications 76 Exhibition and Conference, Metropole Convention Centre, Brighton.

- June 8-12.** Internavex International Audio-visual Aids Exhibition, Olympia, London.
- July 5-8.** International Conference on Automobile Electronics (IEE), Savoy Place, London.
- July 20-22.** Conference on Video and Data Recording (IERE), The University, Birmingham.
- Aug 24-26.** Education and Communication Technology Exhibition, Holland Park School, London.
- Sept 13-17.** Micro 76—International Symposium and Exhibition of Microscopes and Ancillary Equipment, Wembley.
- Sept 13-19.** 21st International Audio Festival and Fair, Olympia, London.
- Sept 14-16.** Eurocomp—European Computing Congress, Heathrow Hotel, London Airport.
- Sept 20-24.** IBC 76—International Broadcasting Convention, Grosvenor House, London.
- Oct 19-21.** Internecon/UK Electronic Production Conference and Exhibition, Metropole Convention Centre, Brighton.
- Oct 26-29.** Microforum International Exhibition, Conference Centre, Wembley.
- Nov 16-18.** International Mini-computer Conference and Exhibition, West Centre Hotel, London.

**Man of Vision**

THE University of Strathclyde recently mounted an exhibition, "Man of Vision", as a Jubilee tribute to John Logie Baird, 1888-1946, the inventor of television and a distinguished former student, who fifty years ago showed the world's first pictures by television. "Man of Vision" occupied the University's Collins Exhibition Hall in Richmond Street, Glasgow, from December 18, 1975 till January 30, 1976, and for the first time assembled under one roof a comprehensive display of Logie Baird's unique television and other equipment supported by personal, photographic, written and other memorabilia spanning his incredibly active lifetime.

**Bipolar Proms and Roms**

INTEL have published a 36-page booklet which provides technical information on 13 different ROMs and 24 different PROM types they manufacture. All the devices in the booklet are of Schottky bipolar construction and erasable PROMs and not included.

The booklet incorporates a data sheet for each device, and equivalents chart and gives details of PROM programming equipment.

For every Intel ROM there is a pin and performance compatible PROM, which means that no circuit changes have to be made when a project is finalised and information in PROM is committed to mask-programmed ROM.

All Intel PROMs employ polysilicon fuses which coat the surrounding area in a protective oxide layer when they are 'blown'. With polysilicon fuses there is no danger of a fuse 'growing back' as has happened before with conventional metal fuses.

Intel Corporation (UK) Ltd., Broadfield House, 4 Between Towns Road, Cowley, Oxford OX4 3NB.

**International Conference**

THE Institute of Physics is organising a Conference to mark the 50th Anniversary of the Discovery of Electron Diffraction. The Conference will be held on 19-22 September 1977 at Imperial College, London. It is the intention of the organisers that all aspects of electron diffraction should be covered with emphasis in specific areas such as crystal structure determination and surface structure studies. Plenary sessions will be introduced by review lectures from eminent personalities.

There will be an exhibition of equipment held concurrently with the Conference.

For further information please contact: *The Meetings Office, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX.*

# AUTOMATIC

Alan C. AINSLIE

# SLIDE SYNCHRONISER

**M**ANY amateur photographers like to play music while presenting a slide show. With the increased popularity of semi-automatic projectors it is fairly simple to synchronise the slide changes to a recorded commentary or music. The conventional method of synchronisation involves recording tones on one track of the stereo tape machine with the commentary on the other. The commentary is played back in mono while the tones are used to close a relay connected to the slide projector remote control circuit.

## OPERATION

We shall first consider the general requirements for a tape-slide synchroniser before dealing with the details of the electronics. A tone is generated at a nominal frequency of say 18kHz. This tone is generated continuously and so must be 'gated' to the output whenever the command to change slides is to be recorded. The signal is recorded for the same length of time no matter how brief the push of the slide change button. This necessitates that a form of monostable oscillator be incorporated.

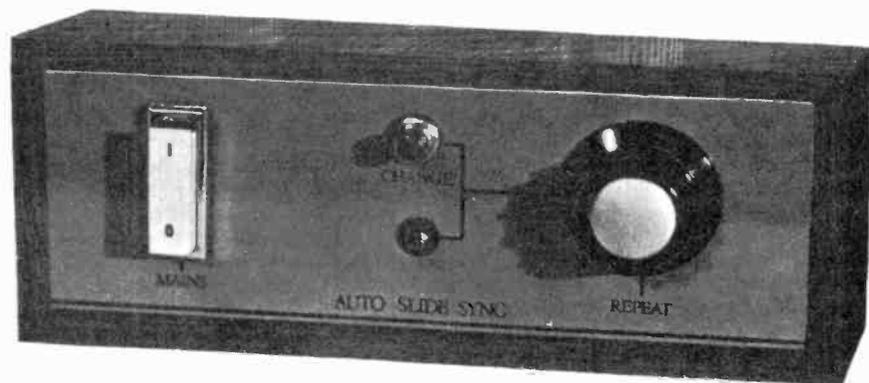
The length of time that the playback relay is closed determines whether the slide projector changes forwards or backwards. Generally, closure for over one second causes the projector to change backwards to the previous slide. Therefore by using a record monostable it is possible to record reversing tones on the tape as well as forward. The detection of the 18kHz tone from the tape playback (which includes fundamentals, high harmonics and hiss)

is a rather difficult task. A narrow bandwidth sensitive detector is needed. This function is provided by a 567 phase-locked loop IC. An additional feature of the synchroniser unit is that the monostable can be switched into an astable and so be used to change slides independently at preselected intervals for continuous unattended showing.

## CIRCUIT DESCRIPTION

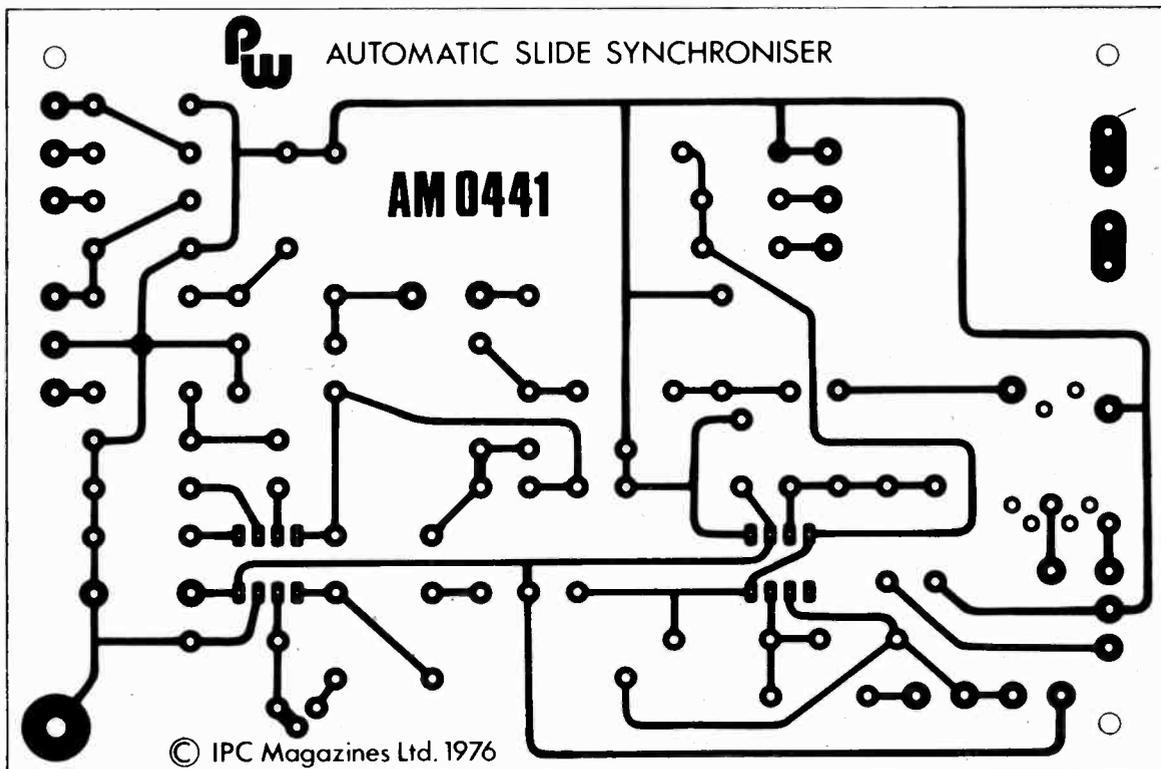
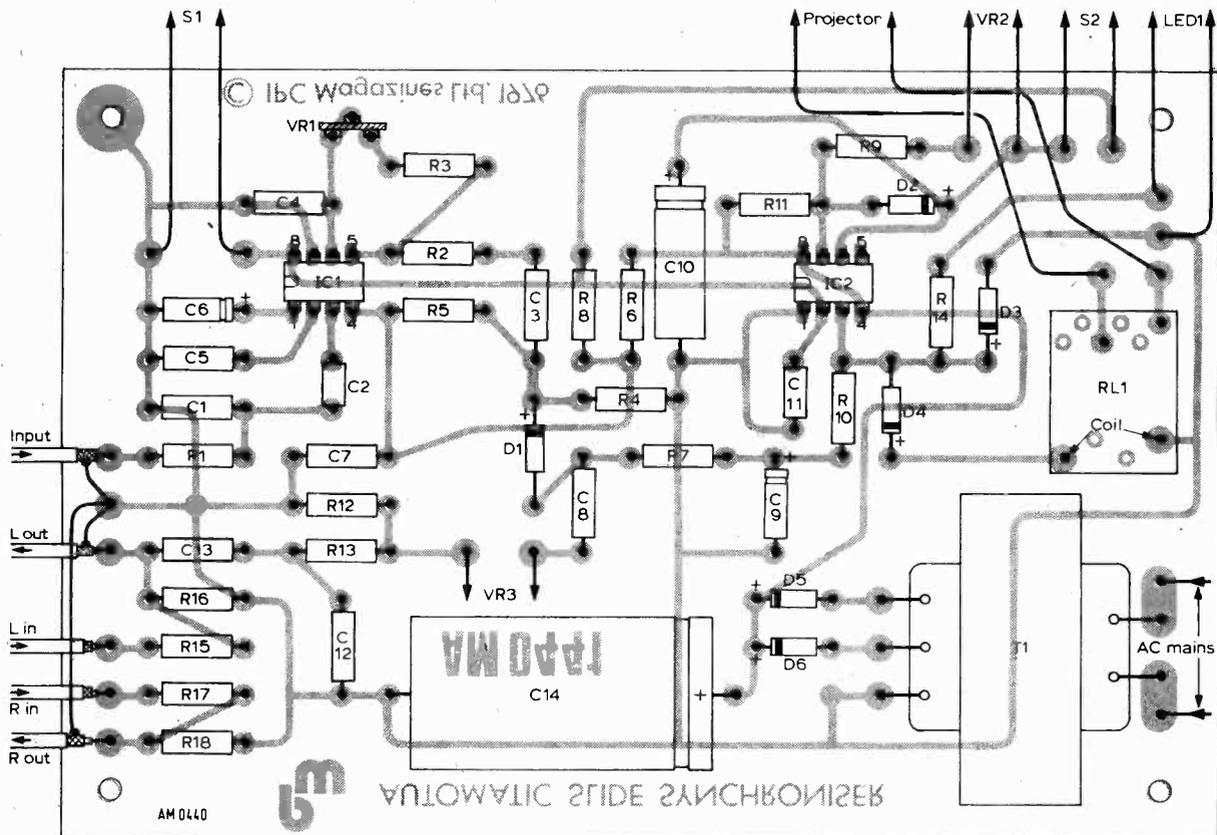
The heart of the unit is IC1, the 567 PLL device. VR1 sets the VCO frequency at about 18kHz. A square wave at the VCO frequency is available from a fairly low impedance at pin 5. The VCO is running continuously and is very stable. When recording, S1 is used as the slide change button to record bursts of the 18kHz tone on the tape. When VR2 is at minimum resistance, S2, which is mechanically ganged to VR2, is open. The 555, IC2, then operates as a monostable with the output at pin 3 normally low. Closing S1, earths pin 2 which is normally held to a slightly positive potential by R8. C10 then charges through R11 and D2 while the output at pin 3 goes high, closing the relay. After about 0.5s, C10 will have charged to  $2/3V_{CC}$  and the output together with pin 7 will go low. C10 discharges through R9 and VR2 (which is at minimum resistance) to wait the next 'change' command.

Keeping S1 closed for longer than the natural monostable period holds the output high until the button is released enabling a long burst of tone to be recorded for reverse slide changes etc. Diodes D4 and D3 prevent pin 3 of the 555 going negative



Photograph showing the front panel of the Slide Synchroniser. The rotary knob marked 'Repeat' is VR2/S2 and the switch marked 'Change' is S1.





The printed circuit board above is shown full size and accommodates all the components of the circuit. The hole spacings for RL1 are those for the RS Components 'continental' series type 40 relay, although with careful redrilling another suitable relay may be used.

## PLAYBACK DETECTION

Having got the signal on the tape, all that remains is to detect it on playback. The 567 PLL is a fairly sensitive device requiring only 20mV of tone burst to start the PLL capture process. At small inputs (less than 200mV) the PLL bandwidth decreases with decreasing signal input. C5 sets the bandwidth to be 5% or 6% with a signal just above the detection threshold. C6 controls the response of the output stage while R1, C1 and C2 form a very simple band-pass filter centred about 18kHz to reduce the possibility of the 567 detecting low frequency signals. Even pure signals below the VCO frequency can be detected if they are large enough, as the input stage is a clipper and so generates harmonics. The output of the 567 goes low for the duration of the tone, once the loop has locked (which takes typically a few  $\mu$ S), and so fires the 555 in the same way as closing the 'change' switch S1.

Should a pulse be missed during playback due to dirty heads, S1 still functions and allows the projectionist to catch up with the sound track manually. In the absence of a playback connection, VR2 can be turned clockwise, S1 closed and the 555 will operate as an astable of period set by VR2 over the range of 2s to about 30s. Thus the unit can be used to give repeated slide changes for demonstration and unattended showing. In the astable mode, C10 charges via R11 and D2 while pin 3 is high. When the voltage at pin 6 reaches 2/3 of the supply voltage then the output, and pin 7 go low. C10 now discharges through VR2 and R9 until pin 2 falls below 1/3 of the supply voltage. The output then goes high and the cycle repeats.

The power supply for the unit is very simple. The 555 timing is independent of the supply voltage as is the VCO in the 567. A stabilised supply there-

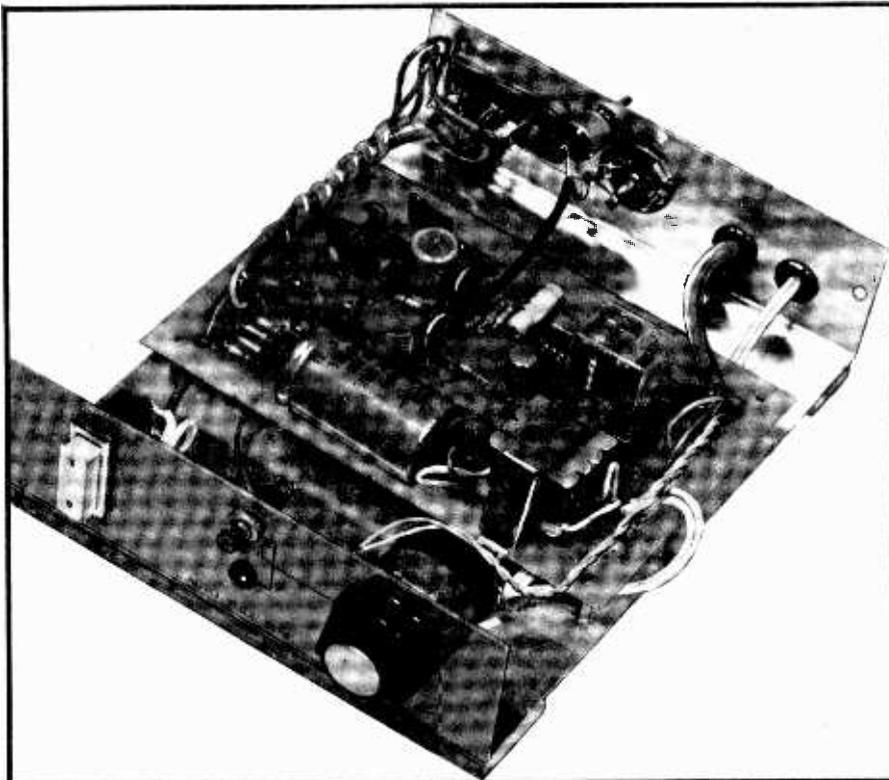
fore is not required. The supply to the 555 is about 12V or 13V while the supply to the 567 has to be limited to no more than 10V. This is accomplished by R6 with C7 for decoupling.

## CONSTRUCTION

The slide synchroniser is a fairly complex unit and is fairly difficult to build other than by means of a printed panel. The layout is shown full size in Fig. 2. The connections to the relay will of course depend on the actual relay used. The board, with the layout marked in resist, is etched washed, and the resist removed with a solvent or paint stripper. Holes are then drilled with a number 60 drill (except those for VR1 and possibly C14 and RL1 which may need to be larger). The completed PCB in the prototype was mounted on 10mm stand-offs on a 'U' shaped chassis 150mm wide and 205mm deep. The front and back were bent up by 45mm to form the front and rear panels.

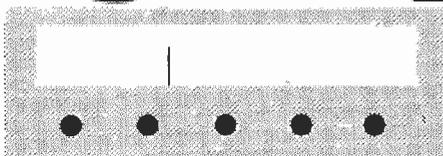
The rear panel has three phono sockets mounted on it (two for left and right inputs, one for the playback signal input) as well as three holes for the mains lead, lead to the projector and a pair of screened leads terminated in phono plugs to connect to the tape recorder input. These holes are fitted with grommets to protect the cables. The three sockets are connected with screened cable with the shields earthed at the securing screw for the tape replay input socket. The electronics are also earthed at this point with a short lead from the point on the print to which the braiding of the S1 lead is connected. The braidings of the screened output leads are earthed at the terminal adjacent to C13. A mains earth is not used as this could introduce earth loop problems.

*continued on page 1038*



*General layout view of the chassis, front and rear panels and sockets. The basic chassis is simply a piece of aluminium bent to a 'U' shape.*

# converting early MONO FM Tuners to STEREO



KEITH CUMMINS

THERE are in existence a considerable number of older valve tuners, such as Quad, Leak, Rogers, Armstrong, etc., which are still giving good service. However, stereo decoders for these tuners are no longer available and the writer has frequently been involved with their modification to stereo operation.

Generally the conversions have been "one-offs" with each situation being individually assessed, bearing in mind the availability of suitable decoders. Mullard have now released their LP1400 stereo decoder module, which is physically small and lends itself ideally to modifications of the type referred to, especially as it needs no alignment or other adjustments. The typical input impedance of the LP1400 is around 150kΩ which is quite suitable for connection to either a ratio detector or Foster-Seeley discriminator. It must be remembered, however, that any de-emphasis network at the output of the discriminator must be removed.

## TRANSMISSION THEORY

A very brief discourse on the principles of stereo broadcasting would not be inappropriate at this point. Let us call the two stereo channels A and B. The FM transmitter is modulated in the normal way with a signal consisting of A and B added together (A+B). Non-stereo receivers will produce this signal only, which, being the left- and right-hand channels added, provides normal mono reception. This arrangement ensures system compatibility. The audio bandwidth of this signal extends to 15kHz.

In order to produce the stereo information, the A and B signals are subtracted, and used to modulate a sub-carrier at 38kHz. This double sideband signal therefore consists of (A-B) modulation. If the transmitted signal is monophonic, i.e. A=B, then A-B=0 and the 38kHz information vanishes completely, since the subcarrier is suppressed in the absence of "difference signal" modulation.

In order to receive and decode the suppressed sub-carrier information, it is necessary to re-insert the missing 38kHz signal at the receiver. To enable this to be done simply, an unmodulated pilot tone at

19kHz is transmitted. As will be seen from Fig.1, this signal slots in between the extremes of the sidebands of the sum and difference signals. The 19kHz signal is doubled in the decoder to provide the missing 38kHz subcarrier, which is then combined with its sidebands. The difference signal can then be demodulated.

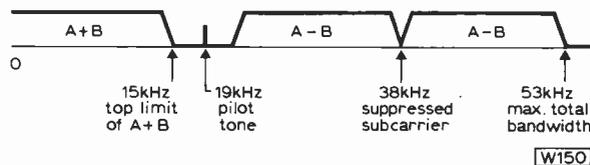


Fig. 1: Frequency spectrum of stereo Multiplex signal. The (A + B) signal provides the normal mono reception.

In order to recover the original A and B signals, a simple algebraic manipulation is carried out. To obtain A, the (A+B) and (A-B) signals are added together:  $(A+B) + (A-B) = 2A$ . To obtain B, they are subtracted:  $(A+B) - (A-B) = (A+B) + (B-A) = 2B$ .

Thus, we can recover the original A and B signals (the digit 2 represents a scaling factor). It will be realised that the presence or absence of the 19kHz pilot determines whether the broadcast is stereo or mono. Usually a stereo beacon lamp is provided which lights up when the decoder is presented with a stereo signal. The foregoing description applies to the Zenith-GE multiplex FM stereo broadcast system as used in the UK and Europe.

## SIGNAL STRENGTH

The bandwidth spectrum of the stereo broadcast signal, Fig.1, is considerably wider than that employed for mono. Because of this, any noise present in the system will have a greater interfering effect. The noise in the upper modulation frequency area is much greater than in the lower region and in the process of decoding, this noise is shifted into the audio range and added to the output signal. In order to achieve an equivalent signal-to-noise ratio, about five times the signal is needed on stereo,

compared to mono. Therefore it may be necessary to improve the aerial arrangements if stereo reception is to be entirely satisfactory.

Since the recovered A and B signals contain difference signal (A-B) components in opposite phase, the noise in the two output channels will be predominantly of opposite phase. As a result, we can revert to mono by shorting the A and B outputs together after the decoder, when the stereo noise will cancel. In our application of the LP1400 module, this method works well, so that we can "mono" the

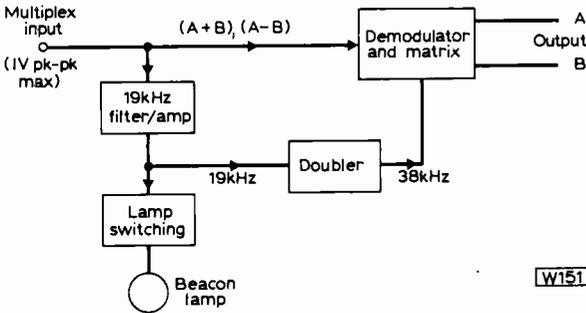


Fig. 2: Block diagram showing the basic circuits of a stereo decoder.

signal at the amplifier control unit or preamplifier without needing to employ the "stereo inhibit" input to the decoder. A block diagram, illustrating the action of the decoder is shown in Fig.2.

## TUNER MODS

Readers will appreciate that "pre-emphasis" of the higher modulating frequencies is applied at the FM transmitter. When de-emphasis is applied at the receiver, the system noise is attenuated in the same proportion. A mono tuner will include a de-emphasis network after the discriminator, and as this would effectively remove the 38kHz difference signal, it is essential that the network be removed when the decoder is fitted. The reader is advised to look for components with 50μs time-constant (the de-emphasis figure) e.g. 47kΩ and 1nF, see Fig.3. When these components have been removed the discriminator

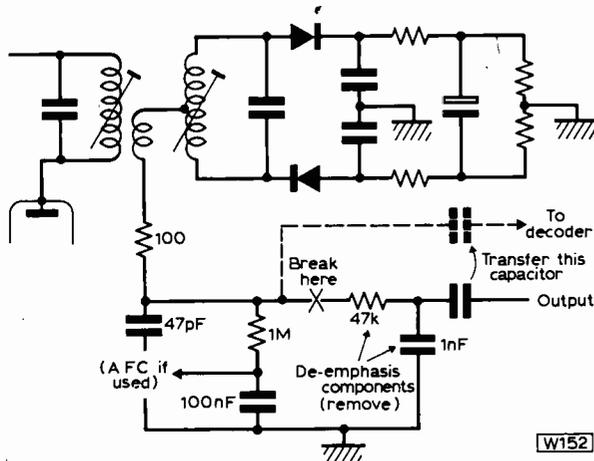


Fig. 3: A typical ratio detector circuit of a valve tuner. Note the removal of the de-emphasis components and the new take-off point.

output can be connected directly to the input of the decoder.

A complete circuit is shown in Fig.4. The low voltage supply is derived from the tuner's HT supply by the use of a resistor R4 and zener stabiliser D1. This simple approach is appropriate where only an HT rail and low voltage heater feed are available. Care should be taken to place the resistor in a position where it can dissipate its heat adequately and feed the circuit from the point where the HT comes into the tuner. Capacitor C3 provides additional filtering of the module power supply.

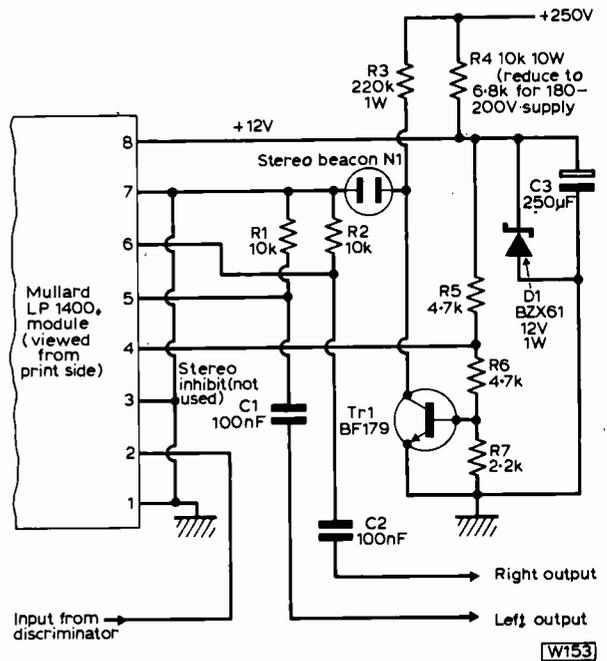


Fig. 4: For correct operation, the Mullard LP1400 module should be connected to a valve tuner, as shown above. The +12V supply to the module is derived from the tuners HT supply via R4, and stabilised by D1 and C3.

## STEREO BEACON

The module is designed to feed a filament lamp as the stereo beacon. Unfortunately no suitable power supply for this is found in the average valve tuner, so a neon indicator is used instead. The filament lamp would normally connect between the supply rail and point 4 on the decoder. Upon reception of stereo, point 4 switches to earth, so turning the lamp on. The neon indicator operates as follows: Transistor Tr1 is turned on, in the absence of a stereo signal, by the base current feed from +12V via R5 and R6 (point 4 is switched open within the decoder). As a result, Tr1 is bottomed and the whole HT voltage is dropped across R3. When a stereo signal is received, point 4 switches to earth and the absence of a source of base current stops Tr1 conducting. The collector voltage then rises until the striking voltage of N1 is reached. The neon lamp then lights, indicating stereo reception.

The neon circuit has the advantage that only one transistor is needed and one side is earthed. This makes the mounting easier, in that the cap can be

soldered to a bracket bolted to the chassis. The reader will have his own ideas on where to mount the neon, although a favourite place is at one end of the tuning dial.

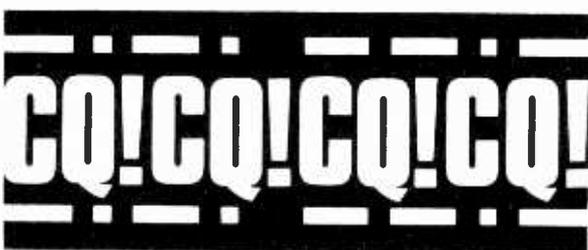
The 10kΩ resistors R1 and R2 are needed to prevent clipping at the output. Note that the decoder module has an overall gain of 6dB under these conditions. If this is too much, R1 and R2 should be replaced by 10kΩ potentiometers so that the levels can be adjusted as required. Note that C1 and C2 are essential to isolate the DC present at the output of the decoder assuming that the unit is to feed the typically high input impedance of a valve preamplifier.

## ADJUSTMENTS

In some cases it may be found that the stereo separation is unsatisfactory resulting from the tuner IF bandwidth being too narrow to accommodate all the sidebands of the difference signal. Careful stagger-tuning of the IF transformers will enable the bandwidth to be increased and so provide adequate stereo effect. The reader is cautioned **NOT** to attempt adjustments on the decoder board itself, since these will have been correctly carried out during manufacture.

When mounting the decoder in a tuner, make sure that it cannot move and accidentally touch the HT supply! This can be an expensive mistake. The positioning should be such that adequate ventilation is provided to prevent overheating. If the unit is to be wired in using the stand-up leads, the print to the edge connector can be cut. This part of the board can then be drilled to accommodate a fixing bracket.

The Mullard LP1400 module can be obtained from Chromosonic Electronics, see ads. Dw



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## AUTOMATIC SLIDE SYNCHRONISER—

*continued from page 1035*

### SETTING UP

With mains applied, a voltage check should show about 13V or 14V on pin 8 of the 555 and about 8V on pin 4 of the 567. With VR2 fully anti-clockwise (S2 open), pushing S1 briefly should cause the relay to pull-in and the LED to light for about 0.5s. Keeping S1 depressed should hold in the relay. With the relay held in, the output leads are connected to the input of the tape recorder. With R8 at minimum and the recorder left hand input control turned up, a deflection should be noted on the VU meter. Switching the monitor to 'source' enables one to hear the signal from which the tone burst is derived. With VR1 at maximum the tone should be clearly audible. Decreasing VR1 takes the tone up in frequency. VR1 should be set so that the tone is just out of the audible range. S1 is now released to cut off the tone.

The leads that previously carried the tape recorder input signal from the amplifier are now plugged in to the two phono sockets on the back of the synchroniser. The recorder level controls are set to give a normal recording level. Leaving the recorder level controls untouched the audio signal leads are unplugged from the back of the synchroniser. S1 is now pressed and VR3 adjusted to give a reading of slightly less than -20VU on the left hand channel (about 6 or 7% of fsd).

A trial recording is now made of the tone at this level and played back with the left channel tape recorder output connected to the synchroniser tape replay input. Playback of a continuous tone should make the PLL lock-on and the LED light, as well as pulling in the relay. If the playback does not cause the loop to lock, VR3 will have to be reduced in value (assuming that the tape recorder output is turned up full). If this fails then it may well be that the recorder has dirty/magnetised heads or is incorrectly biased.

If all is well and the PLL picks out the replay tone then it is necessary to experiment with VR3 to ensure that there is a reasonable safety margin while on the other hand the recorded signal is not any higher in level than necessary. The tone is recorded at such a low level (-20VU) primarily because the equalisation of the recording amplifier causes the gain to increase with frequency very quickly above 10kHz. Hence the record amplifier is rather susceptible to overload at the frequency used.

When VR2 is turned away from its fully counter clockwise extreme the relay should switch on for 0.5s repeating at intervals of between 2s and about 30s.

### IN USE

The synchroniser is connected between the normal recorder input leads and the tape machine as detailed in the setting-up instructions. With the recorder input level controls set to produce a normal recording level (same position as when synchroniser was set up) every push of the 'change' button records the change tone. If the projector is coupled to the unit it is possible to run through the slide sequence while recording the tones. If a three head tape machine is used it is important that the tape replay input is not connected during recording, as the PLL will lock on to the replayed tones and produce a random series of tone bursts. Dw

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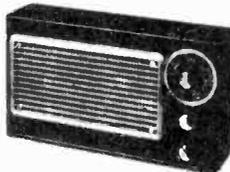
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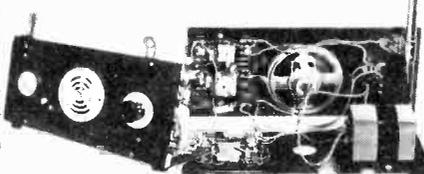
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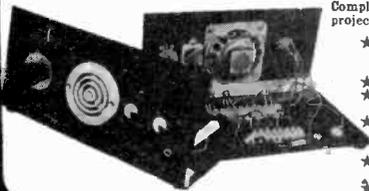


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# TRANSIENT DISTORTION

## in Audio Amplifiers

A. FOORD

**T**HE generation of total harmonic and intermodulation distortion in power amplifiers is well known. These types of non-linear distortion may be reduced by negative feedback. However it has been shown that a form of transient distortion can be produced when the open-loop frequency response of the power amplifier is less than the frequency response of the preamplifier. This article discusses why transient distortion is produced, and how it may be eliminated by careful design of the complete amplifier.

### BANDWIDTH LIMITATIONS

A complete audio amplifier can be divided into two main sections, pre-amplifier and power amplifier, as in Fig. 1. The preamplifier section may be subdivided for equalisation, tone controls, etc. Any feedback loops in the preamplifier will be over two, or at the most, three transistors.

However, the power amplifier will have a feedback loop enclosing three or more stages. In addition the small signal transistors in the preamplifier will have a much greater gain-bandwidth product than the higher power transistors used in the power amplifier. These factors usually result in the power amplifier determining the frequency response and distortion of the complete amplifier. Typically the power amplifier open-loop frequency response without feedback, may be as low as 1kHz, even though its closed-loop frequency response with feedback, may be over 20kHz.

### NEGATIVE FEEDBACK

Before these topics can be discussed in any detail it is essential to understand the basic properties of a feedback amplifier, Fig. 2. The open-loop gain of

an amplifier,  $-A$ , is the gain with the feedback loop disconnected. The minus sign indicates that the amplifier inverts. The amount of signal fed back is less than unity and  $B$  is called the feedback ratio. The closed-loop gain is the overall gain when the feedback path is closed and is given by:—

$$\text{Closed loop gain} = G = \frac{VO}{VI} = -\frac{A}{1+AB} \text{ times}$$

For example, if the gain without feedback is 100 times, and the feedback ratio is 0.1, then the closed loop gain is:

$$G = -\frac{100}{1+(100 \times 0.1)} = -\frac{100}{11} = -9.09 \text{ times.}$$

This illustrates the very important point that the gain with feedback is approximately  $1/B$ , when the product  $AB$  is much greater than unity, i.e.  $G \approx -1/B$ , if  $AB > 1$ . In this example the overall gain is REDUCED by a factor of approximately ten times, while the bandwidth is INCREASED by the same factor.

### NON-LINEAR DISTORTION

Conventional non-linear distortion arises because of the non-linearities of the input/output transfer characteristics which occur in all physical systems. The distortion produced by a given non-linearity depends on its shape and the nature of the signals. For example, a transfer characteristic such as Fig. 3(a) would cause no distortion of any sinewave having a peak value less than unity, whereas larger sinewaves would be severely distorted. However the transfer characteristic of Fig. 3(b) would severely distort music or small sinewaves, while larger sinewaves would scarcely be distorted at all.

Since musical signals are small most of the time

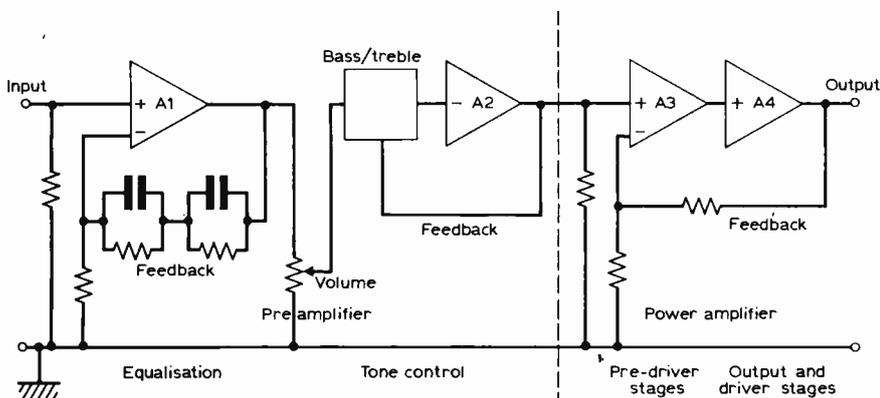


Fig. 1 This block diagram shows the two main sections of a complete amplifier. Three feedback loops, as shown, are typical of a working amplifier.

W163

## TRANSIENT DISTORTION

Fundamentally, transient distortion arises from the poor overload characteristics of feedback amplifiers. The block diagram for a typical arrangement is shown in Fig. 4. The power amplifier is split into two parts with both a limiting and a time delay section shown diagrammatically. The limiting section represents the initial stages of the power amplifier which will limit before the power amplifier's output stages. The time delay section represents the low bandwidth of the power transistors.

When an input signal, having a sufficient amplitude and a higher frequency than the power amplifier open-loop cut-off frequency, is presented to the power amplifier input, overshoots in the internal loop drive voltage may be produced. This effect can best be understood by considering a step input. The overall negative feedback can only come into operation AFTER a time delay determined by the power stages. Therefore internal signals may overshoot momentarily. In a poor amplifier this may be several hundred times greater than the nominal value of this voltage. Consequently overshoots may be clipped in the amplifier driver stages if the overload margin is insufficient. This will produce temporary 100% inter-modulation bursts. Since audio signals have their maximum slopes around the zero signal level these distortion bursts usually occur in this region. The audible effects resemble high frequency cross-over distortion and create a 'metallic' sound.

## TYPICAL OVERSHOOT LEVELS

A complete theoretical analysis is complex, and would depend on both the preamplifier and power amplifier characteristics, but some results are given

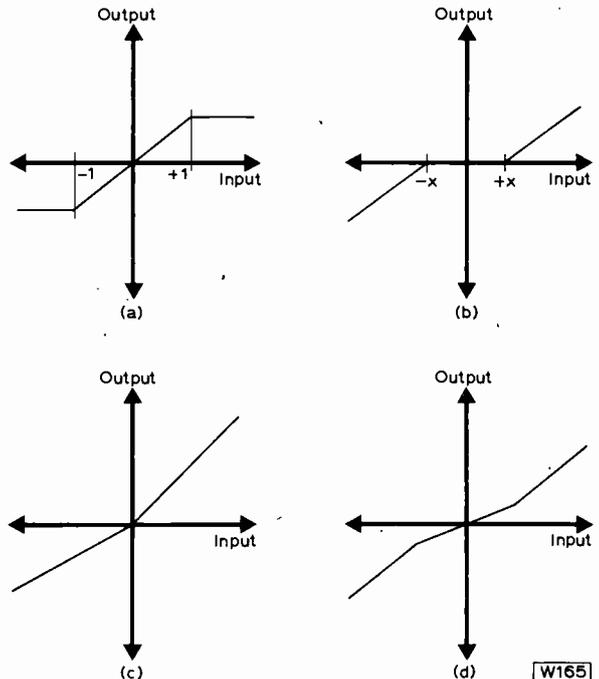


Fig. 3: Transfer characteristic (a) causes clipping, (b) would result in cross-over distortion, (c) is unsymmetrical but acceptable whilst (d) is non-linear but also acceptable.

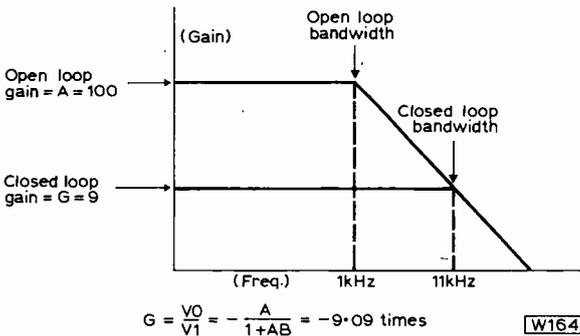
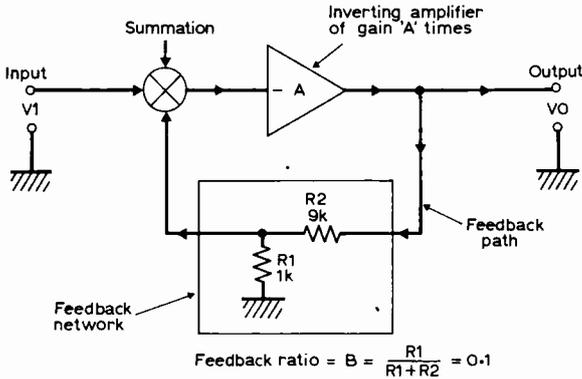


Fig. 2: Properties of an amplifier to which negative feedback is applied

exceeding the RMS value only 15% of the time, a harmonic distortion measurement at full amplifier power has little meaning. Certainly harmonic distortion measurements at lower levels are of much greater importance in detecting cross-over distortion. This can only be satisfactorily detected by using an amplitude of test signal which just spans the cross-over region of  $+x$  to  $-x$  in Fig.3(b).

## REDUCTION OF NON-LINEAR DISTORTION

For reducing this type of distortion two approaches are usually used. Firstly the non-linearity is reduced by biasing Class B output transistors with a small quiescent current of 30mA or so. Secondly, negative feedback may be applied. A necessary and sufficient condition for low distortion is that the slope of the CLOSED-loop transfer characteristic is constant at all levels below the clipping level.

This condition is satisfied if the OPEN-loop transfer characteristic has a constant slope, or by using sufficient negative feedback to make variations in the open loop characteristic unimportant. This means that the product  $AB$  must be much greater than unity. Therefore an open loop characteristic such as Fig. 3(b) would be intolerable, while those of Fig. 3(c) and (d) are acceptable.

The preceding paragraphs show how non-linear distortion is produced, and may be reduced by negative feedback. Most hi-fi amplifiers are satisfactory in this respect. However, when the open-loop frequency response of the power amplifier is less than the overall response of that portion of the transmission system preceding it, additional problems lead to transient distortion.

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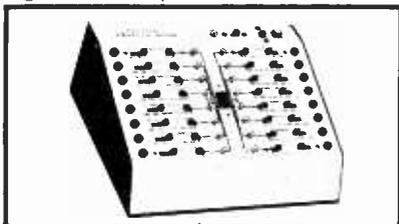
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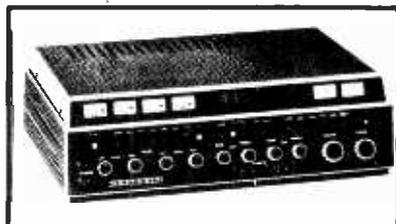
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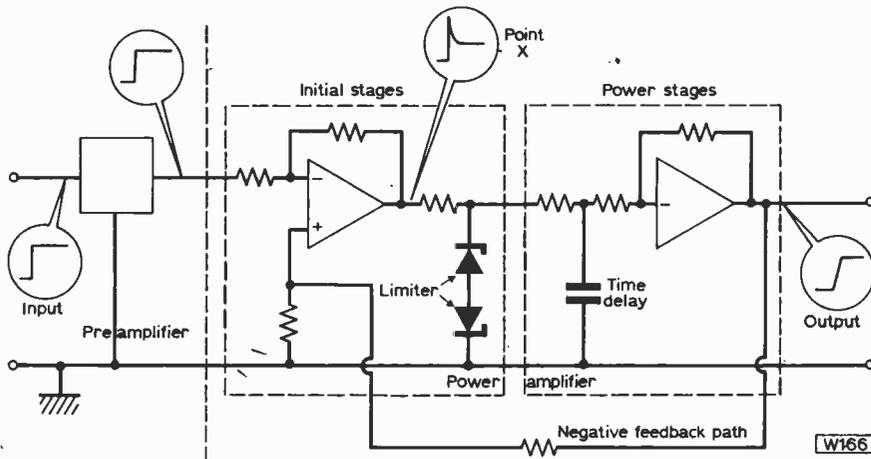


Fig. 4: Diagram to illustrate the development of transient distortion within a feedback loop, mainly due to poor overload characteristics of feedback amplifiers.

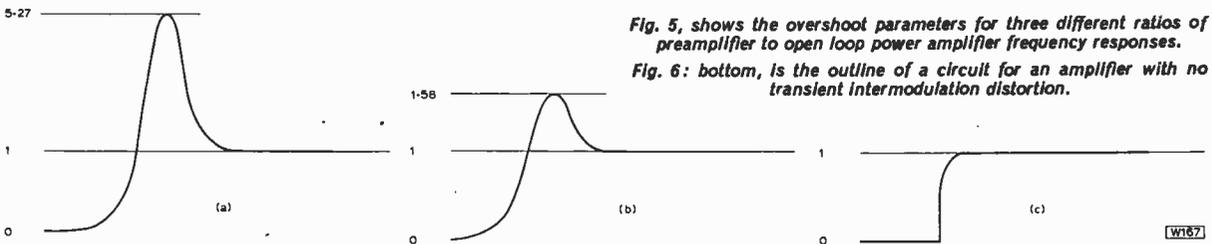
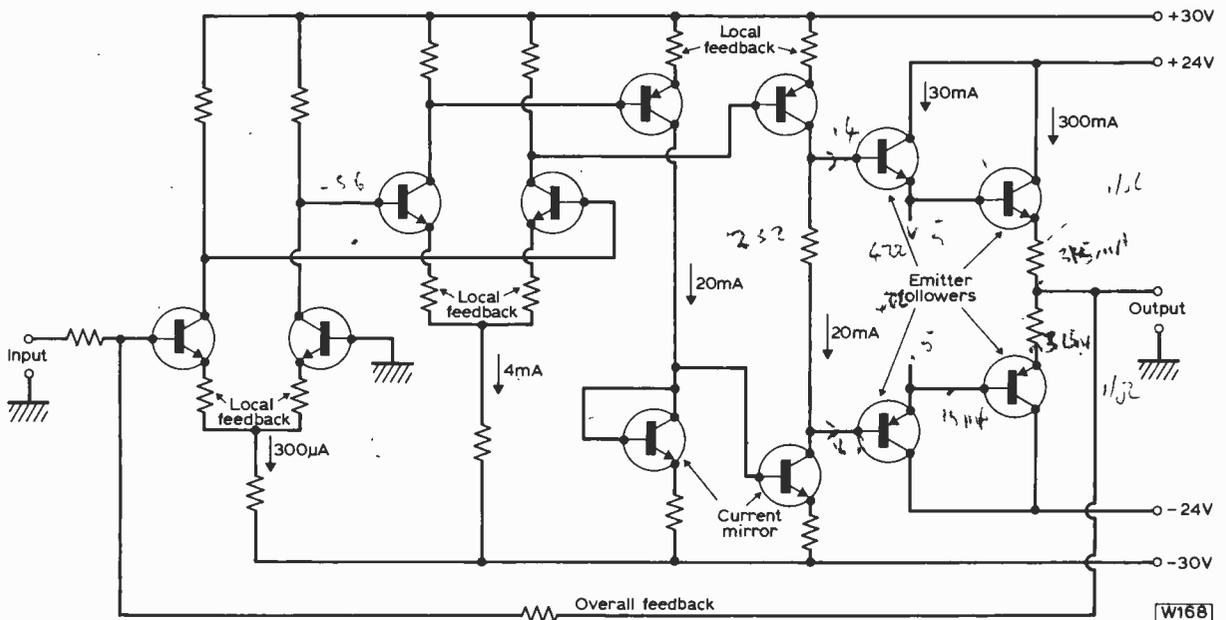


Fig. 5, shows the overshoot parameters for three different ratios of preamplifier to open loop power amplifier frequency responses.

Fig. 6: bottom, is the outline of a circuit for an amplifier with no transient intermodulation distortion.

Overall Frequency Response	Preamp. Frequency Response	Open Loop Power Amp. Freq. Resp.	Closed Loop Power Amp. Freq. Resp.	Peak Output	Overshoot
(a) 22kHz	50kHz	2.5kHz	25kHz	5.27	427%
(b) 19.6kHz	20kHz	10kHz	100kHz	1.58	58%
(c) 19.9kHz	20kHz	20kHz	200kHz	1.00	None

Note:—Peak output is output within the feedback loop, normalised to 1, point X in Fig. 4.



in Fig. 5. For this example the feedback is taken as 20dB and the overall frequency response kept at about 20kHz. In (a) the power amplifier has a closed-loop bandwidth which is half that of the preamplifier, while its open-loop bandwidth is much less. The momentary overshoot within the feedback loop is 427%!

In (b) the power amplifier has a closed-loop bandwidth which is greater than the preamplifier, while its open-loop bandwidth is half that of the preamplifier. Here the overshoot within the feedback loop is 58%. In (c) the open-loop bandwidth of the power amplifier is equal to that of the preamplifier, and there is no overshoot. The closed loop bandwidth of the power amplifier is now 200kHz.

From these results we deduce the general rule that to avoid transient intermodulation distortion the OPEN-LOOP frequency response of the power amplifier should be equal to or greater than the preamplifier frequency response. This requires a good high frequency design with a low value of feedback. When only a moderate value of feedback is used the open loop linearity has to be excellent, because heavy overall feedback is not present to decrease distortion.

When the open-loop frequency response of the power amplifier is higher than the audible frequency range, even moderate overall feedback will give a power amplifier small signal response up to 1MHz and the limiting of the frequency response to 20kHz must be accomplished in the preamplifier.

## DESIGN APPROACH

A design criteria for ultimate quality requirements demands that some of the commonly used circuit 'tricks' are not employed. For example, bootstrapping and higher feedback for DC than for AC should not be used. A high DC feedback value can cause clipping effects which force DC level adjustment transients through the feedback loop every time the signal changes. If the feedback is the same for AC and DC a number of capacitors can also be eliminated.

The required high open-loop linearity is obtained by using heavy local feedback in each amplifier stage. This increases the open-loop bandwidth and minimises the amount of overall feedback needed to about 20dB.

The output transistors should be used as emitter followers to increase their frequency response and improve linearity. They should be driven from emitter followers in order to minimise the effects of non-linearity and to maximise their bandwidth.

A completely symmetrical design should be used, without bypass or bootstrap capacitors, to improve the amplifier clipping and overload characteristics and to increase linearity at high frequencies. All stages should operate in Class A except for the power transistors. These should operate in Class AB with a high quiescent current, typically 300mA, to totally eliminate cross-over distortion and asymmetries in the critical low power region.

## CONCLUSIONS

A complete amplifier design along these lines might be similar to Fig. 6. This would have harmonic and intermodulation distortion levels which are comparable with the best designs, but, in addition, would have no transient intermodulation distortion and excellent phase characteristics over the audio band. **Pw**

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**I**F YOU build or service radios, particularly superhets, and do not possess a wobulator then you are working under a severe handicap. A wobulator is a signal generator whose frequency can be varied by applying an external voltage. In practice, the applied voltage is the timebase output of an oscilloscope, so that as the trace moves horizontally across the screen, the frequency of the signal generator changes. During the flyback period the frequency



T. BAILEY

# An inexpensive WOBBULATOR

returns to its original value.

If the output of the wobulator is connected to the input of an IF amplifier and the oscilloscope's vertical amplifier input applied to the detector, Fig. 1, the 'scope will display the frequency response curve of the IF amplifier. Adjustments to the IF tuned circuits may then be made and the results seen immediately.

The wobulator to be described sweeps over a range of at least  $\pm 80\%$  of the centre frequency and for selective circuits a "divide by ten" and a continuous control allow  $\pm 0.8\%$  to be achieved. The principle output is a triangular wave which may be attenuated. A square wave output is included which is useful for working on harmonics at higher frequencies. The centre frequency may be varied from about 280kHz to 1.8MHz but this is easily adjusted if necessary. A poor impression may be gained of the linearity when using a very wide sweep range, but up to 40%, far more than is needed for conventional alignment, it is very good. The main use of extremely wide sweeps is for finding spurious responses when linearity is not so important.

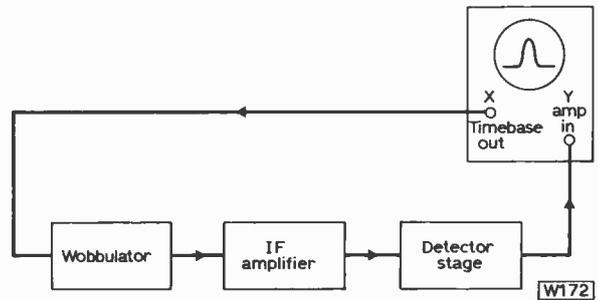


Fig. 1: Block diagram demonstrating the basic use of a Wobulator.

## THE CIRCUIT

The circuit of the complete wobulator is given in Fig. 2. Potential constructors will notice the absence of conventional transistor oscillators and coils which always seem to cause trouble. Instead an NE566 Y IC

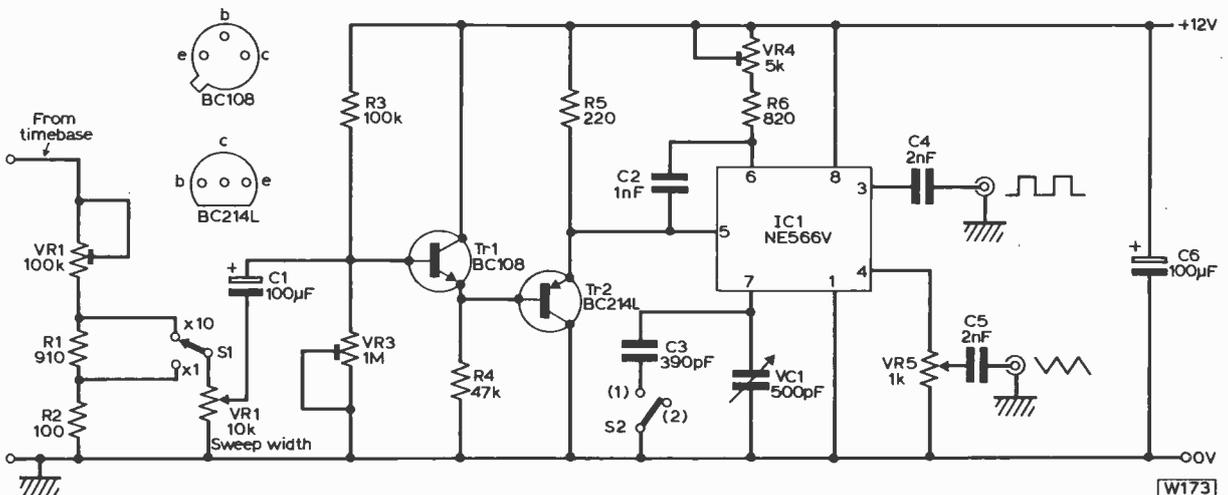


Fig. 2: Circuit diagram of the Wobulator, showing details of the NE566 IC, and the two outputs giving both square and triangular waveforms. The sweep width control should read VR2.

function generator has been used, which has other advantages as well. A very wide sweep range has been obtained plus very good frequency linearity at moderate deviations.

The circuitry up to C1 is an attenuator VR1/2 for the timebase input voltage which sets the sweep range. Tr1 and Tr2 buffer the voltage control input to the IC with VR3 setting the centre voltage. VR4 provides a frequency adjustment used for setting the ranges whilst C3 and VC1 constitute the main frequency control components.

The wobblator runs from an external 12V power supply which the author uses for most of his instrumentation, a technique which is recommended to save money! A suitable design for a stabiliser is given in Fig. 3.

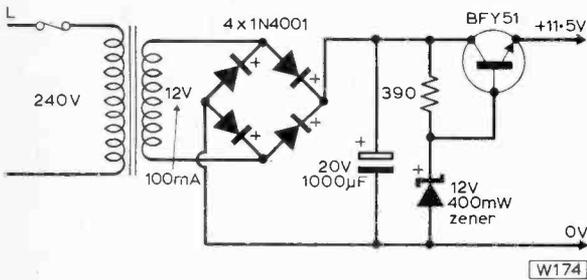
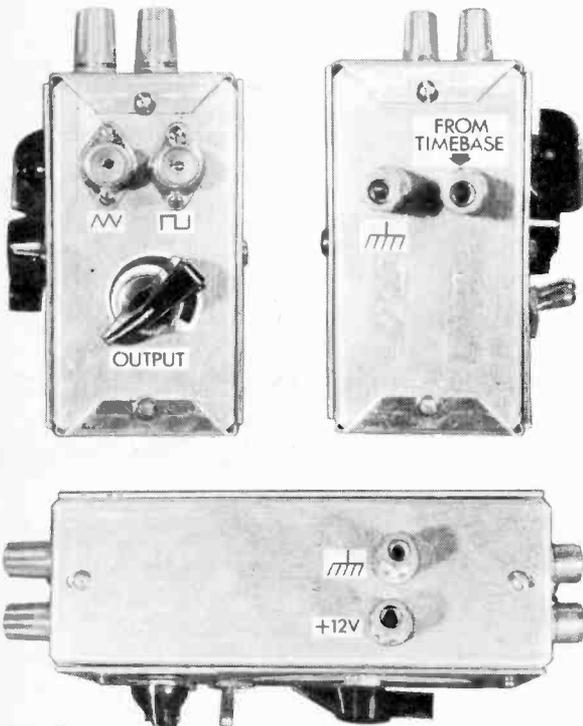


Fig. 3: The above circuit shows a suitable design for a stabilised power supply for use with this Wobblator.

## CONSTRUCTION

The prototype was built on a small piece of veroboard and housed in a "universal chassis" case. Later a PCB was devised and this is shown in Fig. 4. Con-



External photographs of the unit, showing the positioning of the sockets and switches

## ★ components list

### Resistors

R1 910Ω	R4 47kΩ
R2 100Ω	R5 220Ω
R3 100kΩ	R6 820Ω
All $\frac{1}{4}$ or $\frac{1}{2}$ W 10%	
VR1 100kΩ preset (PCB)	VR4 5kΩ preset (PCB)
VR2 10kΩ linear pot.	VR5 1kΩ linear pot.
VR3 1MΩ preset (PCB)	

### Capacitors

C1 100µF 25V	C4 2nF ceramic
C2 1nF ceramic	C5 2nF ceramic
C3 390pF SM	C6 100µF 25V
VC1 500pF variable capacitor	

### Semiconductors

Tr1 BC108	Tr2 BC214L	IC1 NE566V
-----------	------------	------------

### Miscellaneous

Casework, 'universal chassis' 6 x 4 x 2in. plus 6 x 4in. plate (Home Radio) or box 6 x 4 x 2in. (AB13). Switch S1, single pole changeover toggle. S2, single pole on-off toggle. Terminals, insulated (4). Coaxial sockets (2). Knobs. PCB from Readers PCB Service Ltd. see ad. page 1070

structors should find little difficulty in adapting the circuit to veroboard and pins. A piece of 0.1in matrix is cut down to 4.2×1.3in thus giving 41×12 holes with the copper strips running lengthwise. Cuts are made in the copper strips as appropriate.

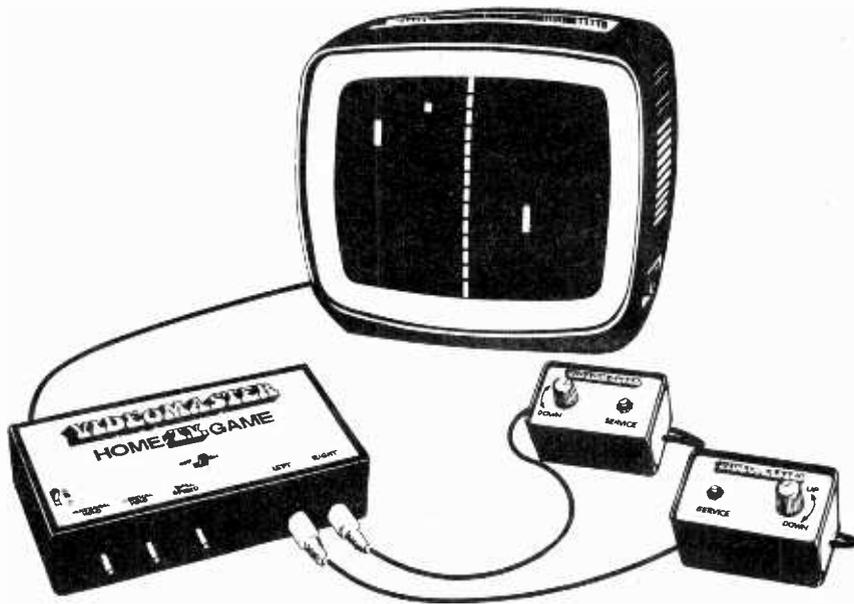
The components are then mounted as in Fig. 5. The IC should be soldered last of all but if desired use an IC holder or use socket pins instead.

Mark out and drill the case with the help of the photographs. No dimensions have been given as there is plenty of room and the optimum layout may depend on the components used. The circuit board is bolted to the base with two 6BA nuts and bolts with nuts as spacers. The co-ax sockets also required 6BA fixing. Complete the wiring and check it before switching on.

## SETTING UP

The process of setting up and testing consists largely of adjusting the three preset potentiometers and calibrating the main frequency control. Starting with VR3, this should be adjusted with no sweep input connected so that pin 5 of the IC is 11.5V with a supply of 12V. Next, connect the oscilloscope's timebase output to the input terminal and starting with VR1 at maximum resistance adjust it until the voltage at pin 5 is swept between the supply line of 12V and about 9V. If the oscilloscope is not calibrated vertically and hence cannot be used for this purpose, employ a very slow sweep and a voltmeter.

Lastly, adjust VR4 to achieve the desired frequency ranges (280-465kHz and 400-1800kHz were used in the prototype) and calibrate the main frequency control against a radio or signal generator, with no sweep input. A simple test is to set up the generator with one of the outputs connected to the vertical input of the 'scope, connect the sweep input and set the wobblator for maximum sweep tuning to its lowest frequency. Adjust the timebase so that a number of cycles are visible. These should vary in period across



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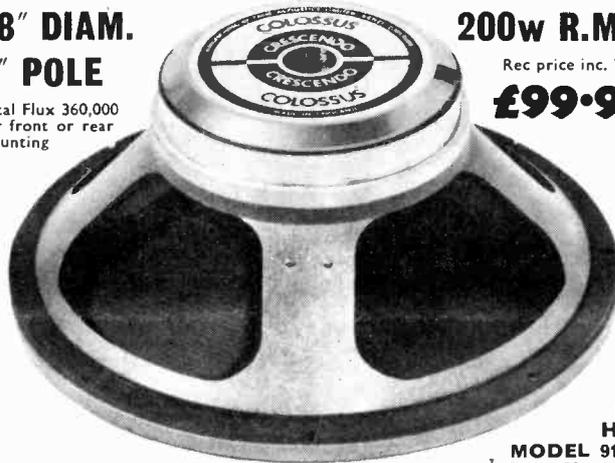
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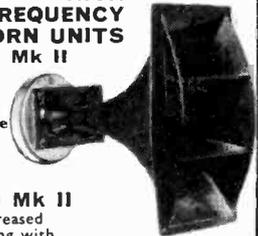
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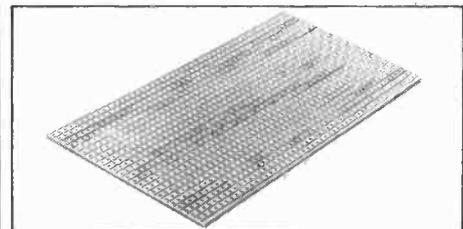
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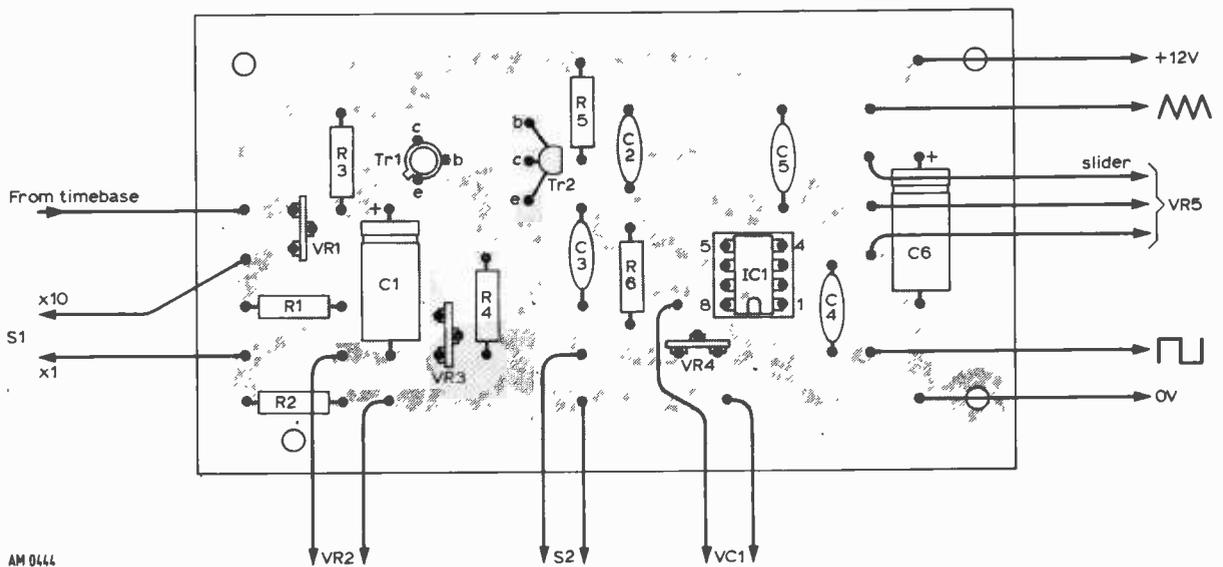
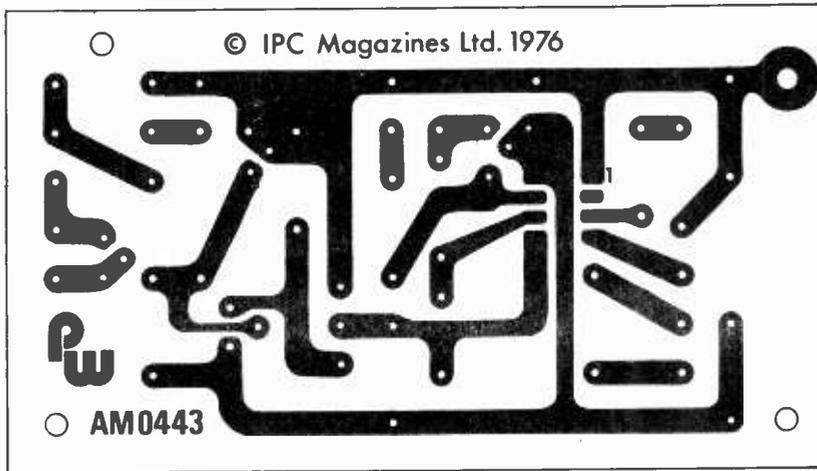


Fig. 4 and Fig. 5: The top drawing shows a foil side view of the pcb, while the lower gives the precise positioning of the various components. Both views are shown full size. Note. A link is required from the rotor of S1 to VR2.

the screen and reducing the sweep width should make the variation less.

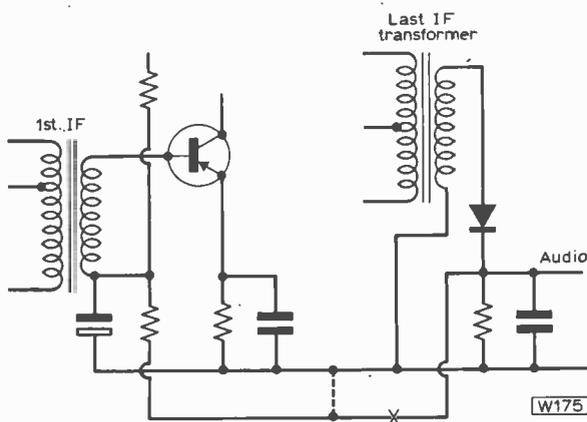


Fig. 6: In order to avoid non-linear displays at maximum sweep, the above AGC neutralising modification is recommended.

The only thing to remember about using the wobbulator is that at near maximum sweeps the display will be decidedly non-linear at the edges. Fig. 1 shows the conventional way of using the wobbulator to align IF amplifiers. When doing this it is advisable to turn off the AGC or otherwise neutralise it. A method of doing this in a conventional IF amplifier is shown in Fig. 6, the circuit being broken at point "X" and the dotted connection being made to earth.

The conventional injection point is the base (grid, in valve receivers) of the mixer which prevents loading the first IF transformer. The 'scope input is connected to the point marked "audio" and the lowest sweep speed used that gives a flicker-free and viewable trace.

Adjustments may also be made to the alignment of RF and oscillator stages but beware of adjusting a tuned circuit to which the wobbulator is connected directly as the loading will be excessive. If, at any time, the output is too great even when fully attenuated, connect a capacitor of a few pF in series with the lead to the receiver.

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It seems impossible and yet, with the aid of electronics, Margaret is leading a very useful life and doing a full-time receptionist's job at a University. So how does it all work. Well, Margaret uses a kind of electronic straw—just like the one you (?) and I use to sip that lemonade through, only it's different if you see what I mean. Her straw has two tiny pressure sensors in it. One sensor responds to blowing while the other is trained to respond only to a suck or sip.

A VDU (visual display unit) is a feature and a list of available things, like telephone numbers etc. are thrown up on the cathode ray tube. At the side of the list of actions (or whatever) is a cursor and this travels down the list a line at a time with each puff in the straw. When the desired line is arrived at, Margaret simply sucks/sips and the computer-based system does the rest. A telephone number is dialled and Margaret can then speak to the person at the other end of the line. By selecting other instructions it is possible to select, say, a tape recorder facility for recording messages. Margaret can now handle a multiple-line business telephone system—all by herself.

Oh, yes, I nearly forgot, she types letters, too. The alphabet is simply called up on the VDU and the cursor "puffed" along to select the required letter or numeral. Print out of the letters is a teleprinter-type of keyboard which types out letters and numbers in response to electrical inputs. A voice terminal is the next step for her electronic helpers but this isn't "on-line" as yet. Please note the system is not available for general use and takes the form of an experiment.

## TIRED TYRES

Electronics in motor vehicles has long been a field of development. Transistor ignition is one such area. An interesting development is taking place in Germany, so I hear. This ingenious application allows the driver of a vehicle to know instantly when his tyres start to go down. In other words, his tyre pressure is constantly monitored—even when the vehicle is in motion!

Transmitting and receiving coils are mounted at each wheel suspension. The transmitting coil is fed with a 7kHz signal. On each wheel rim is mounted a small coupling coil which, as each wheel rotates, passes some 10mm from the two coils on the suspension. The small coupling coil on the wheel rim is connected to a tiny pressure sensing switch located in the tyre valve. While the tyre pressure remains above a predetermined minimum level, the small coupling coil will couple the 7kHz signal from the transmitting coil to the receiving coil with each revolution of the wheel. However, if the pressure were to drop below the minimum level, then the pressure-sensing switch at the valve would open and the wheel rim coil would not couple any signal from transmitting coil to receiving coil as they passed. Thus no signal would be passed back to the control unit on the dash board and a warning would immediately be given to the driver. The company is reported to have said that it is ready to go into production with the system if sufficient demand is evident. Doubtless, motorists who are tired of getting flat tyres will favour what amounts to an air-raising innovation.

## TUBES, AGAIN

Just as I thought that the computer memory research front was going to be quiet for a while, so a group of Dutch workers have proved me wrong. They have come up with a new type of memory which is claimed to be cheaper than ferrite-core stores and offering greater density, too. The new memory relies on what is called the Phonon echoes effect. These "echoes" develop when powdered quartz is excited by high-frequency pulses. One important discovery is

that the echoes so recorded and stored can be read out a year later without any problems. A tiny glass tube, 1cm in diameter and 1cm in length is filled with quartz powder and the resultant capsule has a coil plus capacitor combination around it i.e., a tuned circuit. One of these little tubes has been found to store up to 100,000 bits of information. Pulses are applied in pairs and the highest frequency to date has been 80MHz. Workers believe that up to 10GHz is possible as a frequency for these pulses.

## OW!!

The ancient art of acupuncture has gained in popularity in recent years. Apparently the idea is to poke needles into the body at certain points and this makes you better. Now you wouldn't think that electronics could have anything to offer here because the actual mechanism i.e., the pin sticking is very simple. But no, you'd better believe it, electronic acupuncture has arrived. Of course it's claimed to be superior to the older techniques. It's more accurate, can be quicker and is more hygienic. First we do away with those needles and use a laser beam instead. The beam is completely sterile which can't be bad. A flexible light fibre probe is used to locate the acupuncture point accurately. Apparently the skin resistance at the exact point is slightly lower than the surrounding skin so the probe measures skin resistance at the point of contact. When the correct point is located, a helium-neon laser is persuaded to emit a one milliwatt blast of power and the beam may be continuous or pulsed. The pulses can be varied, too. Some 10 to 15mm of skin tissue is penetrated by the laser and, claims one report, it doesn't hurt. I would have thought that one would feel a bit of a prick.

It will be very sad to see all those acupuncture needles going to waste as electronics advances. I wonder what the Chinese will do with them all? (No, prizes, no prizes.)

*Ginsberg*



# FREE INSIDE!

## IN NEXT MONTH'S PRACTICAL WIRELESS

### Double-sided

## RADIO SERVICING CHART

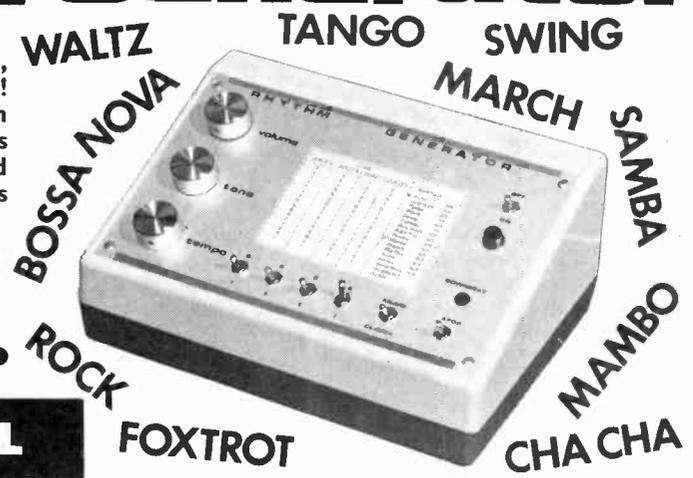
Dead? Weak? Distorted? Intermittent? Poor Sound Quality? If you can describe the basic trouble with your radio then you can use this Radio Servicing Chart to find the cause of the trouble.

# call the tune! on the PW Rhythm Generator

Name your rhythm, then select it . . . samba, rock, bossa nova, they are all there in the box! PLUS LED downbeat indicator with stop switch linked to foot switch PLUS calibrated controls for volume, tone and tempo enabling rapid reset for any rhythm PLUS snares or claves as desired.

Also a 3-band RF mini-amplifier

**ON SALE IN APRIL**





# PRACTICAL WIRELESS FAULT-FINDING GUIDE

8-Page Supplement April 1976

Fault-finding in radio and similar equipment is one of the fastest ways of learning all about electronics. Component suppliers catalogues are an invaluable source of information on the characteristics of components of all kinds and such knowledge is invaluable in locating a fault quickly from the observed symptoms. In this Guide Les Lawry-Johns, a very experienced service engineer, describes the methods of servicing that he has found so successful.

Lots of people start off with the intention of making a living out of servicing radio sets. There are several paths to take once the basic theory has been mastered, more or less. One can specialise in, say, car radios and other car entertainment gadgets, cassette players and the like, or perhaps TVs only. Those who work for a company probably stay in the trade but some who set out to be self-employed rarely stay the course. There are several reasons for this, the main one being economic.

It is extremely difficult to get an adequate return for the capital laid out on component stocks and test equipment if one is repairing domestic appliances, mainly because the time involved in properly servicing each item leaves little reward when the job is completed. Therefore a lot of servicing is done on a part-time basis or as a paying 'hobby' with the accent on the hobby aspect rather than on the paying!

We have to assume that the reader has a basic knowledge of electronics and some idea how radios and the like function. The chief requirement after this is patience and a genuine desire to do the job, and to do it properly.



RF Signal Generator HF135 by AVO for aligning AM or FM sets. An audio output is also available.

## THE TOOLS

First the tools. A goodly selection of screwdrivers, among the smaller of which must be everybody's friend, the neon screwdriver. This little fellow deserves a chapter on his own, being an indicator, detective, fault tracer, a sure signaller of nearby radiated energy and a life saver. No less, but certainly more.

One must have wire cutters, and side cutters are more useful than top cutters. Pliers and tweezers of various types and sizes, files and spanners are essential and



The Advance 'Alpha' digital multimeter takes up little bench space.

# FAULT-FINDING GUIDE



Shown here is the Advance Electronics low-cost dual-trace OS240 oscilloscope.

included in the latter should be the single-ended type with a handle, known as a nut spinner, in at least 6BA and 4BA sizes and with the close metric relatives. A comprehensive set of trimming tools, which can be purchased as a kit; at least two soldering irons, for delicate and heavy work. A reel of 18SWG (1.2mm) resin-cored solder and some means of removing solder, preferably desoldering braid which is copper braiding impregnated with resin flux. It draws the solder away from a heated joint allowing a component to be removed. Alternatively, some form of vacuum pump, possibly combined with a soldering iron.

A small torch which can be held in the mouth, if need be, and a magnifying glass are essential items whatever your age and eyesight! Next, the handmaiden of all electrical work, a decent multi-meter, preferably two. One should be a good quality meter for bench work, the other a smaller, less expensive, knock-about type for general use and back-up for use with the other, as one often wants to make two readings at the same time. Apart from this it often happens that the main meter is out of action for some reason, and at the most inconvenient time. Other instruments such as oscilloscopes, signal generators, bridges and the like can be regarded as highly desirable equipment to be purchased when funds allow.

## MULTIMETERS

The multi-meter should impose as little loading as possible on the circuit being tested otherwise the voltage present will be different when the meter is applied from what it is normally. A voltmeter is operated by current drawn from the circuit being tested and this current must be as small as possible. Most meters are marked on the front with their sensitivity and a figure of 20 000 ohms-per-volt (OPV) should be the minimum requirement. It should also have some form of cut-out or overload protection. The man who hasn't taken a reading with the meter set to the wrong range hasn't yet been born!

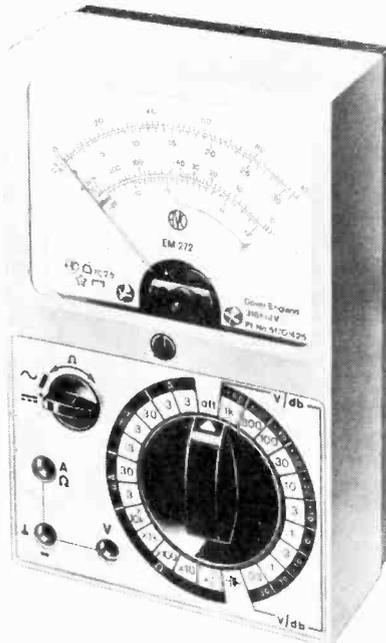
As well as reading voltage, current and resistance the meter can also be used to apply tests to circuits and components since, when switched to the resistance range,

a **negative** voltage appears at the positive test probe and a **positive** one at the negative probe. This enables a check of the approximate characteristics of capacitors, transistors, diodes and the like to be made. After voltage readings, this facility is probably one of the most valuable assets of a multi-meter so we will spend a little time on this subject, later on. However, we must continue with our "tools of the trade" requirements.

There are a great many aerosols (sprayers, squirters etc.) on the market at the present time, each of which has its own merits. Most engineers would select two, a contact-cleaner lubricant, which does not attack plastics, for cleaning switches, volume controls and the like, and a cooling agent or freezer. The value of these two can hardly be exaggerated. Whilst the former has always been accepted as a must, the choice of the latter has been dictated by experience over the last few years. Large numbers of small components grouped on a board can present a problem when tracing intermittent faults or where any one of a number of transistors in, say, an audio stage can be responsible for upsetting the operation of the others. A judicious squirt of freezer has solved many such baffling problems and a hair drier has its uses too!

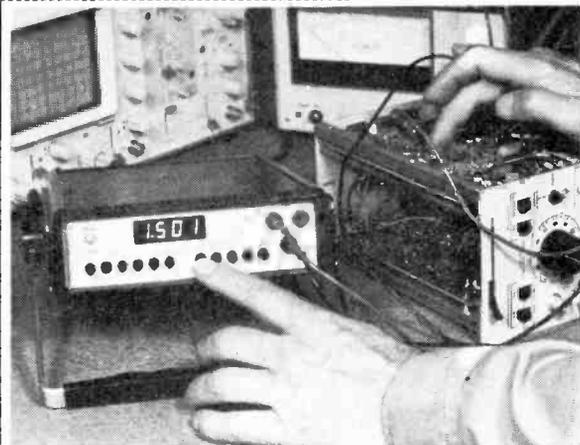
## STARTING

So here we are, with a few tools of the trade and prepared to do battle. However, it is one thing to identify a faulty component, when all you have to do then is to obtain a replacement, but all too often we can only suspect and it is essential then to make a substitution check. Resistors can usually be tested and passed as fit or thrown out, but capacitors present a different problem. They can leak, partially or completely dry up, become open circuit or



The new AVO Electronic Multimeter EM272 provides 39 ranges in spite of the simplicity of its appearance.

# FAULT-FINDING GUIDE

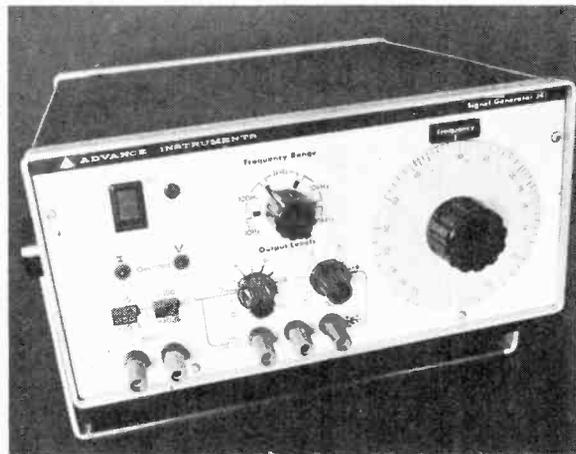


In use here is the Advance DMM7 digital multimeter, a new 3½-digit 5-function instrument.

develop a short sometimes accompanied by heat. Therefore a goodly number of capacitors of various types, capacity and voltage rating must be held in stock.

Voltage rating is important from two aspects. Obviously a capacitor rated at, say, 12V would not be put across a 25V line as the voltage rating marked on the component must not be exceeded, but it is often thought that a capacitor marked, say, 100V can be used in any circuit where the voltage is less than this. Usually this is quite true, but there are exceptions. If the capacitor is electrolytic it requires a certain polarising voltage for it to work efficiently. In some circuits the voltage is very low, say about 4V, and a replacement in such a position should be rated at not much more than 6V or whatever voltage is marked on the defective item.

Diodes are another item which can be checked with a meter, within limits, and a few of the more common types in stock will usually suffice. Bridge rectifiers are commonly used in mains powered equipment and they often give trouble. One is well advised to keep a couple to hand and two types usually suffice, the BY164 for operation up to 40V and the BY176 for higher voltages. Four silicon diodes



A new product from Advance is the J4 signal generator, with sine or square wave outputs.

can be used in place of a bridge and indeed this type of supply will often be found but where a single block bridge is encountered it is often inconvenient to fit four diodes in its place.

The choice of separate power diodes is large but one cannot go far wrong with a few BY142 (BY127 with a smaller package). Voltage regulator diodes (zeners) appear in all types of equipment and one would be very hard put to try to anticipate what is going to be required if many makes and models of radio are tackled. It is no hardship to order the right components at the right time, if one knows in advance the type of equipment which is to be serviced, but if this is not known the stock list could be endless.

The same can be said about transistors and the position is more complicated as the age of the set to be serviced usually dictates the type of device used. The following is a list of transistors which ought to be kept in stock for the general servicing of audio equipment, radios, car radios etc.

AF115	AC187K	BC131	BC186
AF117	AC188K	BC132	BC194
AC127	AD149	BC147	BC195
AC128	AD161	BC149	BC196
AC187	AD162	BC157	BFX88
AC188	BC109	BC159	BFY50

From this modest list one can often find a suitable replacement for the more difficult-to-obtain types and some which are not marked. The latter present a minor problem but this is about all.

## IDENTIFYING TRANSISTORS

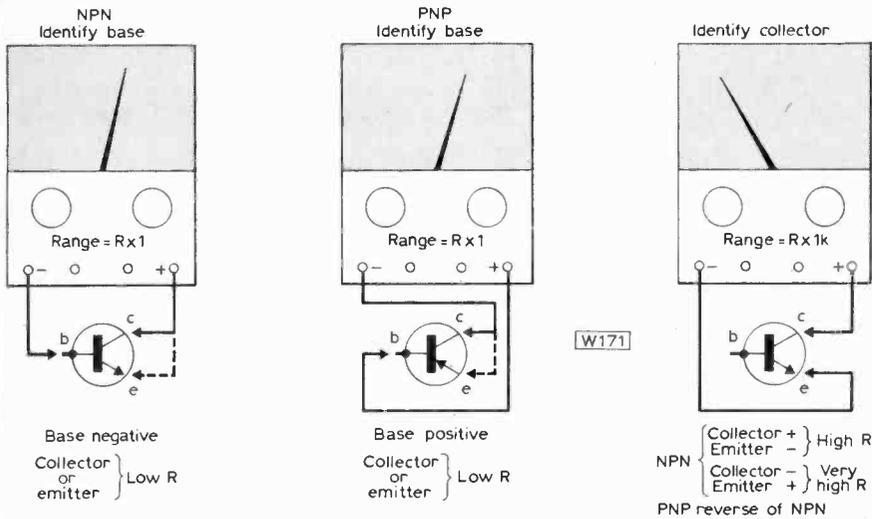
Most transistors have only three leadouts, these being emitter, base and collector. They will belong to one of two basic constructions, NPN (neg-pos-neg) or PNP (pos-neg-pos), so this is the first check to make and it is a very easy one using the ordinary multi-meter. It must be appreciated that when the meter is switched to the 'ohms' range it is battery operated and that the positive (+), or red, probe will be on the negative side of the battery with the negative (-), or black, probe at a positive potential. If the red probe of the meter is applied to the base of a PNP transistor a low reading will be shown when the black probe is touched to the collector or the emitter. On the 'ohms' scale this will look like something between 10Ω and 50Ω depending upon the transistor type and the meter.

If only one reading can be obtained note to which leadout the black probe is applied and assume this is the base of an NPN transistor, when the red probe can be applied to the other two to obtain the low reading. If there is no low reading, the red probe should be applied to another leadout on the assumption that the device is a PNP after all, but that you didn't get the base lead in the first place.

Now that the base has been identified and the device established as a PNP or an NPN, it is necessary to identify the collector and the emitter, remembering that we are supposedly dealing with a good transistor and not one with a short or open circuit.

Switch the meter to the high resistance range, and, leaving the base free, connect the probes to the other two.

# FAULT-FINDING GUIDE



Diagrams to show the method of using a multimeter to identify the leadout connections of NPN or PNP transistors. As explained in the text the polarity of the test prods of most meters is the opposite of that indicated by the colour of the prods. It is best to check this point before using the meter on transistors or electrolytic capacitors.

If the transistor is an NPN and a high resistance is recorded, the negative (black) lead is connected to the collector and the positive (red) lead to the emitter. Reversing the probes should then give a low reading.

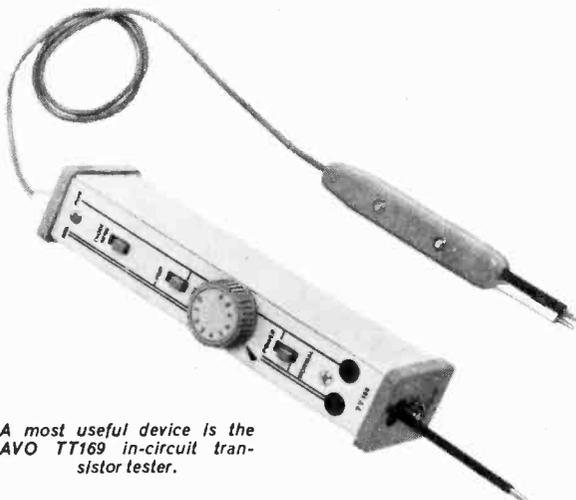
If the transistor is a PNP (we have already established this in the first test, so don't get confused) the readings will be reversed, high reading positive to collector, lower reading negative to collector. A further test can be made on the transistor. Connect as above, negative lead to collector, positive to emitter, if NPN, (reverse for PNP) and note the high reading. Place a finger on the collector and base leads and the reading should drop, showing that the transistor is "turned on". The actual reading will depend upon the current gain of the transistor and the resistance of the skin of the finger. What good is this, you may ask? Well, it does enable you to make a comparison check against a known transistor and so, very roughly, identify the current gain.

Diodes can be checked in a similar way but of course there are only two connections to make. Positive lead to

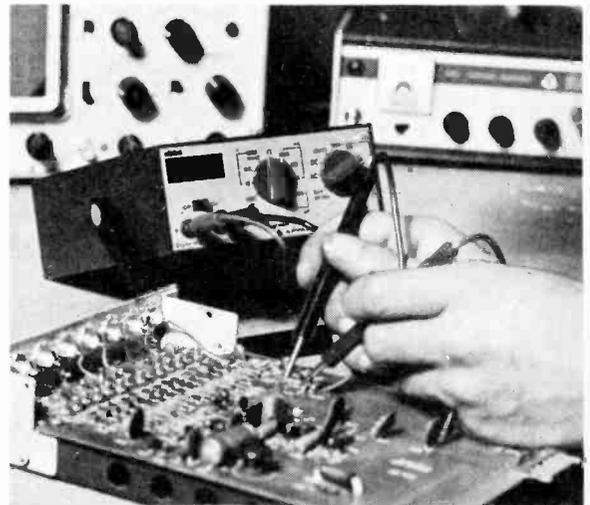
cathode (+) gives a low reading, while negative lead to cathode gives a high reading. A little practice with known good transistors and diodes will show the readings which can be expected. These tests can be used on components in circuit provided the associated circuitry is taken into consideration, particularly where transistors are inter-connected, say output transistors with drivers across them, etc.

## COMPONENT CHECKS

Capacitors can be checked roughly with an ohmmeter switched to the highest resistance range. When the test leads are first applied to a discharged capacitor, the applied voltage will cause the charging current to deflect the meter sharply according to the capacity, the reading going back towards infinity as the capacitor is charged. If the capacitor is leaky, current will continue to flow and a reading



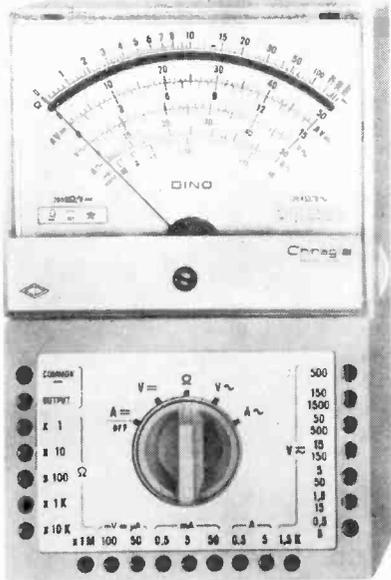
A most useful device is the AVO TT169 in-circuit transistor tester.



Another useful bench instrument is the Advance 'Alpha' digital multimeter, being used here to make resistance checks on a circuit board.

# FAULT-FINDING GUIDE

will be maintained. This is to be expected with high value electrolytics as the meter voltage is insufficient to complete the sealing process. Once again a little practice will show what is to be expected. Very little indication, except leakage, will be shown on capacitors less than say 50nF but the tests are more valuable as the capacity increases. Don't forget, electrolytics require the negative probe to be applied to the positive tag of the electrolytic in order to get the right polarity for the charging voltage.



The Dino is the latest electronic multimeter from Chinaglia, 200k $\Omega$  OPV on DC and 20k $\Omega$  OPV on AC.

Inductors, transformers and the like can be checked for continuity and resistance. The presence of shorted turns can only be assumed if the resistance reading is much lower than that specified.

When a resistor is suspected of being faulty, first look at its appearance. If the colours are clear and bright and the resistor has a fairly low value the chances are that it will be serviceable. If it has a higher value, say over 100k $\Omega$ , it could look right but the value may have increased, particularly if used in a position where it is passing a fair current. Checking depends upon the circuitry, for if it is associated with other resistors or transistors, a direct reading may be of little use and one end may have to be lifted by unsoldering in order to check it out of circuit.

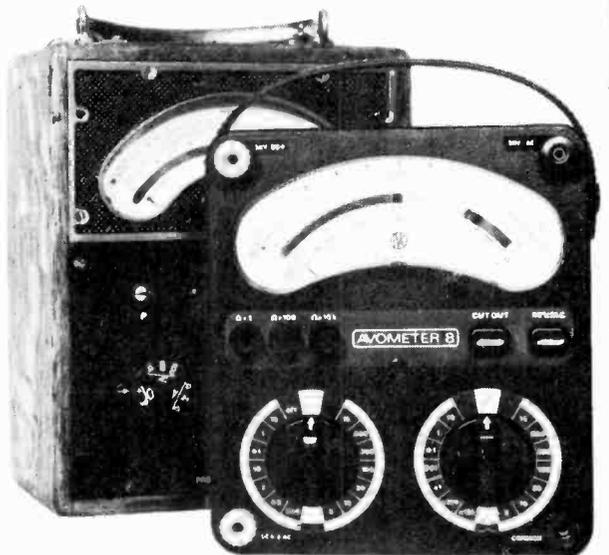
If the colours are not clear or if the resistor presents a well-worn look, replace it, even if it reads right, in order to save probable trouble later. This particularly applies to the low value resistors associated with output transistors usually about 2 $\Omega$  or so). If a high value resistor is suspected it can often be checked with the receiver switched on by connecting a voltmeter across it, on a high range. The recorded voltage drop being of less importance than the effect of the resistance of the meter which shunts the suspect resistor and thus, to an extent, takes its place. Care must be exercised when using this dodge in pre-amplifier stages where the meter resistance can upset the base current of a transistor if the associated resistor values are high.

## SHORT CUTS

There are no substitutes for routine tests, checking supply and stage voltages in logical sequence, injecting test signals to identify the working and the faulty stages. To do this one must be able to think 'electrically', and while this comes easy to some, it is hard work for others and only comes with time. Following certain guide lines the fault will always reveal itself provided enough time is spent on the problem. However, as one becomes used to the type of equipment being serviced a pattern usually emerges which enables a short cut to be made across the routine tests and thus head straight for the source of the trouble, using eyes and ears and sometimes the sense of smell and of touch. A dry joint (one which has not been properly soldered in the first place) can often be seen, rather than traced, by its discoloured and 'powdery' appearance.

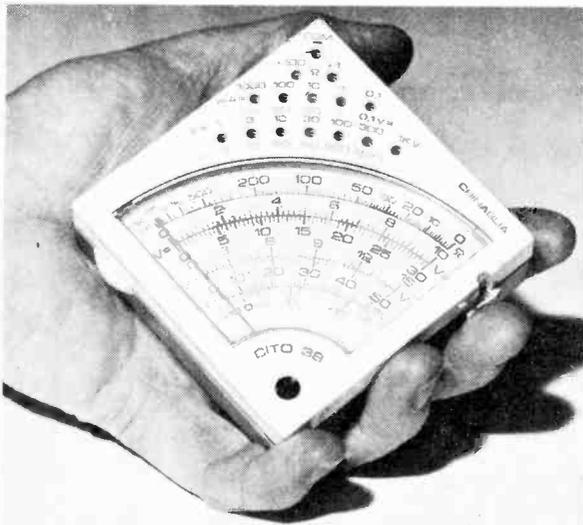
Sound distortion can be caused by many things but after a while the ears will unerringly identify the sound of a rubbing speech coil in a loudspeaker as opposed to a similar noise caused, say, by the output transistors being mismatched. The smell of some types of overloaded or faulty rectifiers immediately proclaims a defective one, whilst touching a hot transistor, apart from being painful, can cool it down and allow it to begin working for a brief period.

Some makes of printed circuit board are more liable to develop hairline cracks than others. Some types of capacitor are far more likely to fail than others. Indeed, we could go so far as to say that where certain types of capacitor are found fitted, we do not bother to check them since they are so very rarely at fault, whilst others are the first suspects and pounced on immediately. Some transistor types are more likely to fail than others. This sort of fault can be repeated over and over again and, whilst it makes life



The Model 8 Mk 5 general purpose multi-range meter is the latest in a very long line of multimeters from AVO. An early version of the meter appears in the background.

# FAULT-FINDING GUIDE



*Smallest of the Chinaglia range is the Cito multimeter but it still manages to provide 14 ranges on six coloured scales.*

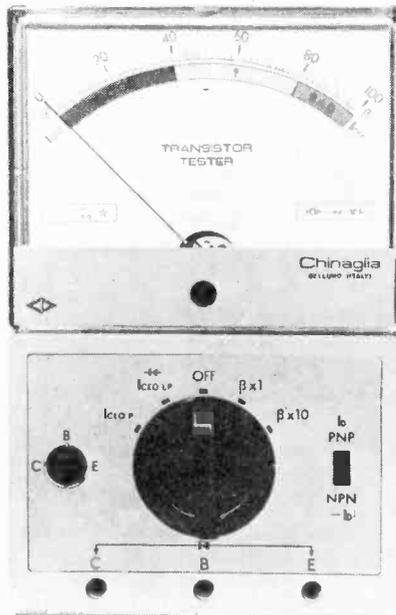
a trifle easier for the experienced, the inexperienced person has no option but to employ routine tests and finally arrive at the same conclusion, having spent a considerable amount of time in the process. If in doubt, ask someone who knows and thus profit from their experience.

## PRACTICAL ASPECTS

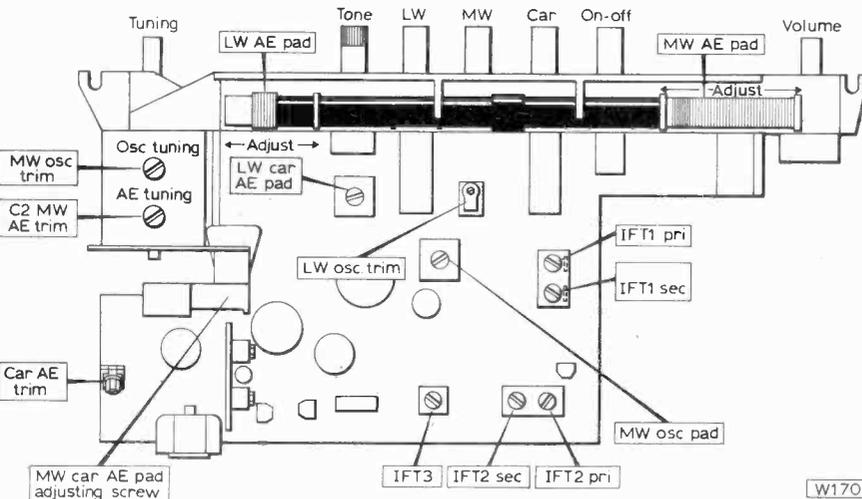
We gave a short list of the items needed to service the simplest of appliances but there are others to consider. A circuit with a layout diagram is an absolute must if the appliance is not well known. Fortunately, in addition to the maker's service information which is the best source of reference, there are volumes of service data in book form available which condense this information, so that it is possible to build up a library of information which is readily to hand and indexed.

Not all appliances are complete when they are received for repair. For example, a car radio will need a 12V supply and most likely a loudspeaker. This is not too bad since most car radios use a  $3\Omega$  speaker, although more recent imports use  $8\Omega$  in some cases. However, it is often inconvenient to remove sited loudspeakers when a unit audio goes wrong, assuming that the speakers are not at fault, so it is necessary to have suitable speakers for test purposes. These are frequently  $8\Omega$ , but not always, by any means. So be prepared to add series resistors to make up the required loading or keep a goodly selection of loudspeakers!

Before we drop this subject, one further point. There are always power amplifiers requiring repair. If you do

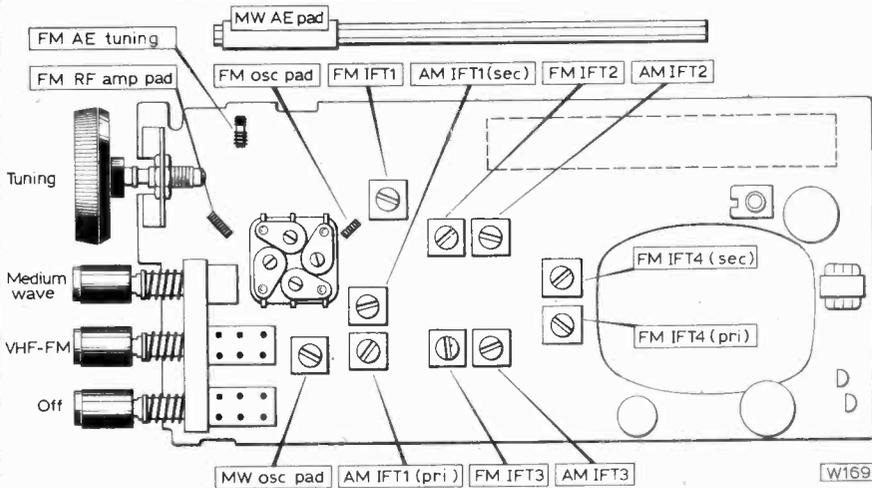


*The Chinaglia transistor tester provides a Good-?-Bad indication plus leakage and  $\beta$ , using internal batteries. Test leads can be fitted for checking external circuits or devices.*



*Service sheets provide information for fault-finding and the alignment of receivers. This particular layout shows the location of the components which may require adjustment when aligning the Marconi 4173 MW and LW receiver.*

# FAULT-FINDING GUIDE



The Marconi 4184 receiver also incorporates the VHF(FM) range so the number of adjustments needed for a complete alignment is increased, as shown here.

take on one of these and repair it, have a care for your test loudspeaker. To touch the input socket with the volume control well up is to ask the amplifier to deliver full power into what may be a small loudspeaker, the probable result being a wisp of smoke from the speech coil which, if it survives intact, will never be the same shape again!

## OTHER TEST GEAR

Whilst our multimeter enables us to check voltages, measure current and take resistance readings, plus a few other things, no serious service work can be carried out without the aid of other instruments, the first of which is a signal generator. This enables us to inject signals of known frequency and level and thus to check the alignment and response of the equipment under test.

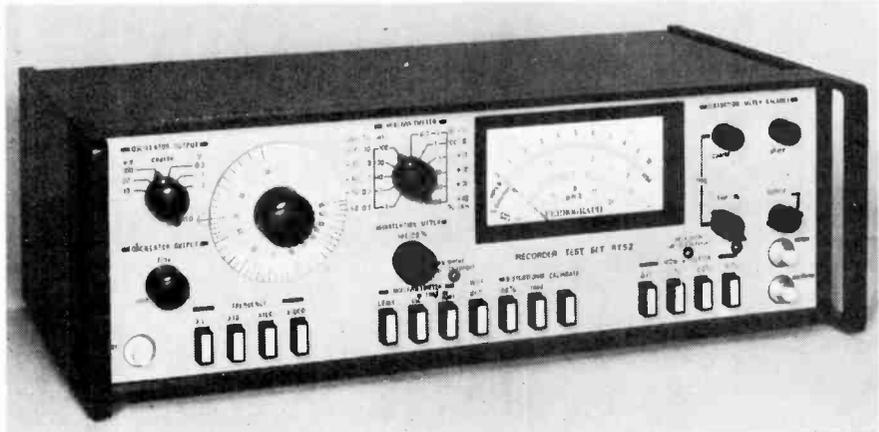
Let us take an average radio set. Considering the medium wave band only, signals from say 600kHz to 1.5MHz have to be selected and amplified. Since there are several stages of amplification, it is clearly not convenient to tune each stage to each frequency separately. What is required is for all signals to be converted to a common frequency which can then be fixed tuned. This is known as

the IF, or intermediate frequency, which for AM reception is usually fixed at about 470kHz. Some imported radios have a lower IF, 455kHz, which is the reason for the annoying whistle sometimes experienced adjacent to stations operating around 908kHz. Therefore the generator will have to cover this band of frequencies plus all RF frequencies likely to be covered by the receiver.

This will enable us to check the tuning of the aerial coils, the oscillator and the IFs. If these coil cores and trimmers are not accurately adjusted the receiver cannot give of its best. The signal generator provides a means of doing this, and much more, since we can now inject signals into various stages of the receiver and thus locate the stage which is not functioning correctly. The wobblers is a variation of the signal generator, which we will not consider here, but which is essential for many kinds of accurate alignment.

An oscilloscope enables us to "see" into a circuit. The signals are amplified and appear as a trace on a screen so that the effect of each stage can be seen and adjusted, if necessary, to the required amplitude or waveform. It therefore enables us to see where signals are lost or become distorted.

The Ferroglyph Test Set RTS2 from Wayne Kerr combines many of the facilities needed for checking the performance of recorders, amplifiers and other audio equipment. Included are an audio oscillator, distortion meter and AF millivoltmeter



# FAULT-FINDING GUIDE

## ALIGNMENT

Having mentioned these two valuable aids, let us immediately correct any misconception. In everyday radio repairs they are rarely needed. If the IF alignment has not been disturbed, do not touch it! If it has, it probably needs only a "tweak" to restore normal reception. Note which core or trimmer has been disturbed (wax or seal broken) and bring this, or them, into alignment with the other circuits. If the oscillator and aerial trimmers have been altered, switch to medium waves, set dial to about 1200kHz (250m) and set the oscillator trimmer to bring in Radio 1 (or any other frequency which is known to correspond to a particular station at this end of the dial) reset to around 1500kHz and trim the aerial trimmer. Retune to the lower end of the dial, to say Radio 3 on 647kHz, (this is the low end from a frequency point of view) with the core of the oscillator coil, appreciating the fact that this is going to upset the previous trimmer setting at the HF end which will have to be done again. Do this a couple of times until satisfactory tracking is obtained.

If a ferrite rod aerial is used adjust the medium wave winding on the rod for best reception on about 650kHz finally trimming the aerial trimmer, back on about 1500kHz. Leaving these settings untouched, switch to LW, tuning to 200kHz, or 1500 metres, then adjusting the long wave trimmer to bring in Radio 2, and setting the LW aerial trimmer to peak the signal, or adjusting the LW coil on the ferrite rod.

At this point any disturbance of the IFs can be corrected. If correct tracking cannot be achieved the IFs have probably been more seriously disturbed than was thought and the signal generator can then be brought out of cold store,

*Photographs were kindly supplied by the following companies to whom all queries on the instruments illustrated should be addressed. Wayne Kerr, Durban Road, South Bersted, Bognor Regis, Sussex PO22 9RL.*

*AVO Ltd., Archcliffe Road, Dover, Kent CT17 9EN.*

*Chinaglia Ltd., 19 Mulberry Walk, London SW3 6DZ.*

*Advance Electronics Ltd., through Peter Bush, Bush Steadman and Partners, Saffron Walden, Essex.*

set to the required IF (as marked on the set, or in the service information) and loosely coupled with a single turn of wire around the ferrite rod. With the set tuned to the low frequency end of the medium wave band, about 600kHz, increase the signal input until the modulating tone can be heard, adjusting the IF coil cores to peak and gradually reducing the signal input from the generator to the minimum, to prevent the AGC coming into action. Repeat the RF tuning procedure.

## SNAGS!

Simple enough, isn't it? So where's the snag? Well, you see, we've only mentioned some of the procedure for AM sets. Two examples of the kind of component layout to be expected are shown, one a long and medium wave design as used in the Marconi 4173. Notice that the tuning adjustment for the low frequency end of the dial is called 'padding' and the high frequency adjustment is called 'trimming'.

The snag arises when there are many coil cans and lots of trimmers! The rule here is not to do anything unless you know the exact purpose of each adjustment. Otherwise you may be disturbing something which was previously correct and this is not the idea at all. Also shown is the layout of another Thorn group model, this time a Marconi 3183. Here we see the IF coil cans clearly marked AM and FM. These will not be marked as such in the actual set and therefore no coil cores should be disturbed unless such a diagram is available. Even then adjustment of the FM coils requires the use at least of an FM signal generator, preferably with 'wobbulator' and oscilloscope, in order to obtain the desired response curves.

The object of all this is to preach the sermon loud and clear. Do not touch what is not fully understood and attend only to that which really requires attention.

**THE GENERAL THEME OF THE FAULT-FINDING GUIDE WILL BE CONTINUED IN THE JUNE ISSUE OF PRACTICAL WIRELESS DUE OUT ON 7 MAY.**

## YOU WILL WANT OUR PW RADIO SERVICING CHART!

**Presented FREE in the MAY issue  
of PW-Out on 2nd. April**

**DOUBLE~SIDED! Use the front of the chart to  
localise the fault — Turn the chart over for an  
analysis of the problems!**

# on ing Receiver

F. G. RAYER



The sense aerial is then used to provide another signal. With one position of the ferrite rod, signals from both aerials will combine, giving a greater meter deflection than the other position, where ferrite aerial and sense aerials are out of phase. By this means it is possible to find which bearing is correct of the two minimum readings obtained without the sense aerial.

## RF and Tuning

Fig. 1 is the circuit of the aerial, RF and oscillator tuning arrangements. L1 and L2 are MW and LW sections on the ferrite rod, which is assembled on a jack plug. This fits into a socket, through a hole in

the top of the case. S1 allows the sense aerial to be connected. S2/3/4/5 are the four poles of a 3-way switch. Positions 1 and 2 of section S2, short L2, for MW reception. Position 3 introduces C3 and TC1 to load the oscillator coil L3 for LW reception. Sections S3 and S5 introduce series capacitors TC5 and TC2 in position 1, to spread the tuning at the high frequency end of the MW band. S4 connects trimmer TC4 for this band, and trimmer TC3 for the lower frequency bands.

To avoid the need for further aerial trimmers and to allow correct trimming with S1 open or closed, a panel trimmer VC3 is used for aerial circuits. Tr1 avoids the need for a coupling winding on the ferrite aerial, which would require four connections in all. A 3-way jack plug and socket may thus be used. Point 1 is the inner (tip), point 2 the centre and point 3 the outer sleeve. Tr1, together with its associated circuitry is fitted to a tag strip near the jack socket as in Fig. 1.

## IF Circuit

Fig. 2 gives details of the IF circuitry, which comprises the oscillator/mixer Tr2, two IF amplifiers Tr3 and Tr4, and detector D1. External connections to Tr2 go from R4 to C5 with a lead from pin 3 of the oscillator coil, to C3, TC1 and C4, Fig. 1. R8 is under the board, from pin 4 to pin 2.

As strong signals can give more than full-scale on the tuning meter, the 1st IF amplifier Tr3 is arranged to have the manual gain control VR1. This can be adjusted to bring the meter back to a central position, when required, as well as controlling IF gain. Bias from D1 is thus applied for automatic gain control purposes to Tr4, via R14 and R16. The meter is positioned to one side of the tuning scale, while the meter amplifier Tr5, is assembled on a tag strip secured to the dial plate. Trimmer pot VR3 is set so that the meter reading is just beginning to rise, with no signal. Increasing signal strength then causes negative base bias to Tr5 to raise collector current, so that the meter reading rises. Maximum meter reading corresponds to maximum signal strength, when rotating the aerial or VC3. With VR1 set so that this is about half-scale on the meter, the directional null should give almost zero reading on the meter, and is used for bearings, as it is sharper than the maximum.

Audio from the volume control VR2 passes to the AF amplifier.

## Audio Amplifier

The AF amplifier comprises pre-amplifier, driver and output stages, Fig. 3, and uses few components and easily obtained transistors. The most suitable

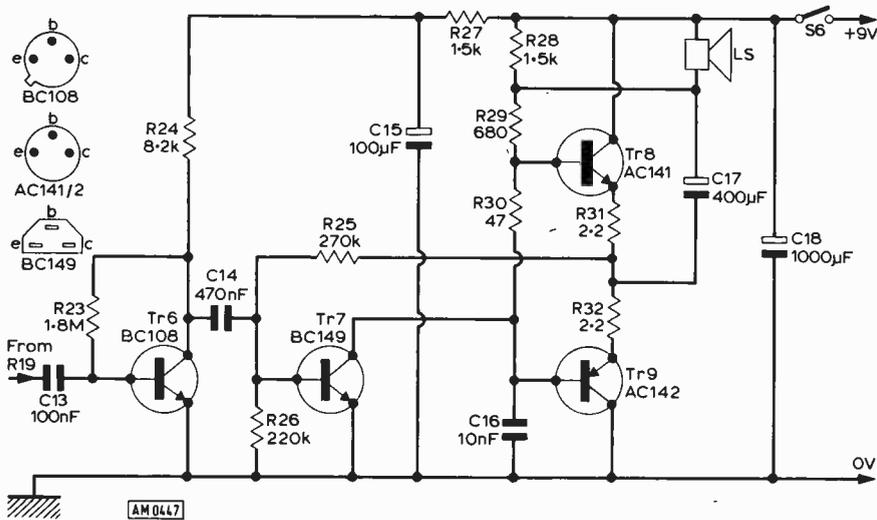


Fig. 3: This shows the circuit for the audio amplifier, which uses for its output a matched pair of AC141/2 transistors. Speaker impedance should be around 15Ω.

speaker impedance is about 15Ω, although the actual value is not too important. However, a speaker of less than about 10Ω ought not to be used, unless pressed into service by including a series resistor to make up the total, while speakers of over about 25Ω will result in some saving on battery current, but reduction in output.

### Chassis and Panel

Holes are drilled in the front of the chassis as in Fig. 4. For the cabinet listed, allow the panel to project below the chassis about 1/2 in and mark the hole positions on it. The 7 × 2 1/2 in scale plate is bolted a little back from the panel, which is not fitted until later. Fit the ganged capacitor with 4BA bolts, noting it is essential to use short bolts, or add washers, so that they do not project beyond the thickness of the metal plate. Two small pulleys are pivoted on 4BA bolts, held with lock nuts to the plate. The cord passes twice round the drum, and then round the small wheels, and is held taut by a spring. Drill a hole in the panel for the slow-motion spindle of the capacitor. The pointer is a straight wire soldered to a small piece of tinplate, which is clipped on the cord. Arrange this so that it is fully to the right with VC1/2 closed and the spring to the left.

The case requires two 3/4 in diameter holes. One is placed centrally, for the ferrite aerial, and the other near the back right hand corner, for the telescopic

aerial. Using a universal chassis flanged runner, 8 × 1 in, cut sections from each flange 3 in from the ends, so that it can be bent to form the mount shown in Fig. 5. This is bolted to the chassis so that the jack socket comes under the central hole in the case.

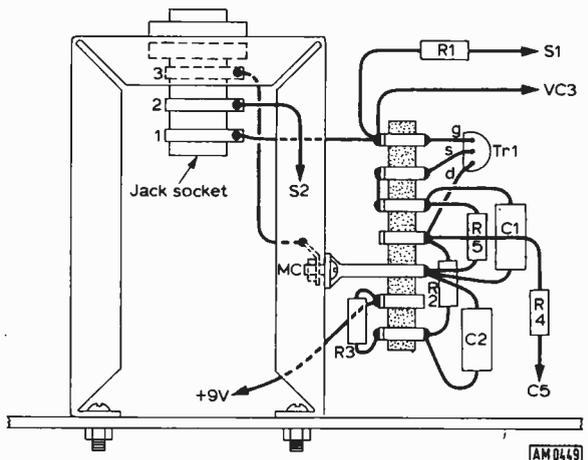


Fig. 5: The mounting for the rotating aerial, and the lag strip that holds the RF stage, is constructed from a Universal chassis flanged runner and bent to fit.

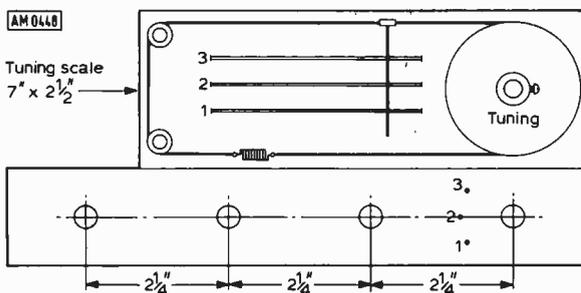


Fig. 4: Details of the scale card, and the spacings required for the variable control positions.

Should a little adjustment of height be required so that the jack socket will clear the top of the case, the legs of this metal part can be spread outwards to lower it. Check that there is sufficient space for the IF board between the mount and scale plate.

The sense aerial must be insulated from the chassis. This was arranged by punching a 1 in diameter hole, over which a piece of paxolin is fixed with 6BA screws. The bolt on which the aerial screws fits vertically in the paxolin, and a lead runs from it to S1. If necessary, the paxolin can be spaced from the chassis, either above or below, so that the aerial closes flush with the case top. This aerial is run on to its screw after placing the receiver in its case.

The internal speaker is mounted on the left side of the cabinet. A grid of nine 3/4 in holes was punched over the position to be occupied by the cone. An alternative is to cut a larger hole and cover this with fabric or expanded metal. A 4 × 1 1/2 in opening is cut in the panel, and is covered by a slightly larger

## ★ components list

### Resistors

R1	1k $\Omega$	R17	680 $\Omega$
R2	4.7k $\Omega$	R18	1.5k $\Omega$
R3	1k $\Omega$	R19	5.6k $\Omega$
R4	100 $\Omega$	R20	100 $\Omega$
R5	2.7k $\Omega$	R21	1.5k $\Omega$
R6	18k $\Omega$	R22	33k $\Omega$
R7	15k $\Omega$	R23	1.8M $\Omega$
R8	1k $\Omega$	R24	8.2k $\Omega$
R9	2.7k $\Omega$	R25	270 $\Omega$
R10	120k $\Omega$	R26	220k $\Omega$
R11	39k $\Omega$	R27	1.5k $\Omega$
R12	470 $\Omega$	R28	1.5k $\Omega$
R13	560 $\Omega$	R29	680 $\Omega$
R14	47k $\Omega$	R30	47 $\Omega$
R15	120k $\Omega$	R31	2.2 $\Omega$
R16	27k $\Omega$	R32	2.2 $\Omega$

All resistors 5%  $\frac{1}{4}$ W

- VR1 100k $\Omega$  linear potentiometer  
 VR2 10k $\Omega$  log. potentiometer with switch S6  
 VR3 100 $\Omega$  pre-set potentiometer

### Capacitors

C1	50nF	C10	125 $\mu$ F
C2	100nF	C11	100nF
C3	160pF 2% silver mica	C12	10nF
C4	220pF 2% silver mica	C13	100nF
C5	20nF	C14	470nF
C6	2nF	C15	100 $\mu$ F 10V
C7	100nF	C16	10nF
C8	100nF	C17	470 $\mu$ F 6V
C9	4 $\mu$ F 4V	C18	1000 $\mu$ F 10V

VC1/2 Jackson 00 208/176pF slow motion gang

VC3 Jackson C804 50pF

TC1-TC5 60pF trimmers

### Semiconductors

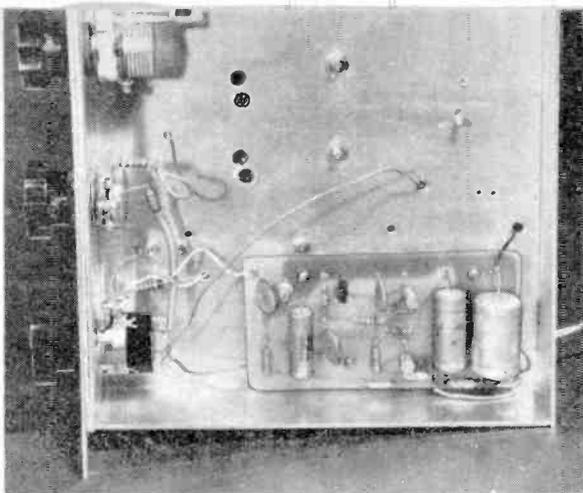
Tr1	MPF102	Tr6	BC108
Tr2	BF194	Tr7	BC149
Tr3	BF194	Tr8	AC141
Tr4	BF195	Tr9	AC142
Tr5	BC179	D1	OA81

### Miscellaneous

L1/L2, Denco MW/LW 5FR. IFT1, Denco IFT18/465. IFT2, Denco IFT18/465. IFT3, Denco IFT14. L3, Osc. coil Denco TOC1. S1, miniature slide switch. S2-S5 4-pole 3-way rotary switch. Moving coil meter 1mA fsd 42 x 42mm. Jackson 54mm diameter drum. Paxolin tube 150 x 29mm diameter. 6mm stereo jack socket. 5 control knobs. 550mm telescopic rod aerial. 6mm stereo jack plug. 15 $\Omega$  speaker. 156mm dia. 360 degree protractor. Plastic bowl 156 x 30mm. OSC/IF PCB, 105 x 55mm. AF PCB, 129 x 55mm. Both boards available from the PW Readers PCB Service, page 1070.

### Case

Type W case 10 x 7 x 5 $\frac{1}{2}$ in. Type K chassis 9 x 6 $\frac{1}{2}$  x 1 $\frac{1}{2}$ in. Type A screen 7 x 2 $\frac{1}{2}$  x  $\frac{1}{2}$ in. All HL Smith & Co. 8 x 1in. flanged Universal chassis runner—Home Radio Ltd.

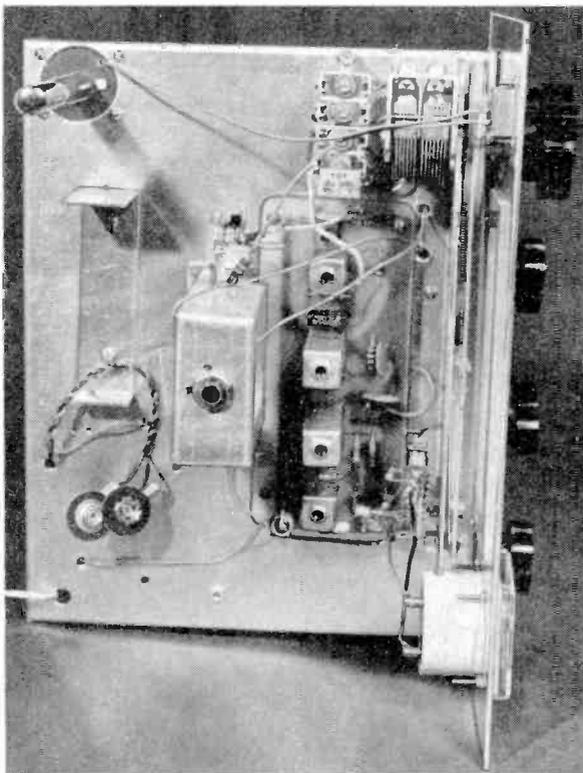


Underside view of chassis, showing the volume control, IF gain and aerial trim controls. The PCB in the lower righthand corner is the Audio board.

## RF Stage

The RF circuit is wired as in Fig. 5, which also shows connections to the jack socket. Leads are fitted to run to S1, VC3, C5, battery positive line and S2. The jack plug and socket, S1 and aerial, as well as VC3, contribute to the stray capacitance across L1 and L2 so when wiring, these unavoidable capacitances should be kept as low as possible, otherwise there may be difficulty in reaching the HF end of the range.

With individual samples of Tr1 it is possible that changes to the resistors R2 and R5 could improve gain. Otherwise the values given should be suitable. R4 may be the lowest value which does not allow instability to develop.



General plan view photograph of the receiver, showing layout of the Osc/IF board, tuning capacitor and trimmers, and the rotating aerial mounting.

piece of  $\frac{1}{16}$ in Perspex, held with two screws. A card scale, upon which three lines have been drawn, is fixed with adhesive, so that the three bands can be calibrated later.

A bracket is bent from scrap metal to hold the PP7 battery and is screwed down behind the aerial mount. Do not overlook that holes are required under IFT1 and IFT2, so that the lower cores can be reached. These are simply positioned by marking them through the circuit board before fitting the IFT's.

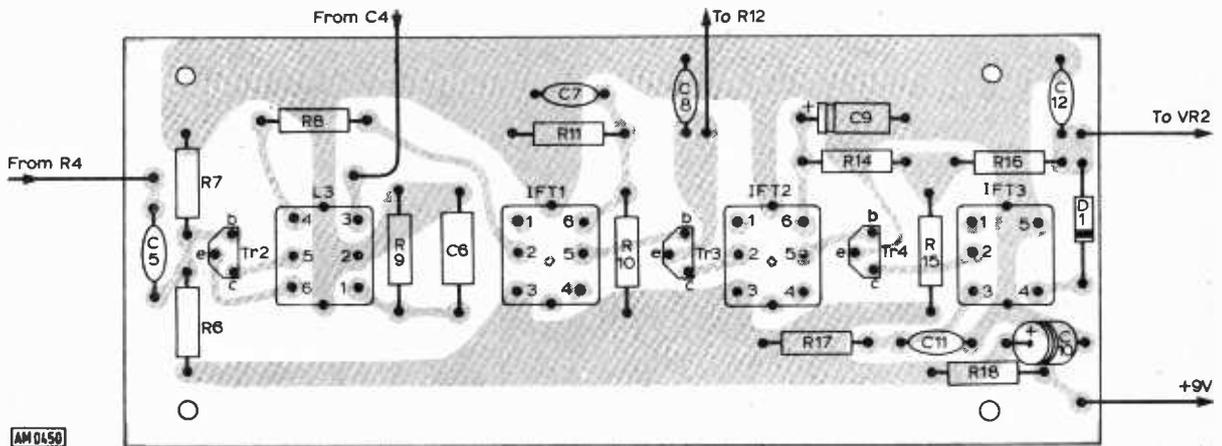


Fig. 6: Foil side and component side views of the Osc/IF board. Both are shown full size. If the board is to be tested outside the receiver, VR2 must be connected

## Osc/IF Board

Fig. 6 shows the PCB carrying the Osc/IF sections of the receiver. The input goes to C5 and the output taken from D1. The oscillator coil and IFTs should fit without any need to use force. If not, the holes for these may be slightly enlarged, taking care not to break the foil. Components are inserted as in Fig. 6, excess length of wire being snipped off after soldering. Provide flying leads for input, output, battery positive (S6), meter amplifier and IF gain control. (If this board is tested before fitting, VR2 must be connected.) Mounting is by means of four  $\frac{1}{2}$ in 6BA bolts, with extra nuts to give spacing from the chassis and locked firmly to provide the necessary chassis return.

Since the gain of individual transistors varies, it might be possible to modify the value of R8, using the lowest value which does not result in uncontrollable oscillation at any frequency. Normally, however, the value given can be fitted.

## Audio Amplifier

The AF board is shown in Fig. 7. Colour coded leads can be soldered on for R19, speaker and battery positive. The PCB is mounted under the chassis with three bolts, with the speaker leads made long enough

to allow the receiver to come well out of the case. If a jack socket is used here, it must be completely insulated from the chassis or be of the insulated type.

## Meter Amplifier

Components for the meter amplifier are wired to the tag strip as in Fig. 8. The meter is a 1mA instrument calibrated in S-points, though the meter is primarily required to show minimum signal positions for the rotating ferrite rod aerial. If after maximum adjustments to VR3 the meter cannot be set so that it is just beginning to rise, with no signal tuned in, then either R20 or R21 may be changed in value, to correct this. Alternatively, R3 can be changed to 250 $\Omega$ , provided R20, VR3 and R21 in series total about 1.5 to 2k $\Omega$ . It does not matter how the potential divider is made up, except that adjustment of VR3 becomes more critical if it forms most of the total resistance.

## Bandswitch

Connections to the switch are shown in Fig. 9, and can be followed in conjunction with Fig. 1. The rotor tag of VC3 must be wired to the chassis. TC5 is soldered directly across the switch, while the four trimmers TC1 to TC4 are mounted on a strip fixed

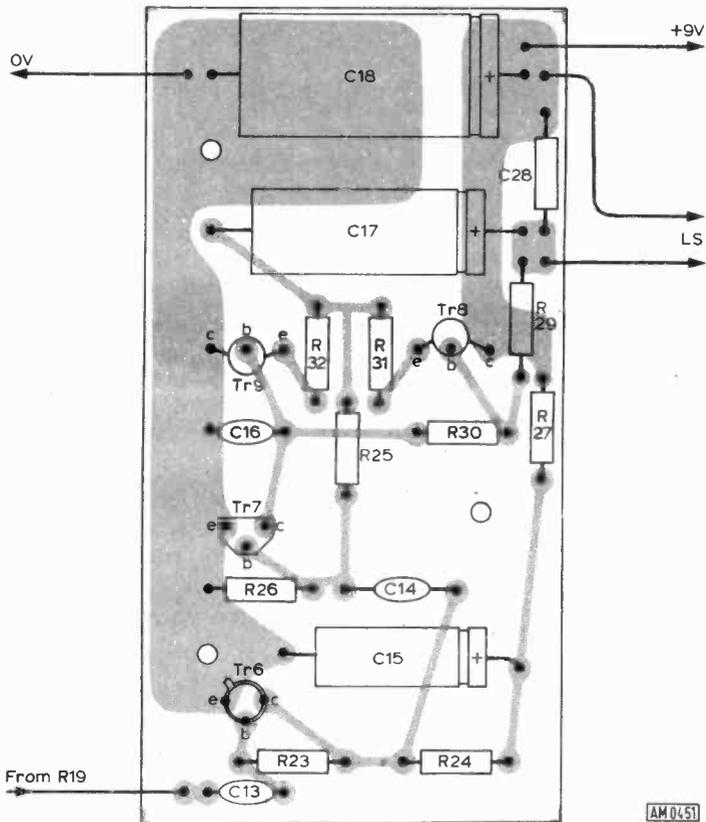
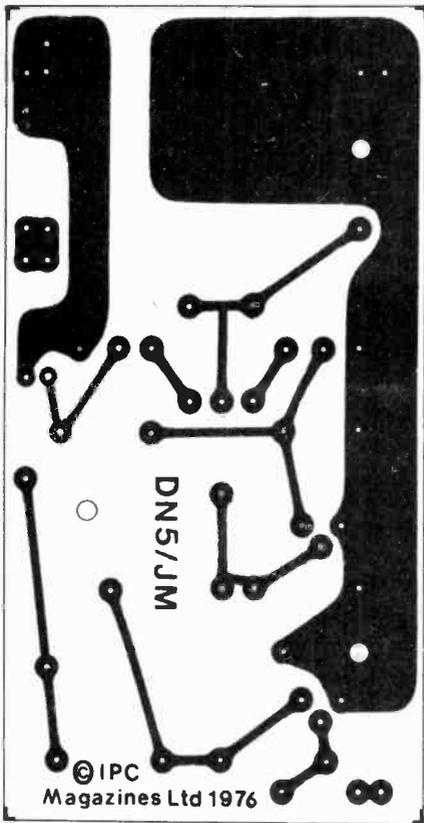


Fig. 7: Audio amplifier board showing the foil side to the left and the component side to the right. Again, both are shown full size. Chassis mounting is by three bolts.

clear of the chassis, by spacers, and behind VC1/2. It is convenient to use these trimmers, from left to right, for the circuit positions in Fig. 1. That is, TC1 LW oscillator trimmer; TC2 Range 1 bandspread coverage; TC3 Range 2 (and LW) oscillator trimmer; and TC4 Range 1 trimmer. This allows a short lead to run from pin 3 of the oscillator coil to TC1 and C4, which is connected from TC1 to TC2. For short leads, use the lower tags of VC1 and VC2, as in Fig. 10.

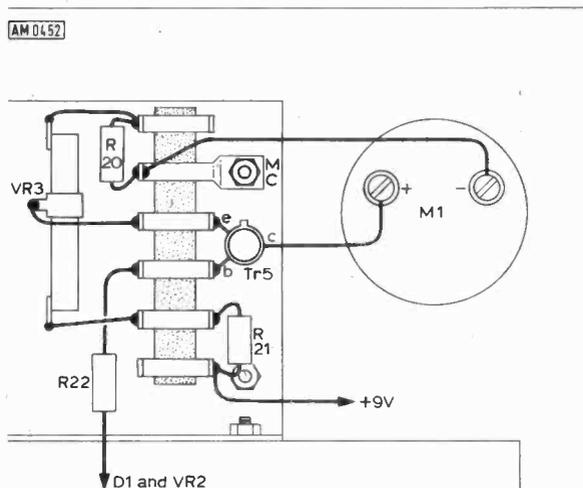


Fig. 8: Components that make up the meter amplifier are mounted on a tag strip adjacent to the meter itself. VR3 can be any pre-set pot of 100Ω.

## Rotating Aerial

A 3-way jack plug is used as a pivot and is assembled as in Fig. 11. A 4¼in disc is cut from plywood (this diameter was chosen to suit the diameter of the 0-360° protractor and is a tight push fit on the insulated part of the jack, to which it is cemented. If necessary, a block with a central hole can be glued here to strengthen the assembly. Insulated thin flexible leads are soldered to the plug contacts; these may be green for 1, red for 2, and black for 3. Thread these wires up through the jack moulding; and bring them out on top of the disc.

The ferrite rod aerial as received has a few turns for base coupling to L1 and these are removed. L1 and L2 must be in the same phase when connected in series, or LW alignment is impossible. The rod is secured to a small piece of paxolin by thread and

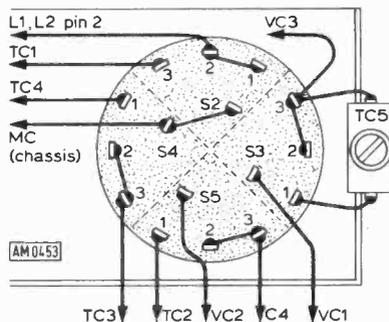


Fig. 9: The band switch comprises four poles and three positions, and the above drawing shows the connections to this switch, and the trimmer TC5.

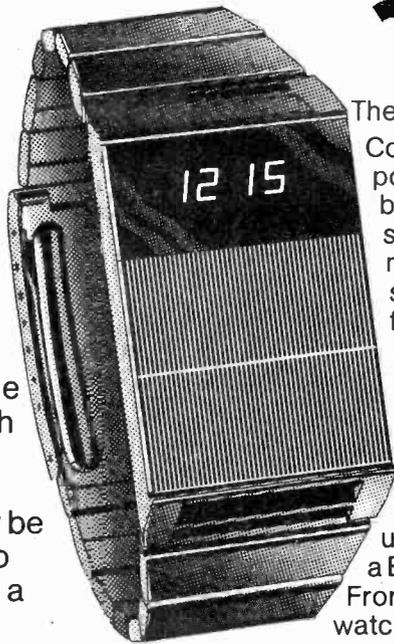
# The Black Watch kit

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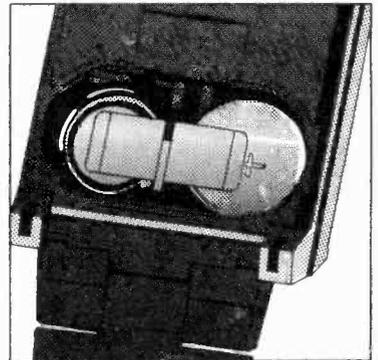
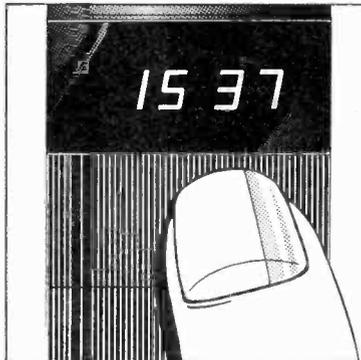
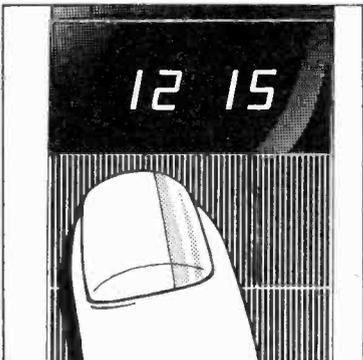
The Black Watch by Sinclair is unique. Controlled by a quartz crystal, and powered by two hearing aid batteries, it uses bright red LEDs to show hours and minutes, and minutes and seconds. And it's styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash.

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## Touch and tell

Press here for hours and minutes... here for minutes and seconds.

Batteries easily replaced at home.



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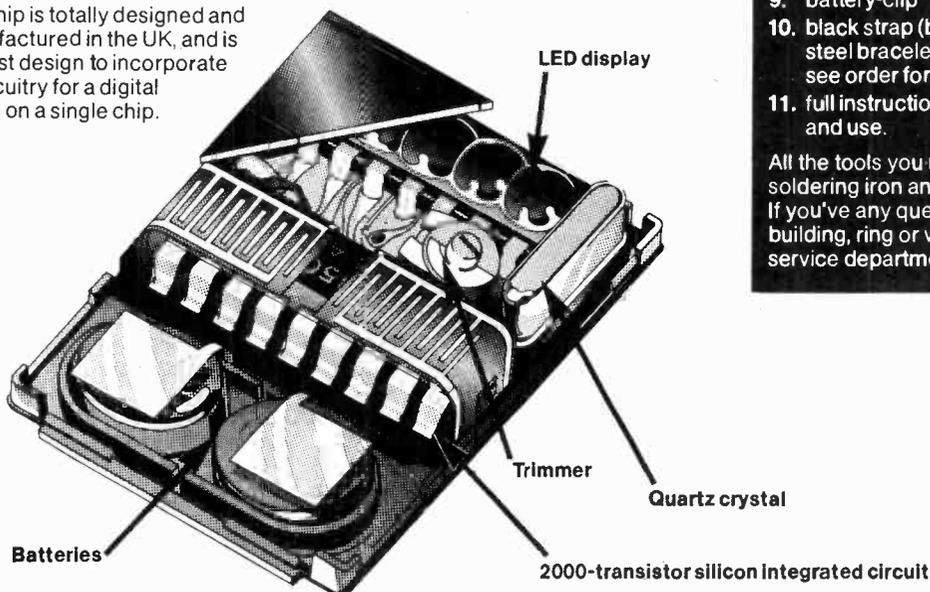
This chip of silicon measures only 3 mm x 3 mm and contains over 2000 transistors. The circuit includes

- a) reference oscillator
- b) divider chain
- c) decoder circuits
- d) display inhibit circuits
- e) display driving circuits.

The chip is totally designed and manufactured in the UK, and is the first design to incorporate *all* circuitry for a digital watch on a single chip.

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..... (qty) black stainless-steel bracelet(s) at £2.00 (inc. VAT, p&p). .....

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Signature \_\_\_\_\_

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FREEPOST – no stamp required.

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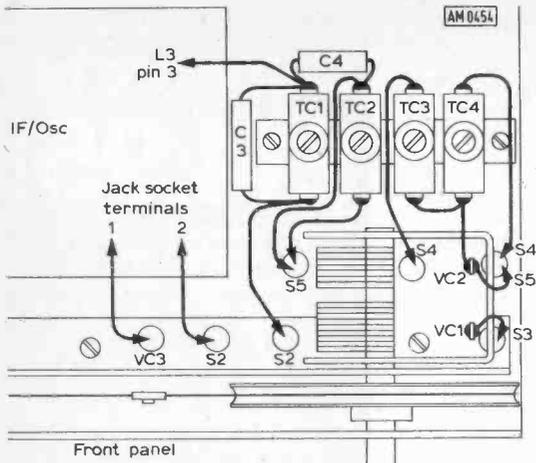


Fig. 10: The trimmers TC1 to TC4 are mounted in the above configuration to enable the leads to be kept as short as possible.

adhesive. This is held with two small screws, with strips to space it slightly from the disc, to clear the plug leads. These are soldered to the appropriate leads from L1 and L2, using pins as anchorage points if required. When the aerial has been tested, it is protected by a 6x1in paxolin tube, cut away just sufficiently on the underside to allow it to be fitted over the rod. A lead from point 3 is brought out from the tube.

The metal shield is bent from aluminium, about 3½ x 2in, to clamp the paxolin to the wooden disc and it is earthed by a tag under one fixing screw, soldered to lead 3. Its purpose is to improve the minimum null by reducing non-directional pick-up by the connecting wires. Approximate alignment can be made before fitting the paxolin tube. Final small adjustments to the positions of L1 and L2 may be made with an insu-

lated tool, through the open ends of the tube. The ends of the tube may be closed with discs of insulating material. Due to stray pick-up by other wiring, the sharpest directional nulls are obtained only with the receiver in its metal cabinet.

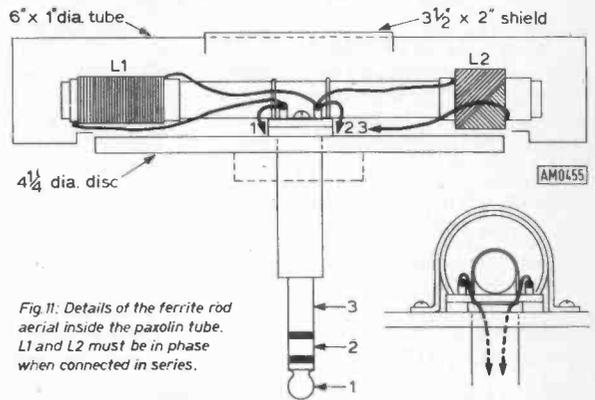
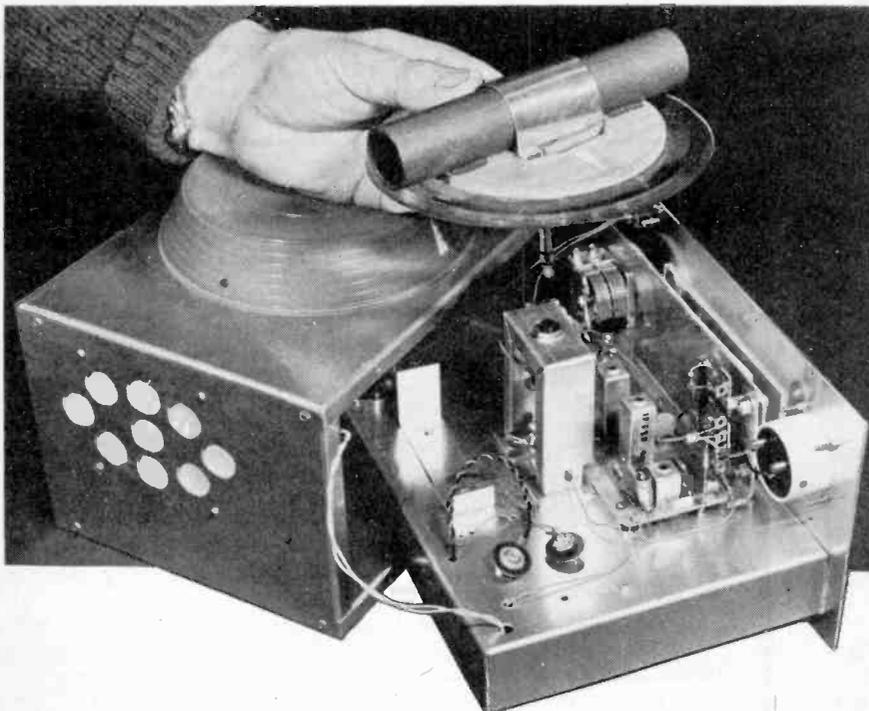


Fig. 11: Details of the ferrite rod aerial inside the paxolin tube. L1 and L2 must be in phase when connected in series.

## Alignment

Band coverage is most easily checked if a signal generator is available, but satisfactory alignment is possible without this. The IFTs are pre-aligned by the maker so only small adjustments to these cores should be necessary and should not in any case be made until signals are received. A correctly shaped tool, such as that available from the IFT maker, must be used, otherwise the cores may crack.

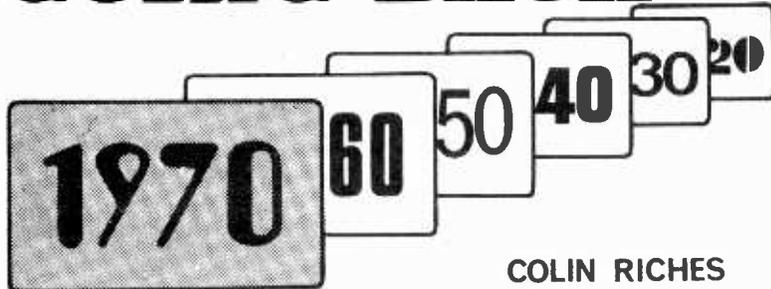
To check the IFTs, tune in any steady, stable signal correctly, with VR1 near maximum gain, but reducing signal strength if needed by rotating the aerial, so that the meter does not go beyond full scale. All the IFT cores can then be adjusted slightly to give the best meter reading. When the IFTs are correctly aligned in this way, they must not be altered or re-adjusted when aligning the aerial and oscillator



The ferrite aerial is mounted inside a paxolin tube and connected via a stereo jack plug. This permits the aerial to be rotated to find the 'Null' point.

continued on page 1080

# GOING BACK...



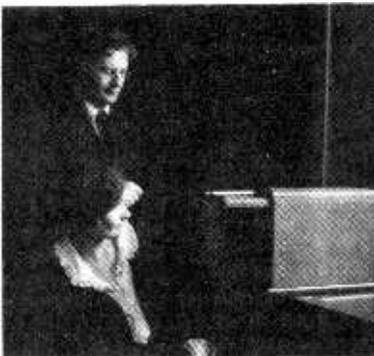
COLIN RICHES

## J. L. B.

SEVERAL readers have expressed interest in the picture of John Logie Baird's "Televisor" shown in the February 1976 Going Back so I thought I would show another couple of pics. of the great man. The small photograph shows J. L. B. with Miss King—the first girl ever to be televised. The larger picture shows J. L. B. in 1926 with his original television apparatus. If anyone wants to see this fantastic piece of equipment, pop along to the Science Museum—it's there in a glass case just like the one in our picture.

Some J. L. B. milestones: **May 1924**—The Baird Television System. "Mr. Baird has achieved some remarkable results which go a long way towards proving that television is practicable." **October 1926**—"The first TV licence was recently granted to Mr. J. L. Baird's stations. One is situated in St. Martin's Lane and the other at Harrow. At present the London Station is a transmitter and, except for an interval of a fortnight, 'looking-in' has been in progress every night for some weeks on a wavelength of about 200 metres." **May 1927**—Said J.

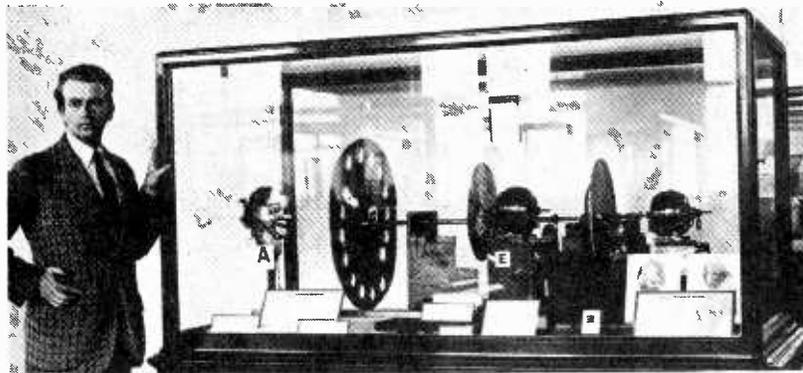
L. Baird, "In ten years time, I prophesy, we shall be able to see on our wireless televisors topical events, such as the finish of the Derby or the finish of the Boat Race."



J.L.B. and his 'first lady'

## Anyone Help?

MR. M. HILL, Hillside, Peaslake, Guildford, Surrey is desperately anxious to obtain an old Murphy A92 "Stationmaster" receiver of 1940 vintage. It's an 8-waveband all-mains receiver which was claimed to have a very good short-wave performance. If you can help, please contact Mr. Hill direct.



J.L.B. and original apparatus.

## Overseas News

MR. KEN McKenzie, one of our New Zealand cousins recently wrote to say that he has been a radio enthusiast since 1924 when he heard, via the telephone, for the first time in his life, a radio broadcast. It was from the South Seas Exhibition on South Island, N.Z. In 1927 he built his first one-valve receiver from a design published in the journal *N.Z. Radio*. His ultimate project was a three-valve receiver working a Philips "Baby Grand" cone speaker.

For a long time his nearest transmitter was 2YA Wellington, which ran at 5kW and was over 40 miles away. Later, for a town of a then population of about 12,000 they became very well served by two dealers in radio sets and parts who set up broadcast transmitters. They were N.R. (Ray) Cunningham with 2ZQ and W. D. (Bill) Ausell, with 2ZD.

It's always good to hear from our overseas enthusiasts so keep the letters coming in folks!

## Vintage Radio Society

I HEARD from our friend Tudor Rees (of *Antique Wireless Newsheet* fame) again recently and he says there is a saying "Put two Englishmen upon a desert island and they will form a club". This however certainly isn't based on fact when it comes to a British Vintage Radio Society. There must be literally many thousands of enthusiasts but no sign of a club or society as yet. Things may be looking up though, for a Mr. A. Constable, 18 Ravensbourne Gardens, Ealing, London, W.13 wishes to conduct an initial survey as to the possibility of forming such a group. He would like all those with a genuine interest in a Vintage Radio Club to write to him (I would suggest you enclose a s.a.e.).

## Vintage CQ Column

FROM time to time we publish a special "Vintage CQ Column" for readers who have requests for old books, equipment etc, and those who wish to dispose of such items. If you want to be included in our next column, please address your request to "Vintage CQ", Practical Wireless, Fleetway House, Farringdon St, London EC4A 4AD.

# PRODUCTION LINES

colin riches

## NEW MIC



A noise cancelling microphone which the manufacturers state has exceptional qualities of discrimination between the voice and random noise is now in production at the Eastleigh, Hampshire works of Selsound Limited.

In their search for the clearest possible transmission of speech, Selsound engineers have demon-

strated that the microphone is able to eliminate extraneous noise to an exceedingly high degree. Exhaustive laboratory development resulted in a high level of response within that band of frequencies most important for clarity of speech, a marked diminution on each side of this band and a steep gradient to the sensitivity/proximity curve.

Selsound microphones are available in the form of a microphone insert, styled "Type 2500", but the company state that they can provide special housings to suit specific requirements and installations.

Full technical details are available from *Selsound Ltd., (Dept. P.W.) Victory Close, Industrial Estate, Chandlers Ford, Eastleigh, Hants. Tel: Chandlers Ford 67158.*

## WIRING PENCIL

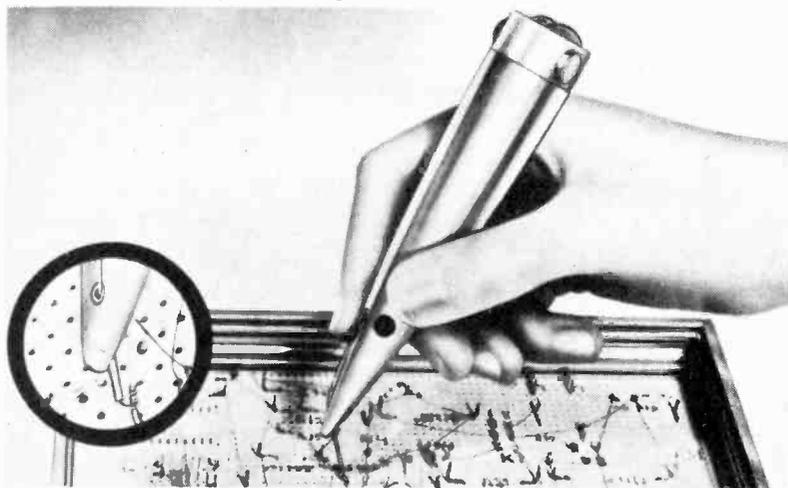
This new wiring pencil, patented by Vector Electronic Co., U.S.A. comprises a lightweight plastic housing, a replaceable spool of wire, and extended metal tip to guide and cut the wire. The wire is said to be a unique solder through nylon-polyurethane insulated tape which, when heat is applied to the wrapped connection points with a fine-tipped soldering iron, the insulation melts away, and produces a soldered joint. The wiring tip of the pencil is angled

to facilitate wrapping and to provide a clear view of operations.

The makers claim that the average time required to make a soldered joint is only seconds—and reckon it's about three times faster than conventional soldering.

The pencil, complete with two 250ft. spools of wire, sells for £6.75 plus postage.

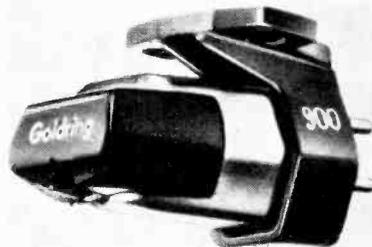
Further information from: *J. H. Equipment Limited, (Dept. P.W.) 91 Redbrook Road, Timperley, Trafford, Lancs.*



Please mention **Practical Wireless** when writing to manufacturers and suppliers whose addresses are given in these pages.

—Thank you.

## THE ALL BRITISH CARTRIDGE



Goldring have just brought out a new Cartridge—the G900SE. The key to the G900SE performance is the great mass reduction (moving mass 32g) which immediately results in extremely low intermodular distortion. (Physical mass has been reduced to 5mg.)

These reductions in mass have been achieved firstly by the introduction of miniature magnets to a specification previously believed impossible. Then spurning conventional methods, the coil assembly used in the main body of the cartridge is created using formerless winding techniques through which Goldring have saved valuable space and therefore weight, which in turn reduces the mass which the stylus has to move.

Welded to the magnet is a micro gold plated nickel tie bar, which is there partly as an earth to reduce crucial static discharges that can occur and also to control the movement of the stylus in unwanted modes. The whole assembly is then pivoted via a special Butyl polymer with optimised damping.

### Specification:

**Frequency range:** 10Hz-28kHz.

**Frequency response:** 20Hz-20kHz  $\pm 2$ dB.

**Playing weight:** 1 gm.

**Playing weight range:** 0.75-1.5 gm.

**Tip mass:** 0.32 mG.

**Stylus point radius:** .0007"  $\times$  .0002" (18 $\mu$   $\times$  5 $\mu$ ).

**Inductance at 1kHz:** 640 mH.

**Inductance at 10kHz:** 630 mH.

**DC resistance:** 720 Ohms.

**Channel separation:** 25dB NOM.

**Output (sensitivity) @ 5 cm/sec:** 1kHz. RMS 5mV  $\pm$  1.5dB.

**Compliance (static):** 40 LAT  $\times$  10<sup>-6</sup>cm dyne, 20 VER  $\times$  10<sup>-6</sup>cm dyne.

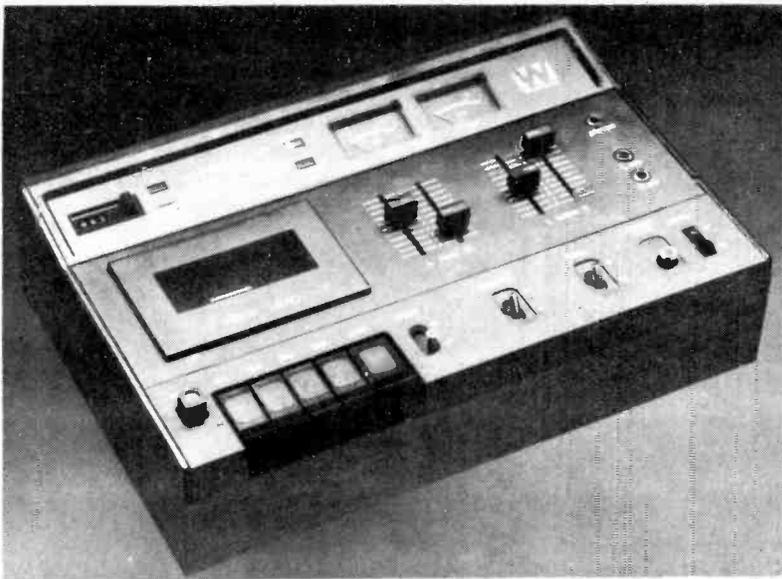
**Vertical tracking angle:** 24° Net weight: 5 gm.

*Goldring Limited (Dept. P.W.) 10 Bayford Street, Hackney, London E8 3SE.*

## WHARFEDALE DECK

Rank Hi-Fi have announced the Wharfedale XP cassette deck (with Dolby) at £165 (inc. VAT). Finished in black and walnut, this 4-track stereo deck has an electronically governed DC motor and automatic bias selection. Tape speed: 4.8 cm/sec (1 $\frac{7}{8}$ ips)  $\pm$  1.5%. Wow and flutter: DIN 45507 0.20% (maximum) (peak weighted). Output levels: DIN socket more than 10K ohm, OVU input, 580mV  $\pm$  1.5%, headphone jack, 2 volts into 50 ohms. Input level: microphone/DIN 2mV, line 30mV. Input impedance (nominal): microphone/DIN 5.6k $\Omega$ , line 50-500k $\Omega$ . Bias frequency: 79kHz. Frequency response (record/playback): standard tape (Dolby out) 50-10,000Hz  $\pm$ 3dB, 10,000-12,500Hz -3 to -5dB; CrO<sub>2</sub> tape (Dolby out) 50-12,500  $\pm$ 3dB, 12,500-14,000Hz -3 to -5dB; Dolby in from Dolby out frequency characteristics within  $\pm$ 3dB. Frequency response (playback only): within 3dB of record/playback, response from 50-10,000Hz. Total harmonic distortion (max.): 3.0%. Typical signal/noise ratio: Dolby out 54dB, Dolby in 61dB. Erasure (minimum): 60dB. Channel separation (min. at 1kHz): 32dB.

Rank Audio Visual Ltd., (Dept. P.W.)  
P.O. Box 70, Great West Road, Brentford, Middx.



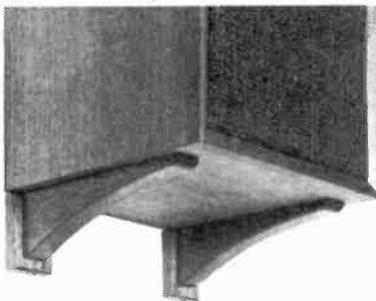
## PHILIPS MULTI-TESTER

Model SMT-111 has as one of its most important features, a high input impedance of 0.5M $\Omega$ . This derives from an integrated circuit amplifier which enables the instrument to be used in many AC applications, up to 25kHz on the 12V range, for example. The use of an integrated circuit amplifier also enables a lower-impedance moving coil movement to be incorporated.

The SMT-111 is based on the combined experience of Philips own

engineers and technicians throughout the world. Its thirty-five measuring ranges were selected with them in mind and an additional feature has been the inclusion of an AC current range. Both the integrated circuit and movement have been fully protected against peak overload and a checking point for the battery has been incorporated in the range selector switch. The SMT-111 is priced at £30.00. Philips Electrical Limited, (Dept. P.W.), Century House, Shaftesbury Avenue, London WC2H 8AS.

## SPEAKER BRACKETS



The brackets holding this speaker are made of hardwood and are manufactured by Esta Limited, Staffs.

These "Astute" brackets, which are very easy to fit can easily be removed for decorating etc. Rubber pads are incorporated to hold speakers so that no screws need to be driven into the actual speaker cabinets.

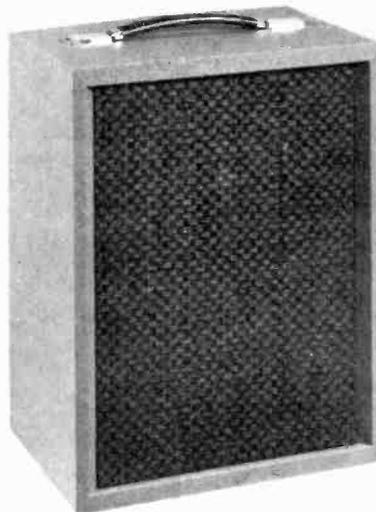
They come supplied sanded ready to finish and are complete with screws and plugs. Prices: 14cm £1.71; 19cm £2.16; 26cm £2.70 further gen from Esta Heating Products Limited, (Dept. P.W.) Green Lane, Walsall, Staffordshire.

## FOR CINE FANS

The Leeds firm of Farnell-Tandberg Limited recently introduced two new loudspeakers aimed mainly at the home-movie market, for both of them are suitable for use with cine sound projectors. Model FT 108 has a 4 $\Omega$  impedance which accurately matches the output of most 8mm sound film projectors. The FT 116 has an impedance of 8 $\Omega$  to match the output of the majority of 16mm sound projectors on the market.

The robust cabinets (and you need them to be pretty strong if you are lugging equipment around doing film shows) are finished in grey rexine with matching vynair. Both incorporate a 10in. loudspeaker giving 10W RMS output. The units are supplied with 15 metres of twin-core sheathed cable which terminates in a DIN speaker plug. All of this can be neatly stowed away in the back of the cabinet where there is a compartment with a removable lid.

We tried one of these speakers on an 8mm projector and also tested it with an ordinary cassette tape recorder to play back sound for slide shows. In both cases results were very good. The price of these speakers



is set at £23.25 plus VAT. Further gen on these and other Farnell-Tandberg equipment for sync sound systems may be obtained from Mr. M. R. Cowing, Promotional Services Manager, Farnell-Tandberg Limited, (Dept. P.W.) Farnell House, 81 Kirkstall Road, Leeds, LS3 1HR.

# THE OTHER SIDE HEARD

65

104

OIRT

73

MHz

87

CCIR

IGOR HAJEK

**S**OME time ago, I suggested in the pages of this magazine that it might be worthwhile to explore possibilities of long distance VHF reception on the East European (OIRT) band, 65 to 73MHz. At that time (PW October 1974) I wrote that Sporadic E openings on these lower frequencies could take place more often than those reaching into the 90 to 100MHz region though the statement was rather in nature of an educated guess, being partly based on other people's observations.

## SEASON 74/75

During the 1974 and 1975 SpE seasons (mid-May to mid-August) I conducted some experiments of my own and the results have shown that if anything, my prediction had not been optimistic enough. In 1974, long distance propagation of FM radio signals

caused by reflection from the ionosphere was observed on 27 occasions; only on 5 of these occasions did the exceptional DX conditions also affect the West European (CCIR) FM band, 87.5 to 104MHz. In 1975, the ratio was 35:6 and there were a few additional days last July when broadcasting stations from Eastern Europe could be received due to enhanced tropospheric propagation.

The duration of these favourable receiving conditions, as well as the times at which they occurred, differed widely. They would last from less than one hour to several hours at any time of the day and on some occasions OIRT stations could be heard from early in the morning till late at night.

Signals were usually of a long-skip character and stations most frequently received were those from the north-western and western parts of the USSR (i.e. Estonia, Latvia, Lithuania, Byelorussia and the Ukraine), eastern Poland, Romania and Hungary, while Bulgarian and Czechoslovakian FM stations appeared less often. The strength was sufficient to make listening in stereo possible, though at times with a considerable level of noise. Indeed, stereo programmes have been received from all the OIRT countries, the only exception being the USSR, where a different system is used for stereo broadcasts (unsuppressed subcarrier at 31.25 kHz), which the common 19kHz pilot tone type of decoder cannot resolve.

## EQUIPMENT

My equipment consisted at first of a small 4 metre converter with the oscillator set at 173MHz and an IF at 100MHz, used in connection with an ordinary FM tuner, an aerial preamplifier and a wideband Yagi array. For the 1975 season, however, the converter was replaced with one of the currently available FM tunerheads. Retuned to the 65 to 73MHz band it was built into the tuner as an alternative, switchable front end.

It is this latter arrangement that I can recommend to anyone interested in similar experiments, and results achieved over the past two years certainly do confirm that the lower FM band is ideally suited to VHF DXing. However, it is impossible to give any advice as to the choice of a suitable front end. There are quite a few types available, costing mostly under £10 (e.g. from Ambit International) and the actual selection has to be made with regard to the specifications of the tuner with which it is to be used.

A word of caution seems to be in order as retuning



—a long-skip character

may prove to be a tricky business as it requires a signal generator or, ideally, a calibrated wobulator. A simple adjustment of cores and trimmers would probably be not enough. In my case, at least, it was necessary to add approximately two turns to each coil as well as increasing the oscillator feedback capacitor by a few pF.

On the other hand, there should not be any difficulty about finding a suitable aerial as any old 405 line TV aerial will do, in particular those for Channel 5. The OIRT transmitters are both vertically and horizontally polarized.

## EXPECTATIONS

The 65 to 73 MHz band is, under normal conditions, fairly quiet in this country. There is some RT traffic, amplitude modulated, around 71MHz and in most areas of the UK the vision buzz of TV channel B5 can be heard on 66.75MHz. There seem to be less and less amateurs operating on 4 metres (70MHz) these days. This means of course that anything else that may suddenly appear on these frequencies in the summer months is fairly sure to be coming from Eastern Europe via SpE, and do not be surprised if it happens to be English pop, as they play a lot of it over there.



—advice on a suitable front-end

An exception is the frequency of 67.75MHz on which TV sound can be heard on such occasions originating from Yugoslavia, Spain, Italy and other continental countries. It should also be mentioned that while the OIRT FM band nominally starts at 65MHz, few stations can actually be found below the 66MHz point because there is a small overlap with channel R2 TV sound on 65.75MHz so that frequencies between 65 and 66MHz are used by FM radio only in areas not covered by this TV channel.

For the British DXer the most difficult problem may well turn out to be the identification of individual stations and countries of origin. Being able to recognize the main languages of the area is of some importance and listening to the foreign broadcasts of the BBC, which are always introduced in English,

could be quite helpful in this respect. After a time, one gets attuned to the sound of a language and it is then possible to identify it without actually understanding it. Once this point is reached, it should be much easier to catch the odd word which makes closer identification possible. News broadcasts and weather reports are particularly revealing as the emphasis tends to be on local events and temperatures PW

## PW TECHNICROSS PUZZLE

Solution to No. 12  
presented last month



## Mail Order Protection Scheme

The Publishers of *Practical Wireless* are members of the Periodical Publishers Association which has given an undertaking to the Director General of Fair Trading to refund monies sent by readers in response to mail order advertisements, placed by mail order traders, who fail to supply goods or refund monies owing to liquidation or bankruptcy. This arrangement does not apply to any failure to supply goods advertised in a catalogue or in a direct mail solicitation.

In the unhappy event of the failure of a mail order trader readers are advised to lodge a claim with *Practical Wireless* within three months of the date of the appearance of the advertisement, providing proof of payment. Claims lodged after this period will be considered at the Publisher's discretion. Since all refunds are made by the magazine voluntarily and at its own expense, this undertaking enables you to respond to our mail order advertisers with the fullest confidence.

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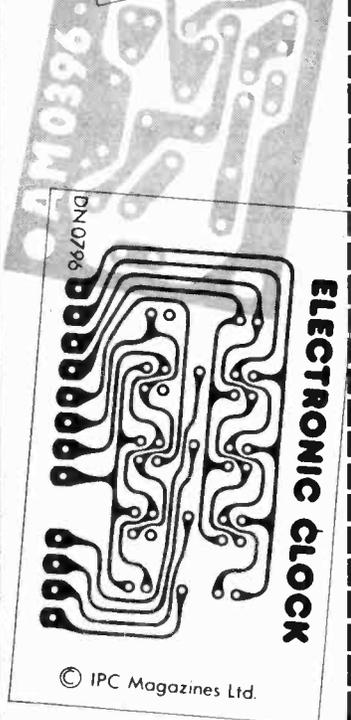
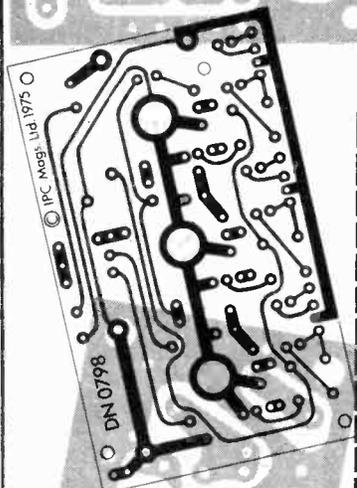
# EDITORIAL ANNOUNCEMENT

# NEW!

# PRACTICAL WIRELESS

# PCB SERVICE FOR READERS

Our new PCB service is well under way and we are now able to add PCBs for two popular projects published prior to December 1975. All boards, except SRBP, are epoxy glassfibre, drilled and roller-tinned.



To:- READERS PCB SERVICES LTD, PO BOX 11, WORKSOP, NOTTS

Please supply PCB/s as indicated by tick/s in box/es

Issue	Project	Ref	Price	
Mar 75	Electronic Organ (set of two)	AMO315 AMO318	7.80 + 25	<input type="checkbox"/>
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Dec 75	Disco System, Amplifier (2 required)	each AM0421	3.40 + 18	<input type="checkbox"/>
Dec 75	Disco System, Light Modulator	AM0423	2.70 + 18	<input type="checkbox"/>
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		glassfibre DN1/JM	3.00 + 18	<input type="checkbox"/>
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Mar 76	CMOS Crystal Calibrator	AM0438	1.19 + 12	<input type="checkbox"/>
Apr 76	DF Receiver (set of two)	DN4/JM DN5/JM	1.92 + 15	<input type="checkbox"/>
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Post and packing is for one board. For each additional board add 4p to the 10p or 18p rate as applicable. Prices include VAT.

Remittances with overseas orders must be sufficient to cover despatch by sea or air mail as required.

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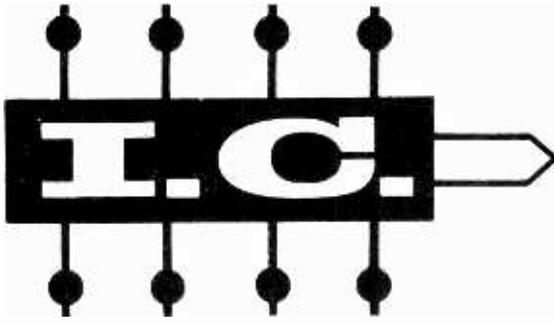
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Any correspondence concerning this service must be addressed to READERS PCB SERVICES and not to the Editorial offices.



# OF THE MONTH

## Number 57 RCA CA3130 CMOS OPERATIONAL AMPLIFIER

THE relatively new CA3130 operational amplifiers manufactured by RCA employ the well-known CMOS (Complementary Metal Oxide Silicon) techniques in which the complementary FET's are fabricated on the same silicon chip as conventional bipolar transistors. This enables important advantages to be obtained in circuits employing this device.

### HIGH INPUT IMPEDANCE

One of the most noticeable features of the CA3130 is the very high typical input impedance of  $1.5 \times 10^{12}$  ohms ( $1\frac{1}{2}$  million megohms). In practice this means that either of the inputs of a CA3130 device can be

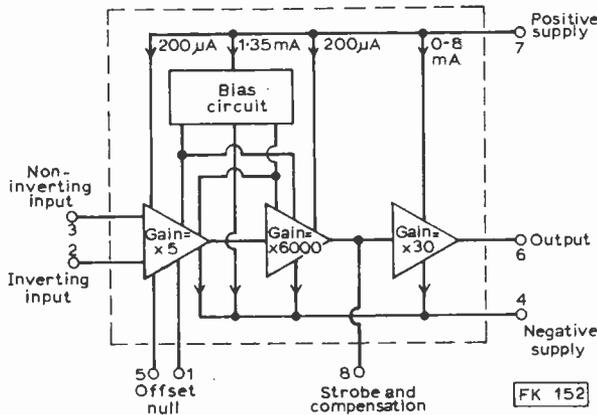


Fig. 1: Internal block diagram of the CA3130, showing the three amplifiers connected in cascade.

connected into almost any circuit without affecting the operation of that circuit by taking an appreciable load current from it. The input current required by a typical CA3130 device is only about 5pA (5 millionths of a microamp) which again shows that this device imposes an extremely small load on the circuit feeding its input. The input current increases by a factor of about two for each 10°C rise in temperature, but even at 80°C it rises only to about 100pA.

Another advantage is obtained by the use of CMOS circuitry in the internal output stage of the device. The CA3130 output voltage can swing to within a few mV of the potential of either supply line if the load impedance is relatively high.

The gain-bandwidth product of this very economi-

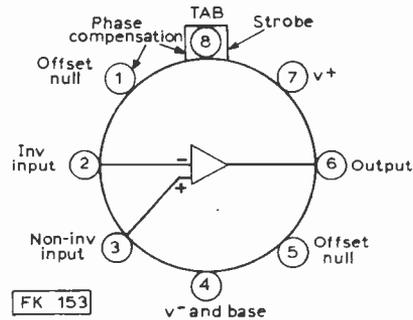


Fig. 2: The CA3130 is encapsulated in a TO-5 type can, and is supplied via eight leads as shown above. The view is from above.

cal device is 15MHz, being a very high value for an amplifier with such a high input impedance. In addition, the slew rate of the CA3130 is about 30V/µs with no capacitance in the output circuit; this may be compared with the value of about 0.5V/µs quoted for the well-known 741 device. The CA3130 can therefore deliver a higher output voltage than the 741 at a given frequency when this is determined by the slew rate.

### INTERNAL CIRCUIT

The internal circuit of the CA3130 comprises three amplifier stages in cascade together with a biasing circuit for the first two stages, as shown in Fig. 1. The input amplifier stage employs CMOS devices to provide a very high input impedance, but the voltage gain of this stage is only about five times. The gate electrodes of CMOS devices are susceptible to damage when an electrostatic charge accumulates in

the high input impedance circuit, since such charges can puncture the insulating layer of silicon oxide between the gate and the channel. Four zener diodes are integrated on the silicon chip to protect the device from damage by static charges in most circumstances.

The second amplifier stage employs a bipolar transistor in a circuit which provides a voltage gain of about 6000 times. The third stage of the CA3130 operates in Class A with a typical voltage gain of thirty times varying with the load impedance of the circuit.

## CONNECTIONS

The CA3130 is available only in a metal can type package with eight leads, Fig. 2, like a TO-5 type of transistor encapsulation but with eight leads instead of three. The CA3130 has the normal inverting and non-inverting inputs of an operational amplifier. The quiescent output voltage can be adjusted to a value half way between the power supply lines if a potentiometer is connected between pins 1 and 5 with its rotor connected to pin 4 (the negative supply).

The output stage can be rendered inoperative by connecting pin 8 (input to this stage) to the negative line at pin 4. The output potential at pin 6 then rises virtually to the positive supply line voltage of pin 7. Electrical strobing pulses may be applied to pin 8 so that the device only operates at the desired times.

## TYPES AVAILABLE

The most economical device of the series is the CA3130, suitable for most applications. However, specially selected devices are available for more critical purposes. The CA3130A has a lower maximum input current than the CA3130 and lower input offset voltage and current. The input circuit specifications of the CA3130B have even tighter tolerances. All of the devices operate satisfactorily over the very wide temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

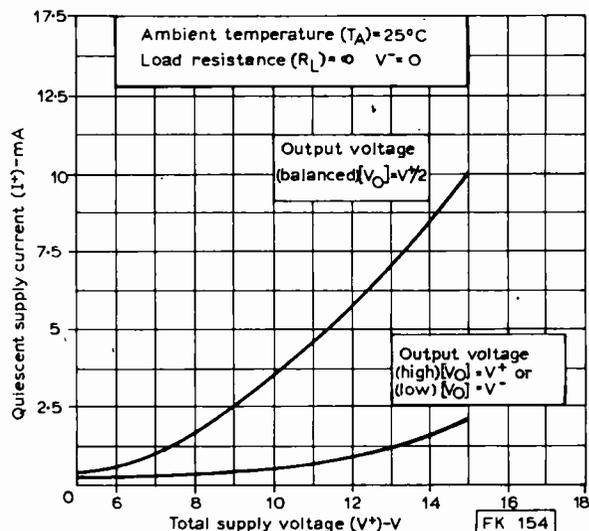


Fig. 3: Graph of the CA3130, showing increase in supply current with supply voltage. These curves occur when the device is not supplying output current.

A letter 'T' or an 'S' may be added. For example, RCA produce types CA3130T, CA3130AS, CA3130BT, etc. The 'T' signifies that the device has straight leads, whilst the 'S' types have their leads bent so that their ends are in an 8 pin dual-in-line configuration.

## POWER SUPPLY

The CA3130 will operate from supply voltages of 3V to 16V or from balanced positive and negative supplies of  $\pm 2.5\text{V}$  to  $\pm 8\text{V}$ . The current required is very low, especially if the load impedance is high and the power supply voltage is low, an advantage obtained with most CMOS devices. Typical power supply currents when the output current is zero are shown in Fig. 3. The supply current is particularly low when the output voltage from the device is equal to either of the supply line potentials, but is higher when the output voltage is half way between the supply line potentials. If a single supply of 5V is

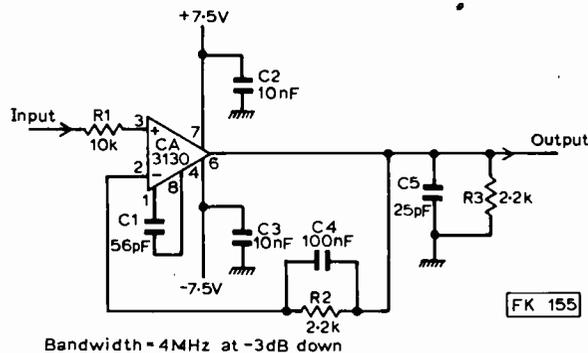


Fig. 4: To achieve a high degree of accuracy between the input and output voltages, the device is connected with a balanced power supply.

employed, the power supply current is only about  $300\mu\text{A}$  when the load impedance connected to pin 6 is infinity and when the potential at this pin is 5V; if the output potential falls to 2.5V, the supply current rises to about  $500\mu\text{A}$  for the same load impedance. The CA3130 series is therefore very useful with equipment which must be operated from small batteries.

## TYPICAL CIRCUITS

One of the most useful applications of the CA3130 is as an impedance transformer. The non-inverting input of the device is connected to a signal source which may have a very high impedance and which can therefore supply only a very small current. The output circuit of the CA3130 can either supply or accept an output current of up to about 20mA, this being of the order of four thousand million times the input current required by the device. Thus the CA3130 can be used to drive a stage which requires appreciable current; in other words it can 'transform' a high impedance at its input to a relatively low impedance in its output circuit.

A typical impedance transformer circuit is shown in Fig. 4. In this case the device is used as a 'voltage follower' where the output voltage 'follows' the input

voltage. One can achieve an accuracy of 0.01% between the input and output voltages in this type of circuit.

The capacitor C1 in Fig. 4 provides frequency compensation. Negative feedback from the output to the inverting input is provided by R2 in parallel with C4. The circuit shown employs balanced power supplies with a supply voltage near to the maximum so as to obtain maximum output voltage swing. Supplies of  $\pm 2.5V$  may be used for minimum current consumption.

Another voltage follower circuit is shown in Fig. 5 in which a single power supply is employed. The potentiometer VR1 enables the quiescent voltage at the output to be adjusted to a required value. In both Figs. 4 and 5 capacitors are incorporated in the power supply lines to assist stability at high frequencies.

Voltage followers of this type are useful when the potential of the high impedance input is to be measured, since it is transformed to the low output impedance which can be measured with a conventional meter.

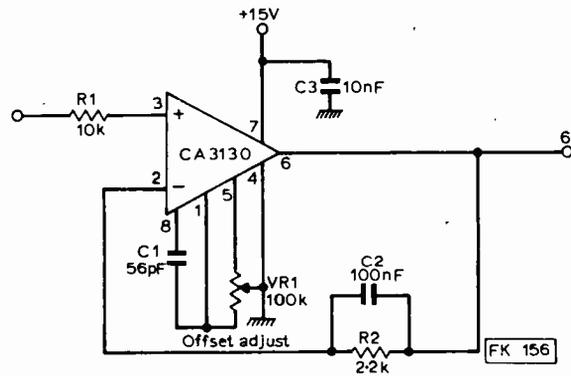


Fig. 5: The circuit above is similar to that shown in Fig. 4, but in this case is supplied by a single power supply. The potentiometer VR1 is used for setting the quiescent voltage at the output.

## OSCILLATOR

A simple square-wave generator circuit is shown in Fig. 6. The resistors R1 and R2 bias the non-inverting input of the CA3130 to a mean voltage equal to half the supply voltage. The timing capacitor is selected by the range switch, S1. The time for which the output voltage is in its 'high' state can be adjusted by VR1 and the time for which it is in its 'low' state by VR2. When the largest capacitor, C1, is selected by S1, each part of the pulse can have a period in the range 4ms to 1s (according to the setting of VR1 and VR2). This period varies by factors of ten with the setting of S1 until one obtains 4 $\mu$ s to 1ms with the capacitor C4.

When the voltage at the inverting input is low, the output voltage will be high and the capacitor selected by S1 will charge through VR1, R4 and D1. As the voltage across this capacitor increases, the potential at pin 2 rises above that at pin 3 and the voltage at the output falls to a low value very suddenly. The same timing capacitor now discharges through D2, R5 and VR2 until the pin 2 voltage falls below that at pin 3, when the output switches

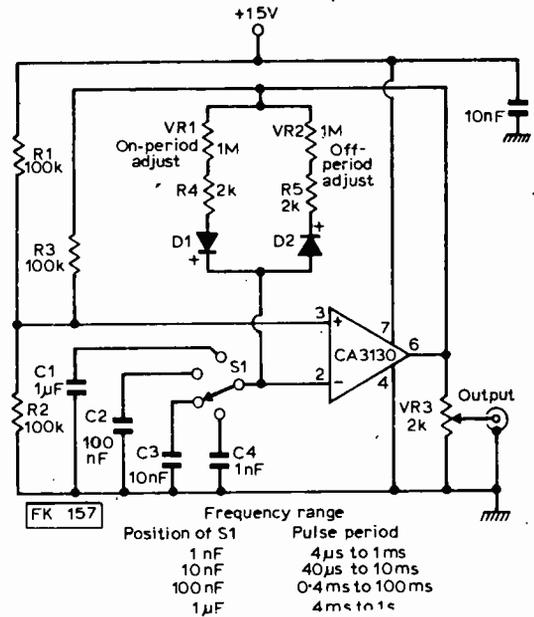


Fig. 6: In this circuit, the CA3130 is used as the heart of a square wave generator equipped with independent adjustment for both periods of the waveform.

back to its former high voltage state. The potential at pin 3 varies with the CA3130 output potential owing to the current flowing through R3.

The use of the CA3130 in this type of circuit has certain advantages. The high input impedance enables relatively high values of timing resistor (VR1 and VR2) to be used and therefore one can obtain very low frequencies with a moderate capacitor value. The timing capacitors used in this circuit should not be electrolytics as they pass an appreciable leakage current which would produce a large voltage drop across VR1 and VR2. The potentiometer VR3 is an attenuator in the output circuit. The supply voltage shown enables square waves of about 15V amplitude to be obtained, but smaller supply voltages down to about 5V may be employed for smaller output amplitudes.

## HANDLING CMOS DEVICES

Although the gate electrodes of the CA3130 are protected with internal zener diodes, it is recommended that reasonable precautions should be taken when using them. Whilst the manufacturer's recommendations are often ignored without the device being damaged, it is certainly wise to observe them. Soldering iron tips used for soldering CMOS devices should be earthed. The devices should not be soldered into the circuit whilst power is applied or even removed from a socket, since transient voltages can be developed which can cause damage. No signals should be applied to the inputs unless the power supply is connected and the input current should be limited to 1mA.

The CA3130 is available from Chromasonic Electronics, 56 Fortis Green Road, London, N10 3HN, at 84p (including VAT) plus 20p packing and postage.



## AMATEUR BANDS

by Eric Dowdeswell G4AR

**A**N oft-repeated complaint from those who would wish to listen to the bands in some sort of reasonable quiet concerns the radiation from the line timebases of colour TV sets. **Paul Turner** (Bishops Stortford) asks for advice since he now finds DX-chasing almost impossible because of the QRM from a set just across the road. All I can suggest is that the equipment is checked for complete screening, that the aerial is placed as far away as possible from the source of the QRM and that some experiments be made on the earthing of the equipment. I think that I have mentioned before that the removal of the mains earth from the equipment can often effect a cure but this can mean an electrical hazard so due care must be taken. Experimentally, a separate earth in the garden can be tried.

Strangely enough the ordinary TV viewer is completely unaware of the trouble he is causing because his own radio is off! But just try walking around the house with a portable radio and see how widespread is the QRM! Particularly near the TV set's coax! If one of us radiated a signal on another frequency at the same field strength of the average colour TV set we would soon be in trouble! Of course, in some civilised countries the set has to be screened but I wonder how long it will be before we get around to taking some practical measures to combat yet another form of pollution.

A mild reprimand from **Tom Brady** G8GAZ for saying that Alan Rae had held the callsign GM8GRO before becoming GM4ENN. G8GRO is a pal of Tom's so apologies all round. Callsigns are very personal, often conveying much more than actual forenames to the distant listener. Incidentally, the junior op at the GAZ QTH is G8HEB. Dad said it, not me!

**Pete Allen** (Taunton) decided to take my advice and put up a 132ft wire. The improvement in his log shows that it was all worthwhile. Now he has fun switching between the long wire and his G5RV. **Mike Green** A8088 (Northwich) has been reorganising his equipment to the detriment of his log. He now has a new 2m beam consisting of an 8+8 slot fed at 20ft. His log shows four stations on 2m heard via the aurora of Jan. 10th. **Martin Kessel** A9016

(Stoke-on-Trent) has now abandoned his one-valver plus five-valve superhet in favour of an AR88D. He is still wearing a groove in the carpet awaiting his RAE results and if successful will be on with a Liner 2 and a five element beam on 2m at 35ft. A Microwaves Modules converter has been added to the AR88 on the receiver side. Notwithstanding the 2m bias Martin is getting his code up to the speed required for the Morse test.

**Robin Bayley** (Kingswood School, Nr Wolverhampton) has started off his DX-ing career with an ex-RAF 1475 set and a long wire, 30ft up. A converter for 2m is under construction. Welcome OM and I am sure that you will soon get into the swing of short wave radio. Overseas now to New Zealand and **Mark Corrigan** of Wanganui whose Heathkit SW717 pulled in some good Europeans for him using either a 20m dipole or 75ft long wire. Seems this column is responsible for Mark becoming a regular correspondent with another Mark, Mark Hill, another contributor of ours. **Dennis Anderson** is now using the receiver section of a 62 set and wonders if anyone has made up a mains unit to power this rig. He'd appreciate any help at 33 Manor Crescent, Pirbright, Brookwood, Surrey. **Mike Bennett** (Slough) finds the 80m band wide open all night with the Far East and Africa coming in from dusk to midnight and the North and South Americans continuing on until mid-morning. However, he has not neglected the other bands, I'm glad to report. **Steve Cottis** A8961 (Harrogate) also found plenty on 80m including ZL3NR/C which looks like Chatham Island, a good catch for anyone. Steve likewise roamed around the other bands from 15 to 40m.

**Paul Barker** BRS34898 (Sunderland) reports some W's on 80m, frequently missing from other people's logs, perhaps because they do not realise that they are to be found only above 3.8MHz! Paul's SSTV station-of-the-month was CT1JI, commended for his excellent picture quality. **Graham Sewell** (Greenford) stuck to 20m and the VK and ZL gang as garnered on his Codar CR70A and 20ft of wire. Don't know how far he would get with a decent aerial! **Peter Walton** A9002 pulls me up for saying he has a 359x, should be 358x of course. I must have been thinking about signal reports! Peter now has a half wave aerial up aimed at South America. **Alan Doherty** (Portrush) now sports an inverted vee aerial on 80m but as he says, "it's a bit close to the dirt".

**Stephen Terry** BRS35669 (Banbury) has a Microwave Modules converter feeding into his FR50B on 2m driven by a 6 over 6 element beam at 20ft

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PW 1

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which, considering he is at 425ft asl, sounds like a good set-up! Lastly, **Ray Woodward** (Colne) is also a first-timer to the page and seems to have been doing well with his Codar CR70A and he awaits the associated ATU. He is one of the brave few that get up at 4a.m. to get in on the DX!

## Log extracts

**P. Turner:**— 10m from 2m via Oscar 7 OE3JBC DB8QP DC6HY PA0GBL I2SRR

**P. Allen:**— 80m FP8DH KP4AM VP9HM 20m CR9AJ VK4PX VK6LK

**M. Green:**— 20m KZ5AS VK1JC 2m Auroral DC9DZA GI8HY GM8FFX

**M. Kessel:**— 80m ZC4PK 40m EA8CR 20m EA9FE FY0BHI VK5MS VP2EEG YB0ACG 15m SV0WZ VK6HE YN7MHN ZS6DQ

**M. Corrigan:**— 80m OA4ASN VK0DA VRIAT ZK2AE 3D2AN 20m C21DC CX7DC KJ6BZ KS6SFA VR1Z YN1AZ WA6LRG/KB6

**M. Bennett:**— 80m A4XFW HK1CHL JY1 KZ5HP VS5DB 9M2PV 20m FB8ZG Amsterdam Is. HR6SWA Swan Is. KC4AAA VK9XI Christmas Is. VU7ANI Andaman Is. YJ8DS 15m A6XP FY0BMI YB0ACG

**S. Cottis:**— 80m CR9AK CT2BU PJ3BB VS5JH ZL3NR/C 40m EA6DA VK9AAN VP8AA 20m CX5DT TG9GI VQ9DF 15m EA8ND KZ5AL ZD7FT 9H4K

**P. Barker:**— 80m EA8JP 20m SSTV CT1JI F3RT IIRHB K1WPS OE1SBA YU2CB 20m A2CGD EA9FC C9MAF VP2LBR 9L1BH

**G. Sewell:**— 20m VK1BH VK6HS ZL1KN

**P. Walton:**— 20m KH6BB ZB2A 5L7F 8P6FX 9J2LL

**A. Doherty:**— 80m A4XFW EL7F FG7AO HI8RRD JY3ZH KZ5HP VP2LC VRIAA VR4DX VR8A ZL3NR/C 40m YN1AWS 20m PZ9AJ VP8HA 9N1MM 2m via Oscar 7 DC6PZ F1BFH I8CVS ON5PX

**S. Terry:**— 2m EI9Q HB9AEN/P HB9AKG

**R. Woodward:**— 80m CR4BS 15m AC2PV M1D 9G1LZ

All SSB except those in bold which are CW.

electric storm in close proximity the results could be rather alarming!

**Andrew Gay** of Wernham Farm, Marlborough, Wiltshire asks if anyone can oblige by letting him have their redundant copy of the Radio Nederland antenna amplifier leaflet. He has written twice with no reply forthcoming and is willing to refund any expenses incurred. Andrew is a jazz fan and has high praise for the SBC Sunday afternoon show on 11870 at 1530. It is packed with inside information for jazz enthusiasts and, comments Andrew, often has a quality that is good enough for recording.

A representative of the clan Mcleod, namely **John Mcleod** of Inverness, sends some interesting notes on the stations that he picks up that are, shall we say, not for our ears. These are the services for other target areas, that pass over the UK. John thinks that living in the highlands of Scotland he has more advantage in DXing than those of us who live rather more south. In this I rather agree with him, considering the DX that the Scandinavians pull in. It is on the cards however that other DXers will be able to tune to these stations and a selection follows:

RAI Rome, to N. America 6010 at 0100

SBC Bern, to Africa 9590 at 0530

ORF Austria, to E. Asia 15105 at 0830

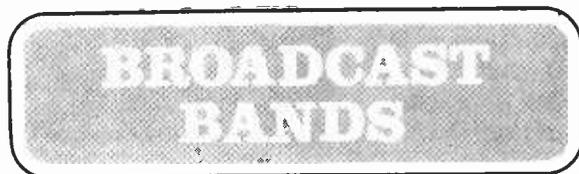
Deutsche Welle, to N. America 6010 at 0530

John goes on to tell us that ORF Austria has informed him that "in future QSL cards will only be issued by ORF if they are specifically requested". This policy statement also says that they are looking for more critical comment on their programmes than hitherto. This is a station sticking its neck out with a vengeance! While on the subject of ORF, **Richard Fuchs** of Windsor points out the difference between Radio Austria and Austrian Radio. If this is a little confusing to you, Richard says that the Radio Austria station is a commercial firm and Austrian Radio is the one often referred to as "ORF" and is the station that transmits the Austrian Short Wave Panorama DX show on 6115 and 9770 at 0915 on Sundays, from Moosbrunn.

Having sorted out your Austrian stations **Niels Montanana** recommends that the booklet issued by ORF is well worth having. To get this the DXer sends a reception report in to PO Box 700, A-1136 Vienna, Austria.

These are days of belt tightening and general pulling in of horns. Not least in the area of our hobby and one such person affected is **H. E. Forder** of Leeds. H.E.'s problem is that he would like to buy a rig that will pull in the short wave bands but not one that is expensive. Asks Mr. Forder, "are the sets under £50 as good as the advertisers claim?" This is a question that I cannot really answer but I will say that many good sets can be obtained for under £50 that are mains operated and can be improved by the addition of extra aerial wire or an aerial tuner unit in a matter of minutes, with little technical knowledge.

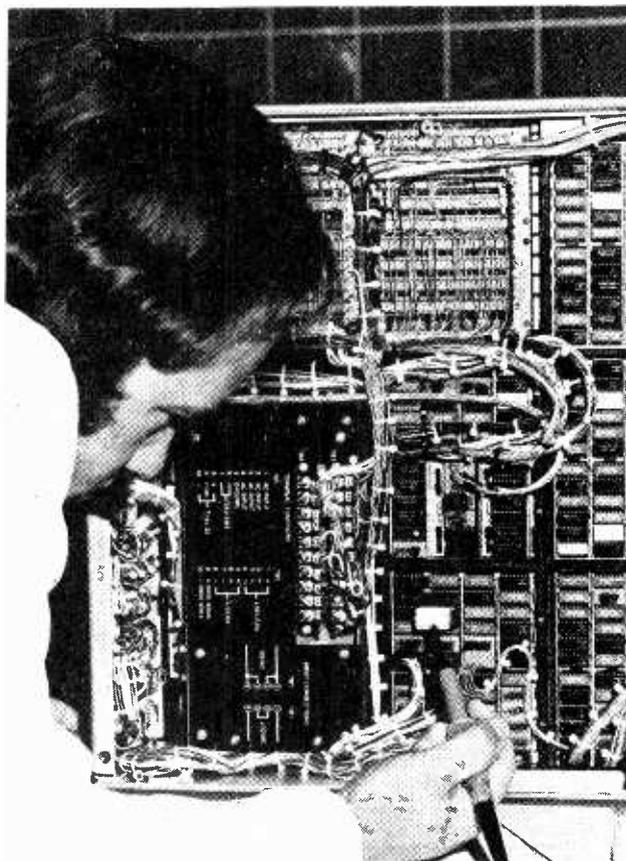
Over the water we go now for a couple of letters from readers who's DXing is a little different from ours. **Lindsey Crawford Cull** of Salisbury, Rhodesia forwards the address of the recently featured National Public Radio the Public Affairs segment of the AFRTS network. This system comprises 142 member stations and can be contacted at 2025 M. Street N.W., Washington DC, 20036 USA. **Vincent Carabott** of Malta GC whose name I have managed



## SHORT WAVE BROADCASTS

by **Derek Bell**

**S**TRANGE are the items that are used for aerials! **Neil Braeman** from Southwater sleeps on his! He has hooked his bedframe to a Pye radio of uncertain vintage by way of a thirty foot length of wire. I would imagine that in the event of an



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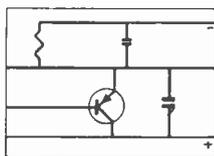
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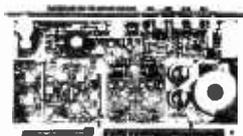
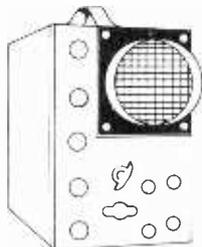
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LAGT	59	6BH6	75	6L9CG	88	12K7G	-50	35L6GT	88	DK92	1-15	ECH83	58	EY88	-80	PCF202	50	UV120A	1-17	Z99	6-85	AD140	47	BY213	-88	
1A7GT	60	6BJ6	64	6L7	-59	12K8	85	35W4	80	DK96	-70	ECH84	58	EY91	-50	PCF203	50	UV200A	1-17	UBF39	47	AD149	64	BY213	-88	
1B3GT	59	6BK7A	85	6L18	-64	12Q7GT	50	35Z3	88	DL96	-64	ECH85	58	EY91	-50	PCF206	50	TH233	1-00	UBF39	47	AD161	59	FSY11A	-89	
1H6GT	60	6BQ7A	64	6L19	-20	12R2C	50	35Z4GT	82	DM70	-80	ECH80	50	EZ40	-55	PCH200	1-00	TP2620	1-00	UV133	80	AD162	59	FSY14A	-89	
LL4	85	6BR7	1-20	6L20	88	12R8GT	-55	35Z6GT	90	DM71	1-78	ECH82	45	EZ41	-55	PCH200	1-00	UBA280	47	W107	75	AF114	33	OA9	-16	
1NG5T	76	6BR8	1-25	6N7GT	70	12R8T	-50	42	1-00	DY802	-47	ECH83	82	EZ20	-85	PCL82	45	UF4F2	-75	W729	1-17	AF115	80	OA10	-55	
1R5	50	6BR7	1-20	6Q7G	60	12R8T	-60	43	1-00	DY806	-47	ECH84	70	EZ21	-85	PCL83	45	UF4F1	-80	X66	1-46	AF117	25	OA7	-18	
184	39	6BW6	1-00	6Q7GT	60	12R8T	-76	50B5	1-00	ER00C	2-67	ECH85	70	EY67	-82	PCL84	45	UF4F1	-80	Z99	6-85	AF121	30	OA70	-90	
1U4	70	6BW7	85	6Q7(M)	-64	12R8T	-75	50C5	70	ER00F	2-20	ECH86	47	GZ32	-82	PCL85	45	UF4F1	-80	UBF39	47	AF122	82	OA73	-80	
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2D21	60	6C4	-47	68A7	-55	14H7	1-10	1-48	ER20C	70	ER91	-50	ECH88	80	GZ34	-80	PEN45	1-00	UB21	2-84	1N474	18	AF126	23	OA81	-12
2GK5	75	6CG6	-59	68C7GT	60	19A05	-85	50EH5	-85	E180F	1-17	ECH89	40	GZ37	-82	PEN45	1-00	UB22	2-84	2N404	23	AF128	62	OA85	-12	
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3D6	-47	6CB6A	-47	68J7	-64	20P1	-80	85A3	-76	E150	-40	ECH92	40	GZ37	-82	PEN45	1-00	UB22	2-84	2N404	23	AF128	62	OA85	-12	
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384	-47	6CL6	-76	6V8G	-60	20P3	-94	90CG	2-81	EAC91	-85	ECH95	40	GZ37	-82	PEN45	1-00	UB22	2-84	2N404	23	AF128	62	OA85	-12	
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6A7	60	6F14	-88	10E1	-88	30C18	-85	AC2/PEN/	EC92	-55	EM80	-52	PC90	-80	EM81	-78	PC84	-40	Y80	1-11	UY4	1-17	AC177	-88	BFY51	-25
6A5	55	6F15	-76	10F9	-78	30F5	-75	DD	1-00	EC83	-80	EM81	-78	PC84	-40	Y80	1-11	UY4	1-17	AC177	-88	BFY51	-25			
6A8H	60	6F18	-64	10F18	-60	30P1L	1-10	ACD/PEN	80	EC83	-80	EM81	-78	PC84	-40	Y80	1-11	UY4	1-17	AC177	-88	BFY51	-25			
6A7E	-78	6F23	-80	10D1L1	-88	30P1L2	1-10	AC/TH/	80	EC83	-80	EM81	-78	PC84	-40	Y80	1-11	UY4	1-17	AC177	-88	BFY51	-25			
6A85	-47	6P14	1-00	10P13	-88	30P1L3	1-10	AC/TH/	80	EC83	-80	EM81	-78	PC84	-40	Y80	1-11	UY4	1-17	AC177	-88	BFY51	-25			
6A86	-70	6P25	1-17	10P14	-84	30P1L4	-82	AL60	1-17	EC82	-39	EM87	1-10	PC189	-80	Q875/20	1-00	U403	-75	AC178	-98	BY100	23	OC204	-89	
6A8A	70	6P28	-78	12A6	-75	30L15	-82	ATP4	-50	EC83	-39	EMM803	PCF80	-47	Q875/20	1-00	U403	-75	AC178	-98	BY100	23	OC204	-89		
6A8B	82	6F32	-70	12A6	-90	30L17	-78	AZ1	-50	EC84	-40	EY51	2-50	PCF82	-50	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6A95	53	6G6G	-80	12AD6	-90	30P4MR	AZ1	-60	EC88	-47	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55		
6A96	80	6G8HA	-88	12AE8	-90	1-05	AZ1	-60	EC88	-47	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55		
6A87	1-17	6G85	-76	12AT8	-47	30P12	-80	BL03	2-84	EC88	-55	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6A7G	83	6G17	-83	12AT6	-53	30P19/	1-85	EC189	-80	EC88	-55	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6A8G	40	6H6GT	-29	12AV6	-80	30P4	-88	CY1C	1-00	EC807	1-41	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6A8V	53	6J5GT	-83	12BA6	-53	30P1L	1-00	CY31	-70	ECF80	-50	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6AW8A	90	6J6	-53	12BE6	-59	30P1L3	1-20	DAF91	-40	ECF82	-50	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6AX4	-88	6J7G	-85	12BH7	-59	30P1L4	1-29	DAF98	-60	ECF86	-88	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	
6B8G	53	6J8A	-88	12BX7	-85	30P1L5	-80	DC90	-70	ECF804	2-88	EY51	2-50	PCF84	-70	Q895/10	1-00	U403	-75	AC179	-98	BY114	23	OC205	-55	

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to decipher this time, reports that the Deutsche Welle African service is coming in very strongly in that part of the world. On his Philips 361A Vincent reports this service at 1340 on 17500 and alongside this go Radio Pakistan on 5955 at 2140 and SBC on 6309 at 2120.

One of the main snags with radios is the nagging thought that the set may not be properly calibrated and may be pulling in a frequency other than that shown on the dial. This is particularly so when one builds a set or when that faint station that has never been heard before whispers in and is just the one to fill that gap in your QSL album. Our old friend **G. E. W. Hewlett**, whom many will remember from columns past, writes of a station that is not only a calibration aid but also a test of that copper wire cobweb in the loft. While tuning around a few weeks ago George decided to try for WWV in order to check his calibration. The service in question is located at Fort Collins, Colorado USA and transmits on 2.5, 5, 10, 15, 20 and 25MHz. The distinctive signal is a time signal and a male voice announcement every minute. Much to George's surprise he also heard a female voice which is the other time and frequency checking station WWVH at Kauai, Hawaii. WWVH transmits on the same frequencies but is most unlikely to be heard here very frequently.

George goes on to tell us that Radio Australia has opened a 250kW transmitter at Carnarvon to cover the gap in its Asian service. The test transmissions are, at the moment, as follows:

9540 Indonesian 0800 to 1030

9560 Mandarin 1030 to 1300

9560 Cantonese 1300 to 1430

The 9560 channel is best heard around 1300 but in summer, when the short route gets better and an extra transmitter has been put into service, these signals should be worth listening for.

For those who like the African stations **John Dipre** using a VEF204 comes up with a few goodies:

4850 Radio Mauritania at 2038

4904 Radio Chad at 2035

4915 Radio Ghana at 2300

4940 Abidjan at 2250

5047 Radio Togo at 2257

To these we can add the loggings of **Charles Wippeny** who reports ETLF Ethiopia at 2020 on 11755 to give you a good handful of the infrequently reported services. Charles also asks if anyone knows what has happened to the Voice of Turkey English service on 9515 at 2200, which seems to have been dropped in favour of a Turkish language service.

Finally, we welcome two newcomers, **Julian Blake** of London and, lo and behold, our first lady correspondent **Diane Kinnear** from Cullicudden, Rosshire. Both ask the same question. "Please recommend a book to start us off and fill the gaps." The one I would plump for is "A Guide to Amateur Radio" by Pat Hawker G3VA from the Radio Society of Great Britain, 35 Doughty St., London WC1, price £1.14 inc. Don't be put off by the title, however, since our SWL DXing owes a lot to the licensed

amateur. As well as explaining many of the terms that they use, the book explains many of the matters that the two branches of our hobby have in common. This winds up the session for this month so I will say 73s to you and yours.

## MEDIUM WAVE DX

by **CHARLES MOLLOY**

**STEVE WHITT** (G8KDL) reports from London NW4 with a good bag of North American medium wave DX. With his Chapman S6BS communications receiver, MW loop and FET pre-amplifier he logged WINS in New York City on 1010kHz at 0130 which he describes as "a phenomenal signal, I actually considered ringing into their phone-in programme". Other North Americans logged by Steve include CJOX Grand Bank in Newfoundland on 610kHz; WOR in New York City on 710kHz; WABC in NYC on 770kHz; CHNS in Halifax, Nova Scotia on 960kHz; KDKA in Pittsburg on 1020kHz and WNEW in NYC on 1130kHz.

North American medium wave stations are allocated identifying call letters which are used frequently by announcers, which makes identification easy for the DXer. These stations can be logged in the UK throughout the year whenever the path across the North Atlantic is in darkness. Even in midsummer, reception is possible for about an hour before sunrise. During March and April start listening around 0130GMT. Reception can be very good at this time of year since interference from Europe is much less than during the earlier winter months owing to the approach of daybreak from the east.

An interesting letter comes from New Zealand reader **Ash Nallawalla** of Dunedin. Ash is president of the Otago branch of the New Zealand Radio DX League and is a keen medium wave DXer. With his Sanyo receiver, 40in delta shaped loop and an FET booster he logged Malta on 1570kHz and Munich, West Germany on 1602kHz. Reception in New Zealand of European broadcasts at the HF end of the medium waves has been reported before. In 1971, the well known New Zealand DXer Arthur Cushen in a letter to the writer, mentioned his reception of Langenburg on 1586kHz and Munich on 1602kHz at 2000GMT. The path at that time of day would be on the western route across South America, propagation being by five-hop F layer rather than by the E layer, which is responsible for most of the DX heard on the medium waves. New Zealand and Australia are not heard on the medium waves in the UK probably because there are so few high power transmitters in these countries and the high level of interference at our end of the path. Reception of 4QD, the 50kW outlet at Emerald in Queensland has been reported on more than one occasion from Finland on 1550kHz, a frequency that is almost buried in QRM in this country during the evening.

Tuning-in a signal on a radio receiver is usually quite a straightforward business. The tuning control is adjusted to give maximum reading on the S meter, or if there isn't a tuning indicator, then the control is "rocked" until the receiver is spot-on the carrier frequency. This procedure works well in the absence of interference when adequate bandwidth is avail-

able (selectivity control at "wide") to include both sidebands of the transmitted signal. When trying to pick-out a weak DX signal in a crowded MW band, high selectivity is desirable to try to reduce adjacent channel interference. High selectivity leads to sideband cutting and loss of HF response at audio frequencies. Speech becomes muffled and difficult to follow. Intelligibility can be improved if the receiver is detuned slightly. Its IF passband now covers all one sideband instead of part of both, speech clipping is reduced while selectivity is maintained and cleaner and easier to understand speech will be the result. If the interference is coming from only one side of the DX then detune away from it. The strength of the unwanted transmission will be reduced while the level of the DX will be unchanged.

The second session of the International Telecommunications Union Conference on the future of medium and longwave broadcasting in Regions 1 and 3, which includes Europe, was held in Geneva last autumn. As expected, the 9kHz channel spacing in Europe is to continue though many channels on the medium waves will have their frequency increased by 1kHz so that they are multiples of 9kHz. Heterodyne interference will be reduced if each channel is harmonically related to the channel spacing. The UK is allowed two additional transmitters on the longwaves, both of which will be located in Scotland. One will be on 200kHz (1500m), the existing longwave channel and the other will be on 227kHz (1321m). They will come into use after the start of the new plan in November 1978.

The retention of the 9kHz spacing will continue to favour the DXer who is interested in reception of Region 2 (North and South America) where the spacing is 10kHz but the 1kHz change in Europe will bring its problems. Reception of KOMO in Seattle and WCFL in Chicago both on 1000kHz will become more difficult as the nearest European will now be on 999kHz. Whether there will be any compensating gains, remains to be seen.

Latin American medium wave stations, especially those situated along the east coast of South America, come in well in the UK. The long sea path across the North and South Atlantic favours propagation from Argentina and Brazil enabling some of the higher powered broadcasters in Buenos Aires and Rio de Janeiro to be heard at surprising strength at times. **D. R. Mayhew** (Littlehampton) has been chasing DX from this area between the hours of midnight and 0300 using a Philips receiver and a 20in loop with RF amplifier. He says "the Brazilians are very exciting and well worth waiting for" and he mentions hearing two broadcasts from Buenos Aires; Radio Belgrano on 950kHz and Radio el Mundo on 1070kHz and no fewer than five from Rio de Janeiro; Radio Mundial on 860kHz, Radio Jornal do Brazil on 940kHz, Radio Nacional on 980kHz, Radio Globo on 1180kHz and Radio Eldorado on 1220kHz plus Radio Record in Sao Paul on 1000kHz.

Portuguese is spoken in Brazil, a language that sounds a bit different from Spanish which is used in Argentina and the remainder of Latin America. The majority of Brazilian stations are commercial, owned often by newspapers. Musical programmes include the rhythms of the samba and bossa nova which beat out from trumpets, guitars and marimbas to entertain the distant DXer!

#### **D. F. RECEIVER**—continued from page 1064

circuits. Band coverage is determined by the settings of TC1, TC2, TC3, TC4 and the position of the oscillator coil core.

Aerial alignment is determined by TC5, VC3 and the positions of L1 and L2 on the rod. Correct alignment of the aerial tuning is shown by maximum meter reading. If VC3 enables a signal to be peaked up, and is not fully open or fully closed, alignment may be regarded as correct at that frequency. However, the settings of TC5, L1 and L2 must be approximately correct or the trimming compensation afforded by VC3 may be insufficient at some frequencies.

**Band 1.** With each band the low frequency end is reached with VC1/2 closed and the high frequency end with VC1/2 open. For this band, TC4 sets the HF limit and TC2 the LF limit. TC5 is set so that VC3 can be peaked as described and may need re-adjustment after dealing with Band 2.

**Band 2.** TC3 sets the HF band limit. With a signal tuned in near the HF end of the band, adjust VC3 for best volume or meter reading. Tune in a signal near the LF band end and move L1 on the rod for best signal level, leaving VC3 untouched. Check that VC3 can peak signals throughout the band.

**Band 3.** Oscillator coverage is independently adjusted by TC1 and L2 which is adjusted at the LF end of the band. A 60pF trimmer may be wired from pin 2 to pin 3, for LW trimming, but is not essential.

On all bands a small adjustment to the oscillator coil core setting will cause a substantial shift in frequency. So if this is made on any one band, the other two bands have to be checked again, as described. The actual coverage which is obtained can be modified quite substantially. It is not necessary that any particular bands are obtained by these adjustments, as other settings will result in no loss of efficiency, provided VC3 allows signals to be peaked up. The ranges actually provided were: Band 1: 1300-1500kHz; Band 2: 600-1300kHz; Band 3: 160-250kHz.

### **In use**

To locate the position of the receiver, bearings have to be taken from at least two transmitters whose positions are known. If these are plotted on a map or chart, the receiver will lie roughly at the intersection of the lines. A third bearing can be expected to give more accuracy and should confirm the first result. To locate the position of a transmitter, directional bearings on its signal have to be taken from two known positions. When these are plotted, their intersection shows the transmitter location.

Low frequency and ground wave signals will generally give quite accurate bearings. Ground wave signals are those which have not been reflected by ionised layers above the earth. Their useful range depends on power, frequency and other factors and may extend to fifty miles or more. Sky-waves, on the other hand, are those reflected down and they provide greatly increased range, especially for higher frequency signals after dark but they may give confused bearings. In coastal areas wavefront bending may cause a deviation of 10-15° while nearby metal objects or structures may also modify the apparent direction of a signal. For ordinary reception purposes, it is only necessary to rotate the aerial for best reception, or minimum interference.

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B	4MM	4V 250 MA	E	4MM	6V 200 MA
		5V 60 MA			6-3 200 MA
		12V 40 MA			14V 40 MA
		12V 100 MA			2-7V 60 MA
		14V 75 MA			12V 160 MA
		25V 40 MA			14V 80 MA
C	5MM	28V 40 MA			

Small telephone jack type 6 or 24V Price: Types A-F £4.00 for 25, 50 and upwards 13p each Type G 45p each. p. & p. 20p per order.

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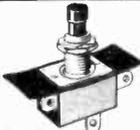
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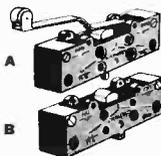
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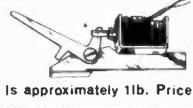
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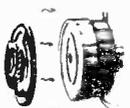


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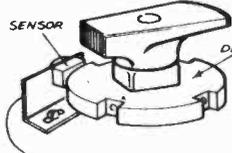
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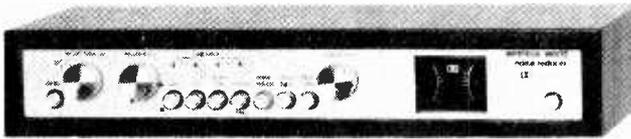
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- no equipment needed for alignment
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- check tape switch for encoded monitoring in three-head machines

The kit includes:

- complete set of components for stereo processor
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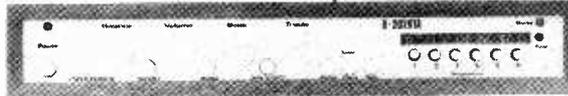
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400	30	40	50	68	80	96
600	36	65	70	1-09	1-10	1-26

### TRIACS (PLASTIC TO-220 PKGE, ISOLATED TAB)

	4A (a)	6A (b)	6A (a)	8A (b)	10A (a)	15A (b)
100 V	0-60	0-60	0-70	0-70	0-78	0-83
200 V	0-64	0-64	0-75	0-75	0-87	0-87
400 V	0-77	0-78	0-90	0-93	0-97	0-113
600 V	0-96	0-99	0-87	0-91	1-21	1-26

N.B. Triacs without internal trigger diac are priced under column (a). Triacs with internal trigger diac are priced under column (b). When ordering please indicate clearly the type required.

### 74 TTL mixed prices

	1-24	25-99	100+	1-24	25-99	100+	1-24	25-99	100+
7400	14p	12p	10p	7445	85p	71p	57p	7492	57p
7401	14p	12p	10p	7447	81p	75p	85p	7493	45p
7402	14p	12p	10p	7448	75p	62p	50p	7495	87p
7403	15p	12p	10p	7447A	95p	83p	67p	74100	£1.95
7404	16p	13p	11p	7470	30p	25p	20p	74107	35p
7408	16p	13p	11p	7472	25p	21p	17p	74121	34p
7409	16p	13p	11p	7473	30p	25p	20p	74122	47p
7410	16p	13p	11p	7474	32p	26p	21p	74141	78p
7413	29p	24p	20p	7475	47p	39p	31p	74145	60p
7417	27p	22p	20p	7476	32p	26p	21p	74154	£1.82
7420	16p	13p	11p	7482	75p	62p	50p	74174	£1.06
7427	27p	22p	18p	7485	£1.30	£1.09	87p	74180	£1.08
7430	16p	13p	11p	7486	32p	26p	21p	74181	£3.26
7432	27p	22p	18p	7489	£2.92	£2.80	£2.10	74192	£1.35
7437	27p	22p	18p	7490	40p	32p	26p	74193	£1.35
7441	75p	62p	50p	7491	65p	55p	45p	74196	£1.64
7442	65p	55p	45p						

### LINEAR IC'S

301A	8 pin DIL	35*	3900	14 pin DIL	70*	565	14 pin DIL	£2.00*
307		55*	709	8/14 pin DIL	35*	566	8 pin DIL	£1.50*
309K		1.00	741	8/14 pin DIL	28*	567	8 pin DIL	£2.00*
380	14 pin DIL	90*	748	8 pin DIL	30*	568	14 pin DIL	50*
381	14 pin DIL	1.00*	555	8 pin DIL	45	CA3064	14 pin DIL	50*

Matching charge 20p per pair. P & P 20p—Overseas 80p. SEND SAE FOR COMPLETE LIST.

## HIGHAM MEAD, CHESHAM, BUCKS. Tel. (02405) 75154

VAT—Please add 8% except items marked \* which are 25%

## MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied.

Model 1153 500mW power output £1.10 + 40p post & VAT.

Model 1172 1W. power output £1.35 + 45p post & VAT.

Model EP9001 4 watt power output £2.40 + 50p post & VAT.

EP 9001 twin channel or stereo pre amp. £2.50 + 50p post & VAT.



## LIGHT SWITCH



Automatically switches on lights at dusk and off at dawn. Can also be used where light and dark is a convenient way to stop and start an operation. Requires only a pair of wires to the normal switch. In bakelite box, normal switch-plate size. 1 amp model £2.75. VAT and Postage 50p.

## MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B worklog). Takes the place of any of the following batteries: KP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1.50 VAT & Postage 60p.

## SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w). Unit in Box all ready to work. £7.95 plus 80p VAT and postage.



## MAINS MOTOR

Precision made—as used in record decks and tapes recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at 95p + VAT & Postage 35p.

1" stackmotor £1.50 + VAT & postage 35p. 1 1/2" stackmotor £2 + VAT & Postage 40p.



## 6 DIGIT COUNTER

Made by famous American Company, operated by 24V D.C. or mains through resistor, 19/16" x 1 1/2" x 2 1/2" deep. 80p Post & VAT 20p each.



## MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 30p + 15p post & VAT each.



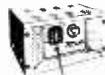
## MULTI-SPEED MOTOR

Six speeds are available 600, 850 and 1,100 r.p.m. and 8,000, 12,000 and 15,500 r.p.m. Shaft is 3/8 in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. x 5 in. long. Price £1.40 + 45p post & VAT.



## BATTERY CHARGER

Famous Atlas in metal case with meter, output leads terminated by crocodile clips. For 6 or 12V charging simply by changing plug and lead size approx. 2 in. dia. x 5 in. long. Price £2.95 plus £1 Post & VAT.



## AMMETERS

Ideal for chargers etc. 2" sq. full vision 0-8 amp 85p, 1 1/4" round 0-2 amp 85p, 0-3 amp 65p, 0-4 amp 75p. Post & VAT 25p each.



## RELAY BARGAIN

Type 600 relay, 2 changeover one open and one closed contact. Twin 500 ohm coils make this suitable or closing off DC 6v, DC 12v, DC 24v or AC mains using resistor and rectifier. 40p each. Resistor or rectifier 20p extra. Post & VAT 20p.

## ONLY £1-50 FOR SEVEN ELECTRIC MOTORS

7 powerful batt. motors as used in racing cars & power models. Output & types vary for use in hundreds of different projects — Toys, models, etc. All brand new reversible & for 1 1/2-12v. batts. Wiring diagram. Inc. VAT & Post 40p. FREE plan for min. power station.



## AUDIO AMPLIFIER

Part of the famous Reditone background music system, secondhand, but believed in good order. However, no guarantee; we are selling for spare value only. These are 6 valve amplifiers, the output valves are 2 x EL 84 in push/pull, complete with mains transformer, rectifier and ample smoothing equipment. The mains transformer alone, today would cost at least £4. Size is 9 1/2" x 11" x 4 1/2". Only £2.00 + postage and VAT £1.50.



## TWIN OUTPUT POWER PACKS

These have two separately R.C. smooth outputs so can operate two battery radios on a stereo amp without cross modulation (they will of course operate one radio-tape-cassette-calculator in fact any battery appliance and will save their cost in a few months). Specs.: Full wave rectification, double insulated mains transformer—total enclosed in hard P.V.C. case—three core mains lead—terminal output. When ordering please state output voltage 4 1/2v, 6v, 7 1/2v, 9v, 12v or 24v. Price £3.95, post and VAT included.

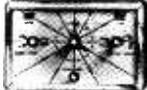
## TANGENTIAL HEATER UNIT

This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. £5.82 plus VAT & post £1, 2kW Model as above except 2kW £4.25 plus VAT & post 75p. Don't miss this. Control Switch 44p. P. & P. 40p.



## ISA ELECTRICAL PROGRAMMER

Learn in your sleep! Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2.95, VAT & Postage 80p, or with glass front, chrome bezel. £1.50 extra.



## THIS MONTH'S SNIP

YOUR TIME is the most precious thing you have. Do you waste it waiting for the soldering iron to heat up? You can be soldering in a few seconds with the E.T.P. Soldering Gun which we offer at a specially keen price. It is in fact this month's snip. A well used lightweight unit with flash lamp to illuminate the work. Has 100 watt double insulated mains Transformer and is built into a shockproof Thermo-plastic case. Suitable for 240 volt, 50c.p.a. This comes complete with 5 spare tips and is offered at a special snip price £2.75 plus 85p Post & VAT.



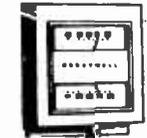
## CENTRIFUGAL FAN

Main operated, turbo blower type. Pressed steel housing contains motor and impeller. Motor is 1/10th h.p. giving considerable air flow but virtually no noise. Dimensions 10 1/2" x 4 1/2" £9.60 plus Post & VAT.



## THERMOSTAT WITH THERMOMETER

Made by Honeywell for normal air temperatures 40-80 F (5-25 C). This is a precision instrument with a differential which can be adjusted to better than 1-5 F. A mercury switch breaks on temp. rise. Elegantly styled and encased in an ivory plastic case with clear plastic windows, thermometer above and switch setting scale below—size approx. 3-8" x 3-2" x 1-4" deep—can be mounted on conduit box or directly on wall. Price £2.25 plus 50p Post & VAT.



## SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands—Kit contains chassis front panel and all the parts, £1.50—crystal ear-phone 55p, VAT & Postage 75p.



## SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in x 18in £1.99. Post & VAT 80p. 13in x 10in £1.50. Post & VAT 65p.

## SMITHS CENTRAL HEATING CONTROLLER

Push button gives 10 variations as follows:—(1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for 2 periods during the day (6) hot water and central heating on for 2 periods during the day time only—then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired programme of heating. Supplied complete with wiring diagram. Originally sold, we believe, at over £15—we offer these, while stocks last, at £6.95 each, VAT & Postage 65p each.



TERMS: Where order is under £5 please add 30p surcharge to offset packing expenses. Send SAE for monthly list.

**J. BULL (ELECTRICAL) LTD.**  
(Dept. PW), 103 TAMWORTH RD.  
GROYDON GRO IXX

THIS MONTH'S SPECIAL OFFER is a very versatile transformer which can be used for a very wide range of purposes. Rated at 250 watts it is very well built with frames for upright mounting and is varnish impregnated. Its primary is for 230/240 volts 50 cycles, it has four secondaries each 10v very high current windings. Just a few of the circuits it can power are: 10-0-10v at up to 12 amps; 20-0-20v at up to 6 amps; single 10v at 25 amps; single 20v at 12amps; single 30v at 9 amps; single 40v at 6.5 amps. The transformer can be used for power circuits (charging, etc.) or for amplifiers, there being an earth screen between primary and secondaries. A transformer like this to-day would cost at least £15 from the makers; however, we are making a special offer at £3.50 + 28p, post £1 + 8p each. (Grab some while you have them!) Apart from the fact that it is illegal for you not to provide adequate protection for any staff or persons working for or with you, your own personal comfort will be greater when you work isolated from the mains. Also, you are not likely to damage equipment if you soldering iron becomes earthy, as often happens. Isolation transformers are normally very costly, in fact we see that the average wholesaler is charging £15 plus for a 250w model. We can offer 250 watts of isolation at only £7 + 56p. Carriage £2 + 16p. Telephone handsets, ex GPO, but in good order, all you need to make an earth connection between the kitchen and your cellar, attic or shed down the bottom of the garden is a battery, a length of wire and two of these handsets. Price 60p + 40, post 25p + 2p. Twin wire £4 + 32p per 100 metres, post 60p + 5p.

8pin motor with Garter gear box, probably one of the best split motor made. Originally intended to be used in very high priced cookers; however, this can be put to plenty of other uses, for instance your garden barbecue or to drive a colour disc for a dance or display or to drive a tumbler for stone polishing; in fact there are many uses for its normal mains operation. Special price during January and February £2.50 + 20p, post 30p + 2p. Multiple contact panel, size approx. 4 1/2" x 2 1/2", this has 200 contacts each cross referenced above and below alphabetically and numerically so each can be easily identified. Contacts are capable of making positive connection with a strip of wire as each contact is spring loaded and has a gold 'pip'. Ideal if you want to make yourself a computer or for circuit bread-boarding (resistors, keep straight in) or for working out printed circuits, even for teaching electronics and novices such as amateur radio clubs, etc. Taken from unused computer panels, price only £2 + 16p each which works out to only 1p per contact, probably less than the value of the gold pip. Post 15p + 1p.

Gold plated strips for permanent contacts into slot of above panels, 15 for £1 + 8p.

Variable 1 rev per hour motor with spindle threaded and nutted ready to easily attach discs or drums. Bakelite encased motor beautifully made and finished. £2 + 16p, post 20p + 2p. Very many uses for this, for instance a disc or drum attached could operate microswitches for display or mood lighting, etc.

Digital Display Unit. 'Digitvisor'. This is a precision instrument which consists basically of 12v lamp focused by a lens system through a numbered scale, the number appears on a ground glass front screen. The number is selected by applying a different voltage to the coil which rotates the scale e.g. 1 volt applied shows figure 1 on scale—by using shunts or multipliers however any voltage or current could be made to indicate any number, or if a photo cell is located behind the screen then an alarm could be triggered. Similarly this could be used for voltage or current regulation. Overall size of the unit is 2 1/2" x 1 1/2" x 4 1/2". Price £4.50 + 36p.

Pulse transformer with circuit for sound to light unit. It is a very simple circuit and all parts are readily obtainable from us or you may already have them in your junk box. Price of the transformer with circuit 75p, post and VAT paid.

ORP 12 light cell. This device has been going for some years now but it has not been bettered and new applications keep being found for it. We have good stocks, price 65p + 5p.

Throat mikes. These are an ex WD item as used by air crew on their intercom, but being electromagnetic they also serve as pick-ups on musical instruments, talking to passengers on motor bike and no doubt many other uses. Price 60p a pair + 15p.

One chip radio. Ferranti ZN 414 IC radio is still in stock, current price £1.40 + 38p. We can also still supply the HI Q kits to go with them, most popular one kit No. 4, comprising a permanently tuned for medium wave, an earth resistor and condenser which when added to the ZN 414 complete the radio for medium wave band. Price of this HQ kit No. 4 is 68p + 17p, post 20p + 5p.

12 watt speaker bargain. 8" round mid-range, made for high priced hi-fi outfit, a really super speaker. £3 + 75p, post 60p + 15p.

Microswitch, Honeywell ref. no. YZ RW 84-N88. This has fairly long lever and is changeover 15 amp 250v rating. Price 30p + 21p each.

Two circuit microswitch, famous American Lincoln motor's ref. 16-4041, size approx. 1" long 1 1/2" wide x 1/2" thick. Two electrically separate circuits, one makes, the other breaks, when nylon push rod is depressed. Circuit rating we estimate at 5 amps 260v. A real bargain at 15p each + 1p—subject to normal quantity discounts.

Reed relay in solenoid. Resistance 1.5K, this will operate from voltages of 10v upwards on a current of 12mA upwards. The flow of the control current closes the reed switch but if you bias this with a small magnet or an opposing current, then the flow of the control current could be made to open the reed switch. Price 75p + 6p.

**A.S.P. LTD**  
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# TRANSFORMERS VAT 8%

## CASED TRANSFORMERS

Housed in smart resin coated steel cases with 3 core power cable and outlet socket, fused primary winding. Isolation types are fitted with 3-pin outlet sockets and are available with 110 volt or 240 volt output (please state). Auto types are fitted with 2-pin flat style sockets up to 500VA. 3-pin sockets from 750 to 3000VA. See Auto Isolation Sections for prices. Plugs extra.



**SAFETY ISOLATING** See catalogue for full range. Prim. 120/240V. Sec. 120/240V. Centre Tap with screen.

VA (Watts)	REF NO.	PRICE Cased	PLUGS 2 Pin + Earth	PRICE OPEN	PRICE POST
50	149	8.00	0.98	4.70	0.72
200	151	12.29	0.98	8.61	0.97
250	152	13.81	0.98	10.81	1.18

## AUTO TRANSFORMERS

See catalogue for full range.

VA (Watts)	REF NO.	PRICE Cased	PLUGS 2 & 3 pin	PRICE OPEN	PRICE POST
1600	93	23.28	0.85	19.22	O/A

## MINIATURE & EQUIPMENT

Primary 240V with screen. See catalogue for full range.

VOLTS	Sec. 1	Sec. 2	MILLIAMPS	REF. NO.	PRICE	POST
3-0-3	0-8	200	238	1.56	0.34	
0-6	0-6	500	234	1.56	0.34	
0-6	0-6	1000	212	2.12	0.46	
0-9-9	0-9	100	13	1.80	0.34	
0-9	0-9	330	235	1.82	0.34	

## 12 & 24 VOLTS

Primary 200-240 Volts. See catalogue for full range.

AMPS	12V	24V	REF. NO.	PRICE	POST
2	1	71	2.47	0.61	
4	2	18	3.07	0.62	
6	3	70	4.50	0.72	
8	4	108	6.11	0.85	

## 30 VOLTS

Primary 200/240V Secondary 12, 15, 20, 24, 30V

AMPS	REF. NO.	PRICE	POST
0.5	112	2.04	0.61
1	79	2.57	0.66
2	3	3.81	0.72
3	20	4.80	0.85
4	21	5.58	0.86
5	51	6.75	0.95
6	117	7.52	0.97
8	8	9.93	1.18
10	89	10.27	1.18

## 50 VOLTS

Primary 200/240V Secondary 19, 25, 33, 40, 50V

AMPS	REF. NO.	PRICE	POST
0.5	102	2.71	0.61
1	103	3.58	0.76
2	104	5.30	0.85
3	105	6.10	0.85
4	106	6.97	1.08
6	107	12.93	1.18
8	118	13.76	1.44
10	119	17.79	1.86

## 60 VOLTS

Primary 200/240V Secondary 24, 30, 48, 60V

AMPS	REF. NO.	PRICE	POST
0.5	124	2.51	0.72
1	126	3.75	0.72
2	127	6.38	0.85
3	125	7.91	0.97
4	123	9.20	1.18
5	40	10.22	1.18
6	120	12.10	1.36
8	121	15.74	O/A
10	122	20.10	O/A
12	189	18.87	O/A

## BRIDGE RECTIFIERS

One Amp	Price	Four amp	Price
50P.I.V.	0.25	100P.I.V.	0.55
100P.I.V.	0.25	200P.I.V.	0.59
200P.I.V.	0.28	400P.I.V.	0.75
600P.I.V.	0.30	600P.I.V.	0.85

Two Amp	Price	Six Amp	Price
50P.I.V.	0.35	50P.I.V.	0.65
100P.I.V.	0.40	100P.I.V.	0.70
200P.I.V.	0.45	200P.I.V.	0.80
400P.I.V.	0.50	400P.I.V.	0.90

**SPECIAL OFFER**  
**2 KVA ISOLATORS**  
 Fully impregnated & screened  
 2 Primary windings 110V each  
 2 Secondary windings 115V each (2 matching transformers) £29.50 plus carriage VAT 8%.

## NEW! 2" and 4" PANEL METERS VAT 8%

Size: 60mm wide x 45mm high x 40mm deep.	I.R.	Size: 110mm wide x 82mm high x 43mm deep	I.R.
Movement	Ohms	Movement	Ohms
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
0-300 Volt	300K	0-300 Volt	300K
"8" meter	170	"8" meter	200
Vu meter	9250	Vu meter	9250

**FOR MULTI-METERS, INSTRUMENTS, RESISTORS, NEONS, TOOLS, POWER SUPPLIES, etc. Send for Catalogue.**

Vu meters are complete with detectors. Modern wide view. Price 2" £3.20 Post 10p. Price 4" £4.00 Post 10p. VAT 25%. Lamps 95p per set. Plus 8% VAT.

**NEW CATALOGUE 25p**

**NEW CATALOGUE 25p**

**orchard electronics**

TRANSISTORS	RESISTORS	INTEGRATED CIRCUITS	SAE for full list of components "same day despatch to mail order customers" *Minimum order £1 p & p 25p". Callers Mon. - Sat. Incl.
AC125 20 A8Y26 30 BC132* 11 BC178B 18 BC291A 16 BC559* 9	50V 3A 15p 100V 3A 15p 200V 3A 18p	7400 18p 7401 20p 7402 18p 7403 18p 7404 23p	
AC126 20 A8Y27 34 BC136* 16 BC179B 19 BC292A 15 BC570 15	1/2 watt E12 1/4-10mΩ	TTL DIGITAL	
AC127 20 A8Y28 30 BC137* 16 BC182L* 11 BC295A 14 BC571 18			
AC128 20 A8Y29 34 BC138 15 BC183L* 10 BC298B 13 BD115 60			
AC132 35 A8Y67 70 BC139 35 BC183L* 10 BC299 13 BD121 90			
AC141 20 BA145* 15 BC142 22 BC184B* 12 BC297 20 BD123 90			
AC142 17 BA154 10 BC143 24 BC184L* 11 BC300 27 BD124 68			
AC154 24 BA165 12 BC147* 9 BC186 25 BC301 28 BD131 38			
AC155 27 BA112 10 BC147B* 10 BC187 28 BC302 24 BD132 38			
AC176 20 BA118 4 BC148* 9 BC201A* 16 BC303 30 BD135* 65			
AC188 20 BA116 6 BC148B* 10 BC205A* 15 BC304 27 BD135* 37			
AD181 42 BC107 11 BC149B* 11 BC206A* 15 BC307A* 16 BD136* 39			
AD182 42 BC107A 12 BC149* 11 BC207* 11 BC308* 14 BD137* 44			
AF114 24 BC108 10 BC153* 18 BC208A* 11 BC309B* 18 BD138* 47			
AF115 24 BC108B 11 BC154* 18 BC209B* 13 BC317A 12 BD139* 54			
AF116 24 BC109 11 BC157B* 12 BC212* 13 BC319B* 12 BD155* 75			
AF117 24 BC109B 12 BC158A* 12 BC212L* 15 BC322B* 15 BD165* 34			
AF118 47 BC109C 13 BC159A* 12 BC213B* 12 BC327* 20 BD292* 70			
AF124 30 BC115 15 BC176* 11 BC213L* 14 BC328* 18 BD320 80			
AF125 30 BC116* 15 BC180B* 14 BC214* 15 BC327* 18 BD315 22			
AF126 28 BC117* 18 BC171A* 14 BC214L* 17 BC338* 16 BF154* 20			
AF139 34 BC118* 10 BC172A* 15 BC237A* 16 BC461 36 BF168* 20			
AF186 50 BC119 28 BC173B* 18 BC238A* 15 BC557* 9 BF139* 28			
AF239 37 BC125* 14 BC177 17 BC239B* 15 BC558* 9 BF160* 27			

**INTEGRATED CIRCUITS**  
 ZENERS (4000m) 52X83/BCY88 3V3, 3V9, 5V9, 4V3, 4V7, 5V1, 5V6, 6V2, 6V5, 7V5, 8V2, 9V1, 10V, 12V, 15V, 15V, 18V, 30V, All at 12p each

**VOLTAGE REGULATORS**  
 5V 1A 175p 12V 1A 175p 15V 1A 175p

**LED**  
 125R Red 20p 125A Amber 27p 125Y Yellow 27p TTL209 Red 25p

VAT—Items marked \* add 25%. Rest at 8%  
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- ★ SYNTHESISER KIT
- ★ ELECTRONIC PIANO KIT

★ Portable Organ kit with 4-Octave keyboard 2 pitches, external tuning, 10 Voices Vibrato. Plywood cabinet and cover finished in black rexine. Price £99.00. ★ Portable Organ kit with 4-Octave keyboard, 3 pitches, external tuning, 10 Voices Vibrato. Plywood cabinet and cover finished in black rexine. Price £145.29. ★ Portable Piano kit with touch-sensitive 5-Octave keyboard. Plywood cabinet and cover finished in black rexine. Price £145.00. ★ Console Organ kit with 5-Octave keyboard 3 pitches, external tuning, 10 Voices, Sustain, Delay Vibrato, Piano Marimba and Wah Wah effects. Console finished in walnut. Price £250.93. ★ Console Organ kit with 2 x 4-Octave keyboards and 13 note pedal board, 4 pitches external tuning, 15 Voices on upper keyboard, 5 pitches and 10 Voices on lower keyboard. 2 Voices on pedal, Sustain Reverberation Delay Vibrato, Snare Drum and Cymbal on Pedal, Piano Marimba and Wah Wah effects, 4 Drum Unit buttons. Console finished in Teak or Walnut. Price £470.65. ★ Console Organ kit with 2 x 5-Octave keyboards and 32 note R.C.O. Pedal Board. 6 pitches all effects and finish as above. Price £680.00. ★ Console Organ kit with 3 x 5-Octave keyboards and 32 note polyphonic R.C.O. Pedal Board, 9 pitches, magnificent range of voices. Price £960.00.

★ Components: 4-Octave keyboard C-C £15.50, 5-Octave keyboard C-C and F-F £20.00. Top octave tone generator, complete with external tuning capacitor, GU500, £12.95. Top octave tone generator and divider unit complete with external tuning capacitor, GD500 £50.00. Construction Manual for Portable Organ, using discrete components £2.25. Catalogue 60p.

**ELVINS ELECTRONIC MUSICAL INSTRUMENTS**  
 Organ Centre: 12, Brett Rd., Hackney, London E8 1JP. 01-986 8455  
 Component Shops: 8, Putney Bridge Rd., London SW18 1HU. 01-870 4949. 40/42a, Dalston Lane, Hackney, London E8 2AZ. 01-249 5624.  
 All prices are exclusive of VAT.

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Complete with three  
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INCLUDING CHANNEL OUTPUT PLUGS AND MAINS INPUT SOCKET.

Connects to your loudspeaker or loud speaker socket.  
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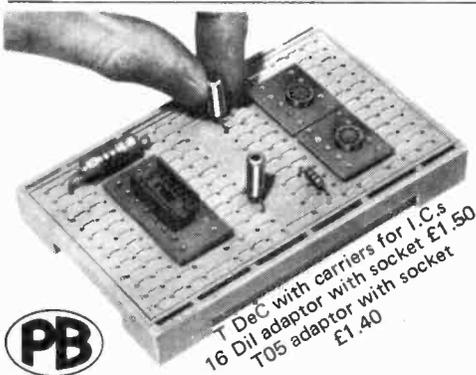
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# RTVC

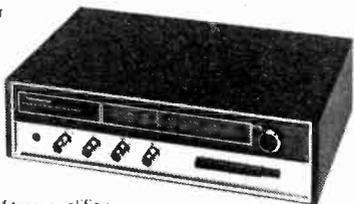
# FOR SPEAKERS AT FANTASTIC REDUCTIONS

## ELIZABETHAN STEREO TUNER AMPLIFIER

This compact Tuner Amplifier gives you full medium wave and V.H.F. coverage and FM stereo. With inputs for your turntable and tape recorder. It has rotary tuning, Volume, Balance, Bass and Treble controls and push button selection switches for Phono/tape FM Stereo, FM mono, Medium wave and A.F.C. has built-in stereo beacon and switched headphone socket.

**Technical Specifications**  
15 transistors, 11 diodes, integrated circuit.

Power output 8 watts. Size of tuner amplifier: 4" x 10" x 15½" approx. Finished in selected rosewood veneer with brushed aluminium front panel and matching controls **£29.00** + p & p £1.50



## THE 'COMPACT'

**NEW!**

### EASY BUILD SPEAKER KIT

A compact bookshelf speaker system giving a high electro acoustic efficiency for the low powered amplifier. The professional finish can be obtained with the minimum of tools, the infinite baffle type enclosures come ready mitred and professionally finished, simply apply glue, fold up around baffle board, and fix together with masking tape till glue dries.

The cabinet measures 12"x9"x5" deep approx finished in simulated teak, incorporating a quality 7"x4" elliptical speaker, power handling 4 watts, flux density 30,000 maxwells, impedance 8-15 ohms nominal, voice coil dia 2½" magnet size 2½" approx.



**£6.00** pair inclusive. P & P £1.70

## SPECIAL OFFER

As above but with a BSR C123 Turntable in matching teak veneered plinth and a pair of 'Compact' easy to build speakers (see opp. panel) **£39.00** + p & p £3.00

## BSR DECKS WITH PLINTHS AT FANTASTIC REDUCTIONS



**MP 60 Type (illustrated) £16.00**  
Less Cartridge p & p £1.50

**C141 (not illustrated) £12.00**  
Auto. with Cue Fitted Stereo Cartridge p & p £1.50

**C123 (not illustrated) £10.00**  
Auto. with Stereo Crystal Cartridge p & p £1.50

All plinths finished in matching Teak veneer.

## EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" x 8" woofer, 3½" tweeter and matching crossover.

Easily put together with just a few basic tools.

**Specification (each speaker):** Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20-20,000 Hz. Size 20" x 11" x 9½" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

**£22.00 pair complete** + £5.20 p & p.

Complete with crossover Components and circuit diagram



Personal Shoppers only at Edgware Road

## SPEAKERS

15" 25 watts **£19.00**

12" 20 watts **£14.00**



## EMI 350 KIT

**£7.25** + £1.20 p & p.

Complete with crossover Components and circuit diagram

System consists of a 13" x 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

## System 1A £69.00 VISCOUNT IV STEREO SYSTEM

The new 20+20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodised fascia to harmonise with any decor. Polished trim and knobs.

The VISCOUNT IV has a comprehensive range of controls - volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter.

Front panel socket for stereo headphones. And a host of sockets at the rear - for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.

**SPECIFICATION:** 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion @ 10 watts better than 0.2%. Six switched inputs: 1. Magnetic P.U. - 3 millivolts @ 47 K ohms (R.I.A.A.); 2. Crystal/ceramic P.U. - 50 millivolts @ 50 K ohms (R.I.A.A.); 3, 4, 6. Tape Tuner/Aux - 140 millivolts @ 50 K ohms (flat frequency response); 5. Microphone - 3 millivolts @ 50 K ohms (flat frequency response).

**CONTROLS:** Push button ON/OFF, stereo/mono, scratch filter, 6 position rotary selector, Individual rotary controls for treble, bass, balance and volume. Headphone socket, tape out socket, Aux mains output. Frequency response: 25 Hz to 25 KHz @ full rate output. Signal to noise ratio: better than -50 dB on all inputs. Tone control range: Bass ±15 dB @ 50 Hz, Treble ±12 dB @ 10 KHz. Power requirements: 200-250V A.C. mains @ 60 watts. Approx. size: 15½" x 3" x 10". MP60 type deck with magnetic cartridge, de luxe plinth and cover.

Two Duo Type 11a matched speakers - enclosure size approx. 19½" x 10½" x 7½" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. 30 watts peak.

Complete System with these speakers **£69.00** + £6.50 p & p.

## System 2. £85.00

Viscount IV amplifier (As System 1a) MP60 type deck (As System 1a)

Two Duo Type III matched speakers - Enclosure size approx. 27" x 13" x 11½". Finished in teak simulate. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS, 8 ohms frequency range - 20 Hz to 18,000 Hz.

Complete System with these speakers **£85.00** + £7.60 p & p.

**PRICES: SYSTEM 1a**  
Viscount IV R103 amplifier £27.50 + £1.90 p & p  
2 Duo Type 11a speakers £30.00 + £6.50 p & p  
MP60 type deck with Mag. cartridge de luxe plinth and cover £22.00 + £3.30 p & p  
Total if purchased separately £79.50  
Available complete for only **£69.00** + £6.50 p & p.

**PRICES: SYSTEM 2**  
Viscount IV R103 amplifier £27.50 + £1.90 p & p  
2 Duo Type III speakers £46.00 + £7.50 p & p  
MP60 type deck with Mag. cartridge de luxe plinth and cover £22.00 + £3.30 p & p  
Total if purchased separately £95.50  
Available complete for only **£85.00** + £7.60 p & p



**20x20 SYSTEM**

Scotland and the Orkneys P & P Surcharge System 1a £1.75 System 2 £3.50

## PUSH BUTTON CAR RADIO KIT- THE TOURIST TT\*



**NO SOLDERING REQUIRED**

**NOW BUILD YOUR OWN  
PUSH BUTTON CAR RADIO** **£9.50**  
+£1.05 p & p.  
Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.

**TECHNICAL SPECIFICATION:** (1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) Integrated circuit output stage, pre-built three stage IF Module. Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide 2" high and 4½" deep approx.

Speaker including baffle and fixing strip £2.00 +45p p & p. Car Aerial Recommended - fully retractable £1.60+40p p & p.

The Tourist I Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £8.20+£1.05 p & p.**

## SPECIAL OFFER

The Tourist I Kit, same specification as Tourist TT complete with speakers, fixing kit and fully retractable aerial **£10.50** + p & p  
£1.50

## \*STEREO 21 QUALITY SOUND FOR LESS THAN £24.00



Stereo 21, easy to assemble audio system kit. No soldering required.

The unit is finished in teak veneer 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.

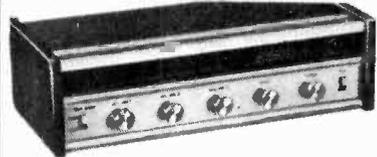
Specifications—For the technically minded: Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8-15 ohms. Stereo headphone socket with automatic speaker cutoff. Provision for auxiliary inputs—radio, tape, etc., and outputs for taping discs.

Overall Dimensions. Speakers approx 12" x 9" x 5". Complete deck and cover in closed position approx. 15½" x 12" x 6".

**Complete only £23.20** +£3.00 p & p.

Extras if required. Optional Diamond Stylus £1.60. Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance £5.80.

## \*DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output, 20 watts RMS into 8 ohms (suitable for 15 ohms).

Inputs \*4 electrically mixed inputs. \*3 individual mixing controls. \*Separate bass and treble controls common to all 4 inputs. \*Mixer employing F.E.T. (Field Effect Transistors). \*Solid State circuitry. \*Attractive styling.

INPUT SENSITIVITIES - Input - 1). Crystal mic. guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) - Inputs - 2), 3), 4). Medium output equipment - ceramic cartridge, tuner, tape recorder, organs, etc. - all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12½" x 6" x 3½".

**£20.00** +£1.35 p & p.

## 8 TRACK HOME CARTRIDGE PLAYER



Yours for only

**£14.00** +£1.70 p & p

Elegant self selector push button player for use with your stereo system. Compatible with Viscount IV system. Unisound module and the Stereo 21 Technical specification Mains input, 240V. Output sensitivity 125mV

## SPECIAL OFFER

As above but complete with build yourself Unisound Amplifier Kit (see opposite panel) + 2 'Compact' easy to build speaker kits (see opposite page) **£25.00**  
+ p & p £2.00

## BUILD YOUR OWN STEREO AMPLIFIER\*

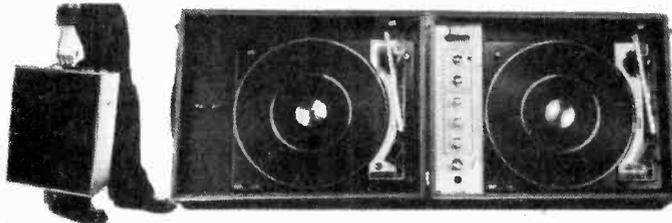


For the man who wants to design his own stereo - here's your chance to start, with Unisound - pre-amp, power amplifier and control panel. No soldering - just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic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

Also available with 2 speakers (7"x4") £10 + £1.75 p & p. **£8.95** + £1.05 p & p.  
Also available with the 'Compact' (see opposite page) easy build speaker kit £13.50 - £2 p & p

INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.

## PORTABLE DISCO CONSOLE\*



### TECHNICAL SPECIFICATION:

Pre-amp - Output - 200mV.  
Auxiliary inputs - 200mV and 750mV into 1 meg. Mic input - 6mV into 100K. 240 volt operation.  
Turntables capacity - 7", 10" or 12" records. Rumble, wow and flutter Rumble Better than -35dB. Wow Better than 0.2%. Flutter Better than 0.08% (Gaumont keele meter).  
Finish - Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

### Console size -

Unit Closed - 17½" x 13½" x 8½" (app.)  
Unit Open - 35½" x 13½" x 4½" (app.)  
This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.  
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only

**£49.00** +£6.50 p & p.

All prices include VAT at current rates



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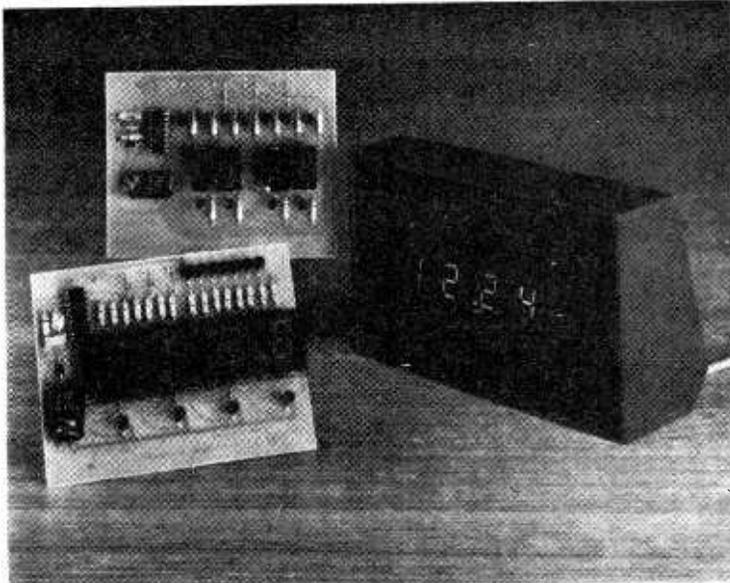
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# Greenbank Electronics Established 1970



The illustration shows the two P.C.B. module kits already assembled, one has 8mm high digits, the other has 16mm high digits. Also shown is an example of a completed clock. Free on request: Data on AY-5-1224 and MK50253 clock chips, 4 and 6 digit alarm clock suggested circuits, quartz crystal timebase, and L.E.D. displays, (if you can send an S.A.E., it makes things a little easier for us).

### CLOCK CHIPS

AY-5-1224A 4 digit basic clock £3.50 MK 50253 4/6 digit alarm/snooze £5.50

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DL-707E/DL-704E 8mm (0.3") 70p. DL-727E/DL-728E 12mm (0.5") Double Digit £1.80. DL-747E/DL-750E 16mm (0.6") £1.50.

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4001/14001	0.15	4024/14024	0.60	4044/14044	0.75	4067/	—	4097/	—	2.95	14516/4516	1.10	14549/	—	2.95				
4002/14002	0.15	4025/14025	0.15	4045/	—	1.15	4068/14068	0.15	4099/	—	1.50	14517/	—	5.40	14552/	—	8.05		
4006/14006	0.95	4026/	—	1.40	4046/14046	1.10	4069/14069	0.15				14518/4518	1.00	14553/	—	3.50			
4007/14007	0.15	4027/14027	0.45	4047/	—	0.70	4070/14070	0.15				14520/4520	1.00	14554/	—	1.20			
4008/14008	0.75	4028/14028	0.70	4048/	—	0.45	4071/14071	0.15				14522/	—	2.00	14555/4555	0.70	0.70		
4009/14009	N/S	4029/	—	0.90	4049/14049	0.45	4072/14072	0.15	4700/	—	1.50	14521/	—	1.50	14556/4556	0.70	0.70		
4010/14010	N/S	4030/14030	0.45	4050/14050	0.45	4073/14073	0.15	7083/	—	4.25	14524/	—	N/S	14557/	—	3.20	0.90		
4011/14011	0.15	4031/	—	1.80	4051/14051	0.75	4075/14075	0.15				14526/	—	1.50	14558/	—	0.90		
4012/14012	0.15	4032/14032	0.85	4052/14052	0.75	4076/14076	1.25				14527/4527	1.20	14559/	—	2.95	0.45	0.45		
4013/14013	0.45	4033/	—	1.10	4053/14053	0.75	4077/14077	0.15				14528/4098	0.85	14560/	—	1.55	0.45		
4014/14014	0.80	4034/14034	—	1.55	4054/	—	0.95	4078/14078	0.15	14501/	—	0.15	14529/	—	1.30	14561/	—	0.45	
4015/14015	0.80	4035/14035	0.95	4055/	—	1.05	4081/14081	0.15	14502/4502	1.00	14530/	—	1.00	14531/	—	0.65	14562/	—	5.25
4016/14016	0.45	4036/	—	1.80	4056/	—	1.05	4082/14082	0.15	14505/	—	3.30	14532/	—	1.25	14566/	—	1.20	
4017/14017	0.80	4037/	—	0.75	4057/	—	20.35	4085/	—	14506/	—	0.35	14532/4532	1.60	14572/	—	0.35	0.35	
4018/	—	0.80	4038/14038	0.85	4059/	—	10.60	4086/	—	0.55	14508/4508	2.35	14534/	—	6.00	14580/40108	6.00	6.00	
4019/14519	0.45	4039/	—	2.85	4060/	—	0.90	4089/	—	0.65	14510/4510	1.10	14536/	—	2.85	14581/40181	3.05	3.05	
4020/14020	0.90	4040/14040	0.85	4061/	—	16.40	4093/14093	0.65	14511/4511	1.25	14537/	—	15.25	14582/40182	1.15	1.15	1.15	1.15	
4021/14021	0.80	4041/	—	0.65	4062/	—	N/S	4094/	—	1.50	14512/	—	1.05	14539/	—	0.08	14583/	—	0.71
4022/14022	0.75	4042/14042	0.65	4063/	—	0.90	4095/	—	0.85	14514/4514	2.55	14541/	—	1.80	14585/	—	1.45	1.45	1.45

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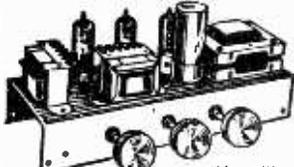
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A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz  $\pm$  3db. 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, ejection panel, input and output plugs. Overall size 3" high  $\times$  6" wide  $\times$  7 1/2" deep. AC 200/240V. PRICE  $\pounds$ 15.00. P. & P. 85p.

## DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. U.S. & Canada heavy duty fully insulated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2  $\times$  ECL86 Triode Pentodes, 1  $\times$  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 8 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  $\times$  4 1/2" h. Overall height including valves 5". Ready built & tested to a high standard.  $\pounds$ 25.00. P. & P. 95p.

**ALL-PURPOSE POWER SUPPLY UNIT 200/240V.** A.C. Input. Four switched fully smoothed D.C. outputs giving 6v. and 7.5v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6"  $\times$  3 1/2"  $\times$  2 1/2". Ready built and tested. PRICE  $\pounds$ 6.35 P. & P. 85p.

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A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide  $\times$  3in. deep  $\times$  6in. high overall. A.C. mains 200/240V. Supplied absolutely Brand New completely wired and tested with good quality output transformer. PRICE  $\pounds$ 5.00 P. & P. 85p BARGAIN PRICE

**BRAND NEW MULTI-RATIO MAINS TRANSFORMERS** Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 20-5-10-15-20-20-35-40-60V. half wave at 1 amp, or 10-0-10, 20-0-20, 30-0-30 cut. at 2 amps full wave. Size 3in. long  $\times$  3 1/2in. wide  $\times$  3in. deep. Price  $\pounds$ 2.75 P. & P. 75p.

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### GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300V. Frequency response 10Hz-25KHz. Gain 26dB. Solid encapsulation size 1 1/2"  $\times$  1 1/2"  $\times$  1 1/2". Brand new complete with instructions. Price  $\pounds$ 1.50. P. & P. 15p.

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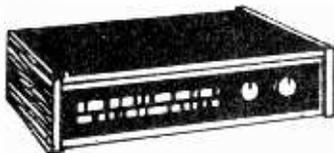


**QUALITY RECORD PLAYER AMPLIFIER MK. II** A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 8 ohm speaker. Size 7in. deep  $\times$  6in. high. Ready built and tested. PRICE  $\pounds$ 6.50. P. & P. 90p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE  $\pounds$ 7.75. P. & P.  $\pounds$ 1.

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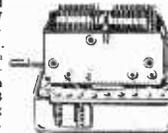
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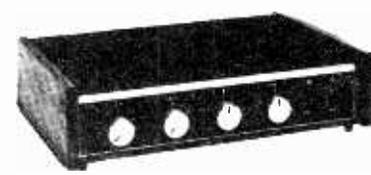
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A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smut brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 8 ohms. Frequency response  $\pm$ 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M $\Omega$ . Full power bandwidth:  $\pm$ 3dB 12-15,000 Hz. Bass boost approx. to  $\pm$ 12dB. Treble cut approx. to -16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12" w.  $\times$  8" d.  $\times$  2 1/2" h.

Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

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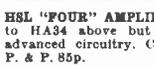
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Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discotekques use, etc.



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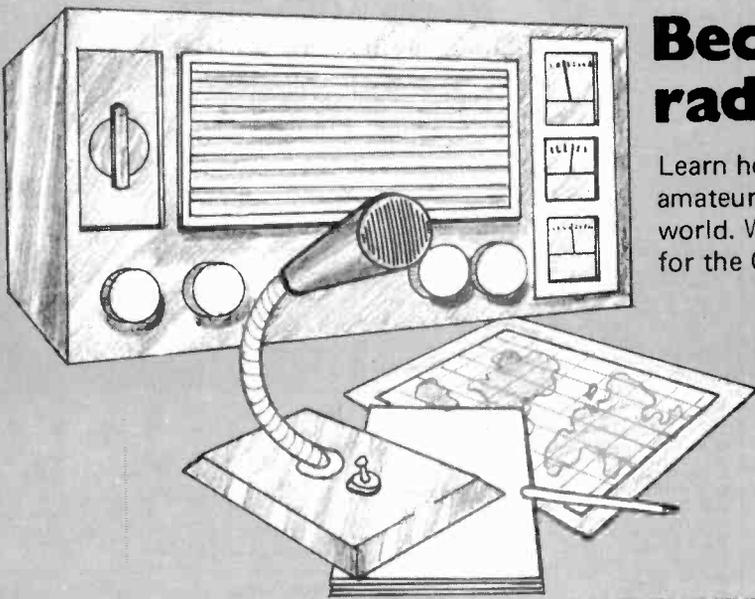


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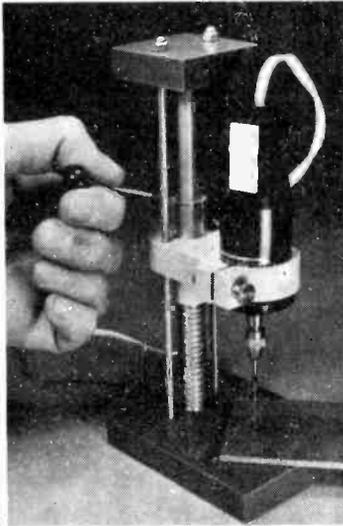
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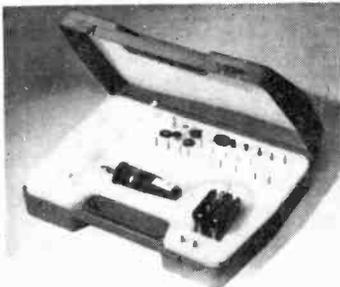
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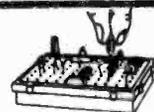
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7417	32p	74145	75p
7420	15p	74150	135p
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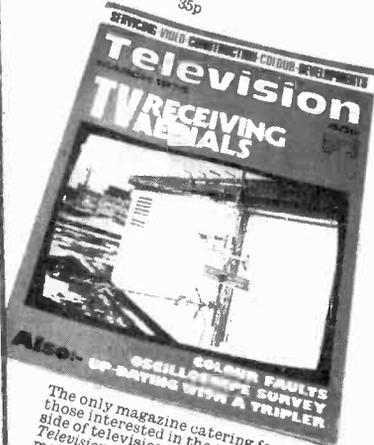
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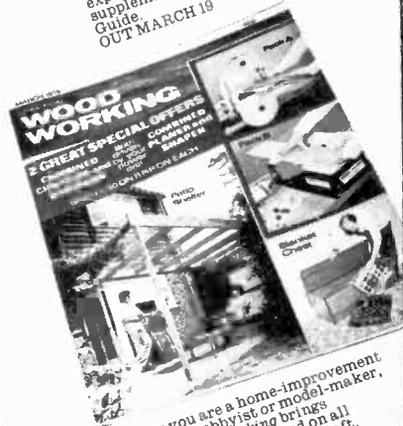
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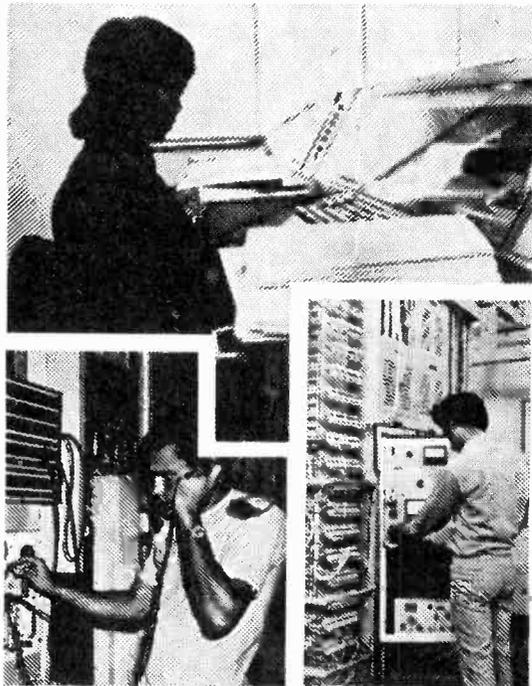
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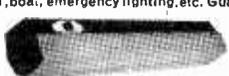
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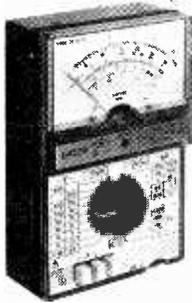
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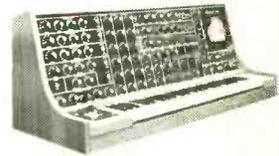
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