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practical
WIRELESS

APRIL 1979
VOLUME 55
NUMBER 4
ISSUE 866

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

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FOR OUR CONSTRUCTORS

GENERAL INTEREST

Our May issue will be published on 6 April
(for details see page 33)

B. BAMBER ELECTRONICS

Dept. P.W.5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 860185 (2 lines) Tuesday to Saturday

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

OSMOR 10V REED RELAY COILS 1k ohm coil) to fit ½" reeds (not supplied) 2 for **50p.**
HF CHOKES wound on ¼" × 1" long ferrites. 4 for **50p.**
VHF CHOKES wound on 6-hole tubular ferrites. 5 for **40p.**
DUAL TO18 HEATSINKS 1" × ½" × ½" with screw-in clamps. 3 for **50p.**

MAINS TESTER SCREWDRIVERS 100 to 500V. Standard size **50p.** Large **70p.**
RADIO PLIERS 6½" £1·80. 6¾" £2·00.
SMALL SIDE CUTTERS (with wire holding device) £4.50

HIGH QUALITY RELAYS, 4 pole C/O. 3A contacts. 12V DC coil, 150 ohm. Size approx. 1" × ¾" × 1½", with plastic covers. **80p** each or 2 for **£1·50.**

LARGE ELECTROLYTIC PACKS. Contain range of large electrolytic capacitors, low and high voltage types, over 40 pieces. **£3·00** per pack (+ 12½% VAT).

Slider Switches. 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for **50p.**

DUE TO A CHANGE OF SUPPLIER, OUR STOCK ALUMINIUM BOXES AND VINYL COVERED EQUIPMENT CASES WILL BE AS FOLLOWS

Aluminium boxes with lids

AL1	3" × 2" × 1"	**60p**
AL2	4" × 3" × 1½"	**70p**
AL3	4" × 3" × 2"	**80p**
AL4	6" × 4" × 2"	**90p**
AL5	6" × 4" × 3"	**£1·25**
AL6	8" × 6" × 2"	**£1·50**
AL7	8" × 6" × 3"	**£1·75**

Vinyl Equipment Cases
Blue Vinyl covered steel tops with plain aluminium lower sections.

BC0	5" × 2½" × 2½"	**£1·00**
BC1	6" × 4½" × 2"	**£2·00**
BC2	6" × 4" × 3½"	**£2·25**
BC3	8" × 5½" × 2"	**£2·50**
BC4	10" × 6½" × 3"	**£3·00**
BC7	12" × 6½" × 5"	**£3·25**

MAINS TRANSFORMERS. Type 15/300 240V input. 15V at 300mA output. **£1·50** each.
MAINS TRANSFORMERS. Type 45/100. 240. 220, 110, 0V input. 45V output. **£1·50** each.

CELESTION 8" × 5" ELIPTICAL SPEAKERS, 20 ohm, 3 watts rated, **£1·50** each + 12½% VAT.

IC AUDIO AMP PCB. Output 2 watts into 3 ohm speaker, 12V DC supply, size approx. 5½" × 1½" × 1" high, with integral heatsink, complete with circuits, **£2·00** each.

NICAD CONVERTER PCB. (Low power inverter). Size approx. 4" × 1¾" × 1" high, 12V DC supply, 60V DC output, through pot on pcb, for charging Nicads, etc. (ideal for charging portable batteries from mobile supply). Only needs one BFY50/51/52 or similar transistor, which can be mounted direct on the pcb pins on board, fitted with a star-type heatsink (Not Supplied). **£2·00** each.

THE NEW EAGLE INTERNATIONAL CATALOGUE IS AVAILABLE ON REQUEST containing Audio, In-car, and test equipment, etc.

DECIMAL KEYBOARDS, pressure sensitive type, when pressed contacts go from O/C to approx. 25 ohms. Switches only, no encoders. Size approx. 3" × 3", with large square touch plates. 0–9 + Clear, A, B, Dual Watch, and spare. Few only, **£2·00** while stocks last.

TYPE 8079 FULL RANGE SPEAKER, 10" dia, 15 ohm, **£5·00** each (or 2 for £9·00) + 12½% VAT.

SEMICONDUCTORS
BSX20 (VHF Osc/Mult), 3 for **50p.**
BC108 (metal can), 4 for **50p.**
PBC108 (plastic BC108), 5 for **50p.**
BFY51 Transistors, 4 for **60p.**
BCY72 Transistors, 4 for **50p.**
PNP audio type TO5 Transistors, 12 for **25p.**
BF152 (UHF amp/mixer), 3 for **50p.**
2N3819 Fet., 3 for **60p.**
BC148 NPN SILICON, 4 for **50p.**
BC158 PNP SILICON, 4 for **50p.**
BAY 31 Signal Diodes, 10 for **35p.**
IN 4148 (IN914) 10 for **25p.**
BC107 (Metal can) 4 for **50p.**
SCRs 400V at 3A, stud type, 2 for **£1·00.**
Tip2955 Silicon PNP power transistor, 60V at 15A, 90 Watts, Flat pack type, 2 for **£1·50.**
GERMANIUM DIODES approx 30 for **30p.**
741 CG op amps by RCA 4 for **£1.**
RED LEDs (min. type) 5 for **70p.**
TO3 transistor insulator sets 10 for **50p.**

SPECIAL OFFER FOR COMPUTER BUILDERS, ETC
19 way ribbon cable, decimal coded, 4 metres for 1.25.
13 way heavy duty ribbon cable, decimal coded, (ideal for PSU runs) 3 metres for £1.50.

CLAREED REED RELAYS, complete with reeds. TYPE 1, Size approx. 2½" × ¾" × ½" 1 pole make, 9V 400 ohm coil, **35p** each. TYPE 2, Size approx. 2½ × 1½ × ½". 2 pole make + 2 pole break, 2 × 9V 200 ohm coils, **60p** each.

VIDICON SCAN COILS (Transistor type, but no data) complete with vidicon base **£6·50** each. Brand New.

IC TEST CLIPS, clip over IC while still soldered to pcb or in socket, Gold-plated pins, ideal for experimenters or service engineers. 28 pin DIL **£1·75,** 40 pin DIL £2·00. Or save by buying one of each for **£3·50.**

GLASS BEAD FEEDTHROUGH INSULATORS. Solder-in type, overall dia. approx 5mm. Pack of approx. 50 for **50p.**

PLASTIC PROJECT BOXES with screw on lids (in black ABS) with brass inserts.
Type NB1 approx. 3¼" × 2¼" × 1¾" **45p each**
Type NB2 approx. 4" × 3" × 1¾" **55p each**
Type NB3 approx. 4¾" × 3¾" × 1¾" **65p each**
Type NB4 approx. 8¼" × 5¼" × 3¼" **£1·50.**

DIE/CAST ALUMINIUM BOXES
Send for Latest Price List.

PLUGS AND SOCKETS
BNC Plugs, new **50p** each.
N/Type Plugs 50 ohm, **60p** each, 3 for **£1·50.**
PL259 Plugs (PTFE) brand new, packed with reducers, **75p** each.
SO239 Sockets (PTFE), brand new (4-hole fixing type). **60p** each.

SOLDER SUCKERS (Plunger type). Standard Model, **£5·50.** Skirted Model, **£6.** Spare Nozzles **60p** each.

NEW MARKSMAN RANGE OF SOLDERING IRONS.
S140D 40W 240V **£4·50.**
S125DK 25W 240V + bits etc., **KIT £5·50.**
BENCH STAND with spring and sponge for Marksman Irons **£2·70.**

Spare bits MT9 (for 15W) **60p,** MT5 (for 25W) **50p,** MT10 (for 40W) **55p.**
ALL PRICES + 8% VAT.

TCP2 TEMPERATURE CONTROLLED IRON.
Temperature controlled iron and PSU. **£30** + VAT (£2·40).
SPARE TIPS
Type CC single flat. Type K double flat fine tip, Type P, very fine tip **£1·50** each + VAT (8p).
MOST SPARES AVAILABLE.

WELLER SOLDERING IRONS
EXPERT. Built-in-spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering tip.
EXPERT SOLDER GUN S100D £12·00.
EXPERT SOLDER GUN KIT (spare bits, case, etc.) **£15·00.** Spare bits **40p** pair.

MIXED COMPONENT PACKS, containing resistors, capacitors, pots, etc. All new. Hundreds of items. **£2** per pack, while stocks last.

BSR AUTOCHARGE RECORD PLAYER DECKS with cue device, 33-45-78 RPM, for 7", 10", 12" records. Fitted with SC12M Stereo Ceramic cartridge and styli. Brand new **£14·00** + 12½% VAT.
GARRARD AUTOCHANGE RECORD PLAYER DECKS, Model 6-300, with cue device, 33-45-78 r.p.m., for 7", 10", 12" records. Fitted with KS41B Stereo Ceramic cartridge and styli Brand new **£16·00** + 12½% VAT. Please note, record decks sent by Roadline, allow 14 days for delivery.

FULL RANGE OF BERNARDS/BABANI ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST.

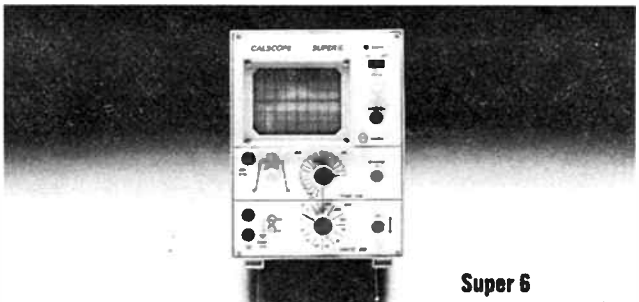
VARICAP TUNERS Mullard type ELC1043/05. Brand New. **£5·00** + 12½% VAT.

BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS. Up to 50V working. Seatronic Manufacture. Approx 100. **£1·50** per pack + 12½% VAT.

Dubiller Electrolytics, 50 F, 450V, 2 for **50p.**
Dubiller Electrolytics, 100μF, 275V, 2 for **50p.**
Plessey Electrolytics, 470 F, 63V, 3 for **50p.**
TCC Electrolytics, 1000 F, 30V, 3 for **60p.**
Dubiller Electrolytics, 5000 F, 35 V, **50p** each.
Dubiller Electrolytics, 5000 F, 50V, **60p** each.
ITT Electrolytics, 6800 F, 25V, high grade screw terminals, with mounting clips, **50p** each.
PLEASE ADD 12½% VAT TO ALL CAPACITORS.

Terms of Business: CASH WITH ORDER, MIMIMUM ORDER £2. *ALL PRICES INCLUDE POST & PACKING, (UK ONLY). SAE with ALL ENQUIRIES*
Please: **PLEASE ADD VAT AS SHOWN.** *ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS WELCOME BY APPOINTMENT ONLY.*

The professional scopes you've always needed.



Super 6
£162.00 plus VAT

Super 10
£219.00 plus VAT

When it comes to oscilloscopes, you'll have to go a long way to equal the reliability and performance of Calscope.

Calscope set new standards in their products, as you'll discover when you compare specification and price against the competition.

The Calscope Super 10, dual trace 10 MHz has probably the highest standard anywhere for a low cost general purpose oscilloscope. A 3% accuracy is obtained by the use of stabilised power supplies which cope with mains fluctuations.

The price £219 plus VAT.

The Super 6 is a portable 6MHz single beam model with easy to use controls and has a time base range of 1μs to 100ms/cm with 10mV sensitivity. Price £162 plus VAT.

Prices correct at time of going to press

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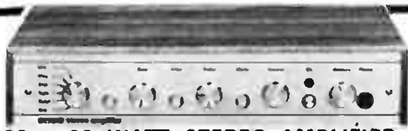


20 x 20 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet. Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic, magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features two mains outlets DIN speaker and input sockets plus fuse 20x20 watts RMS 40x40 watts peak. For use with 8 to 15 ohm speakers.

£29.90 £2.50 p&p

SPECIAL OFFER
FOR PERSONAL SHOPPERS ONLY
FREE 4 dimensional stereo sound adaptor, when purchasing the 20x20 Viscount amplifier

30x30 WATT AMPLIFIER IN KIT FORM

For the experienced constructor complete in every detail, same facilities as Viscount IV, but with 30x30 output 60x60 watts peak. For use with 4-15 ohms speakers.

£29.00 + p&p £2.50

SPECIAL OFFER
30x30 WATT AMPLIFIER IN KIT WITH SPEAKERS

2 Goodman compact 12" bass woofers with cropped size 14,000 Gauss magnet 30 watt RMS handling + 3¼" approx tweeters and crossovers

£49.00 + p&p £4.00

BUILT AND READY TO PLAY

30x30 Viscount. Available fully built and tested

39.00 + p&p £2.50

Mullard

AUDIO MODULES IN BARGAIN PACKS

CURRENT CATALOGUE PRICE £ AT OVER 25 PER PACK

ACCESSORIES ARE ONLY AVAILABLE TO THOSE CUSTOMERS WHEN BUYING OUR BARGAIN PACKS.

SEE OUR PRICES

1 PACK 1. 2 x LP1173 10w RMS output power audio amp modules, + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input.
OUR PRICE p+p £1.00 **£4.95**

2 PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2 Stereo pre amp for magnetic, ceramic and auxiliary inputs
illus. OUR PRICE p+p £1.00 **£7.45**

ACCESSORIES

Suitable power supply parts including mains transformer, rectifier, smoothing capacitors £1.00 p+p **£1.95**

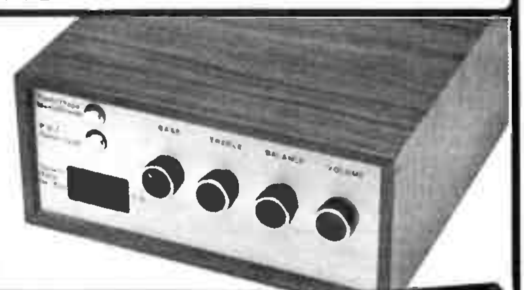
Recommended set of rotary stereo controls comprising BASS, TREBLE, VOLUME and BALANCE p+p 50p **95p**

EMI SPEAKER BARGAIN

Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround, 2½" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS 20 watts max. 8 ohm impedance.

£14.95 Per stereo pair + £3.40 p&p

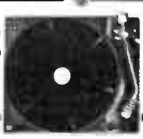
10 + 10 AMPLIFIER KIT



An opportunity to buy a 10 watts per channel stereo amplifier kit which is suitable for use with a ceramic cartridge. The amplifier utilises proven Mullard modules and is available at a very competitive price. The amplifier kit comes complete with instructions and includes: a Mullard LP1183 stereo preamplifier module, two LP1173 power amplifiers with integral heatsinks, a power supply, Zobel networks, front and back mounting panels, a finished fascia panel, all control potentiometers (bass, treble, volume and balance), switches, input, output and headphone sockets, wire, and an easily assembled wrap around cabinet to house the finished unit.

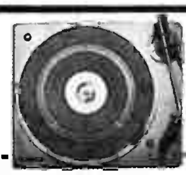
p&p £2.05 **£11.95**

BSR P200



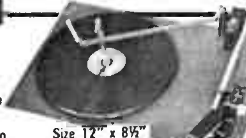
Belt drive chassis turntable unit semi automatic, cueing device. **£24.95** p&p £2.55

A.D.C. QLM 30 Mk III Magnetic Cartridge to suit. **£7.75**



BSR Manual single play record deck with auto return and cueing lever, lined with stereo ceramic cartridge 2 speeds with 45 r.p.m. spindle adaptor ideally suited from home or disco use OUR PRICE **£10.95** p&p £2.55

GARRARD DECK MODEL CC 10A



Record changer with cueing device fitted with stereo ceramic cartridge ready to fit into your own plinth.

£7.95 p&p £2.00 Size 12" x 8½"

SANYO Nic/cad. battery, with mains charger equivalent in size and replaces 4 SP11 type batts. Size 3¾" x 1¼" x 2" approx.

£7.50 p+p £1.50p

AM/FM STEREO TUNER AMPLIFIER CHASSIS COMPLETE WITH DECODER

Ready built. Designed in a slim form for compact, modern installation.
Rotary Controls Vol On/Off, Bass, Treble, Balance.
Push Buttons for Gram, Tape, VHF, MW, LW
Power Output 5 watts per channel Sine at 2% THD into 15 Ohm 7 watts speech and music.
Tape Sensitivity Playback 400mV/30K OHM for max output Record 200mV/50K output available from 25KHz (150mV/100K) deviation
FM signal Frequency Range (Audio) 50Hz to 17KHz within ± 1dB
Radio FM sensitivity for 3dB below limiting better than 10 uV AM sensitivity for 20dB S/N MW 350 uV/Metre LW 1mV/Metre
Size approx length 16" x height 2¾" x depth 4¾"
240 Volts AC Complete **with tuning dial**
Circuit diagram.

£19.95 p&p £2.25

BARGAINS FOR PERSONAL SHOPPERS

LED 5 function men's digital watch stainless steel finish	£5.95
LCD 5 function men's digital watch stainless steel finish	£6.95
LCD 8 Function **CHRONOGRAPH** men's digital watch, stainless steel finish	£12.95
POCKET CALCULATOR. With LED display, memory and percentage key	£2.95
AM/FM DIGITAL CLOCK RADIO Accurate 4 Digit Electronic Clock with ½" LED display Buzzer and snooze timer	£11.95
125 Watt Power Amp Module	£13.95
Mains power supply for above unit	£3.50
MULLARD Built power supply	£1.50
DECCA 20w Stereo speaker kit comprising 2 8" approx bass units + 2 3½" approx tweeter inc crossovers	£20.00
'VIDEOMASTER' Super Score TV Game with pistol mains operation	£14.95
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock LW, MW, SW, VHF mains/battery operation	£41.95

VIDEOMASTER COLOUR SHOT TV GAME

Choice of three games—Football, Tennis and Squash. Ready to play—one or two players. MAINS OPERATED.

OPPORTUNITY AT **£9.95** ONLY

50 WATT MONO DISCO AMP

£29.95 P&P £2.50

Size approx. 13⅜" x 5¼" x 6¾"

50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

SPECIAL OFFER. The above 50 watt amp plus 4 Goodmans Type 8P. 8" speakers. Package price £45.00 + £4.00 P&P.

70 & 100 WATT MONO DISCO AMP

Size approx. 14" x 4" x 10¼"
Brushed aluminium fascia and rotary controls.
Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

70 watt 140 watt peak p&p £4.00 **£57**
100 watt **£65**

DUO II SPEAKERS

Attractive teak finish, modern design, incorporating 2 speaker units—8" approx. woofer and 2½" approx. tweeter. 45 to 1800 Hz. Impedance 8 ohms. Power 15 watts RMS. 20 watts max. Per stereo pair

£17.00 £6.50 p&p

FOR PERSONAL SHOPPERS ONLY

TANNOY 15" Lancaster corner cabinets, traditional design. **£20.95** each

NOTE DUE TO INDUSTRIAL UNREST, PLEASE ALLOW EXTRA TIME FOR YOUR ORDER TO REACH YOU.

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21C HIGH STREET, ACTON W3 6NG
ACTON: Mail Order only, No callers
ALL PRICES INCLUDE VAT AT 12½%

All items subject to availability. Price correct at 30 January and subject to change without notice.

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ERSIN Multicore 5 CORE SOLDER

Handy size reels and dispensers

of the world's finest cored solder to do a professional job at home

Ersin Multicore Solder contains 5 cores of non-corrosive flux that instantly cleans heavily oxidised surfaces and makes fast, reliable soldering easy. No extra flux is required.

handy size reels of

SAVBIT, 40/60, 60/40 and ALU-SOL *solder alloys*

These latest Multicore solder reels are ideal for the toolbox. Popular specifications cover all general and electrical applications, plus a major advance in soldering aluminium. Ask for a free copy of 'Hints on Soldering' containing clear instructions to make every job easy.

Ref.	Alloy	Diam. (mm)	Length metres approx.	Use	Price inc. VAT
Size 3	40/60 Tin/Lead	1.6	10.0	For economical general purpose repairs and electrical joints.	£2.16
Size 4	ALU-SOL	1.6	8.5	For aluminium repairs. Also solders aluminium to copper, brass etc.	£2.46
Size 10	60/40 Tin/Lead	0.7	39.6	For fine wires, small components and printed circuits.	£2.38
Size 12	SAVBIT	1.2	13.7	For radio, TV and similar work. Increases copper-bit life tenfold.	£2.29

SAVBIT

handy solder dispenser

Contains 2.3 metres approx. of 1.22mm Ersin Multicore Savbit Solder. Savbit increases life of copper bits by 10 times.

Size 5 58p inc. VAT

For soldering fine joints

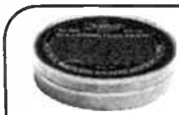
Two more dispensers to simplify those smaller jobs. PC115 provides 6.4 metres approx. of 0.71mm solder for fine wires, small components and printed circuits.

69p inc. VAT

Or size 19A for kit wiring or radio and TV repairs. 2.1 metres approx. of 1.22 mm solder.

Size 19A 63p inc. VAT

SOLDERING FLUX PASTES



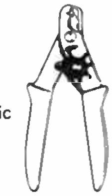
'ERSIN' A non-corrosive, rosin based flux for general and electrical soldering in conjunction with 'Ersin' Multicore solders.

Ref RF10 48p inc. VAT

'ARAX' For general metal joining in conjunction with 'Arax' Multicore solders.

Ref AF14 48p inc. VAT

BIB WIRE STRIPPER and CUTTER



Fitted with unique 8-gauge selector and handle locking device. Sprung for automatic opening. Strips flex and cable in seconds.

Model 8B 97p inc. VAT

Pat. No. 144913

EMERGENCY SOLDER

Self-fluxing, tin/lead solder tape that melts with a match. For electrical and non-electrical applications.

Size ES36 39p inc. VAT

MULTICORE DESOLDERING WICK

Absorbs solder instantly from tags, printed circuits, etc. Only needs 40-50 watt soldering iron. Quick and easy to use. Non-corrosive. **Size AB10 97p** inc. VAT

ECONOPAK

A reel of 1.2mm 'Ersin' Multicore solder for general electrical use.

Size 13A £2.59 inc. VAT

A reel of 3mm 'Arax' Multicore solder for general non electrical use.

Size 16A £2.59 inc. VAT

Sole U.K. Sales Concessionaires
Bib Hi-Fi Accessories Limited,
Kelsey House, Wood Lane End
Hemel Hempstead, Herts. HP2 4RQ

Prices shown are recommended retail inc VAT. From electrical and hardware shops. In difficulty send direct, plus 20p P & P. Prices and specifications subject to change without notice.

TTLs BY TEXAS

7400	13p	7497	180p	74221	160p
7401	14p	74100	130p	74251	140p
7402	14p	74104	65p	74259	250p
7403	14p	74105	65p	74265	90p
7404	17p	74107	34p	74278	290p
7405	18p	74109	55p	74279	140p
7406	32p	74110	55p	74283	190p
7407	32p	74111	70p	74284	400p
7408	19p	74116	200p	74285	400p
7409	19p	74118	130p	74290	150p
7410	15p	74119	210p	74293	150p
7411	24p	74120	110p	74294	200p
7412	20p	74121	28p	74298	200p
7413	30p	74122	40p	74365	150p
7414	60p	74123	55p	74366	150p
7416	27p	74125	55p	74367	150p
7417	27p	74126	60p	74368	150p
7420	17p	74128	75p	74390	200p
7421	40p	74132	75p	74393	200p
7422	22p	74136	75p	74490	225p
7423	34p	74141	70p	**74 LS SERIES**	
7425	30p	74142	200p	74LS00	18p
7426	40p	74145	90p	74LS02	18p
7427	34p	74147	190p	74LS04	20p
7428	38p	74148	150p	74LS08	22p
7430	17p	74150	190p	74LS10	20p
7432	30p	74151A	70p	74LS13	38p
7433	40p	74153	70p	74LS14	100p
7437	35p	74154	100p	74LS20	22p
7438	35p	74155	90p	74LS22	28p
7440	17p	74156	90p	74LS27	38p
7441	70p	74157	70p	74LS30	22p
7442A	60p	74159	100p	74LS47	90p
7443	112p	74160	100p	74LS55	38p
7444	112p	74161	100p	74LS73	50p
7445	100p	74162	100p	74LS74	40p
7446A	93p	74163	100p	74LS75	50p
7447A	70p	74164	120p	74LS83	110p
7448	80p	74165	130p	74LS85	100p
7450	17p	74166	140p	74LS86	40p
7451	17p	74167	200p	74LS90	60p
7453	17p	74170	240p	74LS93	80p
7454	17p	74172	720p	74LS107	45p
7460	17p	74173	120p	74LS112	190p
7470	38p	74174	93p	74LS123	75p
7472	30p	74175	85p	74LS132	900p
7473	34p	74176	96p	74LS133	60p
7474	30p	74177	90p	74LS138	60p
7475	38p	74178	160p	74LS139	60p
7476	35p	74180	93p	74LS151	100p
7480	50p	74181	200p	74LS153	60p
7481	100p	74182	90p	74LS157	60p
7482	84p	74184A	150p	74LS158	120p
7483A	90p	74185	150p	74LS160	190p
7484	100p	74186	700p	74LS161	100p
7485	110p	74190	100p	74LS162	140p
7486	34p	74191	100p	74LS163	190p
7489	210p	84192	100p	74LS164	120p
7490A	33p	74193	190p	74LS165	80p
7491	80p	74194	100p	74LS173	110p
7492A	46p	74195	95p	74LS174	110p
7493A	33p	74196	95p	74LS175	110p
7494	84p	74197	80p	74LS181	320p
7495A	70p	74198	150p	74LS190	100p
7496	65p	74199	150p	74LS191	190p

74LS192	140p	74C157	250p
74LS193	140p	74C160	155p
74LS195	140p	74C161	155p
74LS196	120p	74C162	155p
74LS221	190p	74C163	155p
74LS240	175p	74C164	120p
74LS241	175p	74C173	120p
74LS242	175p	74C174	160p
74LS243	175p	74C175	210p
74LS245	175p	74C192	150p
74LS251	200p	74C193	150p
74LS257	120p	74C194	220p
74LS259	175p	74C195	110p
74LS298	249p	74C221	175p
74LS373	200p	**4000 SERIES**	
74LS374	195p	4000	15p
81LS95	120p	4001	17p
81LS96	160p	4002	17p
81LS97	120p	4006	95p
81LS98	160p	4007	18p
8T28	230p	4008	80p
9301	160p	4009	40p
9302	175p	4010	50p
9308	316p	4011	17p
9310	275p	4012	18p
9311	275p	4013	50p
9312	160p	4014	84p
9314	165p	4015	84p
9316	225p	4016	45p
9322	150p	4017	80p
9368	200p	4018	89p
9370	200p	4019	45p
9374	200p	4020	100p
9601	100p	4021	110p
9602	175p	4022	100p
9603	60p	4023	22p
INTERFACE I.C.s		4024	50p
		4025	20p
MC1488	100p	4026	130p
MC1489	100p	4027	50p
75107	160p	4028	84p
75182	230p	4029	100p
75450	120p	4030	55p
75451/2	72p	4031	200p
75491/2	96p	4033	180p
C-MOS I.C.s		4034	200p
74C00	25p	4035	110p
74C02	25p	4040	100p
74C04	27p	4041	80p
74C08	27p	4042	80p
74C10	27p	4043	90p
74C14	90p	4044	90p
74C20	27p	4046	110p
74C30	27p	4047	100p
74C32	38p	4048	55p
74C42	110p	4049	32p
74C48	250p	4050	40p
74C73	75p	4051	80p
74C74	79p	4052	80p
74C85	200p	4053	80p
74C86	65p	4055	125p
74C90	95p	4056	135p
74C95	130p	4059	600p
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*CA5046	70p	NE543K	225p
*CA3048	225p	NE555	25p
CA3080E	72p	NE556	70p
*CA3089E	225p	NE561B	425p
*CA3090AQ	375p	NE562B	425p
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CA3130S	100p	NE566	155p
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ICL8038	340p	*SN76013ND	120p
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LM311	100p	*SN76023N	140p
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*LM380	75p		
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18V	7818	90p	18V	7918	100p
24V	7824	90p	24V	7924	100p
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*BC147/8	9p	BSX19/20	20p	*TIS43	34p	*2N4060	12p
*BC149	10p	*BU105	190p	*TIS93	30p	*2N4061/2	18p
*BC157/8	10p	*BU108	250p	*ZTX108	12p	*2N4123/4	22p
*BC159	11p	*BU205	220p	*ZTX300	13p	*2N4125/6	22p
*BC169C	12p	*BU208	240p	*ZTX500	15p	*2N4289	20p
*BC172	12p	*BU406	145p	*ZTX502	18p	*2N4401/3	27p
BC177/8	17p	MJ481	175p	*ZTX504	30p	2N4427	90p
BC179	18p	MJ491	200p	2N457A	250p	*2N4871	60p
*BC182/3	10p	MJ2501	225p	2N696	35p	*2N5087	27p
*BC184	11p	MJ2955	100p	2N697	25p	*2N5089	27p
BC187	30p	MJ3001	225p	2N697	45p	*2N5172	27p
*BC212/3	11p	*MJE340	65p	2N706A	20p	2N5179	27p
*BC214	12p	MJE2955	100p	2N708A	20p	2N5191	83p
BC461	36p	MJE3055	70p	2N918	45p	2N5194	90p
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*BC557B	16p	*MPSA12	50p	2N2102	60p	*2N5459	40p
*BC559C	18p	*MPSA56	32p	2N2160	120p	*2N5460	40p
BCY70	18p	*MPSU06	63p	2N2219A	20p	*2N5485	44p
BCY71/2	22p	*MPSU56	78p	2N2222A	20p	*2N6027	48p
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BDY56	200p	OC35	130p	2N2484	30p	2N6254	130p
BF200	32p	*R2008B	200p	2N2646	50p	2N6290	65p
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BFX84/5	30p	TIP34C	160p	*2N3704/5	12p	40411	300p
BFX86/7	30p	TIP35A	225p	*2N3706/7	12p	40594	97p
BFX38	30p	TIP35C	290p	*2N3708/9	12p	40595	105p
BFW10	90p	TIP36A	270p	2N3773	300p	40603	58p
BFY50	22p	TIP36C	340p	*2N3819	25p	40673	90p
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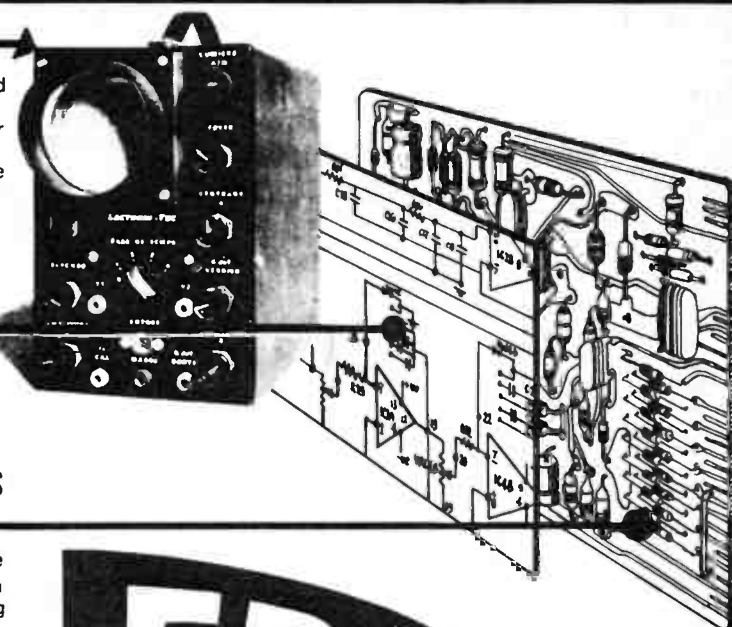

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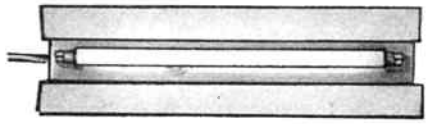

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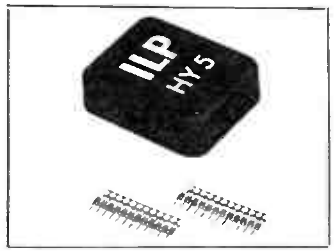

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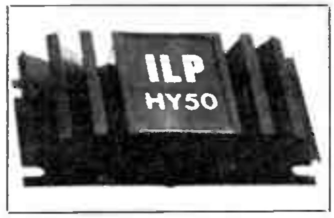
HY30
15 Watts into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω: DISTORTION 0 1% at 1 5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.
Price £6 27 + 78p VAT P&P free.



HY50
25 Watts into 8Ω

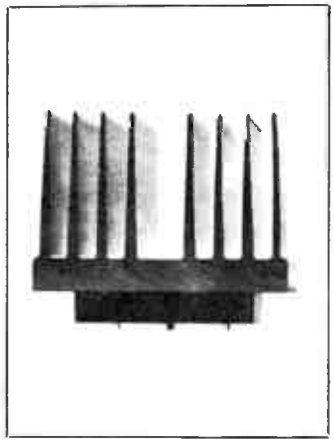
The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm
Price £8 18 + £1 02 VAT P&P free

HY120
60 Watts into 8Ω



The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0 04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £19 01 + £1 52 VAT P&P free.

HY200
120 Watts into 8Ω

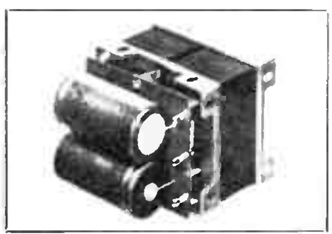
The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0 05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
SIZE 114 50 85mm
Price £27 99 + £2·24 VAT P&P free.

HY400
240 Watts into 4Ω



The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial

SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 100 85mm
Price £38·61 + £3 09 VAT P&P free.

POWER SUPPLIES

PSU36 suitable for two HY30's £6·44 plus 81p VAT. P/P free.
PSU50 suitable for two HY50's £8 18 plus £1·02 VAT. P/P free.
PSU70 suitable for two HY120's £14 58 plus £1 17 VAT. P/P free.
PSU90 suitable for one HY200 £15·19 plus £1·21 VAT. P/P free.
PSU180 £25 42 + £2·03 VAT.
B1 £0·48 + £0·06 VAT.

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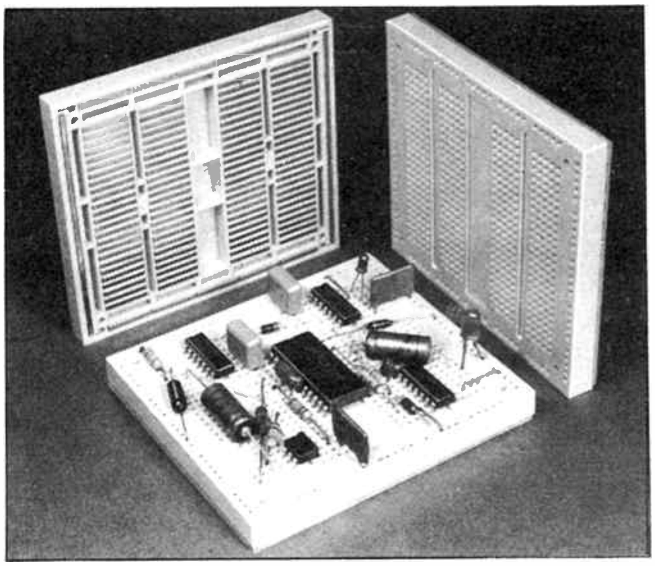
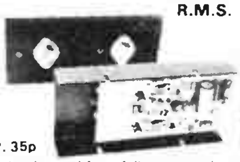


Professionals and Enthusiasts from BI-PAK

AL120 — 50W R.M.S.

AUDIO AMPLIFIER
(With integral heat sink and short-circuit protection).

£11.95
+ 8% V.A.T. P. & P. 35p



OUTPUT POWER	50 Watts R.M.S.
SUPPLY	70 Watts
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	05% Max. (Typically 02%)
FREQUENCY RESPONSE ±1dB	25Hz-20kHz
SENSITIVITY	500mV
MAX HEAT SINK TEMP.	45 deg. C
DIMENSIONS	192 x 89 x 49 mm

Introduced to fulfill the demand for a fully protected power amp., capable of driving high quality speaker systems at up to 50w with distortion levels below 05%. Ideal for domestic use, Discos, P.A. systems, electronic organs etc. The generously rated components ensure continuous operation at high output levels.

SPM120 STABILISED POWER SUPPLIES

SPM120/45
SMP120/55
SMP120/65

£5·80
+ 12½% V.A.T.
P. & P. 35p

AC INPUTS	
SPM120/45	40-48v
SPM120/55	50-55v
SPM120/65	60-65v
OUTPUT CURRENT	2.5A
RIPPLE	1A 100mV 2A 150mV

SPM120 is a fixed voltage stabiliser available with an output voltage of either 45v, 55v, or 65v. Designed primarily for use in audio applications, the stabiliser which provides output currents up to 2.5A, operates direct from a mains transformer requiring only the addition of 2 Electrolytic capacitors to complete the s/c protection.

GE100 Mk2.

10 CHANNEL MONOGRAPHIC EQUALISER

£20·00
+12½% V.A.T.
P. & P. 35p

Control Range	±12dB
Dynamic Range	110dB
Maximum Output	+15dB
Frequency Response	30Hz 20KHz (±1dB)
Power Supply	15-0-15v
Voltage Handling Input	3v R.M.S.
THD	005%

Only 155mm x 65mm x 50mm including the 10 x 10K 1in slider potentiometers and knobs which are mounted on a board positioned above the circuitry. In the frequency range of 31Hz to 20KHz you can cut and boost ±12dB with the 10 sliders, each of which has its frequency marked on the circuit board. The GE100 has numerous uses including mixers, P.A. systems and discos. It will also greatly improve the sound reproduction of your existing audio equipment. Power Supply for GE100, o/d SG30 £3.80

VPS30

REGULATED VARIABLE STABILISED POWER SUPPLY

£7.60 +8% V.A.T. P. & P. 35p

AC Input Maximum	25v
Voltage Regulation	2-30v
Regulated Current	0-2A
Incorporating short circuit protection	

This NEW versatile Regulated Variable Stabilised Power Supply with short circuit protection and current limiting, is a must for all electronics enthusiasts. It incorporates adjustable voltage from 2v-30v, with a current limiting range of 0-2A. With this module there is no need to build a separate power supply for each of your projects, with the simple addition of a transformer (o/d 2033) 0–1ma (o/d 1310 or 1305), plus a suitable shunt, a voltmeter (o/d 1311 or 1306), a 470ohm pot (o/d 1896), a 4K7 pot (o/d 1899), it can be used again and again as a self-contained bench, power supply, eliminating the use of batteries and thus saving ££'s!

PA200

STEREO PRE-AMPLIFIER

£16.55
+12½% V.A.T.
P. & P. 40p

FREQUENCY RESPONSE		20Hz to 20kHz ± 1dB	
TOTAL HARMONIC DISTORTION		Less than 1% (Typically ·70%)	
SENSITIVITY INPUTS	1. TAPE 2. RADIO TUNER 3. MAGNETIC P.U.	100mV/100 K ohms 100mV/100 K ohms 3·5mV/50 K ohms	For an output 500mV
EQUALISATION		Within ± 1dB from 20Hz to 20kHz	
BASS CONTROL RANGE		± 15dBs at 75Hz	
TREBLE CONTROL RANGE		± 10-20dBs at 15kHz	
SIGNAL/NOISE RATIO		Better than 65dBs (All inputs)	
INPUT OVERLOAD		Better than 2dBs (All inputs)	
SUPPLY		35 to 70Gv	
DIMENSIONS		300 x 90 x 33mm (less controls)	

The PA200 is basically our popular PA100. Modifications have been made to make it compatible with the higher output AL120 and AL250 amplifiers

HEADPHONES

A top quality headphone with cushioned earpads and headband. Separate balance volume controls. Stereo or Mono switch. Impedance 8 ohms. Frequency 30-18,000Hz. **o/n 884. £8.70.** + 12½% V.A.T. p&p 70p

A brilliant compromise between price and performance. Superb stereo reproduction for the newcomer to Hi-Fi. Impedance 8 ohms. Frequency 30-15,000Hz. **o/n 885. £4.40.** + 12½% V.A.T. p&p 50p

BIB HI-FI ACCESSORIES

Parallel Tracking GROOV KLEEN
The very latest in automatic record cleaning. Designed to suit all modern single play decks. Simple to fit, it is extremely efficient. Complete with two types of base and three height extensions **o/n 8101. £3.68.** + 8% V.A.T. p&p 35p.

Cassette Tape Editing Kit
Enables cassette tapes to be edited and joined easily, quickly and accurately. Kit comprises: Tape Splicer (3.2mm), 2 Precision Tape Cutters, Tape Piercer, 9 Self adhesive Labels, Reel of Splicing Tape, 3 Winders and removers and instructions, all in a handy wallet **o/n 811. £2.40.** + V.A.T. p&p 35p

GROOV-STAT
The BIB Groov-Stat static reducer neutralises the static charge on records and other plastic surfaces **o/n 8103. £5.45.** + 8% V.A.T. p&p 35p

Cassette Head Cleaner
Essential for cleaning of tape heads, capstans and rollers. Pack contains Tape Head Applicator and tape head polisher tools. Plus bottle of special formula cleaning fluid and full instructions **o/n 832. £0·64.** + 12½% V.A.T. p&p 35p

METERS

Miniature Balance & Tuning Meter
Miniature moving-coil meter for stereo balance indicator, tuning indicator for FM or similar application. Pointer at centre indicates zero or null position. Robust construction. Sensitivity 100-0-100MA. Dimensions 23 x 22 x 26mm **o/n 1318. £1.95** +8% V.A.T. p&p 35p

Balance and Tuning Meter
Clear view edgewise meter. Centre zero application. Sensitivity 100-0-100UA. Dimensions 45 x 22 x 34mm **o/n 1319. £2.00.** +8% V.A.T. p&p 35p

Miniature Level Meter
Moving coil for accurate level indication for tape recorders, amplifiers etc. Neat design, rugged construction will withstand five times rated value. Sensitivity FSD 200UA 0dB, 130UA. Dimensions 23 x 22 x 26mm **o/n 1320. £2.80.** +8% V.A.T. p&p 35p

Vu Meter
Calibrated -20 to +3 and 0-100%, making it suitable for use as a recording level meter or as a power output indicator. Sensitivity 130uA. Dimensions 40 x 29mm **o/n 1321. £2.00.** +8% V.A.T. p&p 35p

ADAPTORS

AC-DC enables a large range of battery powered radios, recorders, calculators to be run off the mains (220-240v AC). Switchable for 6, 7.5 or 9 volts. Current rating 2,500mA. Polarity reversing switch. Universal plug incorporated. **o/n 137 £3·60.** + 12½% V.A.T. p&p 35p.

DC-DC for use in all cars, boats etc., with pos. or neg. earth for a regulated output of 6, 7.5 or 9 volts DC at 1A max. For radios, recorders etc **o/n 138. £2.80.** + 12½% V.A.T. p&p 35p.

CROSSOVER NETWORKS

2-WAY channels for high and low frequencies to correct speakers – high to tweeters, low to woofers. Complete with instructions. Frequency 3,000Hz **o/n 1904. £1.10.** + 12½% V.A.T. p&p 35p.

2-WAY for 8 ohm speakers up to 30 watts. Frequency: .3KHz. o/n 1905 **£1.65.** + 12½% V.A.T. p&p 35p.

3-WAY for 8 ohms speakers up to 30 watts. Frequency: 800Hz and 4.5KHz **o/n 1906. £2.95.** + 12½% V.A.T. p&p 35p.

MICROPHONES

DYNAMIC CASSETTE
For equipment requiring a high quality microphone. Sturdy, solid moulded body in black with neat chrome surround. Pick-up pattern is omnidirectional. On/Off switch, 1 metre of tough lead with floating 2.5 and 3.5mm plugs. Matching moulded strut. Impedance: 200 ohms. Sensitivity 90dB. Frequency 90-10,000Hz. Size: 20mm dia x 120mm **o/n 1326. £1·60** + 12½% V.A.T. p&p 35p

DYNAMIC MICROPHONE
Superior quality portable cassette recorder mike with built-in remote control switch and lead fitted with 5-pin 240° DIN plug (remote switch) and 3 pin DIN plug (microphone). Provides a direct replacement for those supplied with recorders. With detachable stand. Omnidirectional. Impedance 200 ohms. Freq. response 100 to 10,000Hz. Sensitivity 79dB at 1,000Hz **o/n 1327. £2.65.** + 12½% V.A.T. p&p 35p

RE – 317: DYNAMIC MICROPHONE
Highly sensitive high-grade desk or hand mike suitable for use with many popular cassette decks. Incorporates On/Off switch and 1 metre lead with moulded standard jack plug. Complete with desk stand. Omnidirectional. Impedance 5,000 ohms. Freq. response 100 at 12,000Hz. Sensitivity (-7dB at 1,000Hz). **o/n 1336. £4·00.** + 12½% V.A.T. p&p 35p

OMNIDIRECTIONAL CARDIOID
Powered by a 1½v battery located within the aluminium body. Satin silver finish with front disk protection to the diaphragm housing. On/Off switch. Also with 'Busby' type windshield. 'U' bracket and stem and extremely supple cable. Consumption 0.2mA from 1½v battery providing approx. 8-10,000 hours continuous life. Impedance 600 ohms. Sensitivity 70dB. Frequency 30-16,000Hz. Size 23mm dia + 267mm **o/n 1329. £12.80.** 12½% V.A.T. p&p 35p

UNIDIRECTIONAL CARDIOID
Dual imp. 600 and 50,000 ohms. Response 50 to 14,000Hz. Sensitivity 54dB at 50K ohms. Size 1½" dia x 6½" long. Weight approx. 190gm **o/n 1328. £10.95.** + 12½% V.A.T. p&p 35p

STANDS

GOOSENECK CHROME FLEXIBLE HOLDERS
Length 320mm **o/n 1333. £2.40.** + 12½% V.A.T. p&p 35p
Length 515mm **o/n 1334. £3.40.** + 12½% V.A.T. p&p 35p

FLOOR STAND Heavy chrome. Stow away feet with rubber ends for maximum stability. Draws to a height of 5' maximum. o/n 1335. + **£9·50.** 12½% V.A.T. p&p 85p.

BOOM ARM for use with the above stand. Heavy chromed metal, it gives 30" reach from the stand **o/n 1337 £9·20.** + 12½% V.A.T. p&p 70p

WINDSHIELD COVERS
o/n 1331 Medium per pair **£1.20.** + 12½% V.A.T. p&p 35p. **o/n 1332** Large per pair **£1.80.** + 12½% V.A.T. p&p 35p.

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0.60*
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0.75*
114	5 pin DIN plug to 3.5mm. Jack connected to pins 3&5. Length 1.5m	£0.85*
115	5 pin DIN plug to 3.5mm. Jack connected to pins 1&4. Length 1.5m	£0.85*
116	Car aerial extension. Screened insulated lead. Fitted plug & skt	£1.10*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0.68*
118	5 pin DIN phono plug to stereo headphone jack socket	£1.05*
119	2 + 2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	£0.90*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	£0.60*
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1.50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.75*
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.05*
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.68*
131	5 pin DIN plug to 3 pin DIN plug 1&4 and 3&5. Length 1.5m	£0.83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0.98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0.75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0.68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0.68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1.75*
178	AC mains lead for calculators etc	£0.45*

Please add 12½% V.A.T. to all the above leads.

BI-PAK

DEPT. PW4, P.O. Box 6, Ware, Herts.

Citizen's Band—Yes or No?

THE mention of a Citizens' Band for the UK can be relied upon to generate strong feelings, one way or another, among people with any interest in radio. This is evident from the letters received in response to J. S Goodier's proposals published in our December issue. A selection of these letters appears on page 29.

On the right, we print the text of a letter sent recently to the Prime Minister by the Citizens Band Association, urging the introduction of a UK CB service on a v.h.f. band. The Association's comments on four arguments against CB, while certainly valid in themselves, leave several questions unanswered. The adoption of a band other than 27MHz has undoubted advantages from the point of view of reducing interference and illegal long-distance working, and providing a boost for the UK electronics industry. But what would be the price of these sophisticated v.h.f. sets? If it's anything like that of hand-portable transceivers operating in the marine or private-mobile v.h.f. and u.h.f. bands, it seems unlikely that many would be sold to private individuals.

If 27MHz equipment continued to be imported and used, then little would have been gained. It is alleged that several thousand 27MHz sets are presently operating regularly in a net in north London, but apart from an occasional prosecution there is little that the Home Office can do to control them. How would that situation be changed by introducing a legal service in parallel, on another band? And no doubt many would plead for the quoted 15 000 existing users to be allowed to continue to operate their sets, though this figure does rather pale into insignificance against the current 66 000 licensed users of radio model control and the numerous radio-paging systems having a long-standing legal right to the 27MHz band in the UK. At the very least, the government would need to introduce legislation banning further imports of 27MHz CB equipment.

Though the Association quotes several US authorities as now backing the use of CB as an aid to road safety, there have in the past been numerous published reports of CB channels being swamped, leaving broken-down road users and others unable to contact assistance. With the present growing contempt for law and order in some sections of the community, it seems unlikely that we would be spared the interfering carriers, high-powered transmitters, obscene language or continuous music which have plagued CB in other countries.

There is no simple answer to these problems, and little use is served by claiming that there is. Whatever solution may be adopted is going to be unpopular with a lot of people.

PW PERSONALITY

Peter Metalli—Art Editor

From art school, Peter began his career in a newspaper feature agency in Fleet Street, receiving a solid grounding in drawing and publication methods. He remained there for 17 years, interrupted by four years (1943–47), in which he served in the RAF as a Flight Engineer.

In 1955 Peter joined "George Newnes" (incorporated now within IPC) working in the general art department "servicing" the "Practical Group" magazines, and from there graduated to his present position in *PW*.

Peter, Gwen his wife, and daughter Angela, have all settled happily in Bournemouth after their move from Essex, following the company's relocation from London to Poole, Dorset.

Married son, Peter, and wife Alice, still back in Essex, have recently made him a proud grandfather.

Interests are model cars and aircraft, stamps, DIY and gardening.

Citizens Band Association

The Rt. Hon. Mr J. Callaghan, MP, PC,
The House of Commons,
London SW1
January 12th, 1979

Dear Prime Minister,

I am writing to you to ask you to reconsider your Government's opposition to the introduction of Citizens Band Radio in this country.

Eire and ourselves are the only countries left in Europe which do not allow private citizens some form of short range radio communication. While care must be exercised to license a system which offers efficiency without interrupting other services, is it not somewhat repressive to deny the private citizen any access to short range communication in his everyday affairs?

In the past four main arguments have been advanced against CB:

(i) It may be used by criminals and for undesirable purposes;
(ii) The administration required to control it would be prohibitively complex;
(iii) No frequencies exist which might be used for such a purpose; and
(iv) Those countries which have it wish they did not.

I should like to comment on these objections in order:

(i) At present any criminals who use CB equipment are unlikely to be heard. As soon as CB is legal, however, the presence of large numbers of CB users ensures that criminals using CB are heard and quite probably located and arrested. In the USA any criminal who is fool enough to try to use CB is almost invariably detected.
(ii) Modern "silicon chip" technology makes it not only possible but simple to fit every CB set sold, at the factory, with a unique identifying signal which cannot be tampered with without the resources of a microelectronics factory and without which the CB set will not transmit. The extra cost of such identification would be under 50p per set. Such a device makes the identification of CB sets simple and reduces the administrative costs of a CB service to a low level. It also increases the impracticality of the criminal or anti-social use of CB.
(iii) Although there are no unallocated frequencies available for CB there are many MHz of spectrum throughout the v.h.f. and u.h.f. region which, though allocated, are thoroughly under-used. In particular the 220–240MHz range has unused sectors (some never used since 1944), there is space around 900MHz, and the v.h.f. television channels are now so unused that spectrum there might well become available in the near future. Very little spectrum is needed for a Citizens Band—0·5 to 1MHz would be ample and even 200kHz could provide a reasonable service—and given political will it could be found.
(iv) This last reason is the weakest of all, though frequently advanced in official circles. In the USA it is Federal policy to encourage the use of CB radio because of its contribution to road safety, as a recent memorandum from the Secretary of the Department of Transportation, the Chairman of the Interstate Commerce Commission and the Chairman of the Federal Communications Commission makes plain. Over thirty countries, including a number not noted for their liberal regimes, now have CB and although there are inevitably some problems the benefits so far outweigh them that none regret introducing it.

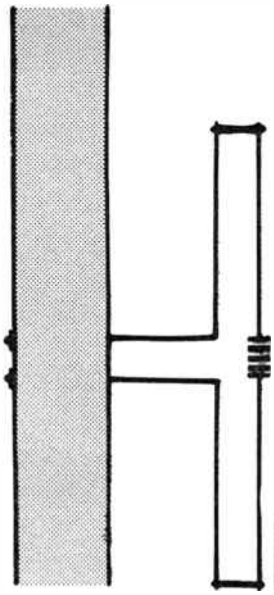
However, I am not writing to you now to rehearse a dialogue which is some years old. There is at present a real danger of a less satisfactory form of CB being adopted in Britain in the future if action is not taken soon to define a better alternative.

In the past year three organisations, the National Electronics Council, the British Radio Equipment Manufacturers Association and the Electronic Engineering Association, have prepared reports on Citizens Band Radio in Britain. All are agreed that the Government should introduce CB and all are agreed that the American 27MHz a.m. standard used in most countries having CB is unsuitable for a small, densely-populated island like our own on various grounds including television interference, the probability of the market being swamped by equipment built in the Far East for the American market and the availability of equipment, legitimately manufactured for the 10 metre Amateur service, which can boost 27MHz transmitters to illegally high powers. Instead they (and the Citizens Band Association) propose v.h.f. and frequency modulation (f.m.). Such a system offers many advantages including local manufacture (four British manufacturers are already prepared to manufacture such sets should CB be legalised), minimal interference and higher quality.

However, many people, angered by the continued illegality of CB in Britain, are now importing American and European equipment and using is illegally. The Citizens Band Association estimates that there are now some 15 000 illegal users in this country and that their number is growing by about 1000 per month. If this continues your own or some future Government will be forced, as happened in Australia, to legalise what is being done. There will then be no possibility of introducing a more sophisticated system or such controls as the automatic identification mentioned above—it will be necessary to legalise another American-style system with most of the American problems. The CBA would prefer such a system to none at all but we feel that we would have missed a golden opportunity of leading the World into a new generation of Citizens Band Radio.

I therefore most earnestly urge you to reconsider your Government's opposition to CB and legalise a sophisticated v.h.f. system, with whatever controls you or your advisers may consider necessary, before you or your successors are forced, by pressure of illegal use, to permit the use of American 27MHz equipment.

Yours sincerely,
James M. Bryant,
President, Citizens Band Association



VHF/UHF FOLDED COLINEAR AERIAL ARRAY

Fred JUDD G2BCX

This aerial is a two-element colinear design for vertically polarised (omni-directional) radiation. It may be constructed for use on either the 2m or 70cm amateur bands and is a development of the very successful "Slim Jim", published in April 1978.

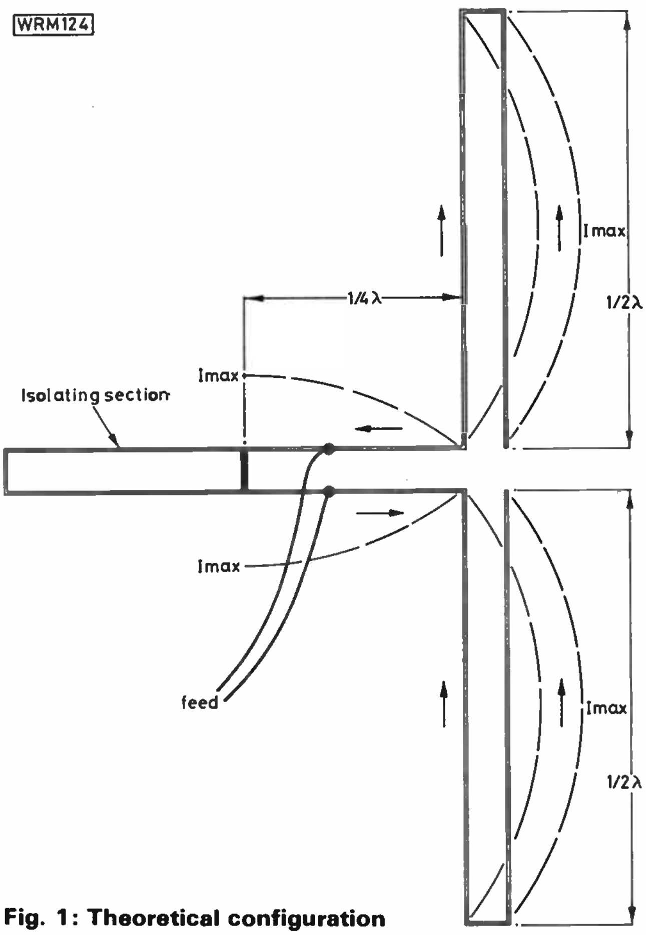


Fig. 1: Theoretical configuration of the colinear array

Two folded half-wave elements driven in phase from a quarter-wave stub constitute the active parts of the device, originally built for use on the Norwich 70cm repeater. The requirement called for a pair of aerials with at least 3dB gain which could be mounted on a mast without undue effect on their omni-directional properties—i.e. with minimal distortion of the otherwise circular radiation pattern.

The theoretical configuration is shown in Fig. 1. Experimentation indicated that the minimum tolerable distance from a metal mast producing the least effect on radiation was 0·625λ. Accordingly, a long stub section is employed which also serves as a supporting mount for the aerial.

The folded radiating elements are voltage driven from a quarter-wave section of the whole stub, the current distribution being indicated by the arrows. The increase in gain over a conventional two-element colinear (gain normally around 1·8dB) is obtained by the use of the folded elements, which contribute an additional 1·6dB. This aerial therefore has a total gain of 3dB over a dipole. Note the break between the return sections, necessary to create a standing wave.

Construction

The diagram of Fig. 2 should provide enough information to enable this aerial to be constructed for either 70cm or 2m, detailed dimensions being given in Table 1. For u.h.f. the aerial will self-support but for v.h.f. some form of boom at right-angles to the mast may be necessary to take the weight of the stub and elements—which are, of course appreciably longer than their u.h.f. counterparts. This could be constructed from wood, and reach at least as far as the quarter-wave section shorting bar. An alternative would be the use of larger diameter tubing for the elements and stubs, say 12·7mm (½in).

Connections to the feed point must be protected from rain and the prototype used an oblong plastic box with tight-fitting lid for this purpose. The insulator linking the two folded element sections should be of high quality material, such as ptfe, which is drilled to fit over the ends.

A piece of aluminium about 10mm square may be used for the quarter-wave shorting bar, drilled to take the stub lines and tapped for the 4BA screws which lock the bar to the lines. Element dimensions are given for both versions, the velocity factor having been taken into account.

Adjustment

When the aerial has been completed it should be set up in fairly clear surroundings, approximately 2 metres above ground, with the full length of feeder cable attached. Adjust the feed tapping points and quarter-wave point (shorting bar) for maximum power and v.s.w.r. All v.h.f. aerials operate most efficiently when high up and clear of rooftops or other obstacles, such as tall trees. This is particularly true in the case of colinears with zero-angle radiation. Sizeable trees in full leaf can attenuate v.h.f. and u.h.f. signals by as much as 20dB when placed in the path of radiation, even in dry weather. Brickwork can reduce signals by 10dB or more.

The vertical angle polar pattern of Fig. 3 was taken from the Author's display unit and clearly shows the radiation characteristics of the u.h.f. prototype.

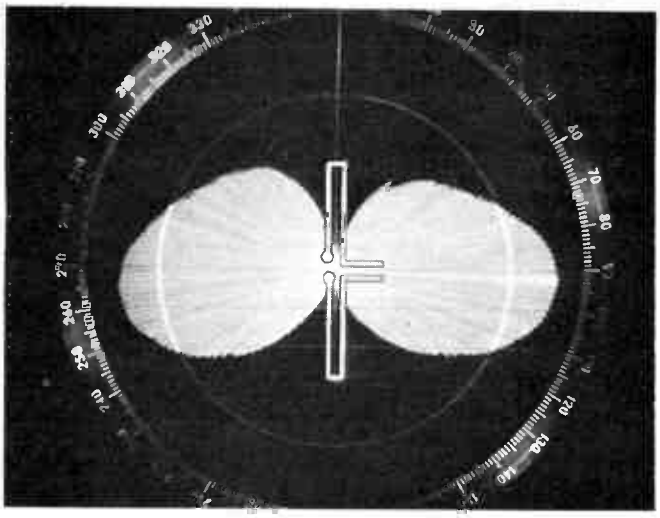
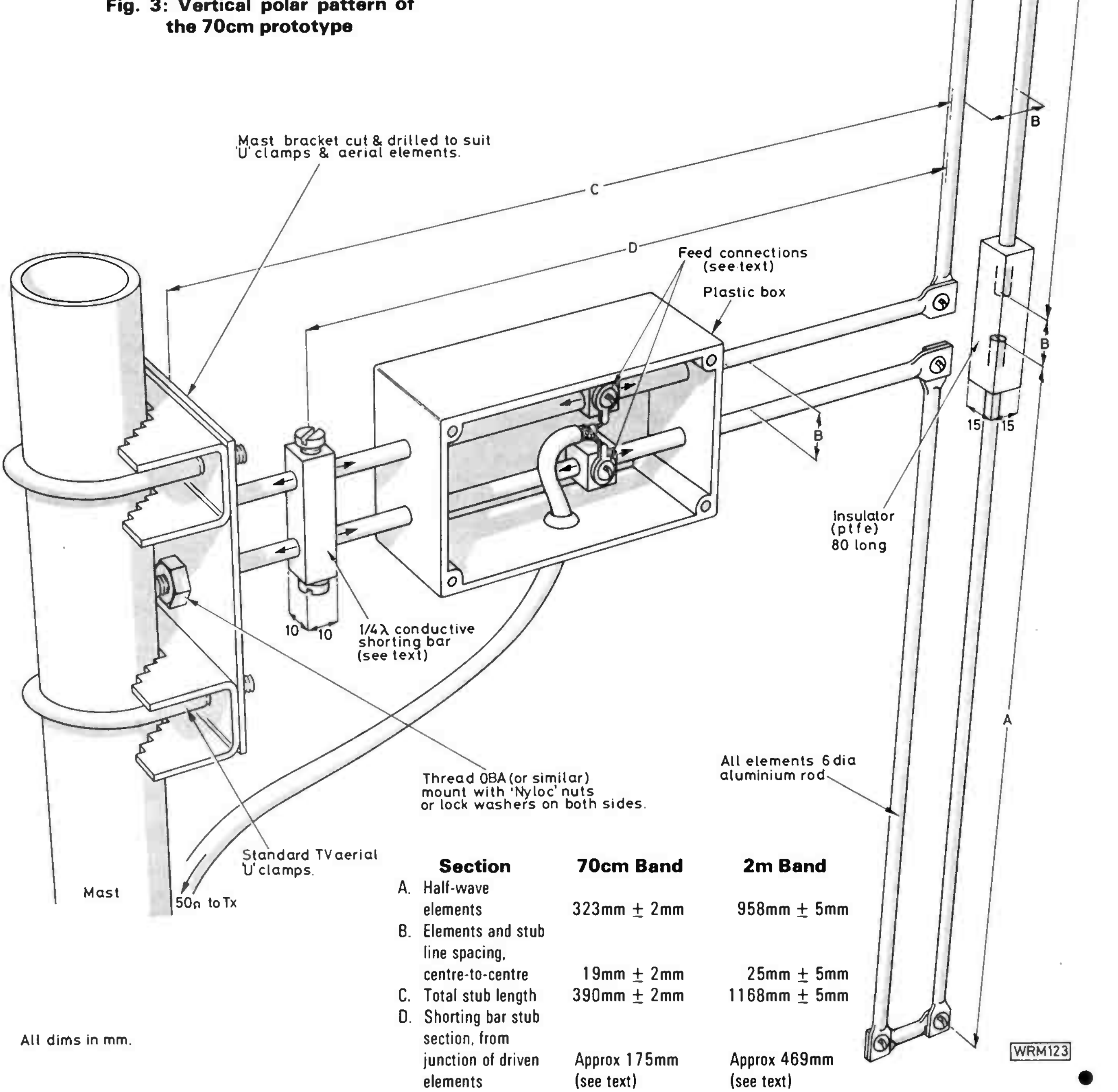


Fig. 3: Vertical polar pattern of the 70cm prototype

Fig. 2: Constructional details



Section	70cm Band	2m Band
A. Half-wave elements	323mm ± 2mm	958mm ± 5mm
B. Elements and stub line spacing, centre-to-centre	19mm ± 2mm	25mm ± 5mm
C. Total stub length	390mm ± 2mm	1168mm ± 5mm
D. Shorting bar stub section, from junction of driven elements	Approx 175mm (see text)	Approx 469mm (see text)

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

MPU evaluation kit

Now available on an off-the-shelf basis from Distronic are two low-cost microprocessor development systems for the RCA CDP1800 COSMAC m.p.u. family. Costing £100 (plus VAT), the CDP18S020 evaluation kit is a complete kit of components for building an evaluation board for the CDP1802 COSMAC m.p.u., while the CDP18S021 Microterminal, which costs only £70 (plus VAT), is a low-cost, hand-held, non-hard-copy alternative to a teletypewriter data terminal.

The two systems are ideally suited to combined operation. The evaluation kit represents a valuable first step in the development of COSMAC programs and prototype systems, and incorporates on-board utility read-only memory for terminal control. The Microterminal provides a convenient means of controlling a COSMAC system, reading and modifying memory, and providing hexadecimal input/output capability. *Distronic Ltd., 50–51 Burnt Mill, Elizabeth Way, Harlow, Essex. Tel: (0279) 32947/39701.*

On Station

For those interested in the whole spectrum of broadcasting, two recent publications are relevant. The 1979 *"World Radio and TV Handbook"*, according to its Assistant Editor, contains comprehensive information on the world's transmitters (including recent frequency changes) and details of operating times, languages, DX clubs, time signal broadcasts, and even religious broadcasting organisations. The book is available at a cost of £8·50 from *Billboard Publications, via Argus Books Ltd., 14 St. James Rd., Watford, Herts, at your bookshop.*

"Radio Stations Guide", by B. B. Babani and M. Jay, has been considerably up-dated, and contains basic information on the world's radio broadcast transmitters, with a special supplement covering the changes in long- and medium-wave transmissions in the United Kingdom. This guide is available at a cost of £1·45 direct from the publisher: *Bernard Babani (publishing) Ltd., The Grampians, Shepherd's Bush Rd., London W6 7NF.*

Rally date

The North Midlands Mobile Rally organised by The Midland Amateur Radio Society and The Stoke-on-Trent Amateur Radio Society, will take place on Sunday, 29 April 1979, at Drayton Manor Park near Tamworth, Staffordshire. The Park is located on the A4091, which is within easy reach of the M1, M5 and M6 motorways.

The rally will open at 11.30am and visitors will be made very welcome. There will be a talk-in on 2 metres and 70 centimetres. For further details contact: *Norman Gutteridge G8BHE, 68 Max Road, Quinton, Birmingham B32 1LB. Tel: 021-422 9787.*

Testing m.p.u.s

Programme details and synopses of papers for "Microtest", the Symposium on the testing, maintenance and reliability of microprocessor-based equipment, being held at the University of Sussex, from 4pm on Monday, 2 April 1979, until midday on Thursday, 5 April 1979, have now been finalised.

The papers being presented are from Industry, the Universities, Government Departments, and the Post Office.

The Symposium is being organised by the Society of Electronic and Radio Technicians in association with the IERE and the Microprocessor Application Group of the IEE.

The Symposium will open with a Keynote Address given by Colin Crook, Managing Director of Rank Precision Industries Ltd. on the evening of 2 April.

Further information and registration forms are available from: *The Symposium Secretary (MS), SERT, Faraday House, 8-10 Charing Cross Road, London WC2H 0HP. Tel: 01-240 1152.*

New catalogues

Tirro Electronics, the mail order division of "Ritro" has issued a new, combined, catalogue/price-list/order form, available from them free of charge.

Products listed include a whole range of components from the AMI-COS m.p.u. system, to resistors, diodes and capacitors. Other useful items included are transformers, i.c.s, aerials, tools, books, etc.

Each item is clearly priced (VAT included), with discounts for quantity orders. *Tirro Electronics, Grenfell Place, Maidenhead, Berkshire. Tel: (0628) 36229.*

Chloride Exide have just issued an updated list of their dry batteries and torches.

In twelve A4 pages plus covers, it gives all necessary information about high-power batteries; transistor equipment batteries; calculator batteries; extra power transistor batteries; low and high tension batteries; torch, lamp and special purpose batteries. It also includes an equivalents list, dry battery terminal diagrams and coloured illustrations of the top ten popular types.

Available on request from: *Chloride Automotive Batteries Ltd., Chequers Lane, Dagenham, Essex RM9 6PX.*

Home Radio

Due to a massive rise in the rent asked for their current premises, Home Radio (Components) Ltd., of Mitcham, Surrey are moving to new offices at the end of March. Because of this, they will be unable to maintain their retail counter facilities, and will in future trade by mail order only.

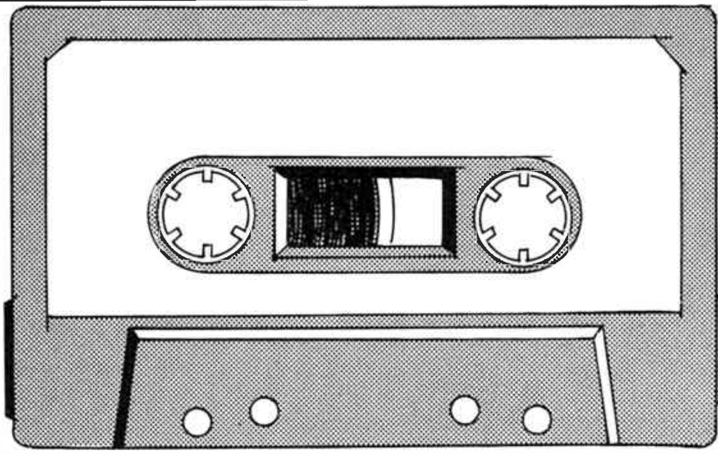
To dispose of some surplus stock items, there will be lots of bargains available **to callers only** in a clearance sale from 24–31 March at the existing address, 9am–5pm daily (close 1pm on Wednesday).

The new postal address for mail order will be notified as soon as possible. For the present, customers should continue to write to: *Home Radio (Components) Ltd., Dept. PW, 234–240 London Road, Mitcham, Surrey CR4 3HD.*

Can I Help You!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in mid-January), so, the earlier I can have details, the better.

Alan Martin



THE CASSETTE TAPE MEDIUM

Part 1

Gordon J. KING

Having in mind the miniscule 0·6mm tracks of the Compact Cassette, and the low tape/head velocity of a mere 4·75cm/s, it seems incredible that the medium is currently capable of high quality recording and replay up to frequencies approaching 20kHz, and it is still improving. When the Compact Cassette system was launched by Philips way back in the Fifties the quality by today's hi-fi standards was, frankly, abysmal. The noise floor was little more than 40dB below signal peaks of some 5 per cent distortion, the upper-frequency response commenced rolling-off around 7 to 8kHz, and the wow and flutter figures could easily reach 0·5 per cent or more!

Assisted by the recent noise reduction systems, notably Dolby B, and the new psuedo-chrome (*Cr*) and pure *Cr* tapes, a noise floor as low as 65dB (CCIR/ARM-weighted) relative to an output of 3 per cent 3rd-order distortion threshold is readily achievable at middle frequencies, which is virtually as good as can be expected from the best gramophone records. At the recording levels likely to be experienced in the treble regions by the vast majority of home recordists, the response holds well to frequencies of 15kHz or more (which is the upper limit of most gramophone records and f.m. radio), while dramatic improvements to tape transport mechanisms have decreased the wow and flutter to less than 0·1 per cent DIN-weighted peak.

With these sort of performance figures, therefore, it is little wonder that more audiophiles and music lovers are turning to the cassette deck as a primary source of programme signal, which is regarded as having the edge on the record deck in terms of its recording attribute, if not in absolute music quality.

If a recording is made of a top quality gramophone record or stereo radio programme with a contemporary hi-fi deck using good tape, it is often difficult to determine conclusively whether one is hearing the original or the recording. Yes, the state-of-art is to this standard. Indeed, there are people who claim that the recording sometimes auditions more favourably than the original, which would appear to have significance, in that the replay distortion is "disguising" some of the less palatable distortion plaguing the original programme signal, but this is a different story!

So far as pre-recorded cassettes (e.g., Musicassettes) are concerned, the quality of the equivalent gramophone records is generally better. It is also more convenient to locate a particular track on a disc than on a cassette record, but even this cassette shortfall is being resolved by the microprocessor chip, such as found in the Optonica up-market cassette decks, for quickly locating a required section of music for replay, without the frustration of having to make experimental fast winds and rewinds.

Cassette Shortcomings

So far, then, it might be supposed that the compact cassette medium no longer has any shortcomings and that all the problems have been resolved. This is certainly not true. For example, the medium cannot yet compete with wider-track reel-to-reel tape running at higher speed. However, with some of the latest tapes the performance can currently exceed that of reel-to-reel tape running at 9·5cm/s, which is a truly remarkably achievement.

When the pure metal particle tapes are more readily available, along with machines to do them full justice, then the improvement will be even more dramatic, and we shall probably be able to obtain the existing cassette performance with a tape speed half that of the existing cassette tape speed! Conversely, by retaining the existing cassette speed, the performance will be lifted virtually to match that of most domestic type reel-to-reel machines running at high speed.

The biggest shortcoming of the cassette medium can be described with one word—compression. A tape can assimilate only a certain amount of magnetism depending on its magnetic properties. If the magnetising force is increased by passing an increasing current through the winding of the recording head, the magnetic flux density of the tape will increase until it can accept no more magnetism. At this point no matter how much more the force is increased there will be no further increase in tape flux. This means that the tape is fully saturated since all the available magnetic domains are then in alignment.

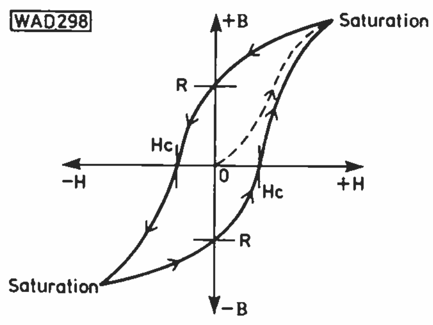


Fig. 1: Hysteresis loop of magnetisation. See text for description

The hysteresis loop in Fig. 1 describes the path taken by flux *(B)* as the magnetising force *(H)* is increased first in one direction, decreased, and then increased in the opposite direction. Initially, the flux follows the broken-line up to saturation; it then falls back from saturation as the force is reduced to zero, and rises to saturation in the opposite direction as the force is increased in the opposite direction. The loop shows that after the tape has been magnetised and the force is reduced to zero a flux remains on the tape of value *(R)* which is, in fact, the magnetism which has been imparted to the tape and retained by it. Points *(R)* on the loop are called the remanent points and thus signify the remanent magnetism remaining on the tape after the force has been removed.

The loop also shows that once the tape has been magnetised, an opposite field of force H_c is required to pull the remanent flux down to zero again, and hence to demagnetise the tape. This is called the coercive force, so the greater the coercivity of the tape, the better it holds its magnetism and the harder it is to demagnetise, which can be useful, particularly for recording high frequencies.

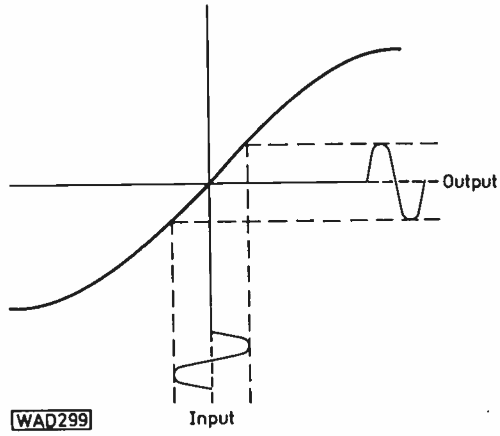


Fig. 2: Transfer characteristic of magnetic tape showing non-linearity of odd-order terms, which is responsible for odd-order distortion on the output signal. The curve takes account of the correction provided by the h.f. bias

Transfer Non-Linearity

To combat the severe non-linearity at low values of magnetising force, the signal for recording is superimposed on a high-frequency sinewave of around 100kHz. This caused the magnetic force, resulting from the signal, to swing on the upper reaches of the two halves of the *BH* curve, which are more linear than the lower reaches. Even so, the resulting transfer characteristic is still not very linear, particularly as the signal pushes the tape towards saturation, which means that in spite of the recording signal being of very low distortion, the replay signal is bound to carry a greater level of distortion, especially at high recording levels.

The nature of the transfer characteristic, after the improvement by the h.f. biasing has been taken into account, is shown in Fig. 2. As this type of curve contains odd-order terms, most of the distortion is odd-harmonic, such as 3rd, 5th, 7th, etc., harmonic, with the 3rd harmonic predominating. Moreover, because the curve goes more non-linear as the tape approaches saturation, so the 3rd harmonic distortion increases. If the signal being recorded is so strong as to push the tape into saturation, then there can be just as much 3rd- and odd-order distortion as there is fundamental! Hence the reason why cassette recordings sound abysmally poor when they are over-recorded on signal peaks.

The maximum output level (MOL) of a tape refers to the level of flux that it can accommodate up to a specified level of distortion—usually 3 per cent. In the SI units, magnetic flux density is expressed in webers per metre (Wb/m), but as tape flux is so small the expression nWb/m is used, where n is the nano or 10^{-9} multiplying factor. Some idea of the flux level on a tape can be gleaned from the fact that the majority of Japanese cassette decks show +3VU on their meters when the recorded tape flux corresponds to about 200nWb/m which, incidentally, is the Dolby noise reduction reference level. This means, then, that at 0VU the tape flux is about 141·5nWb/m (e.g., 3dB down from 200nWb/m, which is 200 × 0·707).

The curves in Fig. 3 give some indication of how the 3rd harmonic distortion increases with increasing tape flux, based on the average of five different tapes as used in domestic cassette decks at low, middle and high frequencies. It should be noted that different machines and tapes of different samples might well result in a different distribution. For convenience, lines have been drawn to indicate the 0dB 200nWb/m point on the horizontal scale and the 3 per cent distortion point on the vertical scale.

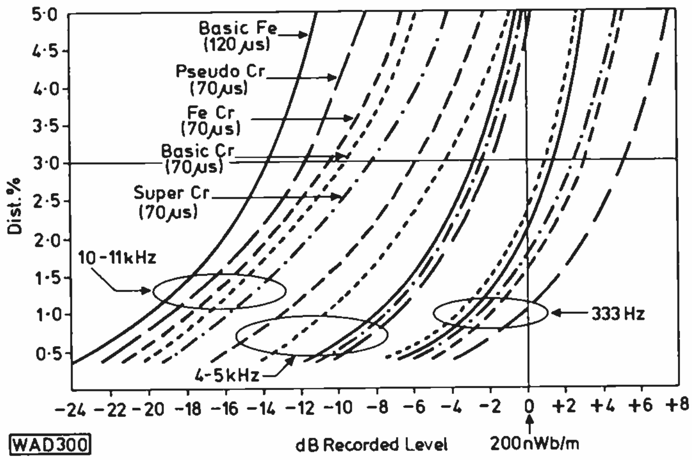


Fig. 3: Curves showing how the distortion increases at three different frequencies as the recorded level and hence the tape flux is increased. The results represent the averages of a number of samples and batches of the tape types indicated, when used with domestic cassette decks

The curves show that with this particular combination the pseudo-*Cr* tape (such as Maxell UDXL II, TDK SA, etc.) is capable of the greatest flux at the low frequency of 333Hz where, to the 3 per cent distortion point, a flux of +5dB (corresponding to about 356nWb/m) can be accommodated. The basic *Fe* will only yield about +1dB, basic *Cr* a trifle less, *Cr* Super (a recent BASF formulation) about +2·5 (depending on bias), and ferrous-chrome *(FeCr)* about +3dB. Clearly, then, the pseudo-*Cr* is a clear winner so far as sheer flux is concerned at l.f.

Although a good deal of music energy and peaks reside at low and middle frequencies, this is not the whole story because high quality music can undoubtedly contain quite high-amplitude transients at much higher frequencies. Looking at the curves applicable to 10–11kHz, it will be seen that the distribution has altered somewhat, for now the greatest flux is yielded by the Super *Cr* to 3 per cent distortion at about −8dB (80nWb/m). The pseudo-*Cr* is down to about −12dB (50nWb/m), while the basic *Fe* is at the bottom at about −14dB (40nWb/m). The basic *Cr* is quite respectable at −10dB (63nWb/m) and the *FeCr* is not bad at −11dB (56nWb/m). These curves, then, indicate that *Cr* and *FeCr* are good upper-frequency performers.

The middle-frequency curves fail to reveal the upper-frequency attribute of the *Cr* and *FeCr* tapes, since the pseudo-*Cr* is still showing the highest flux at −2dB (159nWb/m). Nevertheless, the Super *Cr* is not far behind, nor is the basic *Cr*. The lowest output is given by the *FeCr* at −6dB (100nWb/m).

These curves, then, signify that as the frequency of the recorded signal increases, so the tape arrives at the beginning of saturation at decreasing levels of flux. If we were to record a tape at a constant level over the frequency spectrum, starting at, say, 200nWb/m at 333Hz, on replay we would find that the flux carried by the tape would gradually decrease with increasing frequency, as shown in Fig. 4. The upper-frequency roll-off of the curve is caused by the progressively increasing compression (that is, the inability of the tape to retain a given high level of magnetic flux as the frequency is increased).

This is the result of self-demagnetisation of the high-frequency, short-wavelength magnetic domains recorded on the tape oxide. For each half-cycle of recording signal the equivalent of a miniscule bar magnet is produced on the oxide, and because the poles get closer together as the frequency of the signal is raised, the ability of the magnet to sustain its strength is diminished.

The recorded wavelength is equal to the tape velocity divided by the frequency in Hz. Thus, at 15kHz and at the cassette speed of 4·75cm/s, the wavelength is a mere 3·16µm, so each magnet has a length of 1·58µm. Little wonder, then, that there is a strong tendency towards demagnetisation! It is noteworthy that the length of the gap of the replay head must be of a similar small order fully to define the high-frequency components of the signal.

During recording, pre-emphasis is applied to the signal current fed to the head to help combat the h.f. loss. However, if excessive magnetic force is applied to the tape, the tape tends to demagnetise while it is actually being recorded, which can further worsen the compression distortion at h.f. Tapes which give the best h.f. performance with the least compression and hence h.f. distortion, are those of relatively high coercivity, such as the recent *Cr*, *FeCr* and the latest high-energy *Fe* and pseudo-*Cr* formulations, the first mentioned particularly including the BASF *Cr* Super if the programme material warrants the extra price and the machine can do full justice to the tape.

Although there are more factors involved in tape choice, the performance at h.f. cannot be over-stressed for the adequate recording of high quality material, from microphone channels direct, from electronic music-making devices, and from synthesisers where the peaks and energy at h.f. are likely to be relatively high. For dubbing from gramophone records and f.m. stereo radio, tape choice is less exacting (but it is desirable always to use the best that can be afforded and never cheap non-proprietary brands which can quickly shed their oxide and clog up the head gaps) because of the limited high-frequency energy and signal peaks of this nature of signal.

Although the curve in Fig. 4 is interesting, more useful are those curves which refer a given level of distortion to tape flux over the lower, middle and upper parts of the frequency spectrum. Since odd-order distortion predominates (particularly 3rd-order), the distortion measured is 3rd harmonic at l.f. (around 333Hz) and 3rd-order intermodulation distortion at upper-middle (4–5kHz) and h.f. (10–11kHz).

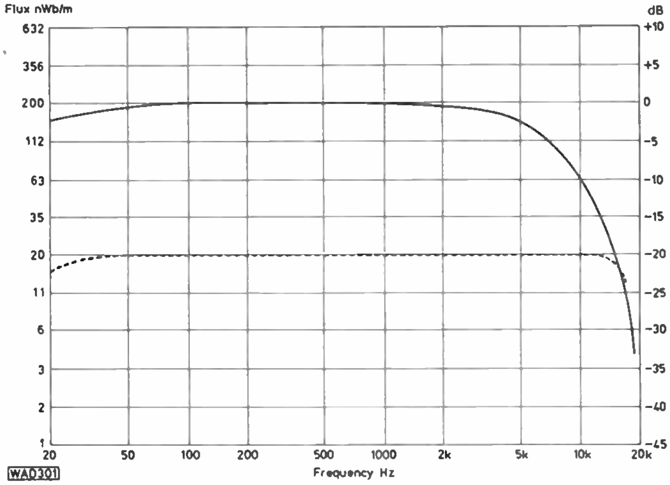


Fig. 4: Compression curve. The magnetic flux assimilated by a tape recorded at high level corresponding to 200nWb/m at 333Hz falls off with frequency as shown. To avoid the effect of compression, the frequency response is taken at a recording level at least 20dB below 200nWb/m, a curve shown by the broken-line is then achieved provided the bias and equalisation are set to suit the tape. If the bias is too low the upper frequencies will tend to show a boost, while if too high the upper frequencies will tend towards early roll-off

There is no difficulty in measuring 3rd harmonic at l.f., for at 333Hz it falls at 999Hz, which is well within the passband of the system. At upper-middle and particularly h.f., the 3rd harmonic is likely to fall outside the passband and be affected by the replay equalisation. To avoid this, two-tone driving signals are used of f_1 and f_2 and the 3rd-order IM products of $2f_1 - f_2$ and $2f_2 - f_1$ measured in ratio to the driving signals. Since there is a mathematical relationship between 3rd harmonic and 3rd-order distortion, perfect correlation is achieved provided due attention is taken of the difference between the crest factors of the single-tone and two-tone signals.

For hi-fi applications, an upper limit distortion threshold of 3 per cent would appear to be appropriate, so the plan, then, is to find the flux assimilation of the tape when used with a specific domestic machine (or batch of such machines—taking the average) over the spectrum for 3 per cent distortion threshold.

NEXT MONTH

Spectral distortion, bias and equalisation, head problems, noise floor and dynamic range

letters

The Editor,
PRACTICAL WIRELESS,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG

The letter from J. S. Goodier regarding Citizen's Band in the UK, which appeared in our December 1978 issue, provoked a flood of letters from readers. These were fairly evenly divided between "for" and "against" CB. Several writers took violent exception to Mr Goodier's suggestion that part of the 2 metre band should be allocated for novice use, as a substitute for a Citizen's Band in the UK. We print here a selection of the letters received.

Sir: I have recently returned from Australia, where Citizen's Band radio has been legal for just over a year. I feel, however, that the Australian service follows too closely the American service. I also feel that the biggest problem with these two services is that a licence is far too easily obtained, and that a bad frequency band and emission type have been employed. A CB service could be introduced in this country, with heavy modifications to the American system of licensing.

I think that the following would greatly reduce the problems of such a service:

1. Correct radio procedure should be used, with proper station identification at the beginning and end of each transmission; only normal speech should be allowed, such as would be used on the telephone, with no "10-codes", which seem to make up the total vocabulary of many CBers.
2. The 11 metre h.f. band should be maintained, but the frequencies used changed to, say, 26MHz–27MHz (11·538m–11·111m), thus avoiding any overseas contacts. This band can be used in its entirety, perhaps utilising v.f.o. controlled transceivers, and allowing plenty of space for everyone.
3. Emission should be s.s.b. only, avoiding a.m. heterodyning and giving less overcrowding and more signal clarity.
4. A maximum output of 15W p.e.p. to be allowed, with no directional or gain antennas of the beam or quad type.
5. Licensees would be required to undergo an examination on regulations, including possible interference problems and remedies, a procedural test, and show a basic knowledge of antennas for the frequencies used and their alignment.
6. A licence fee of £7 to £10 should be charged and a callsign allocated once the examination had been passed. A callsign could take the form SD123W, etc., where SD indicates the county, 123 is the licence number, and W is the initial of the town in which the licensee lives.

I feel that the "Toms, Dicks and Harrys" could be greatly reduced by the initial pre-licensing exam. There is obviously a demand for a service in the UK, so with the appropriate licensing conditions there is no valid reason for such a service to be denied to us.

Gerald Yates
Watcombe
Torquay

Sir: I do not think that Mr Goodier's idea of a novices' amateur band on 144·5–145·0MHz would be accepted by present 2m users. The code-free facility of the present G8-type licence should not be beyond the capability of any interested enthusiasts, and any lowering of the licensing requirements would certainly make channelised f.m. on 2m sound like CB.

Anyhow, quite a lot of the 144·5MHz region and upwards is used for s.s.b. contacts, and 144·90–145·0MHz is used for beacon facilities. As one amateur using s.s.b. on 2m and trying for beacons here in Ireland (both their reception from distant places and their establishment here too), I would not welcome private communication type facilities in the band.

We here in EI (Eire) have just been given the facility of a code-free v.h.f. licence, so we welcome the increased use of 2m throughout the country. Only a small percentage of present amateurs are active on v.h.f. here—the silence has to be heard to be believed.

Perhaps the supporters of a novice type band could try for additional frequency allocations in the v.h.f. spectrum, say, 100–105MHz, 220–225MHz, 400MHz, or some other unused band. Enthusiasm for private communications should be directed positively towards a technical service with technical requirements for operation, and also giving the home electronics industries a chance to manufacture the equipment. Re-crystalling of expensive imported 2m f.m. equipment should be made very, very difficult. CB on 27MHz has caused havoc in the USA, not only from the TV interference aspect but also by upsetting the balance of trade. A novices' v.h.f. band is a possibility for the UK.

Des Walsh EI5CD
Carrick on Suir
Co Tipperary

Sir: Why is it every now and then some crank wants to do something with 2m below 145MHz? First G3RKL wanted to put repeaters and channels for s.s.b. Letters in *Radio Communication* told him where to put them! Now a reader in Stockport wants it for CB.

The 2m band from 145MHz down is for amateur use—true amateur—with DX, RTTY, SSTV and all modes. If our reader gets a good 2m receiver and antenna, he will be able to hear these signals.

The only people we want on the air in G-land are those who have passed the RAE.

John Tye
Dereham
Norfolk

Sir: Your correspondent J. S. Goodier suggests that if a Citizen's Band was permitted in the UK "they will come in their millions".

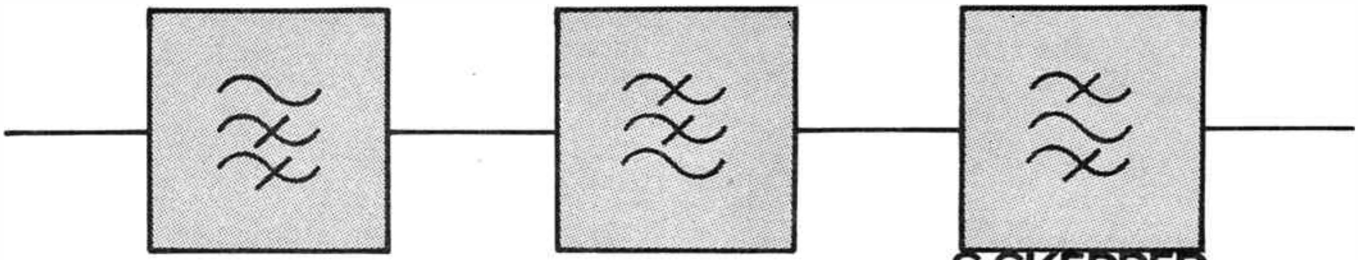
We must assume more than, say 1 million—perhaps as many as 5 million. If we take the price for an average 2 metre transceiver equipment, let's say £200, then the total market for 5 million sets will be worth £1000 million. On this will be charged 8 per cent VAT, which comes to £80 million. Good grief, man, what is the Chancellor of the Exchequer waiting for?

Who is fooling who? Cut the b******t and legalise what other sensible countries have already done.

J. Acton
Iver
Bucks

continued on page 67

SIMPLE AUDIO FILTER DESIGN



S.SKEPPER

Knowing how to design a filter for a pre-amp or mixer is a very handy thing if you do a lot of playing with audio circuits, but can be uphill work if your knowledge of maths does not extend a great deal beyond Ohm's Law. If you fit into this category then despair no more! To design passable (if you will pardon the pun) filter circuits, all one needs is a (modified) version of Ohm's Law (a pocket calculator helps, too!).

The simplest type of filter is the CR filter, so called because it uses only capacitors and resistors. Fig. 1(a) shows a low-pass filter, and Fig. 1(b) a high-pass filter.

Low Pass

The low-pass filter works like this: at low frequencies, the reactance (a.c. resistance) of C is much larger than the resistance of R, so the circuit functions as a voltage divider. Because the reactance of C (called X_c) is so much larger than R, the voltage dropped across R is very small, and the output is very nearly the same as the input. As the input frequency rises, the reactance C drops until, at a certain frequency called the cut-off frequency (abbreviated F_c), X_c equals R.

If we have a voltage divider composed of two equal resistors, then the output is exactly half the input. This is the frequency that gives the filter its name, e.g., we talk of a "10kHz low-pass filter", meaning it halves a 10kHz signal and rejects all frequencies above, because as the input signal rises above the cut-off frequency, X_c gets smaller and smaller and the output drops off correspondingly. When we design a filter, we have to take into account the input impedance of the amplifier or pre-amp, Z in the circuits.

Now let's design a filter. The three things we may know or may not know are C, R and F_c, so the three formulae for calculating them are shown below:

$$F_c = \frac{1}{6{\cdot}28 \times R \times C}$$

$$R = \frac{1}{6{\cdot}28 \times F_c \times C}$$

$$C = \frac{1}{6{\cdot}28 \times F_c \times R}$$

1. Design a scratch filter for an amplifier with an input Z of 100kΩ.

Scratch filters reject at about 15kHz, so we know F_c approximately. As a general rule, at F_c, R should equal Z, so we now know R; 100kΩ. All that leaves is C. From the above equation we get:

C in μF
R in kΩ
F_c in kHz

$$C = \frac{1}{6{\cdot}28 \times 15 \times 100}$$

$$= \frac{1}{9420}$$

$$= 0{\cdot}0001 \text{ or } 100\text{pF}$$

To check, work out the other two equations;

$$R = \frac{1}{6{\cdot}28 \times 15 \times 0{\cdot}0001}$$

$$= \frac{1}{0{\cdot}0094}$$

$$= 106\text{k}\Omega$$

$$F_c = \frac{1}{6{\cdot}28 \times 100 \times 0{\cdot}0001}$$

$$= \frac{1}{0{\cdot}0628}$$

$$= 15{\cdot}9\text{kHz}$$

Both results are near enough, considering we are only working to four decimal places.

High Pass

The high-pass filter (Fig. 1(b)), in the same way as the low-pass filter, has a point where the output is half the input: the cut-off frequency. Because the capacitor and resistor are inverted, the output rises as the frequency rises and so the circuit rejects frequencies below F_c. The equations for calculating C, R, and F_c are the same as for the low-pass filter.

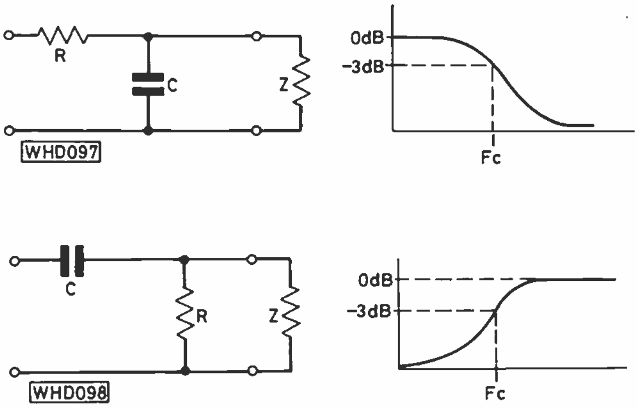


Fig. 1: Basic filter circuits and their response curves: (a) (Top) Low-pass. (b) (Bottom) High-pass

2. Design a rumble filter for a pre-amp with an input Z of 250kΩ. Rumble is mechanical noise from a record deck motor, and occurs at frequencies below about 25Hz, so we know F_c (25Hz) and R (250kΩ);

$$C = \frac{1}{6{\cdot}28 \times 0{\cdot}025 \times 250}$$

$$= 0{\cdot}025\mu F$$

Band Pass

Finally, let us look at band-pass filters. The simplest form of band-pass filter is shown in Fig. 2. It is simply a combination of Fig. 1(a) and 1(b). Band-pass filters are used for a variety of things, such as "middle" channel separation in tone controls, or combined rumble and scratch filters. The only limitation of this circuit is that the upper cut-off frequency, F_h, must be at least ten times the lower cut-off frequency, F_l, or interaction between the two circuits will occur, and the filter will not have a smooth response curve. Only two equations are given, as R = Z, and Z is usually known. Units are in kHz, kΩ and μF.

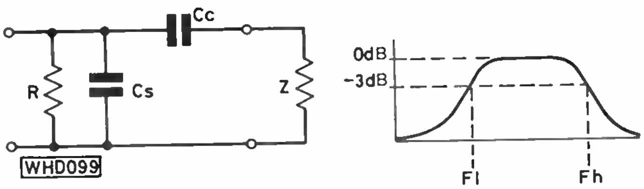


Fig. 2: A band-pass filter circuit and response

C_s determines F_h:

$$C_s = \frac{R + Z}{6{\cdot}28 \times F_h \times R \times Z}$$

C_c determines F_l:

$$C_c = \frac{1}{6{\cdot}28 \times F_l \times (R + Z)}$$

3. Calculate a combined rumble and scratch filter for an amplifier with an input Z of 50kΩ. R = Z = 50kΩ. F_h wants to be, say 12kHz, and F_l about 40Hz.

$$C_s = \frac{50 + 50}{6{\cdot}28 \times 12 \times 50 \times 50}$$

$$= \frac{100}{188\,400}$$

$$= 0{\cdot}0005\mu F \text{ or } 500pF$$

$$C_c = \frac{1}{6{\cdot}28 \times 0{\cdot}04 \times (50 + 50)}$$

$$= \frac{1}{25{\cdot}12}$$

$$= 0{\cdot}03\mu F$$

Phase Shift

The output signal from a CR network will always differ in phase (to a greater or lesser degree) from the input signal. Whether this is important depends on the application. In this introductory article, the effects of phase shift have been ignored. ●

KINDLY NOTE!

PW "Hythe" Receiver, February 1979.

IFT1 is Denco type IFT18/465.
IFT2 is filter type CFT455 from Ambit.
IFT4 is Denco type IFT13.

Referring to the circuit diagram Fig. 2, presets VR4 and VR5 appear on the overlay (Fig. 4) as VR1 and VR2 respectively.

In Fig. 2, L2 (collector of Tr3) is unmarked. The BZY88/C6V2 diode from the junction of R17/L2 to ground should be shown at D1 (not D3).

The following may help those who are having difficulty locating specialised components:

The Denco coils are available from Maplin or Watford Electronics; C. Bowes & Co. Ltd., 4 Wood Street, Cheadle, Cheshire (Tel: 061 428 4497) supply the p.c.b. Front panels may be obtained from D. J. Pattle, "Juniper", Hillbury Road, Alderholt, Fordingbridge, Hants (Tel: 0425 52081). The vernier drive is Home Radio Type DL66—it is necessary to re-calibrate the scale. Suitable knobs are available from Marshalls or West Hyde Developments. Instrument case Type BC2121 is from West Hyde Developments. The signal-strength meter is RS Components Type 259-561 from Ace Mailtronics. Where no address is shown, see index to advertisers.

Wimborne Music Centre, October 1978.

The 2N6133 power transistors are incorrectly shown as "2N6103". RCA type BRC6103 is suitable, but alternative complementary pairs may be fitted where supplies are short, TIP41A/TIP42A being an example.

Follow-up to PW Sandbanks METAL DETECTOR

P. J. WALES

The more experienced constructor, having built his "Sandbanks", may wish to increase its performance, and these notes are a guide as to how that may be achieved.

The locator works by transmitting a heavy magnetic field over the find (which we shall call the subject) and comparing the decay of that field in the subject, to the decay in the coil. Hence, if the rate of decay in the subject is faster than that in the coil, the subject will not be detected. Thus the first item to evaluate is the coil.

Energy Storage

To detect small and fast-conducting objects such as gold, silver or copper, the energy stored in the coil must be as low as possible. The energy is stored in three ways. First the magnetism, which we want as large as possible, secondly the inductance, which is very low in an air-cored inductor, and thirdly and most importantly, the capacitance, which has no effect other than to slow down the rate of decay of the magnetic field. The capacitance is produced by the proximity of the conductors in the coil, and they are only separated by the thickness of the insulating varnish, so a significant improvement can be obtained by insulating the wire used for the coil with a pvc sleeve. Greater gains can be obtained by winding the coil, with the extra insulation, in a neat manner so that the inside turns are as far away from the outside turns as possible. This leads us on to a flat coil which has about two-thirds of the capacitance of the wire bundle coil. However, it is very difficult to wind, but if you succeed, then Araldite the coil before potting it or the turns may move in the potting compound. By far the best solution is to use a printed circuit coil, as designed by the author and available from Plessis Electronics, Castle house, Old Road, Leighton Buzzard, Beds, which has a capacitance of about half that of a wire bundle.

Coil Shape and Size

The next stage in the coil design is to alter the size of the coil. Generally speaking, to maintain the same parameters within the machine, it is necessary to increase the number of turns when reducing the diameter of the coil. A small coil will locate objects very accurately, but its range is reduced. For greater range, the coil can be increased in diameter, and as a rough guide, doubling the coil size will double the range, within limits.

Square coils also have a lot to offer, because the range on a square coil is greater than that on a round coil of a similar size. Even greater range can be obtained by using a rectangular coil, and the optimum ratio of the sides is 4:1. One manufacturer of machines using the Pulse Induction principle offers a coil 1·83 × 0·48m (72 × 18in) as a standard with one of his detectors.

Modifications

Experimenting with coils for enormous range is very easy, but finding nails 3m under hard ground is not very rewarding, so stay within reason. In order to take maximum advantage of any reduction in coil capacitance achieved, it is necessary to reduce the time between the transmit pulse and the sample pulse, called the delay time. The shorter the delay time, the more sensitive the detector is to gold. The delay time in the PW "Sandbanks" is altered by changing the value of R31 and R32. It is easiest to replace these two with 47kΩ presets during tests, putting in suitable resistors when a satisfactory performance has been reached. It is best to check the delay time using a double-beam oscilloscope, but lacking one of these, the control VR2 should be set to its midpoint and VR1 adjusted to ensure that the output of the 709 is at 0V. Then reducing the added presets until the speaker just starts clicking ensures the optimum delay time.

Internal Delays

It may be argued that the internal circuits produce their own delays and this is certainly true, but the circuit has a fall time of 3 microseconds and this is quite fast enough. No improvement was obtained with a £4·50 r.f. power transistor and low-capacitance diodes. The capacitance at the coil connections was measured as 231pF and an ordinary coil as 681pF. Reducing the 100Ω resistor R7 will reduce the decay time but it will also reduce the current in the coil and its damping effect will alter, so leave it alone.

When you have wound the coil that meets with your requirements, do not forget to waterproof it and make it rigid. If it is left loose, the machine will drift all over the places as the coil capacitance changes when the coil moves.

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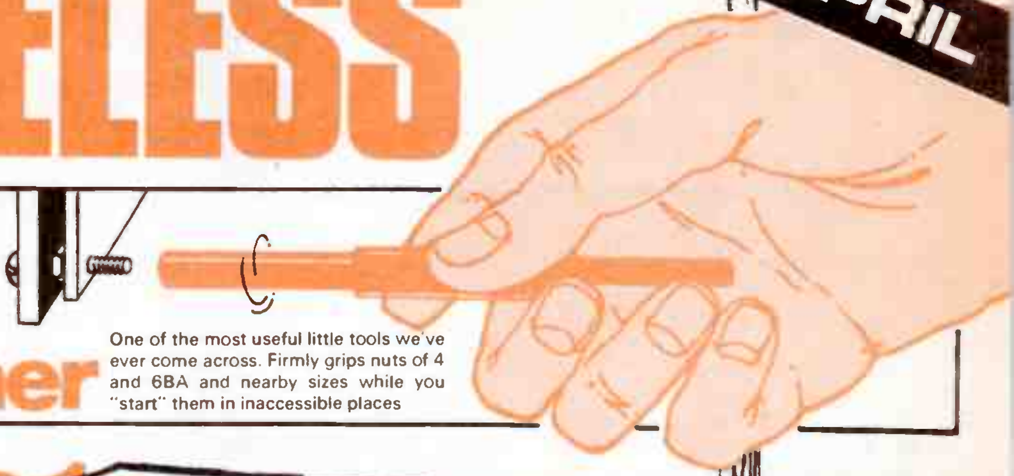

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This article describes the construction of a miniature, high-performance v.h.f. receiver for narrow-band frequency modulation, based on the Plessey SL6640 integrated circuit. The SL6640 is a complete i.f. strip, detector and audio system for n.b.f.m., requiring the minimum of external components. It consumes only 3·5mA of current in the standby mode and can produce 200mW of audio.

The receiver is so simple that it may be built even by the relatively inexperienced, and yet it gives a professional account of itself, with a sensitivity better than 0·4µV for a 20dB signal-to-noise ratio. Physically, the module is only 46 x 82mm (1·8 x 3·2in) and although the details given are for operation within the 144MHz (2m) amateur band, the receiver will easily tune to marine v.h.f. channels, and could be used to keep a watch on, say, channel 16, the distress and calling frequency. In this respect it would be a useful project for the yachtsman or small boat-owner, and is licensable for use on board such vessels.

VHF MONITOR RECEIVER

*James M. BRYANT B Sc

The circuit diagram of the complete receiver is given in Fig. 1. It can be seen to consist of a double-tuned input arrangement feeding a dual-gate m.o.s.f.e.t. amplifier with a gain of 18dB. Another double-tuned circuit couples the amplifier to a second dual-gate m.o.s.f.e.t. which acts as a mixer whose conversion gain falls around 12dB. The local oscillator uses a *pnp* v.h.f. transistor in an overtone configuration.

A crystal filter, specially designed by Cathodeon, filters the 10·7MHz signal and then passes it directly to the

* *Applications Manager, Radio Communications Group, Plessey Semiconductors, Cheney Manor, Swindon Wilts*

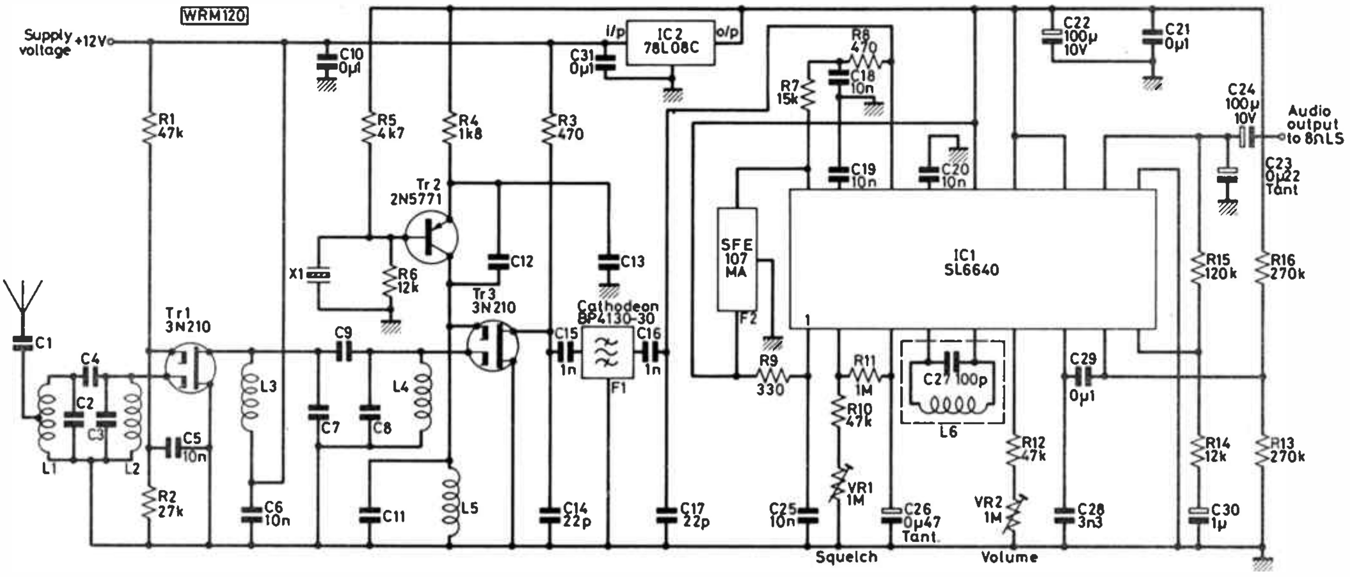


Fig. 1: Complete circuit diagram of the single-channel version of the receiver

SL6640, which performs the functions of i.f. pre-amplifier, main i.f. limiting amplifier, quadrature detector, squelch and audio output stages.

Dual-gate m.o.s.f.e.t. devices were selected on the grounds of their good noise (about 4–6dB) and intermodulation performance. They will cope with large off-channel signals with the minimum of intermodulation distortion. Prototypes used the 3N210 in a plastic encapsulation, but 3N211, 3N201 or 40673 devices in the metal TO-72 packages will fit the board and work equally well.

Only five components, in addition to the capacitors and inductors of the tuned circuits, are employed in the r.f. amplifier: the m.o.s.f.e.t., two resistors to bias gate 2 of the m.o.s.f.e.t. and two decoupling capacitors. Standard Toko coils are used throughout, and the small ceramic capacitors are of ITW manufacture. At 2m, C2 is 12pF, C3–6·8pF, C7–8·2pF and C8–6·8pF. *Note that C4 and C9 are not "real" components, but represent stray capacitance.*

A 2N5771 *pnp* transistor has been chosen for the local oscillator. This reduces the number of devices necessary in the circuit, as the collector load coil is at d.c. ground potential and hence no coupling or bias components are needed for the second gate of the mixer m.o.s.f.e.t.

The oscillator is very simple and reliable, using only nine components. Any additional expense incurred by the selection of overtone crystals is easily justified against the increased complexity and power consumption of multiplier stages.

In the case of a 2m receiver, C12 may have to be omitted or may be found to be as large as 1·8pF, a certain amount of experimentation being necessary to determine the optimum value. Capacitor C13 will not usually be required; C11 is 6·8pF and L5 a Toko S18/301–SN-0300.

Using 7th or 9th overtone crystals can lead to oscillator starting problems, but this circuit has been rigorously tested and found to be completely reliable, provided the supply voltage remains stable. Crystal frequencies are calculated from the formula:

Crystal frequency = Carrier frequency minus 10·7MHz

If the receiver is required to work on more than one channel, some sort of d.c. switching will have to be evolved, as long leads are not permissible. Such techniques will be found to complement the use of scanners. A suitable method is shown in Fig. 2, where the diodes should exhibit low-capacitance characteristics, such as the 1N4313.

The mixer consists of another dual-gate m.o.s.f.e.t. with both gates at d.c. ground. Signals are applied to gate 1, whilst gate 2 is connected to the oscillator tank circuit, which drives it with about 2 volts r.m.s. of r.f. Better conversion gain and a lower local oscillator could be achieved by biasing gate 2 between 2·5 and 4·5 volts, but this would degrade the strong-signal performance of the front-end.

Two signals of 100mV, one 50kHz and the other 100kHz off-channel, could be tolerated by the prototypes without receiving an intermodulation product. Never-the-less, an even better performance may be obtained by sacrificing some front-end gain—and therefore sensitivity.

The mixer drives a crystal filter, designed specifically by Cathodeon for this receiver, which has a relatively low terminating impedance of 470Ω at 25pF—eminently suited to the output of the dual-gate m.o.s.f.e.t. and the input of the SL6640. Other filters, some appreciably cheaper, are acknowledged as being available, but will almost certainly present the constructor with problems, due to their different terminating impedances. Although C14 and C17 may be changed if necessary, it is not possible to increase the value of R3 and R8 above 820Ω without upsetting the operation of both Tr3 and IC1. A reduction of their values, on the other hand, will cause the gain to deteriorate.

From the filter, the signal is applied to the pre-amplifier input (pin 16) of the SL6640, which has a gain of 46dB and an output impedance of 330Ω. This matches the interstage ceramic filter between its output (pin 18) and the main i.f. amplifier input (pin 14). The pre-amplifier is biased, via R7 and R8, from its own output: R8 sets its input impedance and C18 decouples the bias line. Similarly, R9 and C25 provide bias and decoupling for the main i.f. amplifier input.

The interstage filter is intended only to limit broadband noise within the i.f. and not to determine the receiver pass-band. Thus an inexpensive ceramic device is employed for this purpose.

About 60dB gain is available from the i.f. amplifier, giving the SL6640 in total an overall sensitivity of about 10μV. Such high gain makes bias decoupling essential and this is achieved by C19 and C20. The output of the main i.f. goes to the quadrature detector and squelch system.

The squelch works by detecting the amount of limiting in the i.f. amplifier, pre-set VR1 determining the operating threshold. This control could be panel-mounted, if required.

Resistor R11 sets the hysteresis of the squelch—that is, the amount by which the signal must drop in order to mute the receiver. With R11 at 390kΩ and an 8 volt supply this is about 7–9dB. A reduction to 4–6dB is possible by increasing R11 to 1·5MΩ.

The muting arrangements control power to the detector and audio stages. In the absence of a signal they turn off, reducing the total current drain to around 3·5mA. Under "signal applied" conditions, the current consumption would be in the region of 8mA plus the amount drawn by the audio output stage.

A squelch output is also present on pin 3 of the SL6640, which is "high" in the absence of a signal and "low" when a signal is detected. This logic may be employed to control a scanner, if a multi-channel receiver is ultimately constructed, or to illuminate a l.e.d. status indicator (Fig. 3). The inclusion of C26 on pin 3 prevents the squelch fluttering if rapid changes of signal level occur.

The detector is self-contained, with the exception of the quadrature coil (Toko) connected between pins 4 and 5. Plessey Semiconductors SL6640 i.c. is intended for narrow-band f.m. applications and should not be confused with such devices as the CA3089, TBA120 and CA3189, which are essentially for the domestic market and similar wide-band situations. It works well even with 10·7MHz i.f.s, as the Q of the quadrature coil is not loaded by the resistance of the i.c. Signal-to-noise ratios of 50dB for 2kHz deviation with a 10·7MHz i.f. can easily be achieved, whilst to produce the same performance from, say, a CA3089 would require either a 455kHz i.f. or a crystal quadrature element.

The detected audio is routed via a d.c. "volume control" (VR2) to the a.f. output stage. Any residual r.f. is filtered out by C28, C29 being used for interstage coupling. The potentiometer VR2 would normally be located on the front panel. Note that the output is at its highest when the resistance of this control is at *maximum*.

The a.f. output stage is biased by R13 and R16, negative feedback being applied via R14, R15 and C30. Overall gain can be varied by altering the value of R14, but this should not be reduced to below 1·2kΩ, if excessive distortion is to be avoided. Up to 200mW output is possible with the 8 volt supply. Any h.f. instability is decoupled by the tantalum capacitor C23.

The receiver module is powered from an 11–15 volt supply, which is reduced to 8 volts and regulated by IC2 for the crystal oscillator and the SL6640. Decoupling is provided in several places by 0·1μF ceramic capacitors. If the supply source impedance is likely to exceed 2Ω, l.f. decoupling may also be a necessary—a capacitor of a few hundred microfarads being called for.

Readily-available components were part of the design philosophy, so this aspect should present no problems to the constructor. The printed circuit board uses minimal-inductance layout techniques which are very effective at v.h.f. and quite easy to assemble. *Note that plated-through holes are necessary and all components should be mounted as close to the board as possible.*

The alignment of the receiver is fairly simple, but of course if the constructor has access to an r.f. milli-voltmeter and a good oscilloscope really professional performance can be attained.

Alignment

Initially the crystal oscillator coil L5 is adjusted for maximum output, consistent with reliable starting. To avoid loading the oscillator, the test probe should be connected to the drain of the m.o.s.f.e.t. Tr3 (mixer): coils L1, L2, L3, L4 are adjusted in turn for maximum gain from the aerial input.

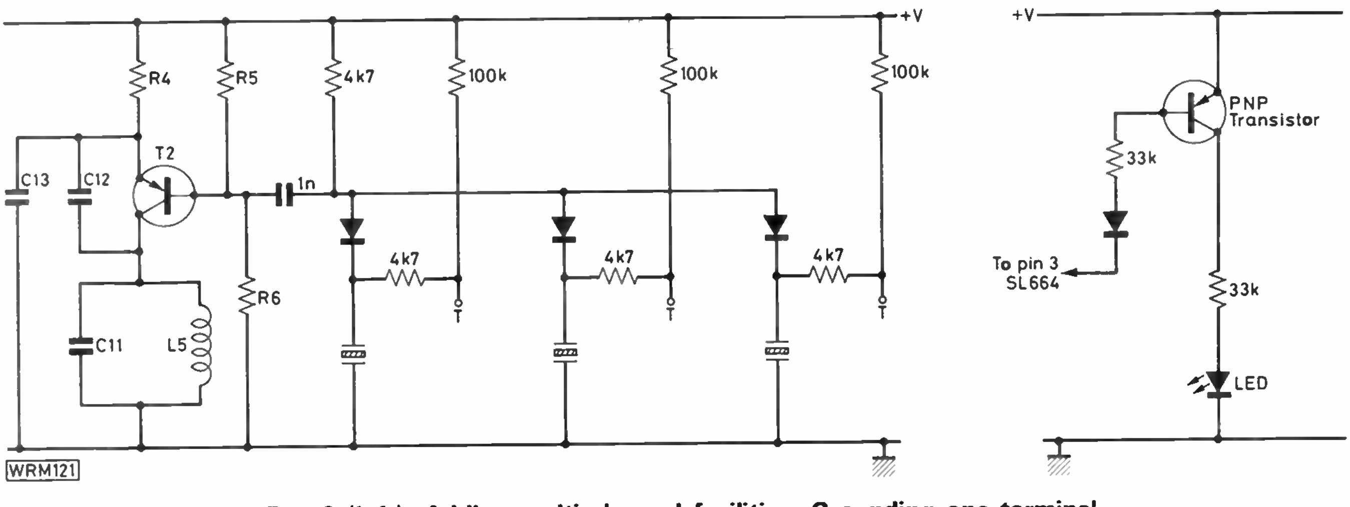
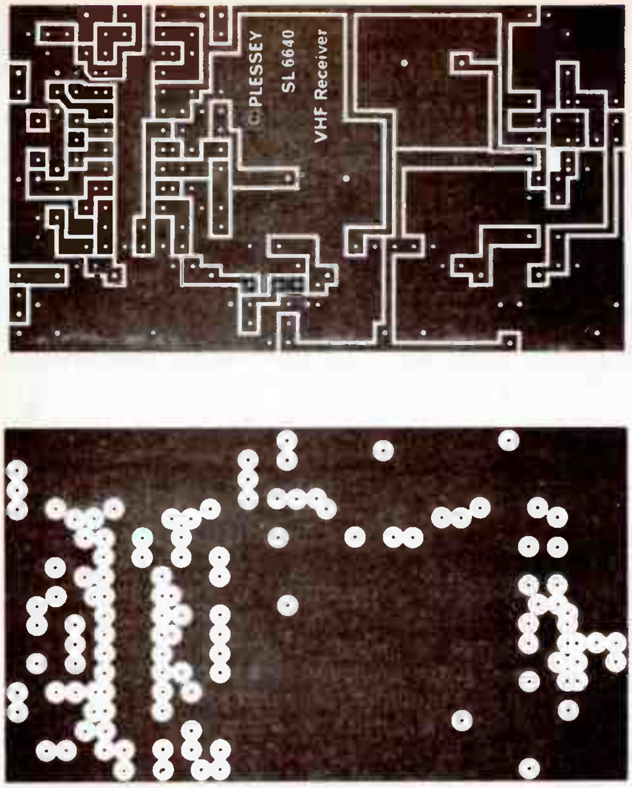


Fig. 2 (left): Adding multi-channel facilities. Grounding one terminal "T" activates the associated crystal

Fig. 3 (right): Driving a l.e.d. squelch indicator requires this simple buffer stage



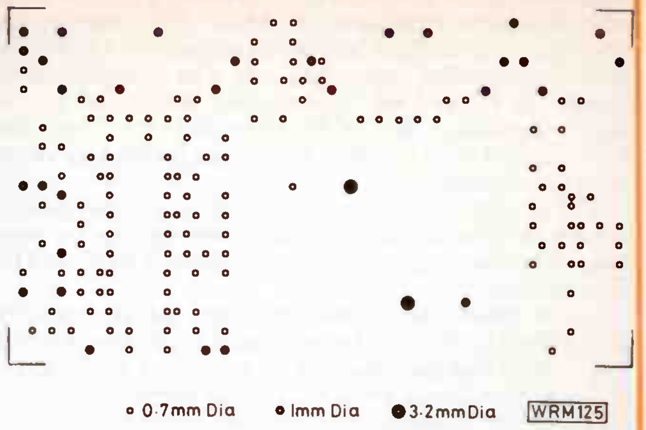
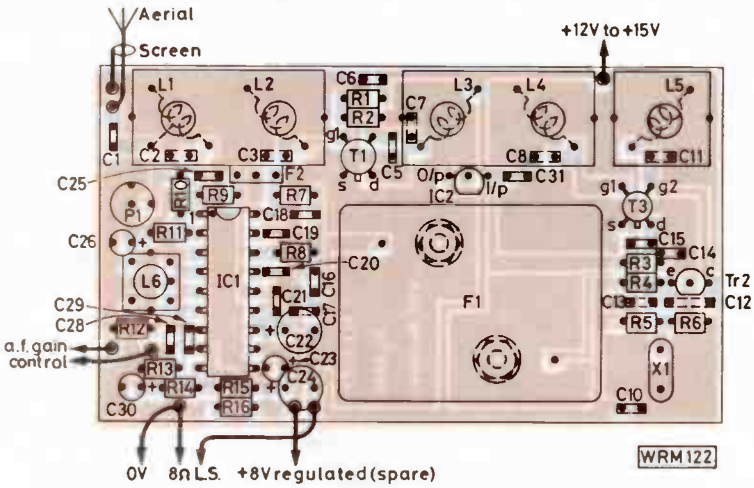


Fig. 4 (left): Full-size track patterns for the p.c.b. showing non-component side (top) and component side (bottom)

Fig. 5 (above): Drilling drawing for the p.c.b.

Fig. 6 (below): Component layout. The ground-plane pattern on the component side of the board is shown in orange tone



Feed a 10·7MHz frequency-modulated signal to the input side of the crystal filter. Now, with full audio gain and minimum setting of the squelch resistor, tune the quadrature coil for minimum distortion at the output. If clipping occurs, back off the audio gain slightly.

Adjustment without instrumentation is, of course, somewhat less precise. Never-the-less, acceptable results can be obtained and lack of test equipment should not deter the constructor from building this project.

With the presence of a strong v.h.f. signal, tune the local oscillator coil L5 until it is heard at maximum volume and minimum distortion. Having done this, turn the power on and off several times to ensure that the oscillator will always start.

Next, set the quadrature coil for minimum apparent distortion with the squelch potentiometer at minimum resistance. Then reduce the strength of the alignment signal, perhaps by using progressively smaller aerial lengths, tuning L1, L2, L3 and L4 at each stage for the best signal-to-noise ratio.

Finally, the squelch control is set so that muting occurs when the signal-to-noise ratio becomes unacceptably low.

★ components

Resistors

$\frac{1}{8}$ *watt carbon*

330Ω	1	R9
470Ω	2	R3, 8
1·8kΩ	1	R4
4·7kΩ	1	R5
12kΩ	2	R6, 14
15kΩ	1	R7
27kΩ	1	R2
47kΩ	3	R1, 10, 12
120kΩ	1	R15
270kΩ	2	R13, 16
1MΩ	1	R11

Potentiometers

**Miniature, round, linear law preset. Plessey type 416*

1MΩ	1	VR1 mute threshold

Miniature log law, panel mounting

1MΩ	1	VR2

Capacitors

***ITW type M2 monolithic*

22pF	2	C14, 17 (but see text)
1nF	3	C1, 15, 16
3·3nF	1	C28
10nF	7	C5, 6, 10, 18, 19, 20, 25

Ceramic Plate

0·1µF	3	C21, 29, 31

Tantalum Bead

0·22µF	1	C23 35V type
0·47µF	1	C26 35V type
1µF	1	C30 35V type
100µF	1	C24 6V type
100µF	1	C22 10V type

Note: C2–4, 7–9, 11–13 see text C27 is part of coil assembly.

Filters

****BP4130–30	1	F1
SFE10·7	1	F2 (Ambit)

Semiconductors

Transistors

3N210	2	Tr1, 3 (or 3N201, 3N211, 40673)
2N5771	1	Tr2

Integrated Circuits

***SL6640	1	IC1
µA78LO8C	1	IC2

Crystal(s)

*****7th overtone, Type WW239

Inductors

Toko S18/301 –SN-032	1	L1 (Ambit)
Toko S18/301 –SN-0300	4	L2–5 (Ambit)
Toko 85–4402SEJ	1	L6 (Ambit)

Printed Circuit Board

The special p.c.b. for this project is available from Ambit International. Kelan Engineering Ltd., 27–29 Leadhall Lane, Harrogate, Yorkshire HG2 9NJ. Tel: 0423 879126, are also able to offer a multi-channel option, using 3rd overtone crystals.

Hardware

Two double coil screening cans are required for L2-L3, L4-L5 and a single can for L1. These are obtainable from Ambit International.

COMPONENT SOURCES

*Preset available from Ambit International.

**ITW capacitors available from ITW Electronics, Darville Ho., 4 Oxford Road East, Windsor, Berks and Ambit International.

***SL6640 available from Catronics or Ambit International.

****BP4130–30 available from Cathodeon Crystals Ltd, Linton, Cambridge CB1 6JU. Tel: 0223 891501.

*****7th overtone crystals available from Webster Electronics, Rose Mills, Hort Bridge, Ilminster, Somerset TA19 9PS. *Important:* specify crystal Type WW239 with channel (carrier) frequency *and* crystal frequency (carrier minus 10·7) when placing order.

With a calibrated signal generator, this point should be between 0·15 and 0·5µV—however, it is preferable to set the squelch to a signal-to-noise ratio, rather than to an absolute input voltage.

No instrument case or mechanical details are given for this project, but the receiver is a complete module, requiring only the addition of a battery, volume control, squelch control and small loudspeaker as external components. It could therefore easily be constructed within an existing receiver, using the incoming v.h.f. signal to mute and over-ride the normal programme. For example, the marine version on channel 16 could mute an m.f. signal, or indeed another v.h.f. signal, thus giving priority to channel 16 traffic. On the other hand, it could easily be a self-contained unit.

Multi-channel Conversion

If coverage of more than one channel is necessary, then the circuit of Fig. 2 can be regarded as a working basis, and could probably be accommodated on a small sub-assembly. If a multi-channel facility is decided on at the outset, a small extension could possibly be made to the printed circuit board.

The 7th overtone WW239 crystals are relatively expensive, but on the other hand the end-product will hold its own with many professional receivers of its type. The original design work for this project was carried out for a specific professional application, and the specification of this version has in no way been degraded. ●

Wireless went to War

Ron HAM

In the 1830s, Samuel B. Morse invented a code which was used by signallers to convey military information along thousands of miles of telegraph lines during the American Civil War (1861–1865) and, some 40 years later, Alexander Graham Bell's telephone was extensively used by both sides throughout World War I.

To find out more about communications during that war, the author spoke to several old-timers who were there. One, Bert Knight, now 90 years old, a veteran of the Rifle Brigade, remembers seeing telephone cables at Ypres being laid from a large drum, mounted on a limber drawn by a team of horses, and signalmen in dugouts wearing headphones. However, this means of communications had its drawbacks because, the cables, whether overhead or underground, were vulnerable to secret tapping by enemy signalmen, calculated cutting of the wires, and being totally destroyed by artillery bombardment.

During the last decade of the 19th century, men like Edouard Branly, Oliver Lodge (later knighted), and Guglielmo Marconi, to name a few, were pioneering a means of transmitting both the Morse code and the human voice over great distances without wires. Before their ideas were fifty years old, wire-less communications (later called radio) was used during two world wars on land, sea and in the air.

The Great War

Wireless during the 1914/18 war rested mainly with the electric spark transmitter and receivers, using a coherer or catswhisker and crystal detectors and, for amplification, a limited range of bright-emitter (triode) valves, so called because their high filament current produced a lot of light.

Wireless installations were also vulnerable to enemy action, mainly because the high aerials required gave away the position of a signals unit to enemy spotters. Also, the noise from the transmitter spark gap and the receiver tuning buzzer could be heard for some distance on a quiet night.

The late Bill Longmire, G3TKL, joined the signals section of the 26th Canadian Battalion in 1914 and after three months training had to pass in Morse at 12 w.p.m. with buzzer, lamp and heliograph, and in semaphore and flags. "Serving in France in 1915," said Bill, "I found that war was a bloody business and that communications (by land-line) were not only most important but also dangerous." He used a "D3" telephone set, phone and Morse, with a single-strand wire and an earth return. Later, Bill transferred to the Canadian Corps wireless section to learn the basic facts of radio and then was selected for a special, three week, training course in London. At the end of the course, a team of three could erect an aerial consisting of a 100ft long wire on two 24ft masts, with guys, earth rods and counterpoise, in under five minutes. On returning to France, Bill saw action at Vimy Ridge, and was told to set up a wireless station on a front where shell fire kept land lines out of action. For such an advanced post Bill said: "An NCO and two men with a 24-hour watch and frequent checks with headquarters station, were required. Usually we had a 2–3 week stretch in the line if the enemy was not too active."

The trench set illustrated in Fig. 1 consists of a spark transmitter, spark-gap and coil at bottom right, and a crystal detector receiver on top, with its tuning buzzer on front left. The output meter, stud-type aerial matching switch and Morse key are mounted on the top panel, all beautifully engineered and housed in a mahogany cabinet. Bill said that this type of set, plus six 6 volt storage batteries, aerial masts and earth mat was the equipment used in an advanced station. When possible, they tried to select a site for the station which was concealed from the enemy and had easy access from the rear for delivery, by carrying party or mules, of their food and replacement batteries.

Most messages were passed in cypher, code words and callsigns being changed daily, their lighting was by candle and heating by coke. Around midnight, the news could be

Fig. 1: 50 watt Trench set made by the Marconi Company

copied from Poldhu, Cornwall; Eiffel Tower, Paris; or Naum, Germany. "The extra copy taken to the local infantry or artillery cook-house was always good for a handout," said Bill, but Passchendaele was an exception. "Ten days in, four operators and self, one killed, four wounded, but station was able to handle all traffic in spite of the antenna being shot down eight times."

Wireless in the Air

Mark Denny, G6DN, said: "Before the war many amateurs became proficient in Morse by following a programme which started with a session of listening to the Eiffel Tower news bulletin, which was sent at 12 w.p.m. with a T1 note. Then followed a period of receiving the news from a German station at about 15 w.p.m. The final achievement was the ability to copy Cleethorpes Naval Station weather report sent at 10pm each day. This was initially at 20 w.p.m. and repeated at 25 w.p.m." At that time the Navy required aspirants for entry to their W/T branch to copy, for five minutes, without error, a message in clear at 25 w.p.m.

In 1914, Mark entered the Royal Navy as a Wireless Telegraphist and in 1915 was commissioned in the (Army) Royal Flying Corps, later the RAF. While in the RN he was posted to a Naval Airship Station and along with a group of W/T matelots had to unpack and assemble the wireless equipment for airships, which consisted of a "Stirling" spark coil and a Marconi crystal receiver plus a hand-operated winch containing over 300ft of wire, with a lead weight attached, for the aerial. Mark said: "We were ordered to install the apparatus in the airships and to assemble a ground station without delay. Our difficulty was that, whilst every material item necessary was provided, no written instructions or wiring diagrams were available. This is where our amateur, pre-knowledge of radio helped and we were on the air to the C/O's satisfaction."

The author showed Mark Denny a photograph of the Marconi transmitter in Fig. 2 and he recognised it as the type he used in the RNAS airships and in the RFC and said: "I used to feel rather apprehensive when adjusting the tuning clips on the helix, considering the thousands of cubic feet of hydrogen gas just above your head."

Their best DX from air to ground was a QSO with Malta Naval Station from the English Channel, using a half-inch spark coil. Sending Morse messages by spark, situated only a few feet below a gas bag, was one of the hazards of life in those days.

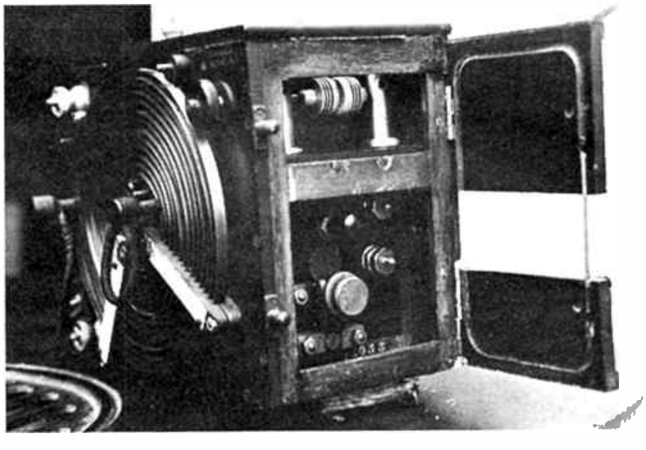


Fig. 2: Marconi spark transmitter from World War I

Fig. 3: Short-wave Tuner, Mark III made by Johnson and Philips

Aerial Installation

As a wireless officer in the RFC, Mark saw active service in France. At one stage he was supplied with portable sets, especially flown out from England for the use of certain gentlemen who were deposited over the lines, and later he listened to their transmissions. Soon after he established listening posts in "No Mans Land" and still has his pass permitting him to advance in front of the front line. Like Bill Longmire with his 24ft masts, Mark also had aerial problems to solve. While in France, they used steel rods which were a loose fit in their rifle barrels, and marched down a village street firing these rods with cords attached over opposite houses. On joining the cords with aerial wire, they soon had an excellent antenna.

Later, back in England, Mark put up the first ground-to-air telephony stations for the Air Defence of Great Britain, which involved getting up in the early hours, before the traffic was about, because one antenna was across Horse Guards Parade, from the Foreign Office to the Horse Guards building in Whitehall, and from the Horse Guards to the War Office, just over the road in Whitehall.

The late John Clarricoats, G6CL, referring to the RFC in the *T & R Bulletin* (then the journal of the RSGB), December, 1939, wrote: "The chief job of the 1915–1918 wireless operator was to act as "the ears" between a roving plane and the battery to which he was attached; his equipment was primitive (usually a Mark III tuner) and his only means of communication with the observing machine was by means of "white" ground strips which, sad to relate, seldom lived up to their name." Mark Denny also remembers the Mark III tuner, as the set supplied to them on the Western Front, and used by RFC wireless operators in their dugouts in conjunction with the Royal Artillery batteries.

The Wireless Reserves

In the 21 years which elapsed between the two world wars, radio made fantastic strides both in broadcasting and short-wave communications around the world, and it is well-known that amateur radio enthusiasts played their full part in both fields.

With the war clouds gathering again in the early 1930s, the authorities, knowing there would be a need for trained wireless operators if war came, once more called upon the amateur radio enthusiasts for assistance. On August 26, 1932, *Wireless World* commented: "At last British wireless amateurs are to be given the opportunity to assist His Majesty's Forces"; when they reported that: "The Secretary of the Admiralty announces the institution of a Royal Naval Wireless Auxiliary Reserve (RNWAR) in Great Britain and Northern Ireland, to be recruited largely from Wireless Amateurs owning transmitting sets." One of the objects of the RNWAR was, "to provide a reserve of operators trained in Naval procedure, for Naval service afloat or ashore in war or emergency."

The setting up of this organisation was the result of careful work by officials of the Admiralty and the Radio Society of Great Britain, as was the establishment, by the Air Ministry, in September, 1938, of the Royal Air Force Civilian Wireless Reserve (RAFCWR). The announcement, by the Air Ministry, reported in *Wireless World*, December 29, 1938, made it clear that the CWR was to "consist largely of amateur experimenters which would, if the need arose, provide a reserve of personnel experienced in the operating procedure of the RAF." Both the RNWAR and the RAFCWR attracted several thousand radio enthusiasts from all walks of life. They divided the United Kingdom into areas where small groups could train to the required military standard. Experimental sections were manned by experienced radio amateurs who dealt with the design of transmitters and receivers to meet a particular section's needs; and all in harmony with the signals branch of their respective service.

JANUARY 26th, 1939. Wireless World

NATIONAL WIRELESS REGISTER

THE MINISTRY OF LABOUR is issuing a booklet giving the details of various services which are essential for the defence of our country, and is asking members of the public to volunteer their services so that the whole efforts of the country may be rightly directed. Every individual can then be put to that task for which he is most fitted by previous training. A large percentage of readers of "THE WIRELESS WORLD" possess technical qualifications which in many cases have been acquired from years of training and practical experience. In the event of a state of emergency arising, the defence services of the country will have a great need of wireless operators, teleprinter operators, and technical personnel capable of caring for and repairing wireless and light electrical apparatus. During the Great War the needs of the Services for operators were largely met, especially during the early stages by the voluntary enlistment of trained Post Office operators, but as Morse is no longer used in the Post Office, this possible source of supply is rapidly dwindling. It is therefore imperative that all our readers who have at least a good working knowledge of Morse or have other qualifications such as ability to service and repair wireless and electrical apparatus, should apply to help fill the vacancies which now exist in the R.N.V.(W.)R., the Royal Corps of Signals, T.A., and the R.A.F.C.W.R.

Such applications will enable much valuable time to be saved and will facilitate volunteers being in their right position at the right moment if the necessity arises.

Readers who are not at present in a position to volunteer in the above-mentioned Services are asked to complete the Questionnaire which is reproduced below, and post it without delay. From the answers to this Questionnaire a register of wireless experts who are willing to serve their country should an emergency arise will be compiled in conjunction with the Wireless Telegraphy Board. This Register will be regarded as confidential and the information contained therein will only be made available to the Defence Services.

1 Name in full (in capitals) ....
2 Permanent address ....
....
3 Age ....
4. State whether British by
(1) Birth ....
(2) Naturalised ....
(If naturalised, state former nationality and date of naturalisation.)
5. Give particulars of any technical degrees or other recognised qualifications ....
....
6 In which of the following categories would you place your qualifications —
(1) Research and design of wireless apparatus ....
(2) Servicing and tracing faults ....
(3) Construction of apparatus from blueprints and designs ....
(4) Wireless operating State number of words per minute ....
(5) Teleprinter operating ....
7. Have you a sound knowledge of wireless theory and the ability to read circuit diagrams? ....
....
8. Have you had war experience, if so, give brief details ....
....
9. Are you already liable for service with any Force or Organisation? (If so, state particulars) ....
....
10. Have you any preference for service in either the Navy, Army or Air Force? ....
11. Are you physically fit? ....
12. Present occupation ....

Fig. 4: National Wireless Register, published in *Wireless World* on 26 January, 1939

National Wireless Register

Both the RSGB, through their journal, *The T & R Bulletin*, and *Wireless World* frequently reported the progress of the Wireless Reserves and, furthermore, *Wireless World* did much to find out what radio skills were available among their readers that would be of use to the armed forces in the event of war.

In their editorial on January 26, 1939, *Wireless World* comments: "In the event of an emergency which would require everyone to put himself at the service of the Country, the moment will arise when every individual will ask where he can offer his services so that such qualifications as he may possess will be of greatest value." As a pull-out in the same and some subsequent issues, *WW* enclosed a printed OHMS form, addressed on one side to . . . Secretary, Wireless Telegraphy Board, c/o Admiralty, Whitehall SW1, and with a general and technical ability questionnaire on the other. This document, Fig. 4, was

continued on page 60

THE PW 'WINTON' Stereo Amplifier

Part 2

E.A.RULE

As the p.c.b. must be mounted into the chassis before the other parts, we will start construction by assembling the components onto the boards.

The leads of the components should be preformed and inserted into the holes, as shown in the component overlay Fig. 7. Turn the p.c.b. over so that it rests on a sponge or foam mat, which will then hold the components in close contact with the p.c.b. while they are soldered into place.

Coils

Before assembling the main p.c.b., the two coils L1a and L1b should be made up as shown in Fig. 6. Each coil consists of 30 turns of 18 s.w.g. insulated wire wound in three layers of ten turns each. The internal diameter of the first layer is 8mm. If masking tape is wound over each layer after winding, the turns will stay in place while the next layer is wound. When the coil is completed the 1W 10Ω resistor is fed through the centre of the coil and the leads soldered to the coil as shown. The coil ends are then opened out to a spacing of 22·5mm to fit the p.c.b. It will, of course, be necessary to scrape the insulation from the coil ends before soldering.

Assembly should start with the terminal pins, which will be a tight fit and can be tapped into place with a light hammer, but you must support the p.c.b. from behind when doing this. Insert them from the top of the p.c.b. and then turn the board over and solder the pins to the track.

Once the pins are in place, the suggested order of assembly is resistors, small capacitors, transistors, electrolytics, switches, etc.

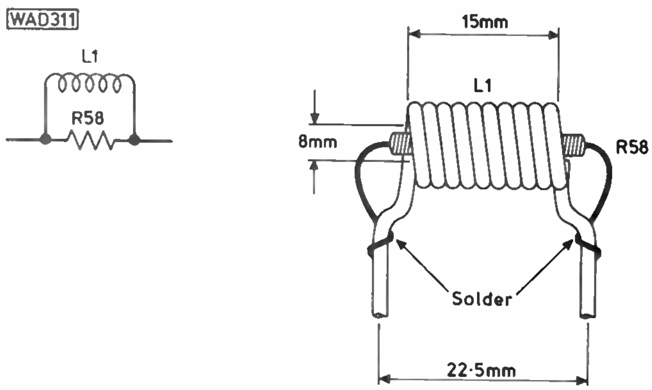


Fig. 6: Winding details of the two coils L1. Internal diameter 8mm; Length 15mm; 3 layers of 10 turns each (Total 30 turns) 18 s.w.g. enamel copper wire. R58 is 10Ω 1W carbon resistor

Switches

Be sure to mount all electrolytics the correct way round as indicated on the overlay. This also applies to diodes and i.c.s. When fitting the push-button unit to the p.c.b., first make sure that all the pins are straight, then "walk" the pins into the holes by starting at one end of the switch with the switch at a slight angle to the p.c.b. and gradually lower the switch pins into the holes as the switch is levelled out. Make sure that the switch is parallel to, and in close contact with, the top of the p.c.b. before soldering the pins to the track, otherwise the push-buttons will not align with the front panel holes.

Use only the components specified as only then will the specification, of which the Winton is capable, be achieved.

Chassis

The main chassis is made in the form of an inverted "U" from aluminium sheet and the overall size required, before bending, is 462 × 298mm + twice the bend allowance for the thickness of metal used, i.e., 462 × 300mm when using 1·2mm thick (18 s.w.g.) aluminium. Most d.i.y. suppliers will cut aluminium to size for a small charge, and it is well worth having this done as it will save work and ensure a "square sided" chassis. The author used aluminium of 2mm (16 s.w.g.) thickness for the main chassis but has access to a bender capable of folding this thickness. Unless a suitable bender is available, the 1·2mm material will be found easier to work with and will still provide adequate strength.

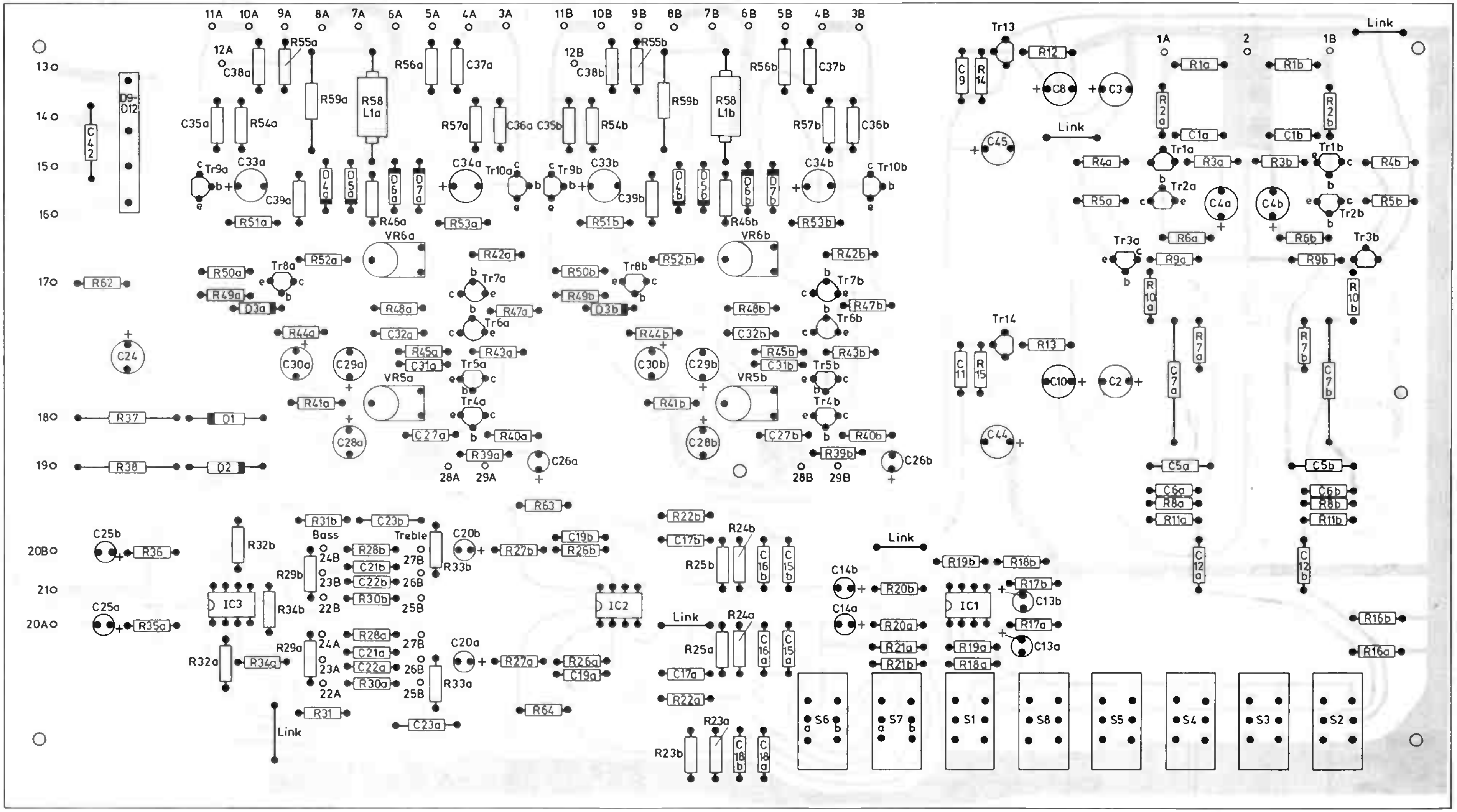
Mark out the chassis as shown in the drawing (Fig. 14), not forgetting to scribe two lines to allow for the thickness of metal used when bending.

The centre height of the push-button holes must be 20mm above the inside edge of the bent-up chassis, and this is the reason for scribing two lines. If the bottom line is used as the guide line in the bender the holes should be correctly positioned after bending.

Cut-outs

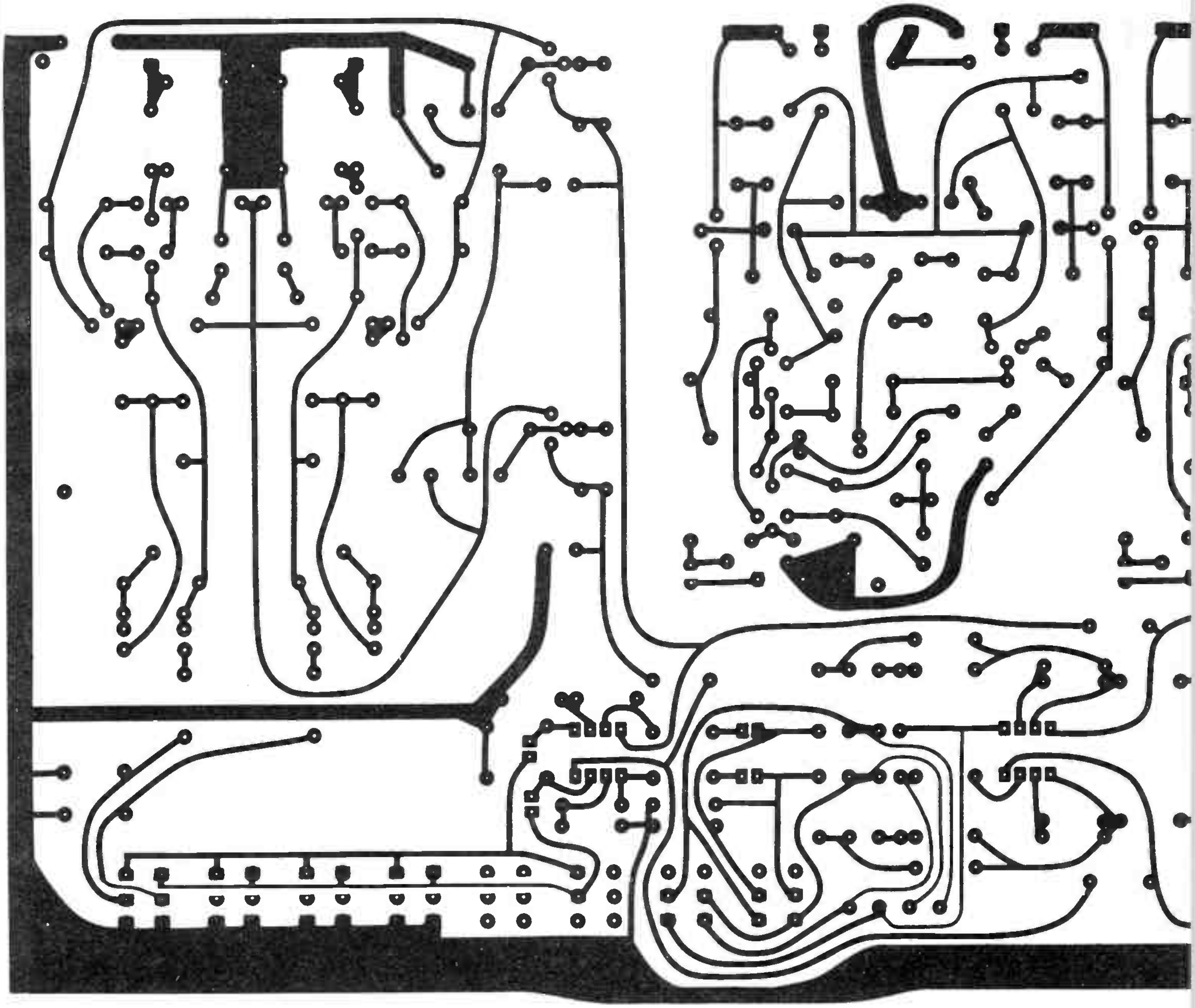
After drilling, all the holes should be deburred. The four large rectangular cut-outs in the chassis are provided so that the underside of the p.c.b. can be reached, as it would be almost impossible to remove and/or test the p.c.b. otherwise. These cut-outs are made using an Abrafile blade fitted to a standard hacksaw, any burrs being removed with a suitable file.

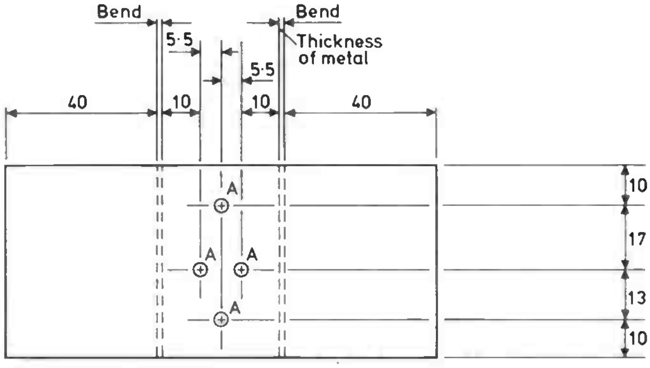
When all the holes and cut-outs have been made the chassis can be bent up. Make sure you bend it the correct way!!



WAD315

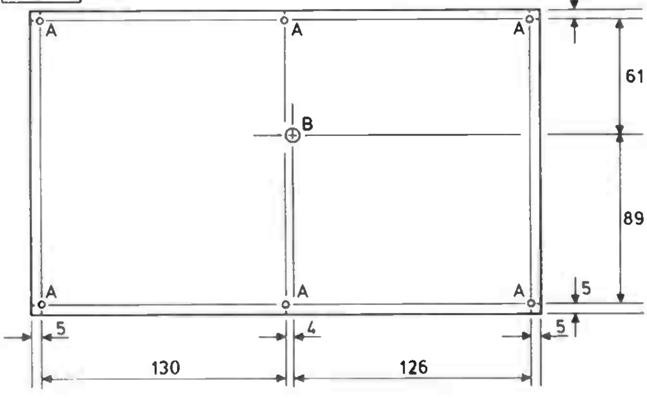
Fig. 7: Component layout for the PW Winton amplifier. This is shown slightly reduced in size



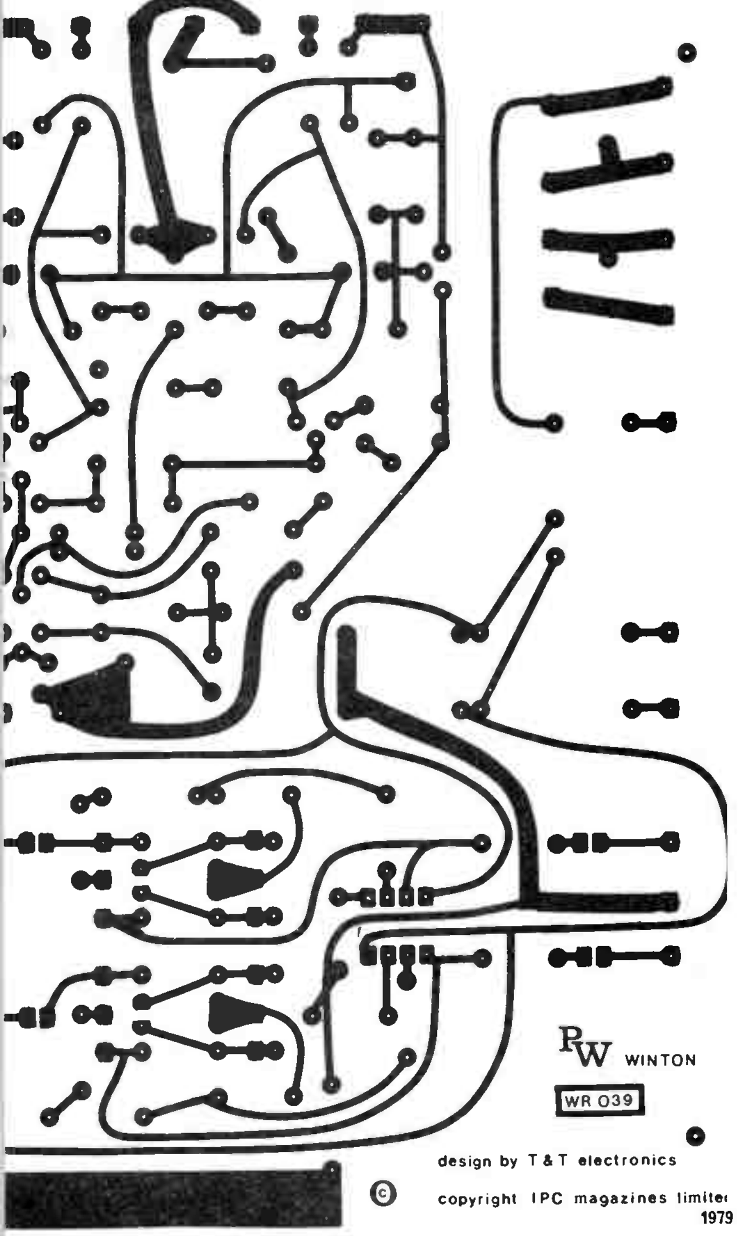


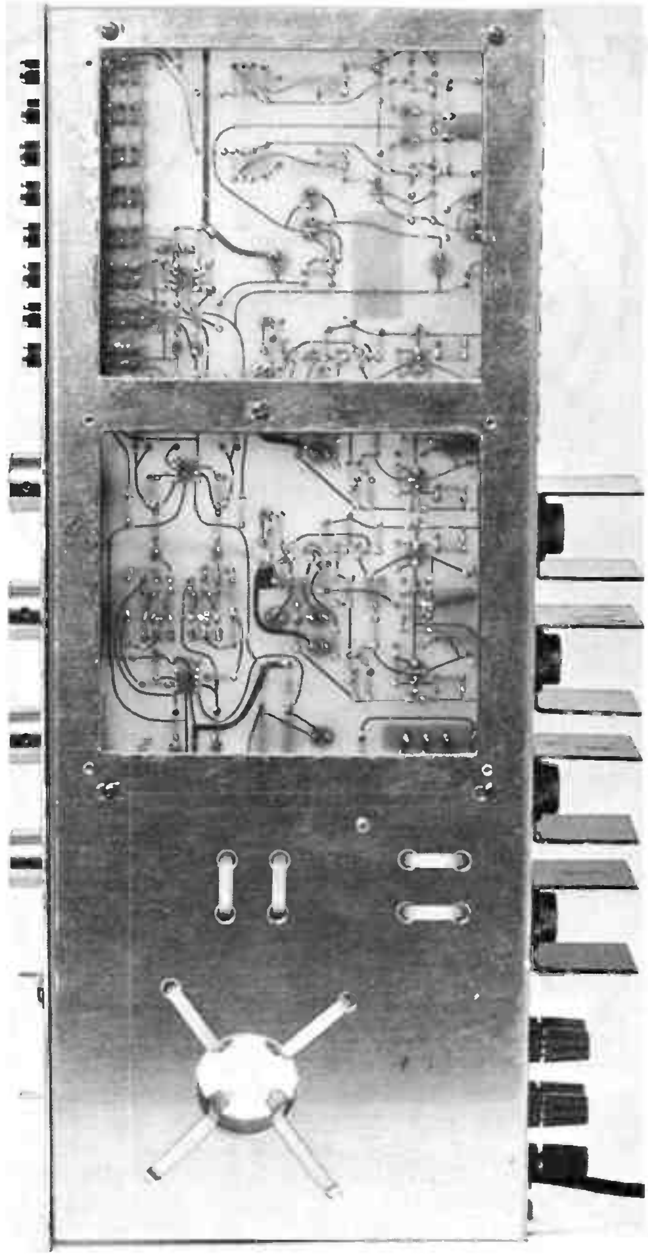
Hole sizes
A 4mm Dia.

WAD308



Hole sizes
A 4mm Dia.
B 8mm Dia.





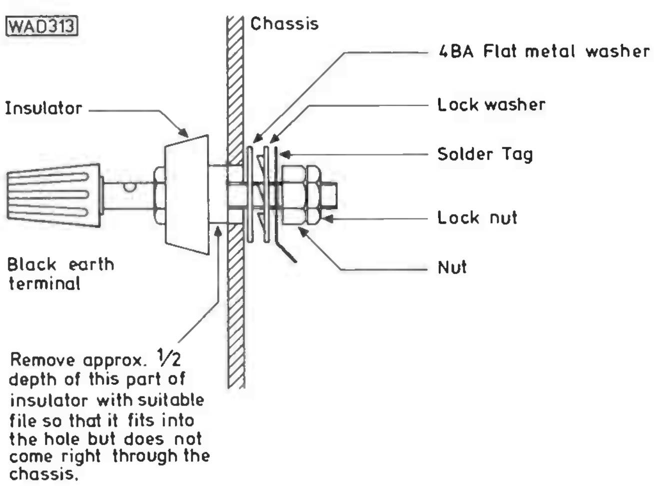
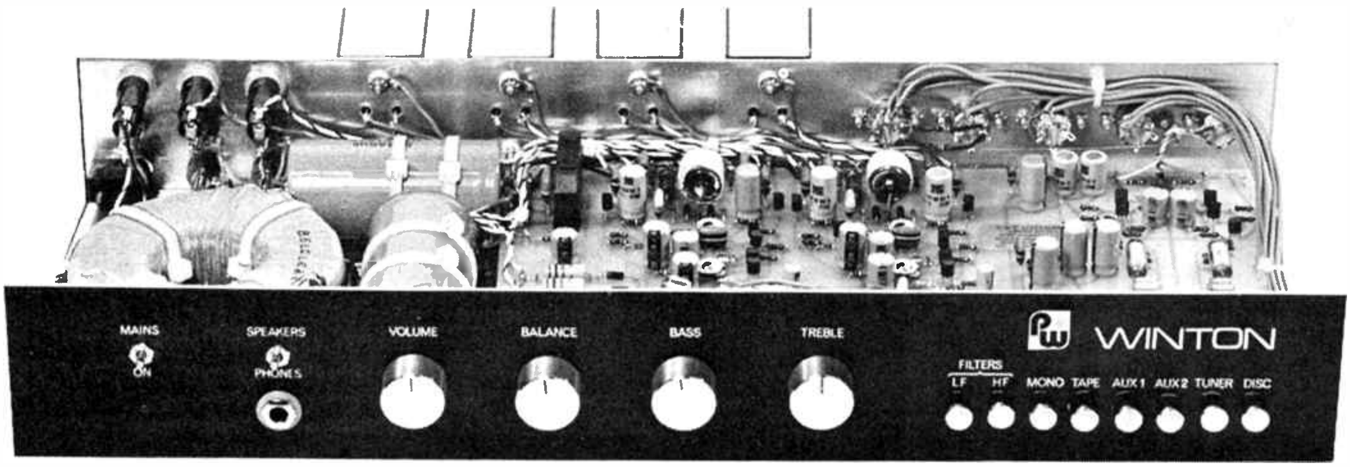


Fig. 8: Above left, the full size copper track pattern of the PW Winton printed circuit board

Fig. 9: Far left, details of the output transistor heat-sinks. Four of these are needed made from 1·2mm thick aluminium sheet with all burrs removed and the mounting surfaces absolutely flat. Paint matt black when completed

Fig. 10: Centre, the baseplate which covers the cut-outs in the aluminium chassis. Only one is needed from 1·2mm thick aluminium

Fig. 11: Left, details of the earth terminal assembly



Heat Sinks

The four heat sinks can be made from the aluminium removed from the four rectangular cut-outs and should be made up as shown in Fig. 9. It is very important that the holes on the heat sinks are completely free from burrs, also the part in the centre should be flat and any high spots removed with a suitable file. The power f.e.t.s must be mounted on a perfectly flat surface and the parts used for this must be filed flat and freed of burrs.

Once the p.c.b. is fully assembled it should be very carefully checked for any errors. If possible get someone else to check your work for you. When you are satisfied that it is correct, it can be assembled into the main chassis.

First, fix the five p.c.b. pillars onto the chassis. These are held in place with No. 6 self-tapping screws approximately 9mm long. The p.c.b. can then be mounted onto the pillars by lowering the push-button end so that the buttons line up with and project through the front panel holes. Then press the p.c.b. firmly onto the pillars. Check the action of the push-button switches, which must all be free to move without catching on the chassis. The use of a small file may prove helpful if problems exist but if the chassis has been made correctly, all should be well.

The other components can now be fitted to the chassis in the position shown in the drawings and photographs. Note that the volume, balance and tone controls are assembled onto their mounting bracket (Fig. 15), before the whole assembly is fitted to the chassis.

Control Spindles

First cut the control spindles to a length of 22mm. Do not strain the control when doing this. Clamp the unwanted part of the spindle in a vice and hold the potentiometer end to steady it, while cutting the spindle with a small hacksaw. Then remove any burrs.

Assemble the controls into their respective positions on the mounting bracket and tighten all nuts firmly but do not overtighten. The bracket is fixed to the chassis front with countersunk 6BA screws, approximately 12mm long, and spaced from it with two 6BA nuts. Finally it is held in place with another 6BA nut and lock washer.

When fitting the socket for the headphones, the tags come up either side of the phone/speaker switch and should be bent slightly outwards.

When the heat sinks are satisfactory, they should be painted *matt* black and left to dry thoroughly before using.

Finally, make up the chassis base plate and the control mounting bracket as shown in Figs. 10 and 12.

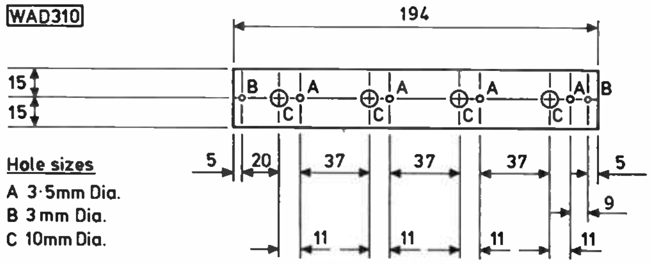
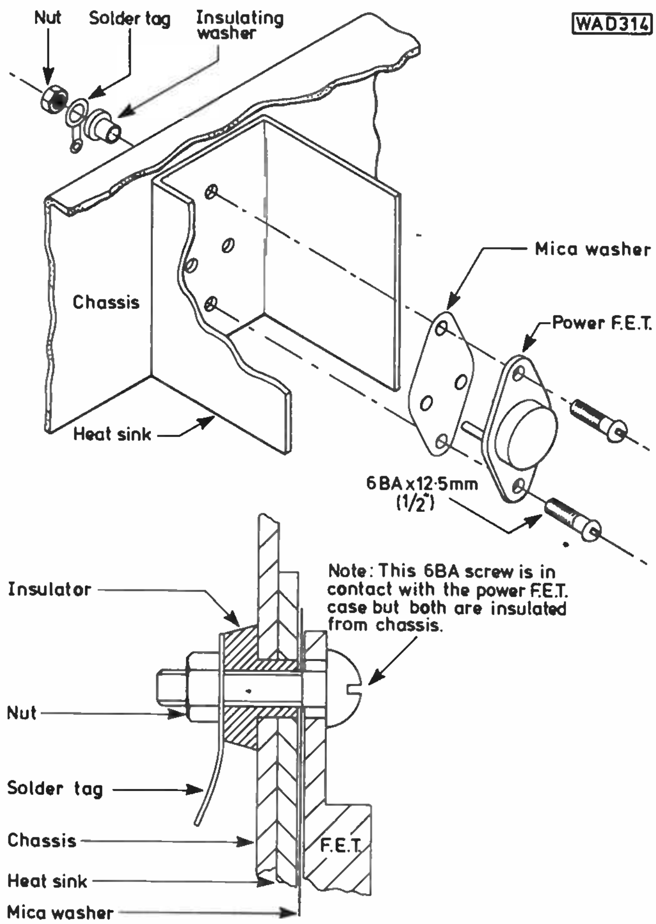


Fig. 12: Above, details of the control mounting bracket which is made from 1·2mm thick aluminium

Fig. 13: Below, the mounting details of the power f.e.t.s and heat sinks



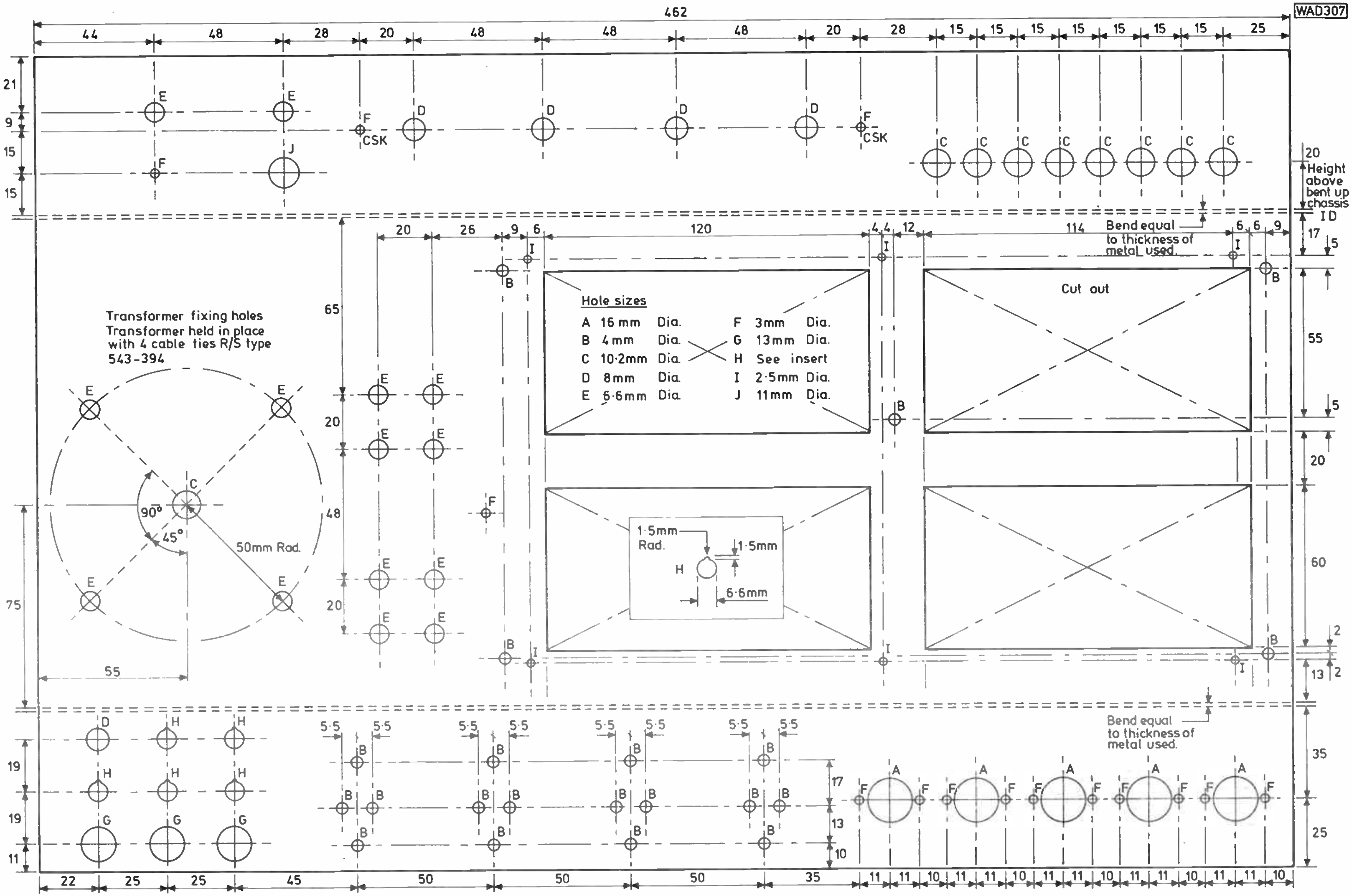


Fig. 14: Marking out details for the aluminium chassis which is made from 1·2mm thick sheet

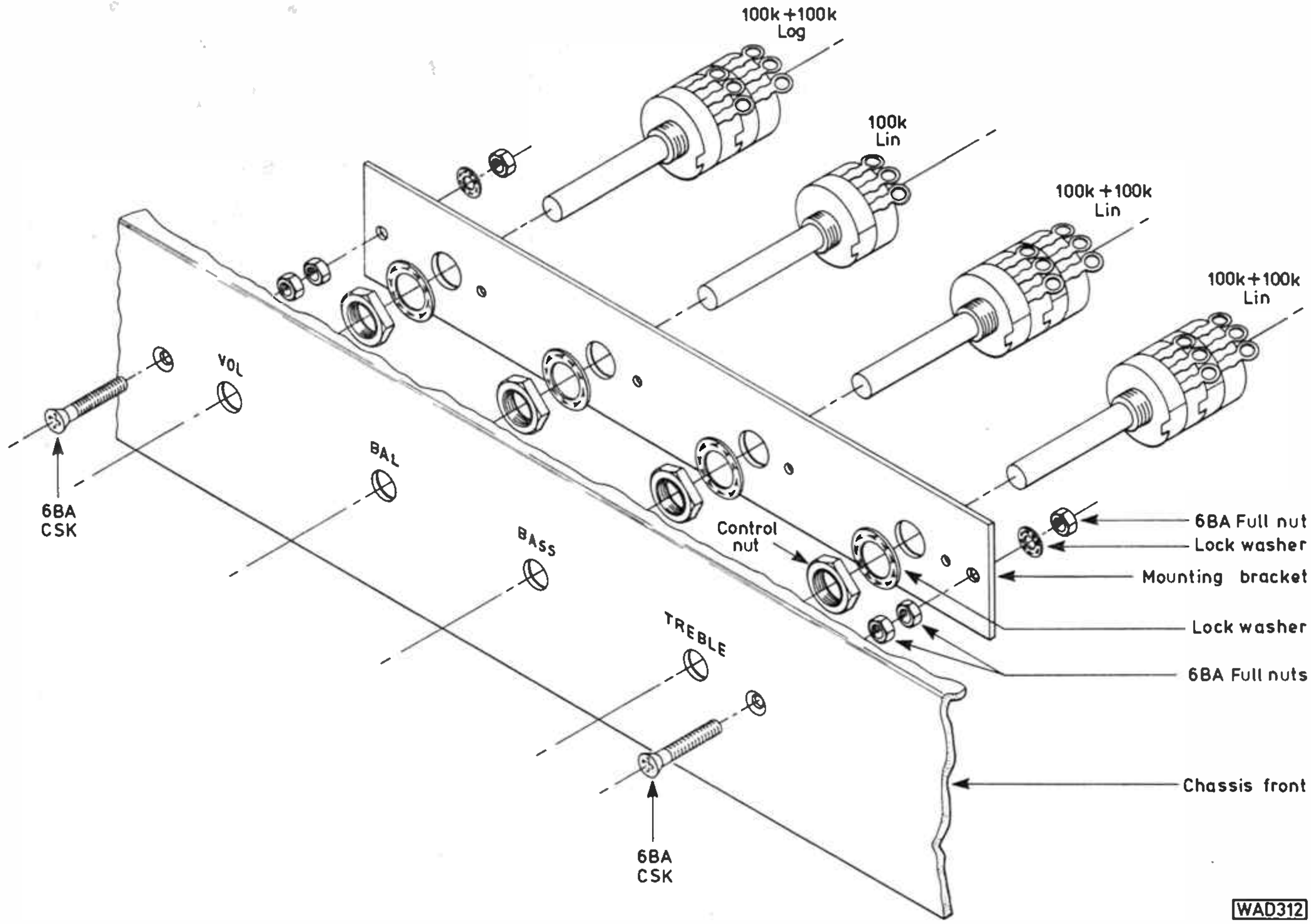


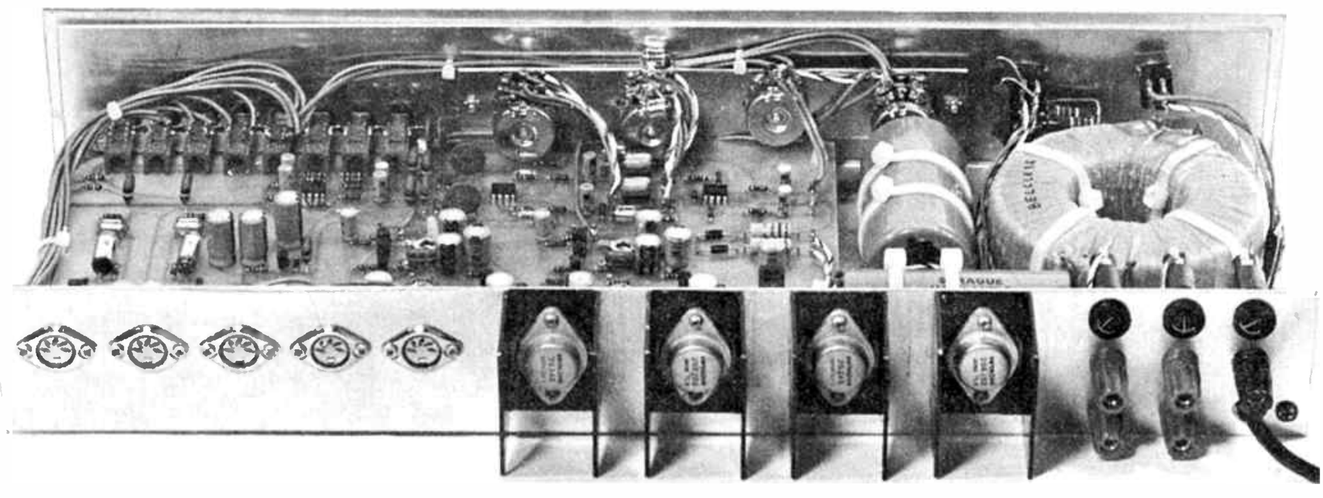
Fig. 15: Method of mounting the control potentiometers using the pot mounting bracket

The black earth terminal on the rear of the chassis is mounted without its rear insulating washer to ensure a good electrical contact with the chassis (Fig. 11).

The output power f.e.t.s should be assembled onto the heat sinks and chassis as shown in Fig. 13, but it is very important to make sure that the pins do not touch the sides of the holes, and that the mica washers are not damaged. The use of a heat sink compound helps here. After assembly, a multimeter may be used to check for shorts between pins and chassis.

Both the 4700μF reservoir capacitors are held in place with plastic cable ties. Four large plastic cable ties are used to hold the special toroidal mains transformer and should be firm but not over tightened, otherwise they may distort the chassis. A piece of foam is placed between the transformer and chassis to reduce vibration. This method of fastening the transformer to the chassis has been used instead of the bolt and plastic centre method as it has proved to be considerably cheaper and is just as easy and reliable. Do not be tempted to use metal ties, wire, or a bolt and clamp bar through the centre of the transformer, any of these methods can create a shorted turn, overloading the transformer. The l.e.d. used as an "on" indicator is a firm push fit into the hole provided.

Next month finishes the wiring of the amplifier and covers testing and setting-up procedures



PRODUCTION LINES

alan martin

If you please

Would readers kindly mention "Production Lines", when applying to manufacturers or suppliers featured on this page.

Pattle's panels

We all know the problems of making a really good front panel for our projects. Dymo tape and typed sticky labels are no substitute for a photographically reproduced anodised aluminium panel. Several of our recent projects have featured front panels professionally made by D. J. Pattle to our designs. These panels are available to readers and come in a variety of styles, colours and thicknesses.

The thin type is available, self-adhesive backed, ready to be cut out and mounted on to a sub-panel. A full thickness aluminium version is available which also acts as the front panel.

If you want to add a touch of class to your shack, then the aluminium RSGB badge with your callsign across the centre, is available to order from Pattle. Full details and prices from: *D. J. Pattle, Juniper, Hillbury Road, Alderholt, Dorset. Tel: Fordingbridge 52081.*

Grounded

A portable field service kit which can prevent electrostatic charge from damaging sensitive electronic components during construction or servicing operations is now available from 3M UK Ltd.

This is the "Velostat" 8005 Field Service Grounding Kit, which provides an effective method of draining electrostatic charge from the individual to ground before it can damage or destroy sophisticated components, such as MOS, bi-polar devices and microprocessors.

Research has shown that thousands of volts of electrostatic charge can be generated and stored in a technician's body by simply walking across floors and sliding on and off stools. When the individual then handles a p.c.b., the electrostatic charge flows from him through the circuitry, literally blowing components.

The kit consists of a "Velostat" Table Top (614mm square), a conductive wrist strap and a ground cord. The Table Top has convenient storage pockets and can be rolled or folded to fit neatly in tool cases.

For details of price and availability contact: *3M United Kingdom Ltd., 380–384 Harrow Road, London W9 2HU. Tel: 01-286 6044.*

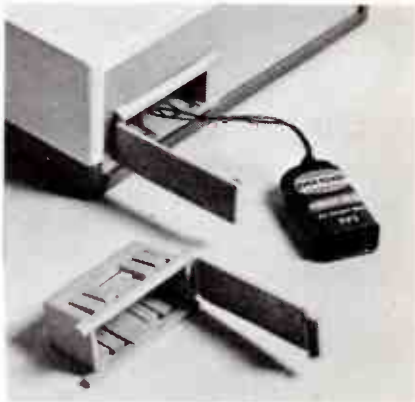
Battery holder

Most small equipment enclosures on the market today make no provision for battery housing and dismantling a complete instrument in order to replace an exhausted battery is both tedious and time consuming.

Vero Electronics Ltd. now make available an injection-moulded battery housing of simple clip-in design offering access for battery changing from outside the instrument.

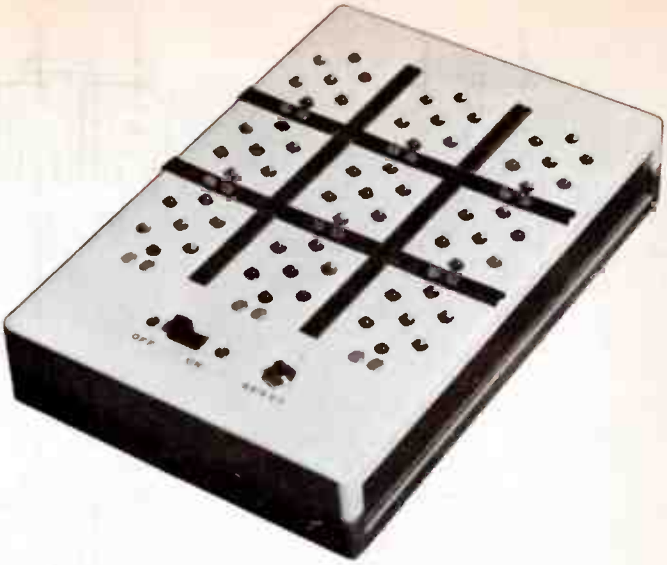
The holder accepts a 9V battery and may be easily fitted to a panel or enclosure with a thickness of 1·5 to 3mm. All that is required for fitting is a rectangular cut-out into which the holder is pressed home.

Supplied as a kit, the battery holder comes complete with connector and lead for less than £1. Further details from: *Vero Electronics Ltd., Industrial Estate, Chandler's Ford, Eastleigh, Hants SO5 3ZR. Tel: (042 15) 69911.*



LOGICAL NOUGHTS & CROSSES

J. D. MITCHELL PART 1



The game of Noughts and Crosses presented here is a less ambitious development than the automated opponents currently advertised, but has proved itself a source of great interest to friends and offspring alike. Babysitters particularly appreciate trying to beat the "computer" after the television closedown.

The game uses TTL integrated circuits, directly driven l.e.d. displays, and inputs are made by touch-switches or alternatively with a simple prod. The circuit automatically remembers the first input and sets its program for the remainder of the game. With the advantage of first move, the player may win 126 or 16 of the 945 different possible games as explained later. This facility was added at the cost of a few extra gates. The programming could have been wired to win or draw only, but there is little interest in competing against an infallible opponent. Mis-switches cannot override previously lit noughts and crosses.

Identifying the board squares as in Fig. 1(a), if the first input is to any outer square the reply is to 5. Should the first move be to square 5, the reply is to 1. The first reply is directly gated, but this is not possible for subsequent replies and a 9-bit event latch is used to set a program. The programs set by the first input made in each game are identified as in Fig. 1(b).

Figure 2 details the event latch, gating for the first reply, input latches which store the momentary Logic *0*'s from the touch-switches or probe, and display latches which directly drive the l.e.d. displays.

Six input latches are contained in IC13, type SN74118. The other three are cross-coupled 2-input NAND gates type SN7400. Capacitor C1 connected to the reset input prevents the discrete latches setting in the opposite polarity to those in IC13 on powering the circuit. All other capacitors shown are for decoupling.

Display latches

The display latches operate differently to the usual set-reset of the input latches. Initially, both inputs are at Logic *0*. When one input is switched to Logic *1*, both inputs to one gate are then at *1* and its output is at *0*. The display in that square is thus lit.

Display gating for squares 2, 4, 6 and 8, Fig. 2(b) are modified forms of the above latches. If a nought or cross input is made first, the display will be lit accordingly. If the third (inhibit) input is made first, a nought cannot then be displayed although a subsequent cross can. Five 3-input NAND gates are also used in the gating. Outputs from these are connected to the inhibit inputs of the latches. Two are spare type SN7410 as used in the 3-input display latches. The other three are type SN7412 (o/c collector) so that two may be connected as a wired-OR to the inhibit input of display latch 4. These latches with their associated gates prevent replies being made after the player has won a game.

Wired-OR gates

The 9-bit event latch comprises IC10 and square 5's input and display latches. IC10 is a dual 4-bit latch with clear inputs, type SN74116. Each 4-bit latch also has two enable inputs, which are connected as two pairs on PCB 1. All outputs from IC10 are connected as a wired-OR gate into one pair of enable inputs. The other enable inputs are connected to the $\overline{Q}$ output from square 5's input latch. When either pair of enable inputs is switched from Logic *0* to *1*, all eight latch outputs are held in the condition they were in previous to the switch. If the first input switched is 5, all outputs from IC10 are held at *0*. Display latch output 5x is enabled, and inverted to enable program E. Output E is inverted again to enable display latch ouput 1o. The inverters buffer display latch 5. Should any other input be switched first (say 3x), output 3 from IC10 switches to Logic *1* and enables program C. The other programs remain disabled by the output of the wired-OR gate, whilst display latch output 5o is enabled.

The nine outputs from the event latch circuit are taken to PCB 2 where they are connected with eight of the Input latch $\overline{Q}$ outputs in a gated matrix. Input latch 5 is not re-

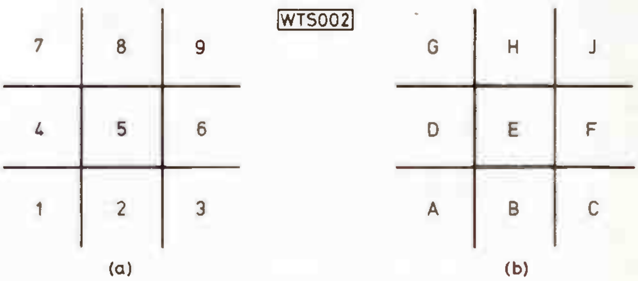


Fig. 1: The identification of the squares on the board

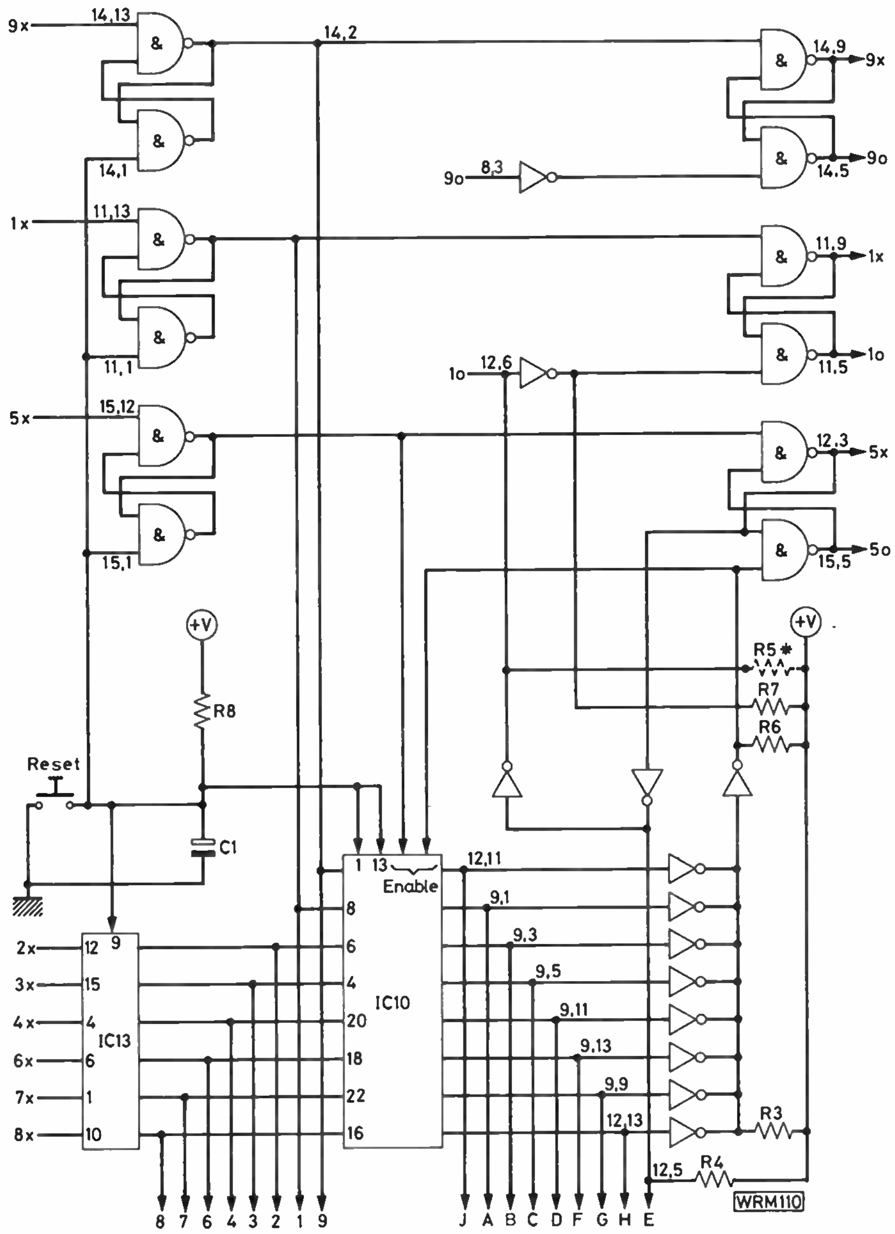


Fig. 2(a): The input latches are contained in IC13, an SN74118. The 9-bit event latch is made up from IC10 (SN74116) and square 5 input and display latches. C1 is to prevent the discrete latches from setting in the opposite polarity to those in IC13 when power is applied

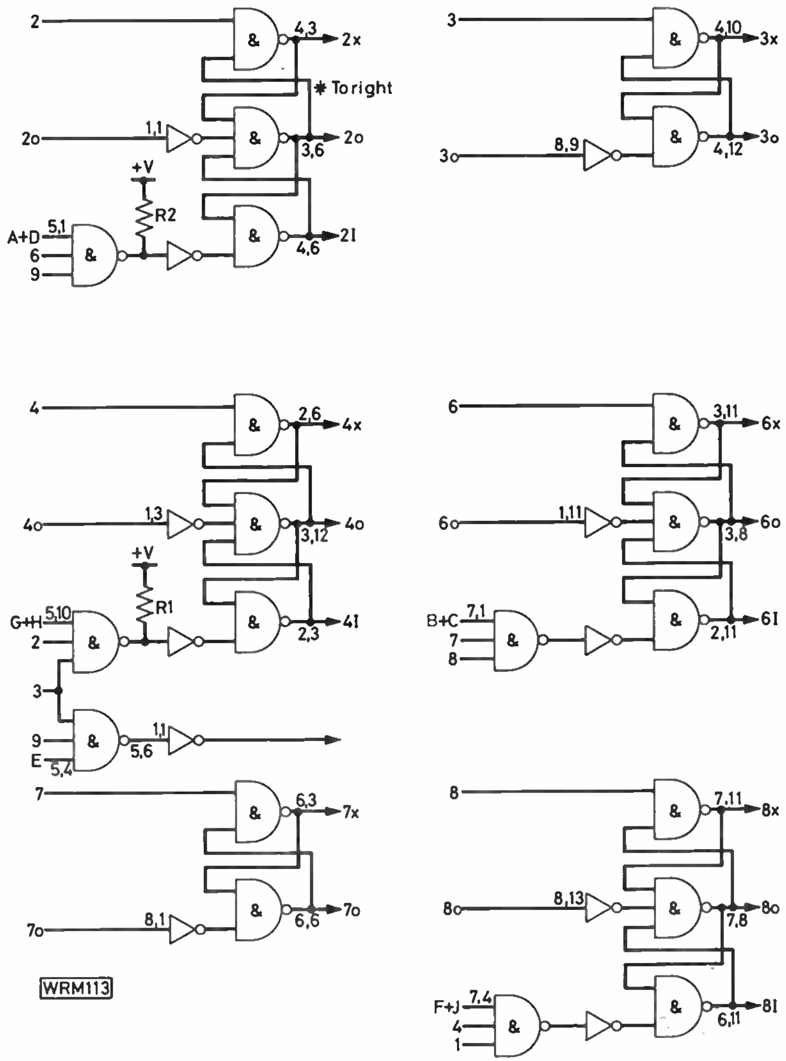
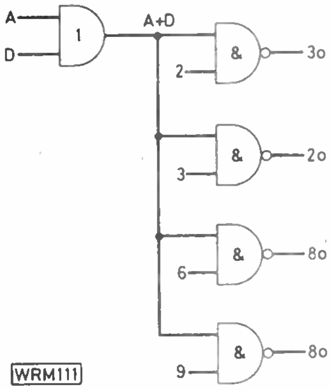


Fig. 2(b): The display gating for squares 2, 4, 6 and 8 are shown in this drawing. These gates ensure that the correct symbol is displayed in the appropriate square



Wired prog. o/p connections to nought display latches													
Inputs	A	B	C	D	E	F	G	H	J	A+D	B+C	G+H	F+J
1	-	3	2	7	-	-	-	-	-	-	-	4	2
2	-	-	1	-	8	1	-	-	4	3	-	6	-
3	-	1	-	-	7	9	-	-	6	2	-	6	-
4	7	7	8	-	6	-	-	-	-	-	-	1	2
5	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	4	-	2	3	3	8	9	-	-
7	4	-	-	1	3	-	-	9	-	-	4	-	8
8	6	-	-	9	2	-	9	-	-	-	4	-	7
9	-	-	-	-	7	3	8	7	-	8	6	-	-

Fig. 3: Circuit board 2 connects the nine event latches to eight of the input latch $\overline{Q}$ outputs in a gated matrix. All outputs with the same numbers are 'wired-OR' connected to the appropriate resistor on Board 2 and then to Nought inputs of display latches on Board 1

★ components

Resistors

¼W 2% metal oxide

270Ω	9	Display
1kΩ	10	R8 and input switching
1·2kΩ	2	R3, 9
1·5kΩ	1	R14
1·6kΩ	5	R10, 11, 12, 13, 15
2kΩ	1	R16
2·2kΩ	9	Input switching
4·7kΩ	2	R1, 4
7·5kΩ	1	R6
9·1kΩ	3	R2, 5, 7

Capacitors

Disc Ceramic

0·01μF	7	Decoupling

Tantalum bead

22μF 6V	1	C1

Semiconductors

Diodes

1N4001	1	D1
Red l.e.d.	63	Display

Transistors

BC108C	18	

Integrated circuits

SN7400	6	IC2, 4, 6, 11, 14, 15
SN7403	12	IC17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28
SN7404	2	IC1, 8
SN7405	2	IC9, 12
SN7410	2	IC3, 7
SN7412	1	IC5
SN7432	1	IC16
SN74116	1	IC10
SN74118	1	IC13

Miscellaneous

Push-to-make switch (1), miniature slide switch (1), Battery holder B203 (1), Verocase 205 × 140 × 40mm (1), Veropins, nuts, bolts, washers, printed circuit boards (set of 4).

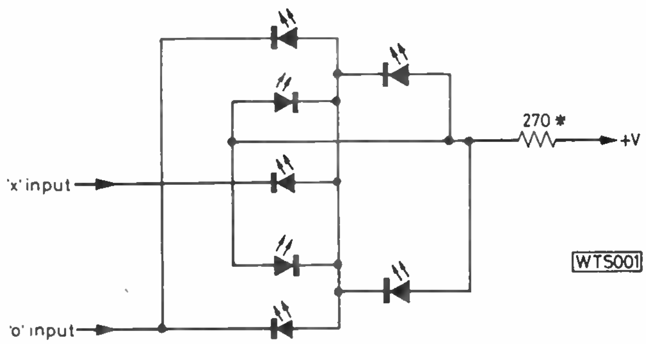


Fig. 4: Circuit diagram of one l.e.d. display. This forms the display for one square and nine of these are required for the complete game. The 270Ω resistor is the approximate value needed to limit total current to 10mA

quired because of the direct gating used for the first reply. 2-input o/c collector NAND gates type SN7403 are used for the matrix, their outputs connected as wired-OR gates—see Fig. 3. To reduce the number of gates in the matrix, four 2-input-OR gates type SN7432 are used to provide outputs A + D, B + C, F + J and G + H. The NAND gate outputs are connected back to inverters on PCB 1 and then to the nought inputs of the display latches.

Outputs

Outputs from the display latches are connected directly to the display l.e.d.s, which are interconnected and positioned as shown in Fig. 4. Initially, both outputs of a latch are at Logic *1*. If the "X" input to a display is switched to 0V, current flow is from the positive rail via the four corner-mounted l.e.d.s, through the centre l.e.d. into the gate, displaying a cross in the appropriate square. If a "O" input to a display is switched low, current flow is via the corner l.e.d.s and through the top and bottom l.e.d.s to show a nought. The resistor is selected to limit current to 10–15mA.

PART 2 will cover the construction of this interesting project together with the circuit diagrams and printed circuit board layouts

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

Lasers Again

Readers may remember the fuss over using lasers as part of London's Christmas decorations last year. Apparently some thought the beams would constitute a hazard.

In the American town of Atlanta they've been using lasers for some time to control traffic lights. Before anyone sees "red", the health hazard is virtually nil and the system has been given a fond, approving kiss by the US Bureau of Radiological Health Standards as being "safe for eyes".

Previously, the digital computer that controls the city's traffic lights was coupled to the lights via telephone lines, or by dedicated cables. The system can control up to 500 separate road junctions. At each set of lights is an optical transceiver that faces its neighbour at another junction.

Sensors, in the road, monitor the traffic density and this information is fed back along the laser chain to the computer. The digital computer "computes" all this information and, having computed sends a master command signal to the relevant traffic lights.

Tests on the laser's range showed reliable operation at distances of well over $\frac{1}{4}$ mile even in the very worst weather conditions (such as heavy fog, etc). In a good, clear, typical English summer's day (singular!) type weather, the range approaches 10 miles.

Peak power outputs of the GaAs laser diodes used are around 10W, and these are pulsed at 2kHz.

A shining example to traffic light manufacturers everywhere.

Thermometers

For those with an interest in electronic thermometers, keep an eye open for the magic number AD590. It's a completely self-contained temperature transducer with an accuracy of $\pm 0{\cdot}5°C$ over the temperature range $-55°C$ to $+150°C$. And it's only "transistor size" being housed in a standard TO-52 can. Better still, there are only two leadout wires.

During manufacture, the resistive elements are precision laser trimmed to precise values. The result is a sensor that is linear over the range. So much so that you can plug in different ones without any need to recalibrate. For the technical buffs, the output is 298·2μA at 298·2K (that's 25°C) and any temperature change up or down gives a 1μA/K variation.

The cheapest version costs barely the equivalent of a single British quid. A miniature, ceramic flat pack version is also available. Note that these are the prices for 100 off, though!

Stronger yet Faster

High gain-bandwidth product and high collector-emitter breakdown voltage are two conflicting ideals according to many bipolar transistors. These comments are particularly pertinent in the field of switching applications.

The Japanese think they've found an answer, and it's quite a clever one. They've combined a field-effect transistor gate structure with a standard bipolar transistor. One of the beneficial effects observed is that, assuming the same base width, where a particular conventional transistor had a breakdown voltage of say 20V, the new hybrid would make this figure 200V.

Not only does the new structure give a ten times increase in breakdown voltage, but it also offers a four times increase in gain-bandwidth product. One set of figures quotes 80MHz/500V.

Midget Supplies

Ever since the advent of switching power supplies, these items seem to have shrunk ever smaller. An American company began one power supply development programme by asking itself a question. "As digital panel meters get smaller and smaller, how will they be able to keep the useful feature of being operable from d.c. supplies and mains?" Pointless to have a beautiful, small d.p.m. only to find a dirty great power supply (by comparison) is required to power it.

Since many miniature d.p.m.s use c.m.o.s. and require only small currents and voltages, their power needs are not great, never-the-less with mains one side and a d.c. voltage the other, something very small has to go in the middle.

The result is the μS-A series power supplies. They measure only 12·5mm cube and will supply from 1·5 to 15V d.c. from a 120 or 240V a.c. mains supply. They don't mind if the frequency of that supply is anywhere between 47Hz and 440Hz. The one-off price in the US is about the equivalent of £4 sterling. But the 100 off price plummets to just over £1.

Tiny Switch

Always well worth watching is the International Electron Devices Meeting. Among the many fascinating papers that caught my eye was one which described a small electro-mechanical switch. And when I say small, I really do mean small with a very little "s". This intriguing device is built using semiconductor technology. The switching cantilever is just 76 micrometres long. It is fabricated from a very thin layer of metal coated on a membrane of silicon dioxide. The membrane itself certainly isn't very thick, either; only 3500 Ångströms! Switching takes place by electrostatic action on the membrane. Switching time is around 40 millionths of a second using a "switching" voltage of 60V. The author claims the higher voltages give even shorter switching time—but one then starts to get contact bounce.

An important aspect of this new device is that the switch (or switches) could be fabricated on the same chip as the active devices.

A parting shot. It is thought that, after development, these tiny switches could be made to function at switching times to the order of 10μs using 30V max. and with a current carrying capability exceeding 100mA.

Although obviously in its infancy, the idea seems to be promising when one examines the prototype test figures. Some of the switches under test in the laboratory have exhibited lifetimes of over 2 million switching operations while switching current densities of 5×10^4 amperes per square centimetre.

It might be as well for readers who are avid constructors to purchase a powerful watchmakers glass as a precautionary aid to future projects!

Ginsberg

STEREO DECODERS

DEVICES & CIRCUITS

PART 1

M. J. DARBY

In previous articles we have seen how a basic f.m. receiver functions, and have also considered front-end devices and circuits in detail.

However, many f.m. transmissions carry stereo information, and this part of the series deals with the essentials of the stereo decoder.

The Multiplex Signal

The audio output from the demodulator of a stereo receiver consists of both audio frequencies and ultrasonic frequencies which carry the required information for both the left and right hand channels. These two channels are said to be "multiplexed' so that they can be present as a single signal. It would obviously be very uneconomical to employ two separate transmitters for the left and right hand signals.

The multiplex signal from the output of the receiver demodulator circuit contains a number of parts which are illustrated in Fig. 1 and listed below.

1. The audio frequency band from about 30Hz up to 15kHz contains the required audio signal and constitutes the sum of the signals in the left and right hand channels. In a monaural receiver, only this part of the signal will provide the output in the loudspeaker.

The transmitted signal is thus "compatible", which means that the one signal can be used to operate both monaural and stereo radio receivers.

2. A 19kHz pilot tone which is transmitted at a relatively low signal level. This pilot tone is required for the operation of the stereo decoder circuit: if the tone is not present in any signal (or not present at an adequate amplitude), the stereo decoder circuit will switch to the monaural mode and the same signal (left-plus-right) will be fed to the two speakers.

3. A left-minus-right signal which is modulated onto a 38kHz sub-carrier signal. The sub-carrier itself is suppressed so that there is a small gap of about 60Hz in width at 38kHz. The left-minus-right signal covers a frequency band of about 30Hz to 15kHz. The sub-carrier modulation process generates signals of 38kHz ± (left-minus-right frequency); this means that the lower sideband of the sub-carrier extends from 38 − 15 = 23kHz up to within 30Hz of the 38kHz frequency, whilst the upper sideband extends from 30Hz above 38kHz up to 38 + 15 = 53kHz. The upper and lower sidebands are shown in Fig. 1. The 38kHz sub-carrier itself has an amplitude which does not normally exceed 1% of the total signal amplitude.

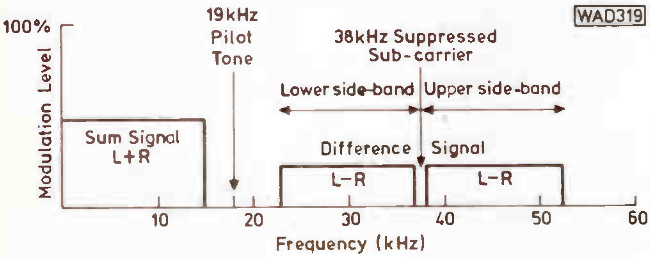


Fig. 1: Spectrum of the stereo multiplexed signal

It is obvious from Fig. 1 that the stereo multiplex signal has a much wider bandwidth than the monaural signal which extends up to only 15kHz. This wide bandwidth inevitably results in more noise being present in a stereo signal than in the same signal in the monaural mode. In practice the degradation in signal-to-noise ratio is some 20dB, so a much better aerial is required for good, low noise stereo reception than is necessary for good reception of the same signal in the monaural mode.

When a broadcast is to be monaural for a period of more than a few minutes, the pilot tone at the 19kHz frequency may be switched off so that stereo receivers are switched to the monaural mode. This automatically ensures that the optimum signal-to-noise ratio is obtained when only a monaural signal is being transmitted. Similarly, if the signal level falls below that required for good quality stereo reception, most stereo decoders will automatically switch to the monaural mode so that a better signal-to-noise ratio is automatically obtained without the listener having to take any action.

Decoder Types

Some of the earlier forms of stereo decoder circuits are of the so-called switching type. In such circuits the 19kHz pilot tone is extracted from the multiplexed signal using a tuned circuit and is doubled in frequency to re-generate the 38kHz sub-carrier frequency. This latter signal is used to switch the multiplexed input to the decoder between the left and right hand channels.

Switching circuits of this type are not at all easy to set up and to align. In addition, they have the disadvantage that they do not provide the optimum separation between the left and right hand channel signals and require ferrite cored inductors (which are always difficult to design effectively.

All modern circuits employ phase-locked loops in the stereo decoder circuit. The frequency of oscillation of the voltage controlled oscillator of the phase-locked loop automatically locks on to a harmonic of the pilot tone frequency and the loop will remain locked to this latter frequency until the pilot tone is switched off. Any normal

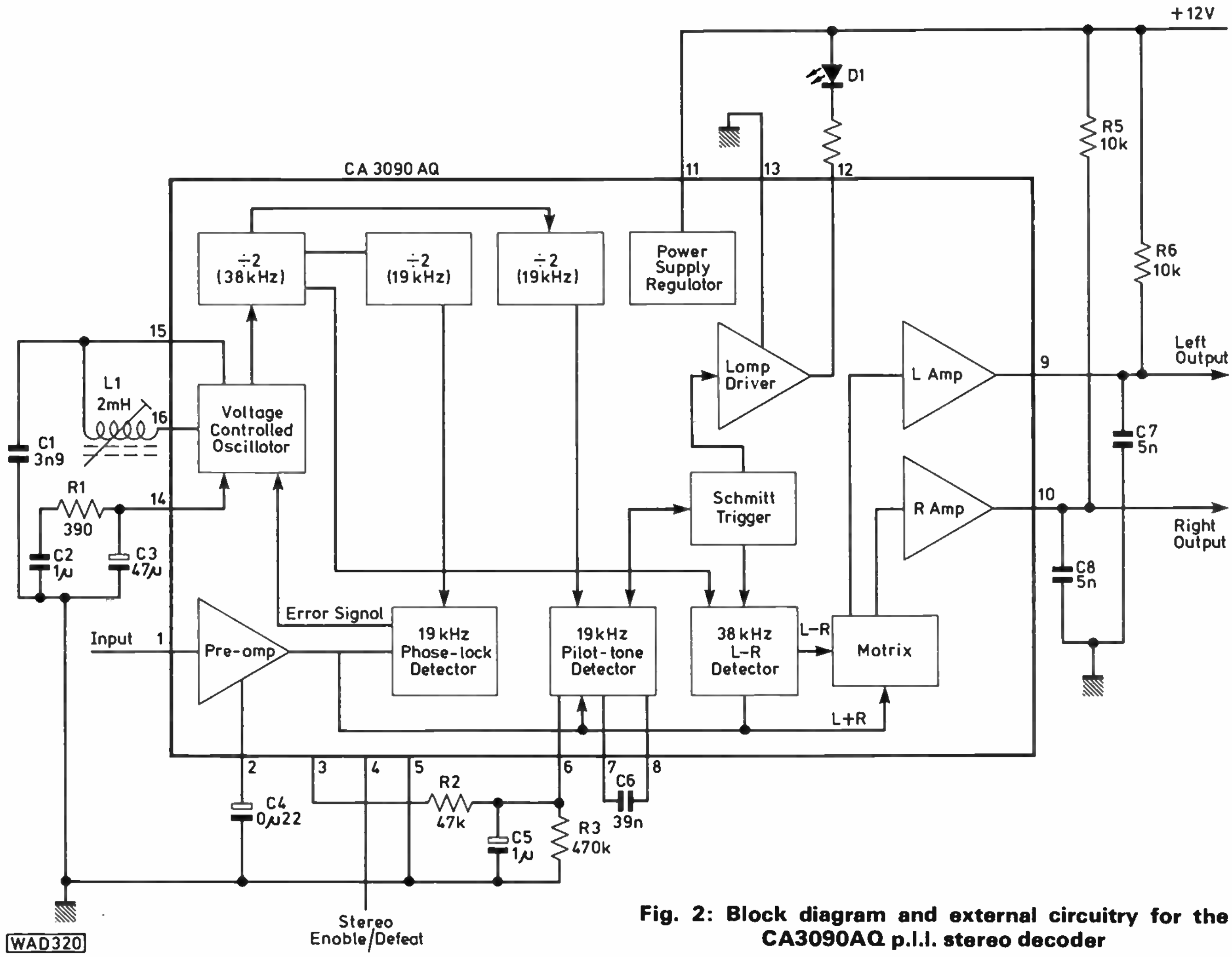


Fig. 2: Block diagram and external circuitry for the CA3090AQ p.l.l. stereo decoder

variation of the component values with temperature or normal ageing will not affect the performance of the circuit, so no critical component values are required in phase-locked loop decoders. In addition, this type of decoder is easy to set up, a simple adjustment of the loop free-running frequency being all that is required. Circuits employing a phase-locked loop for stereo decoding can provide excellent separation of the two channels, the interference between the channels normally being at least 40dB below the signal level.

Special integrated circuits for the phase-locked loop decoding of stereo signals are readily available. We will now discuss the principles of operation of a phase-locked loop stereo decoder and look at some typical circuits. It is much simpler to use a monolithic device than to try to make a stereo decoder from discrete components.

The RCA CA3090AQ

The first integrated circuit phase-locked loop stereo decoder to become available was the RCA Type CA3090Q in 1971, but this has been replaced by the CA3090AQ which is an improved version of the device, and provides an excellent performance. It has the disadvantage that the phase-locked loop is tuned by means of an inductor, whereas the other devices are tuned by a variable resistor; however, the thermal stability of the CA3090AQ is reputed to be better than that of other devices.

The internal circuit of the CA3090AQ is shown in block form in Fig. 2 together with a typical external circuit. This device is encapsulated in a 16 pin dual-in-line package and requires a supply of around 21mA from a +12V line. It can be seen that the internal circuit of the device is relatively complex, but the external circuit is quite simple and easy to construct.

A demodulated multiplexed stereo signal with a frequency spectrum like that shown in Fig. 1 is applied to pin 1 of the CA3090AQ; the input impedance at this pin is fairly high (about 50kΩ), so there is very little loading on the demodulator circuit which feeds pin 1. The signal is first amplified by a low-distortion pre-amplifier circuit inside the CA3090AQ and is then fed to both a 19kHz phase-locked detector and to a 38kHz detector of a similar type. In addition, the amplified signal is fed to a 19kHz pilot tone detector, the output of which determines the state of a Schmitt trigger circuit which controls the mode of operation (monaural or stereo).

The voltage controlled oscillator in the CA3090AQ operates at the fourth harmonic of the pilot tone frequency, namely 4 × 19 = 76kHz, this 76kHz signal being locked in frequency to the harmonic of the pilot tone. However, the 2mH external inductance connected to pin 16 must be adjusted so that the free-running frequency of this voltage controlled oscillator is fairly close to 76kHz; when the pilot tone is applied with the signal to pin 1, locking is then automatic.

The 76kHz voltage controlled oscillator signal is divided in frequency by a factor of two to produce a

38kHz signal exactly at the frequency of the suppressed sub-carrier; this 38kHz signal is fed to the L–R (left-minus-right) signal detector. The 76kHz signal is also divided in frequency by other circuits which produce two 19kHz signals in phase quadrature (that is, 90° out of phase with one another. One of these 19kHz signals is passed to the 19kHz phase-lock detector which generates the error signal which keeps the loop in lock, whilst the other 19kHz signal is required by the pilot tone detector.

The amplified multiplex signal and the output from the 38kHz L–R detector are applied to a matrix circuit which produces the left and right hand audio signals. These signals are amplified internally before appearing at pins 9 and 10. The 5nF capacitor and the 10kΩ resistor in each of these output circuits provide the required de-emphasis time constant.

If the pilot tone is absent or at such a low amplitude that the signal could not provide good stereo reception, the pilot tone detector does not switch the Schmitt trigger circuit to the stereo mode. The circuit therefore, operates in the monaural mode and the left-plus-right sum signal appears at both of the outputs so that both speakers produce a monaural output.

The signal from the Schmitt trigger also operates a lamp driver circuit. The latter causes the light emitting diode D1 to glow when the circuit is operating in the stereo mode. If no 19kHz pilot tone is present at the input or if the pilot tone is too weak to cause the circuit to operate in the stereo mode, the light emitting diode does not glow. A light emitting diode consumes less current than a tungsten filament lamp and also has the advantage that it is more reliable (since filaments tend to break after much use!). Nevertheless, the light emitting diode and its series resistor R4 in Fig. 2 can be replaced by a suitable small tungsten filament lamp which requires not more than about 100mA.

The Coil

The Toko coil type YXNS 30450NK has been especially designed for use with the CA3090AQ device; it has 270 turns on a ferrite core and a blue colour coded core adjuster. The use of this miniature coil (available from Ambit International) is much more convenient than trying to wind a suitable coil oneself.

In order to adjust the core, a stereo signal should be fed to the circuit of Fig. 2. The core of the coil should be rotated first in one direction and then in the other to find the points at which the circuit switches from the stereo to the monaural mode (as indicated by the light emitting diode, D1). The core should be set about half way between these two points. The centre frequency of the voltage controlled oscillator is then quite close to 76kHz, but the setting is not very critical, as the capture range of the phase-locked loop circuit is some ±10% of the centre frequency.

The mode of operation (stereo or monaural) can be controlled by the application of a suitable potential to pin 4 of Fig. 2. At potentials of more than about +1·2V, the circuit is switched to the stereo mode, whilst at voltages of less than about +1V the circuit operates monaurally. If this mode switching facility is not required, pin 4 should be directly grounded.

The CA3090AQ provides a channel separation better than 25dB, the typical value being about 40dB. The 2nd harmonic distortion in each of the outputs is some 0·2% typical, but higher order harmonics are less than 0·1% of the output amplitude.

The CA3090AQ is readily available from Arrow Electronics Ltd., Coptfold Road, Brentwood CM14 4BN, the current price being £2·96 including VAT, but 25p is required for p&p on orders under £5.

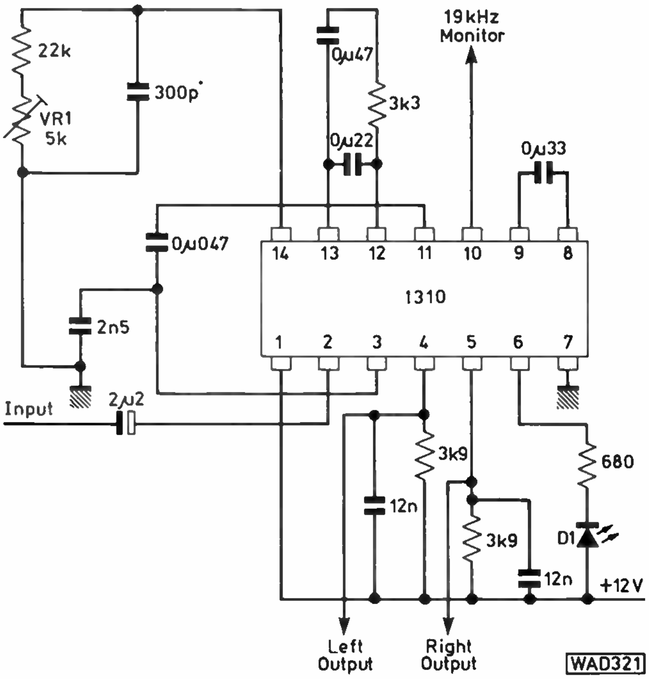


Fig. 3: External circuitry required for the MC1310

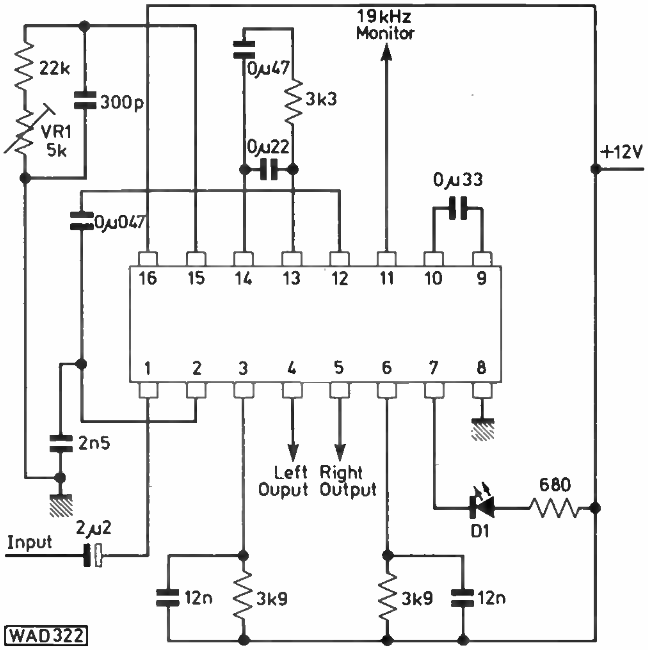


Fig. 4: External circuitry for the National LM1310E

The 1310 Types

The Motorola MC1310P first appeared on the market in 1972, but is now an "industry standard" type of device which is second sourced by many other manufacturers. For example, National Semiconductor market it as their LM1310, Signetics as the MC1310, RCA as their CA1310E, Texas Instruments as their SN76115N, Sprague as their ULN-2210 and Exar as their XR1310.

All of these devices can be used in the circuit shown in Fig. 3, although there may be minor differences between the various types, such as the exact supply voltage range over which they operate satisfactorily.

The circuit of Fig. 3 operates on very similar principles to that of Fig. 2, but the free-running frequency of the voltage controlled oscillator is set by the adjustment of VR1 instead of by the adjustment of the core of a coil. The adjustment can be made by connecting pin 10 to a frequency counter and adjusting VR1 with no input signal until the frequency at pin 10 is 19kHz. The amplitude of the signal at pin 10 is about 3V peak. However, it is usually far easier to adjust VR1 with a small stereo input signal so that it is set at about the centre of the range over which the light emitting diode D1 remains illuminated.

The value of the capacitor employed between pins 8 and 9 determines the stereo-monaural mode switching delay. The time constant for this switching is equal to the value of this capacitor multiplied by about 53kΩ. If pin 8 is connected to ground, the circuit will operate only in the monaural mode.

The capture range in the circuit of Fig. 3 is less than that in the case of the CA3090AQ, being typically about ±3%. However, it can be increased by reducing the capacitance between pin 14 and ground and increasing the resistors in parallel with this capacitor in proportion; nevertheless, care must be taken to ensure these changes do not result in increased beat note distortion at high signal levels due to oscillator phase jitter.

The MC1310P is available from Arrow Electronics Ltd., at £3·14 including VAT.

Emitter Follower Outputs

A number of other devices, such as the National Semiconductor LM1310E, are available in 16 pin dual-in-line packages. They are similar to the MC1310P, but include an emitter follower in each output circuit to provide low impedance outputs. A circuit for the use of the LM1310E is shown in Fig. 4. It can be seen that the de-emphasis components in the pin 3 and pin 6 circuits are not connected to the output pins themselves, but rather in the base circuits of the internal emitter followers. In general the remarks made about the MC1310P also apply to the versions with emitter followers (with a change of pin number), but the emitter follower device circuits will not be discussed further, as they have been largely replaced by a rather better device.

The industry standard Types LM1800, CA758E, SN76116N, MC1311, μA758 and ULN-2244 are similar to the LM1310E, but in addition to their emitter follower outputs, they incorporate a circuit which provides some 45dB of power supply ripple rejection. In other words, they can give the lowest possible hum level. These devices are encapsulated in 16 pin dual-in-line packages and can be used in the circuit of Fig. 4. They are adjusted in the way already described and the remarks about the 1310 type of device also apply to these devices except for pin number changes.

It should be noted that the total harmonic distortion from devices of this type increases with increasing input signal level, as shown in Fig. 5. However, a low signal level will give rise to a poor signal-to-noise ratio. A suitable compromise between distortion level and signal-to-noise ratio must therefore be reached. The output typically consists of the wanted signal plus a second harmonic component at −52dB down together with a 19kHz pilot tone at −37dB down, the 38kHz suppressed carrier at −40dB down and the sidebands of this sub-carrier at about −28dB down. The channel separation in dB at various levels is shown in Fig. 6 for a typical device of this type.

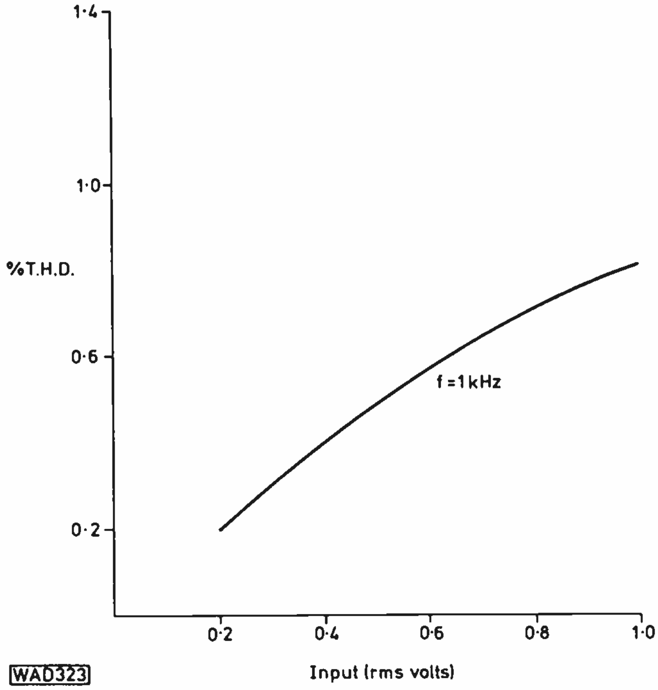


Fig. 5: Relationship between total harmonic distortion and input signal level

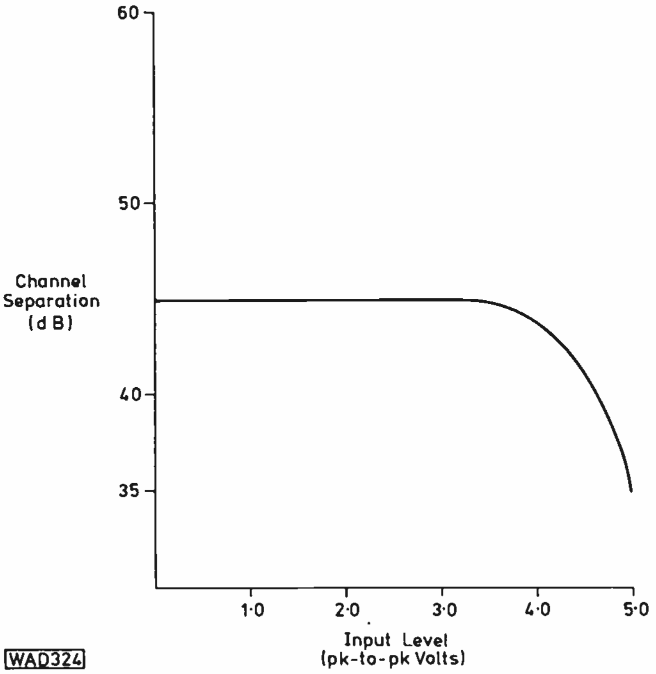


Fig. 6: Channel separation plotted against input signal level

The Sprague ULN-2244 device is available from Phoenix Electronics Ltd., 139 Havant Road, Drayton, Portsmouth PO6 2AA at £3·38 (including VAT) plus 20p p&p at the time of writing.

The TDA1005

The Mullard/Signetics TDA1005 phase-locked loop stereo decoder device has been designed so that it can provide an output which is very low in unwanted signal levels. The device was originally designed for use with an

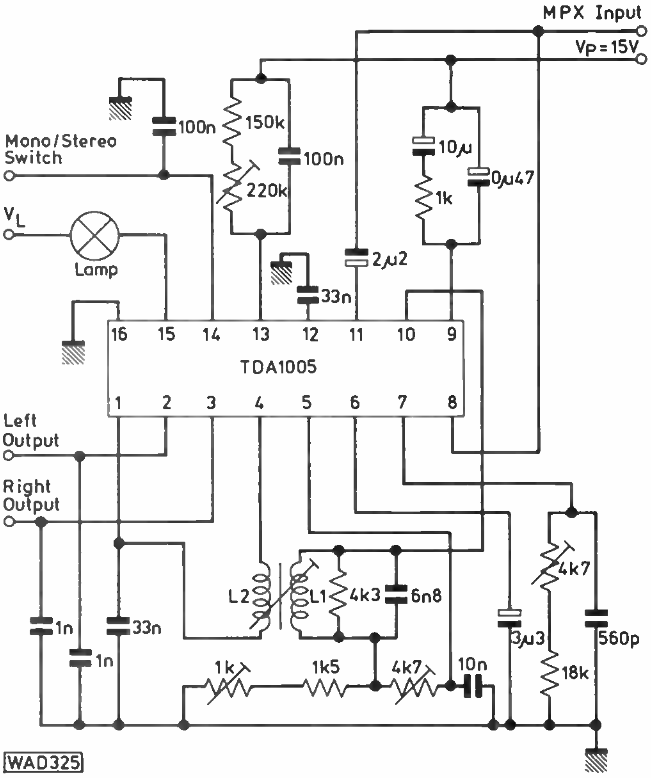


Fig. 7: External circuitry for the TDA1005 in the frequency multiplex mode

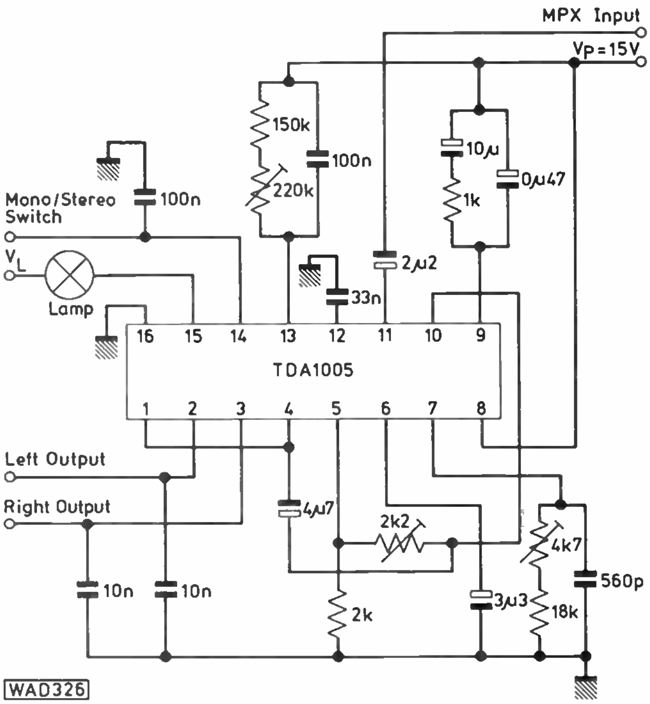


Fig. 8: External circuitry for the TDA1005 operating in the time multiplex mode

inductor in a frequency multiplex decoder, but can also be used without any inductor in the so-called time multiplex circuit. Typical circuits of these types are shown in Figs. 7 and 8 respectively.

CONTINUED NEXT MONTH

WIRELESS WENT TO WAR

continued from page 41

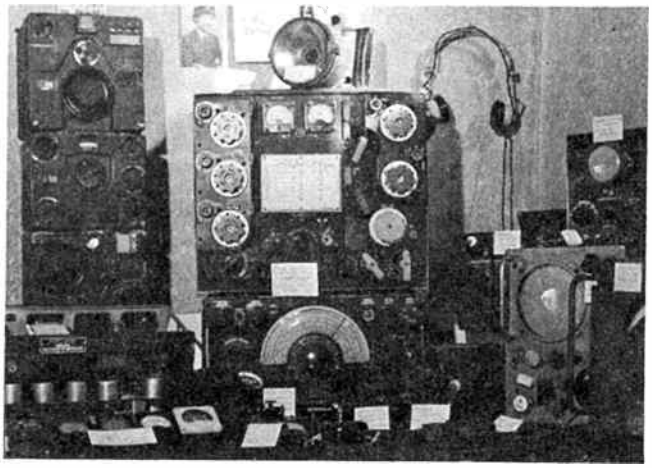


Fig. 5: Now museum pieces, the R1155/T1154 stands proudly in the centre with three sets from the Heinkel 111 on the left and a piece of wartime RADAR on the right

called the National Wireless Register, and readers were invited to complete the form so that they might be classified into technical groups which would be useful to the authorities, and avoid the real danger that the ability of wireless men might be lost through individuals being hastily drafted into non-wireless categories.

The form itself states: "During the Great War the needs of the Services for operators were largely met, especially during the early stages, by the voluntary enlistment of trained Post Office operators, but as Morse is no longer used in the Post Office, this possible source of supply is rapidly dwindling. It is therefore imperative that all our readers who have at least a good working knowledge of Morse, or have other qualifications such as ability to service and repair wireless and electrical apparatus, should apply to help fill the vacancies which now exist in the RNV(W)R, the Royal Corps of Signals, TA, and the RAFCWR."

Less than a year later, Great Britain was at war and in the early days a party of 55 ex-Civilian Wireless Reservists went to the Maginot Line and were christened the "Early Birds" by the amateur radio fraternity. According to the RSGB journal, September, 1942, some 2500 of their members had joined the forces. By the end of the war, thousands of people from the radio fraternity had served their Country in one of the many branches of radio communications in the armed forces. Ex-service personnel still talk with affection about such famous pieces of equipment as the Army's Wireless Sets, Nos 18, 19, 38 and 46, the Navy's CR100, the RAF's R1155/T1154 combination, the AR88 and the B2 and MCR-1 Clandestine sets, all of which are now collectors' items and stand silent in various museums representing a period of time when Wireless and thousands of its enthusiasts went to war. ●

ACKNOWLEDGMENTS

We are indebted to the Editor of *Wireless World* for permission to reproduce Fig. 4 and other extracts from that journal, and to the RSGB for permission to quote from the *T & R Bulletin*.

The sets in the photographs are from the author's collection and are on display at The Chalk, Pits Museum, Houghton, Sussex.

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FM MULTITESTER

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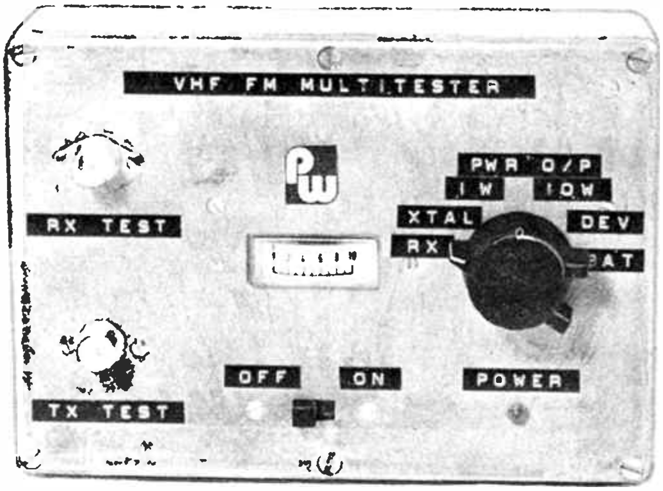
This multitester was originally evolved as a constructional project for members of the UK F.M. Group in London, where several such instruments were very successfully built. Together with a suitable wavemeter, it forms the basic test equipment necessary to carry out performance checks on frequency-modulated v.h.f. equipment and meets Home Office requirements in this respect.

The majority of people owning commercial apparatus will possess basic test equipment but are unlikely to have the sophistication of r.f. power meters, deviation meters and so on. The unit to be described was developed as a means of carrying out rapid assessments of performance and offers an accuracy, after initial calibration, which is quite adequate for amateur use.

Receiver check, crystal test, power output (1W and 10W) and frequency deviation are the four functions provided, together with a battery status indication. The instrument and battery pack is built into a small, diecast box, which makes it rugged and readily portable.



Functions

Function 1 selects the crystal oscillator, which puts out a low-level signal on a pre-determined frequency within the 2m band. The choice of crystal is left to the constructor but perhaps the most useful channel to use would be S20 (145·500MHz), the UK calling frequency.

The oscillator operates at the fundamental frequency of the crystal — which falls in the 8MHz range — the output frequency being achieved by a stage of multiplication. The facility may be used for checking receiver gain, S-meter calibration and alignment.

Function 2 provides a crystal test, and devices within the range 4–24MHz may be checked for performance. The internal crystal is removed and that to be tested plugged into its socket. If the constructor foresees regular use of this facility, it may be worthwhile bringing the socket to the outside of the unit — possibly putting several different types in parallel.

The measurement of r.f. power, to a maximum of 1 watt, may be carried out using Function 3 and the internal 50Ω dummy load, at a typical v.s.w.r. of 1·1 : 1. Although the power scales are non-linear, it is possible to draw up a calibration chart for the instrument by reference to a commercial power meter.

Measurements of up to 10 watts may be made by selecting Function 4. The internal dummy load will handle these levels only for a short period however — typically 30 seconds.

Function 5 measures the deviation of an f.m. signal on a pre-calibrated scale of 0–10kHz. The signal applied should be at a power level of between 500mW and 10W and must be of the same frequency as that used for the receiver check (Function 1).

A check on the carrier frequency is also possible using Function 5. If the internal oscillator is accurately adjusted by means of a frequency meter or against a communications receiver with crystal calibrator, the meter will

Table 1

Voltages
(Multitester switched to range 2, Cystal Check)

Tr1 (with crystal fitted)	c	12V
	b	5·1V
	e	8·5V
Tr1 (crystal removed)	c	12V
	b	5·8V
	e	5·2V
Tr2 (with crystal fitted)	c	12V
	b	1·7V
	e	2·5V
Tr2 (crystal removed)	c	12V
	b	0V
	e	0V
IC1	pin 2	6V
	pin 3	6V
	pin 6	6V
	pin 7	12V

The above voltages were measured with a 10MΩ resistance d.c. voltmeter and a 1MΩ probe.

The r.f. voltages at various points are:

Tr1	emitter	1·5V r.m.s.
Tr2	base	1·4V r.m.s.
Tr2	collector	0·15V r.m.s.
D6	cathode	0·05V r.m.s.

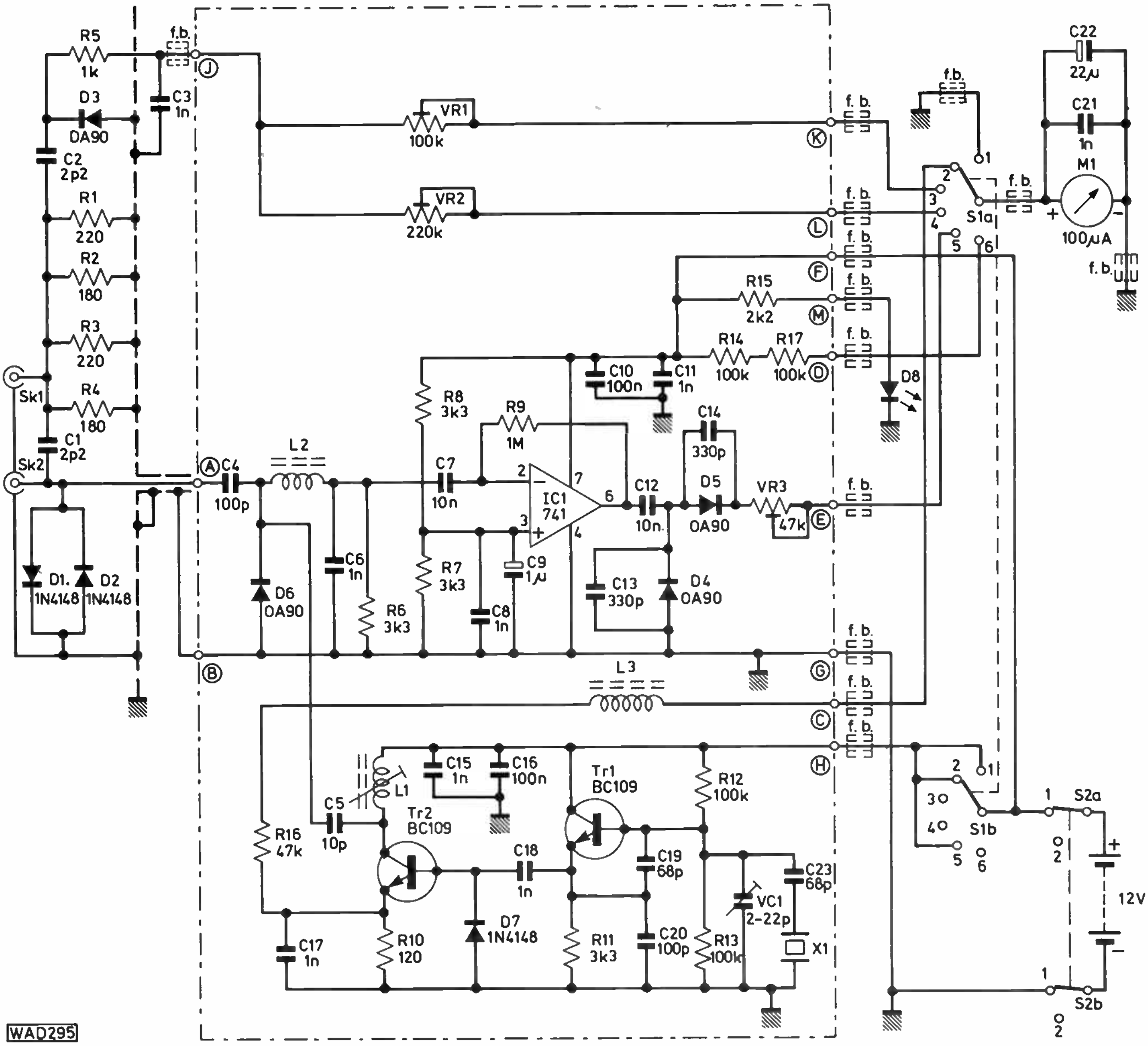


Fig. 1: Circuit of the Multitester

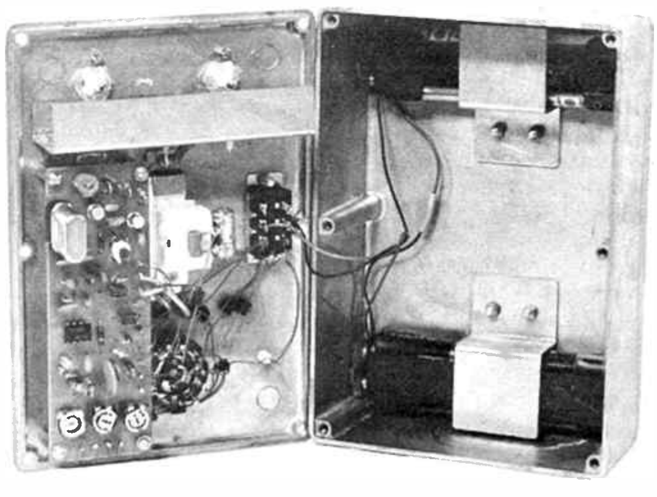
indicate a standing reading corresponding to the error, ir kilohertz. For example, a reading of 4 in the absence ol modulation would indicate that the transmitter is 4kHz ofl channel. Hence, the instrument can be used for checking both the receive and transmit frequencies once correctly calibrated.

The final function serves to test the internal batteries. Here the meter operates as a voltmeter with a full-scale deflection of 20 volts.

Circuit Description

Transistor Tr1 functions as a conventional Colpitt's oscillator, the frequency being adjusted by trimmer TC1, whilst Tr2 acts as a multiplier and amplifier, the diode D7 improving the harmonic content of the signal at its base.

With suitable crystals, Tr1 will readily oscillate at any frequency between 4 and 24MHz. However, the circuit is optimised for operation at 8MHz and when a crystal for



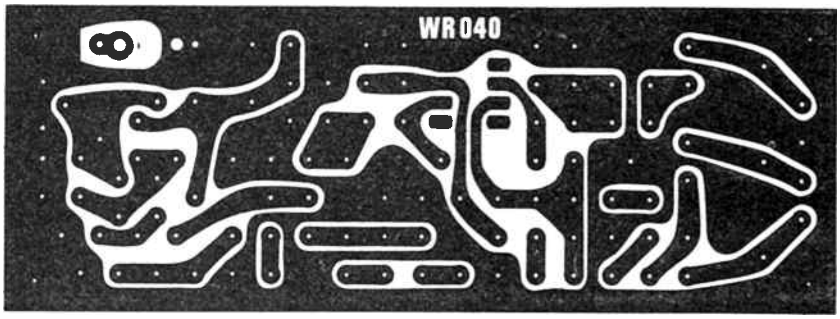


Fig. 2: Layout of the p.c.b. (shown full-size)

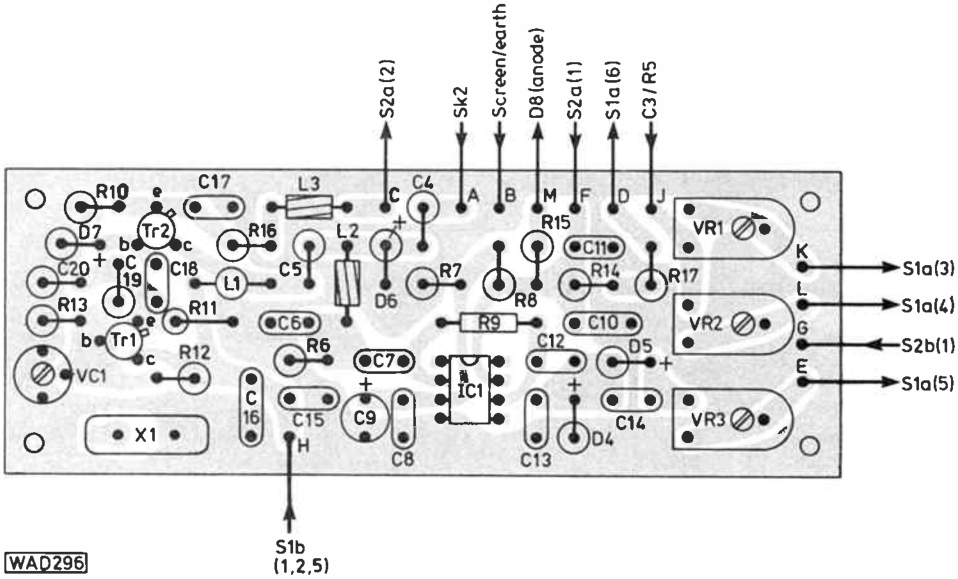


Fig. 3: Component layout

this frequency is used (8·08333MHz for 145·5MHz, for instance), Tr2 multiplies 18 times, L1, together with the stray and internal capacitance of Tr2, resonating at approximately 145·000MHz.

The integrated circuit IC1 is arranged to operate as a very high gain audio-frequency amplifier and requires only a very small input voltage to achieve full limiting of its output. This means that a small sine-wave input is converted to a 6 volt peak square-wave output of the same frequency. Diodes D4 and D5, together with C12, form a charge-pump arrangement. Thus, the current through VR3 and the meter will depend on the frequency of the signal applied to IC1 and not on its amplitude. The relationship between the input signal frequency at C7 and the meter current is substantially linear.

Potentiometer VR3 is used to calibrate the instrument. Diode D6 acts as a simple, but effective, mixer, the output of which passes through an r.f. filter formed by L2 and C6 and is the frequency difference between the output signal at Tr2 and the input from SK1. This is subsequently passed to IC1 and the circuit previously described. The diodes D1 and D2 form a limiting circuit to prevent the input to the mixer diode (D6) from exceeding 1·2 volts peak-to-peak whilst D3 is used to sense the r.f. at SK1 for the power ranges, the calibration being by adjustment of VR1 and VR2.

Construction

In order to ensure the circuit operates satisfactorily, it is essential to closely follow the recommended layout. Newcomers to the construction of v.h.f. and u.h.f. equipment take heed that conventional wiring techniques will introduce stray reactance which will adversely affect the ultimate performance. Hence component leads must be as short as possible, the neatness of the wiring being a secondary consideration.

Most of the devices are mounted on a p.c.b., the remainder being fixed on the lid of the box. Ferrite beads provide the necessary r.f. decoupling, and these may be rigidly mounted by the application of a small amount of adhesive.

The dummy load resistors (R1–R4) are positioned on the screen and as close to SK1 as possible. In use, these are likely to become fairly warm, so the screen will also double as a heatsink. The free length of the resistor leads should not exceed 5mm for minimum v.s.w.r.

The full circuit of the multitester is shown in Fig. 1 and the p.c.b. details and component layout in Figs. 2 and 3. It should be noted that many devices are vertically mounted and this should be borne in mind when shopping!

The inductor L1 consists of 3½ turns of 20 s.w.g. enamelled copper wire, wound on a 4mm diameter ferrite-dust core. It is self-supporting and after initial adjustment should be secured with wax. Chokes L2 and L3 are each made from 6 turns of 36 s.w.g. enamelled copper wire, wound on a ferrite bead. Note the capacitor C23, which is mounted below the p.c.b. between the "hot" end of crystal X1 and the junction of R12 and R13.

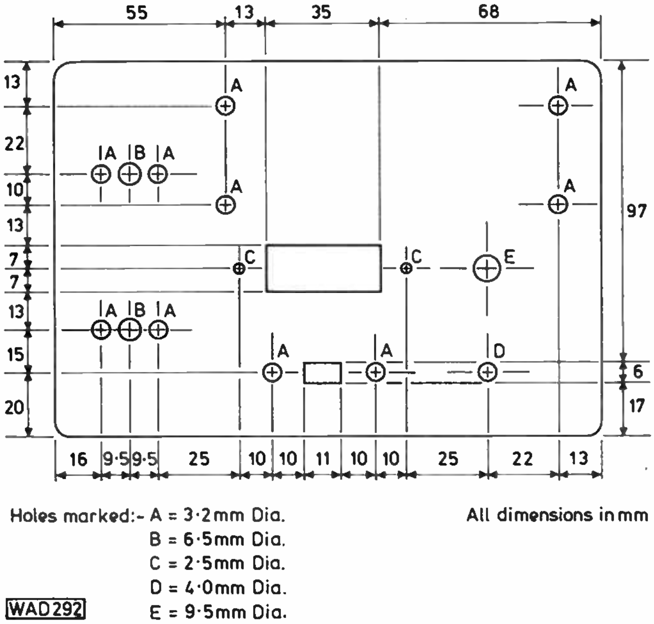


Fig. 4: Drilling details for the box lid

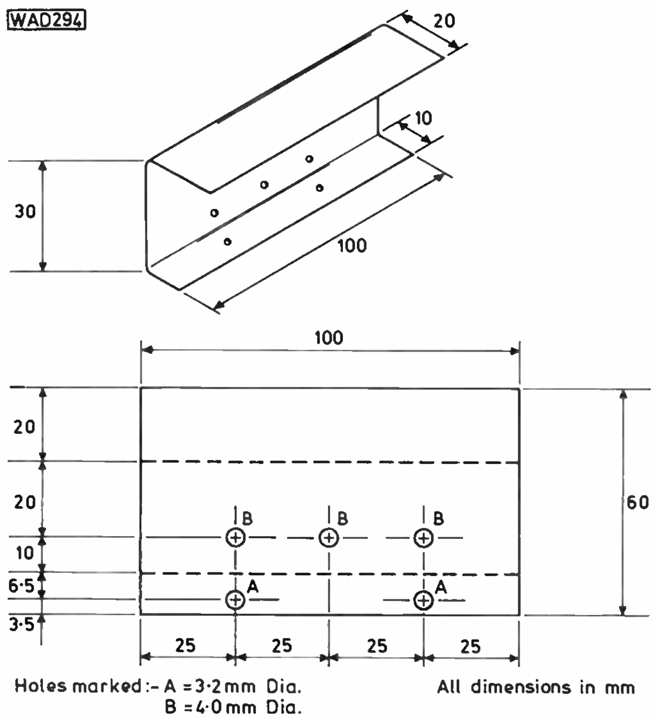
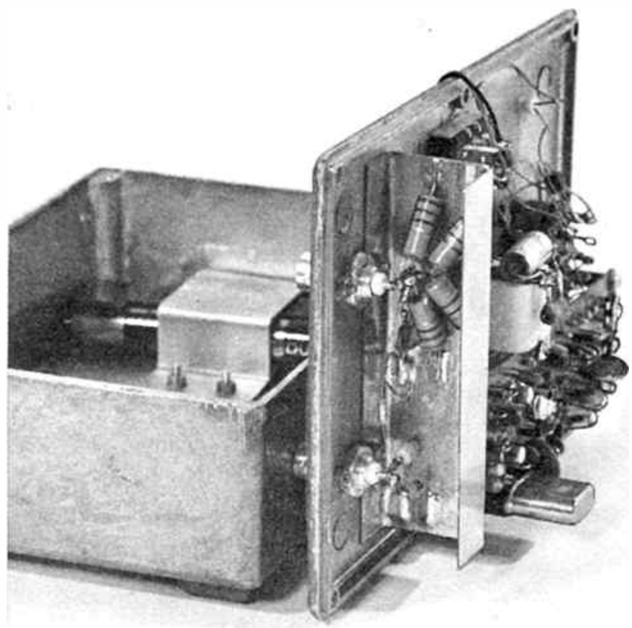


Fig. 5: Construction of the tinplate screen

Testing and Calibration

Make a thorough visual examination of the p.c.b. when the assembly has been completed, paying particular attention to the polarity of components and soldering. Assuming all seems correct, connect the batteries and switch on, setting the function switch to "Battery Check". The meter should indicate "6" — corresponding to 12 volts — and the l.e.d. should illuminate.

Now set the function switch to "Crystal Test" and observe the meter reading: if the oscillator is working then some indication should be present. Adjust VC1 for max-



Internal view of the unit, showing arrangement of dummy load resistors

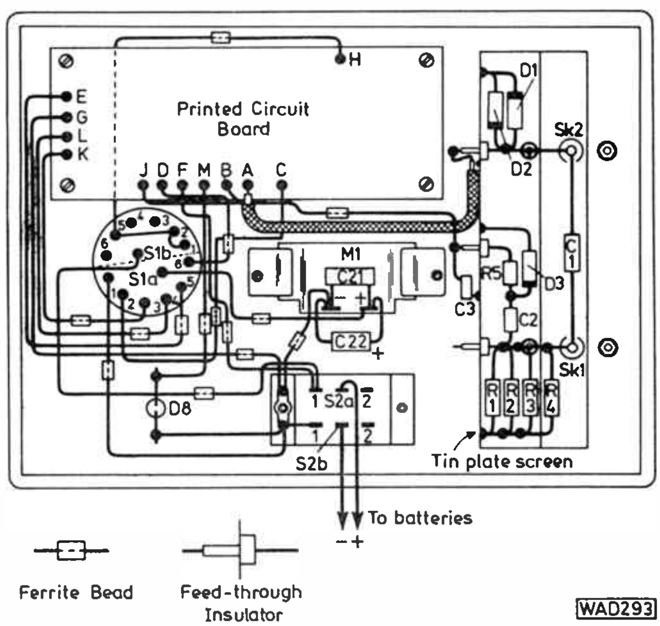


Fig. 6: Wiring diagram

★ components

Resistors
¼W 5% Carbon film

120Ω	1	R10
1kΩ	1	R5
2·2kΩ	1	R15
3·3kΩ	4	R6,7, 8, 11
47kΩ	1	R16
100kΩ	4	R12, 13, 14, 17
1MΩ	1	R9

2W High stab. carbon

180Ω	2	R2, 4
220Ω	2	R1, 3

Semiconductors
Transistors

BC109	2	Tr1, 2

Integrated circuit

741	1	IC1 (Mini-dip type)

Diodes

1N4148	3	D1, 2, 7
OA90	4	D3, 4, 5, 6
LED	1	D8 (Red)

Crystal
Within 8MHz range (see text), HC25 series 8·08333MHz for S20 (145·500MHz) from P. R. Golledge Electronics, Merriott, Somerset TA16 5NS

Sockets

50Ω BNC	2	SK1, 2
HC25	1	SK3 Crystal Holder (P. R. Golledge Electronics)

Switches

S1	1	2-pole, 6-way rotary
S2	1	2-pole, 2-way slide

Potentiometers
Miniature skeleton pre-set, horizontal mtg.

47kΩ	1	VR3
100kΩ	1	VR1
220kΩ	1	VR2

Capacitors
Silver Mica

2·2pF	2	C1, 2
10pF	1	C5

Polystyrene

68pF	2	C19,23
100pF	2	C4, 20
330pF	2	C13, 14

Miniature disc ceramic

1nF	8	C3, 6, 8, 11, 15, 17, 18, 21
10nF	2	C7, 12
100nF	2	C10, 16

Electrolytic 16V axial leads

1µF	1	C9
22µF	1	C22

Trimmer. Single turn miniature ceramic

2–22pF	1	VC1

Miscellaneous
100µA meter, edgewise-reading. RS type 259-561. Diecast box 171 x 121 x 55mm. Ferrite beads (14 off). Battery cradle (2) to accommodate 4 x HP7-type cells. Pointer knob (Sifam). Feed-through insulators (3). 25mm stand-off pillars for mounting p.c.b. (4). Piece of tinplate approx. 100 x 60mm x 20 s.w.g. Printed circuit board.

imum deflection. Connect a receiver (or transceiver) to SK2 "Receiver Test" and tune to the test channel frequency. Peak L1, with reference to the meter, adjusting VC1 also to obtain the best indication possible. If you are fortunate enough to have access to a reliable digital frequency meter, swing VC1 to the correct fundamental frequency, as measured at the emitter of Tr2. This completes the oscillator and multiplier alignment for functions 1 and 2.

Switch to the 1 watt r.f. function and set VR1 and VR2 to mid-position. Using a variable power supply, inject 4·6 volts at point "J" on the p.c.b. and adjust VR1 for a full-scale deflection on the meter. Now select the 10 watt r.f. power function and inject 14·6 volts at point "J"; adjust VR2 for a full-scale reading. If a commercial power meter, such as the Antenna Specialists or Bird Throughline, is available, then the meter calibration may be very accurately carried out and a chart drawn up.

Finally, select the deviation function and apply a signal of between 0·5 and 1 volt r.m.s. at a frequency of 10kHz (sine or square wave) to pin 2 of IC1, via a 10nF capacitor. Adjust VR3 for full-scale deflection of the meter.

The alignment and calibration is now complete. Typical voltages are given in Table 1 to facilitate troubleshooting should problems subsequently arise, but in practice, little difficulty should be experienced with the instrument. ●

LETTERS

continued from page 29

Sir: I agree entirely with Mr Goodier's letter. A lot of what people consider to be progress in this world is anything but. I think it must be because people don't hear what they don't like!

G. M. Pheasant
Great Wyrley
Walsall

Sir: I am an ardent supporter of CB, and unlike the majority of its critics, I have had five years of operating on a Citizen's Band in a more enlightened country, where I learned the true value of low-power radio communications for the general public.

I wonder why Mr Goodier singles out hikers and climbers? There are numerous situations where two-way radio could be a lifesaver. Yes, hikers would benefit—how many times do we hear of mountain and moorland rescue teams being called out each winter? But what about the owners of small boats that do not warrant a marine-band ship-to-shore radio? I think it fair to say that the lifeboat service would have been spared many hours of searching if small fishing boats and yachts had the right to carry a CB radio. What about the everyday motorist, broken down on the motorway or involved in an accident—both situations where CB would be of immense value? There are, of course, emergency telephones to cover these eventualities, but how often does one find these out of order due to vandalism? I think these points must surely form the basis of a good argument in favour of a UK Citizen's Band.

I am not so naive as to believe the band would be full of do-gooders permanently listening and waiting for emergencies. I am sure it would suffer misuse and abuse, but I think you will agree that there are very few aspects of modern life that are not abused by someone, somewhere. I can say in all honesty, that during my five years of operating CB, I encountered only a very small number of cases of illegal operating, such as the use of high-power r.f. amplifiers and v.f.o.s, etc.

I will agree with those who say the 27MHz band is in some ways unsuitable due to the ease of DXing when conditions open up. Although this would contravene the terms of the licence, I feel it much less likely to offend the listener than the fiasco on GB3LO and other repeaters. I would like to see a portion of the v.h.f. spectrum opened up to CB, but to be practical I think the 27MHz band would have to be accepted, as there is an unlimited amount of good-quality equipment already available at very modest prices.

I believe many people, especially some of my fellow amateurs, are being very guarded about this issue, but this is hardly surprising when Mr Goodier suggests using part of the amateur 2m band. There is no connection between CB and amateur radio—they are worlds apart and will always remain that way.

The suggestion of a novices' band is excellent. I have spent many enjoyable hours working slow c.w. and giving American novices some overseas contacts, and it is towards the United States that we must look when considering such a band.

I rather suspect Mr Goodier's motives to be somewhat personal, and I see them as an attempt to use 2 metres without taking the RAE. When his proposals are carefully studied, I believe they would benefit neither amateur radio nor a Citizen's Band service.

John M. Southall G4DMT
Somersham
Suffolk

Sir: Contrary to Mr Goodier's suggestion, 144·5–145·0MHz is not "A dead part of the 2 metre band". Many local nets use this section of the band, including the Norfolk-Lincolnshire nets, also it contains various beacons and the Dutch National (similar to RAYNET) frequencies. Why should the small amateur frequency allocations be cut up for a Citizen's Band, albeit in the guise of a novices' band?

It is quite simple these days to obtain an amateur licence without having to study Morse. Also to allow a free-for-all with 10 watts is just inviting interference problems. One watt would be more than adequate in any novices' band, but let it not be in the amateur frequency allocations, please.

D. G. Blake G3MWV
Cromer
Norfolk

New publication

Sir: I intend launching a new publication called *Innovation News,* initially as a newsletter, devoted to new designs, ideas, inventions, etc.

If anyone is interested in this idea, either as a subscriber or contributor, would they please contact me at the address below. An s.a.e. would be appreciated.

B. McAleer
59 Castledine Street
Loughborough
Leicestershire
LE11 2DX

Information Please

Sir: I would be glad to hear from readers with any knowledge of pulsed High Frequency as used in Medicine.

G. H. Anthony
17 Ledbury Road
Hereford
HR1 2SY

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

Letters from readers on aerial matters are very common, but reveal a certain misunderstanding on the results to be expected with simple half-wave dipoles. Such an aerial is usually cut to length using the formula 468/frequency (MHz) giving the answer in feet. It is sufficient to take the middle of the band concerned rather than a specific frequency. On 20m for example, take 14 200kHz, giving $468/14{\cdot}2 = 33$ft approximately.

This length of wire is then cut in half and fed in the centre with low-impedance feeder, preferably 75 ohm, which is led to the receiver. Some readers seem to think that this aerial will virtually eliminate all signals except those on 20m! Such an aerial is similar in electrical characteristics to a simple tuned circuit which has quite a broad selectivity curve, so it will still work, albeit with decreasing efficiency, from 10m to 160m, peaking on 20m. On the transmitting side one would not use a half-wave dipole on other than its design frequency, except perhaps on its third harmonic (a 7MHz aerial on 21MHz) but that is another matter.

I feel that it is rather pointless using an aerial designed for one band with a multi-band receiver. Much better to use a dipole, say 66ft, centre-fed with open wire tuned feeder and an a.t.u. to give optimum performance on all bands. Details with possible feeder lengths can be found in most aerial handbooks. The end-fed version, known as the "Zepp", was one of the first aerials ever designed and can be very useful in certain locations.

I am surprised that readers do not progress to simple wire element beams from end-fed wires, as they need not cost anything but can be made from copper wire obtained from old transformers, with bits of plastic strip for insulators. It seems to be thought that such beams will not work well unless the elements are nice and straight, precisely vertical or horizontal, as they appear in the books.

Nothing could be further from the truth, as the ends of elements may be drooped down and attached to such sundry supports as are available. Simple V-beams are very useful provided the legs are each at least a wavelength long, which is easily obtainable for say the 10 and 15m bands. An a.t.u. will permit operation on other bands and still retain some gain. The legs of the "V" can even go from the top of a pole down to ground level if no distant supports are available.

The thing is to try out various designs and to experiment, but always use an a.t.u. to bring the whole system to resonance. The experience obtained will come in very useful indeed when a transmitting licence is eventually obtained.

On the Bands

In spite of finding it a problem to stay awake **Ian Marquis** A9140 of Leigh-on-Sea, Essex, has managed to cover all bands and it is very obvious that the 80m band is really waking up now with prefixes like EP2, JA, TU, ZL showing up in Ian's log, caught on his FRG-7 and "multi-band Slim Jim". A new one on me and I await details with great curiosity! On 20m Ian found a nice one in VK9XW on Christmas Island, very appropriate!

A pleasant letter from G4HLN, **Lawrence Bennett** of Bristol, who finds working DX a lot less easy than just listening to it! He has a Heathkit HW32A on 20m s.s.b. but is very keen on c.w. and would like to see some c.w. logs in this column. I agree, being a code nut, and as there must be plenty of readers studying code for their "A" licence how about some c.w. logs for a change?

Regular **Bill Rendell** from Truro, Cornwall, got very excited when he heard the "long path effect" on some OH stations on 20m and even went to the trouble of calculating the distances involved, having done some navigation in the past. However, I feel that there was probably an intense aurora borealis at the time, reflecting signals from the Scandinavian area. The effect is better known on the v.h.f. bands, when best results are obtained if all concerned turn their beams to the north. On 80m Bill logged CT2, KG4, TF, W0 and ZL4 for his first look at this band this season.

David Parker BRS40420 got his hands on some shiny new sets at the Leicester, show but didn't feel too jealous when he got back to his HQ120X. I'd plump for that set any day OM! David found Jan Mayen on 20m in the form of JX9WI for a rare one, plus ZD7SD on St. Helena.

General Notes

From Stokenchurch, Bucks, **Peter Recklin** BRS40425 found the *PW* series on the RAE to be easy reading compared to other books on the subject. Having organised the series, I feel rather good about his remarks. He, like many others, comments on the lack of interest shown by the RSGB in the "very beginners" and adds: "after all, that is where the new generation of radio amateurs will come from". Precisely! Peter had a go at an RAE course but found the pace too hot for the time he had available, but I'm sure it was good experience. Peter has an FRG-7 modified with a Toko MFL455 filter, as per *Radio Communication,* August '78. Naturally enough, he finds reception of s.s.b. signals greatly improved.

Greg Duffy of East Kilbride, Glasgow, has been using a 15m dipole on several bands and still managed to copy things like HR3, 9N1 and YN1 on 20m on his FR50B. You may be interested in my opening few paragraphs, OM. From 23 Palace Avenue, Paignton, Devon, **Tom Hillier** writes to ask for advice on improving his ex-naval B40 receiver. There are plenty still around so if you think that you can help Tom, drop him a line direct.

With little time for DXing **Dave Wyatt** in Oswestry, Salop, found ZD9GH on Tristan da Cunha, with his BC348 and 90ft long wire on 20m. Good luck with the exams OM. Another seeking information is **Jim Clow** of 7 Montagu Road, Datchet, Berks, who has a Collins TCS10 set and no manual. "Complete stranger" **Colin Price** of Leuven in Belgium hails from Cambridge and is keen on taking the RAE with a view to getting an ON ticket, to keep in touch with home. Having just finished a post-graduate course, Colin acquired a Marconi Electra set plus an old 19 set and an a.t.u., so he's well on the way.

Through the kindness of a reader, **Chris Mortlock** of Brackley, Northants, acquired an R107 and, with the help of G3YMQ, is getting it up to scratch. Chris has been playing around with pins in maps to see what his aerial is doing on 80m as far as directivity is concerned. A good idea but a world map must be one of the great circle type that gives true direction and distance. Other maps are useless for this purpose.

Newcomers

Following my odd notes offering guidance to those newly acquainted with amateur radio, I have heard from a couple of dozen readers who were obviously standing on the sidelines, just looking in, but a bit shy to write in case they should be thought to be "slow". As I've said before, we all have to start somewhere, whatever the hobby, and it is only commonsense to seek advice and no-one will think less of us for that. **John Bull** (Laughton-en-le-Morthen [lovely!] South Yorks) wanted the aerial chart to go with his new SRX30 (Lowe Electronics).

George Grzebieniak, London W4, is 14 and collects old radios but now favours amateur radio. He has a Realistic DX160 and inside long wire. **Ian Scrimshaw** of Grimsby has an AR88 now and wonders about an aerial for 160m. Well, other than a specialised one, a long wire around 132ft and a.t.u. is probably the best answer, with a good earth connection if at all possible.

Glasgow University lecturer in biochemistry **Barry Clark** BSc, PhD, AIMLS, did not hesitate to write in, having been interested in crystal sets and simple valve sets a few years ago, at school. He is about to buy a receiver and intends to go on for his ticket. London W3 is the QTH of **Peter Smith** who has a National DR2800 but didn't have much luck with an a.t.u. I don't know this set but it sounds as if the "very long wire" is the trouble, already causing intermodulation problems on strong signals, compounded by the a.t.u.

David Allsop started recently with a CR100 in Abingdon, Oxon, and logged ZD7SS on St Helena. An FR50B has been added, greatly improving reception, with a 60ft wire. Heart attack victim **Len Wilson** of Scarborough wanted the aerial chart to go with his DX160 receiver and 60ft of wire in his bungalow loft. He, quite rightly, reckons amateur radio is for him now that he has to take things easy. Raised in the RAF on the R1155, AR88 and the R1475, **Jim Bence,** now of Hamilton, Lanarkshire, has returned to radio with an Elizabethan Pathfinder set with 12 bands running from long waves to 470MHz, after 27 years, so not quite a newcomer!

Electronics technician **Eric Hayes** (Freckleton, Lancs) specialises in the repair of hi-fi gear but got the bug when a friend brought in a Trio QR666, and finished up buying the set! He's tried a 60ft wire and a vertical in the loft but wants something better. He intends to go for the RAE in the near future and I don't imagine you will have much difficulty OM.

In Stanford-le-Hope, Essex, **Alan Taylor** has "hung up his football boots" and with family ties having cut out sailing, gliding and skiing, he has turned to amateur radio, realising that it will keep him at home! Having been a 25 w.p.m. operator in the RAF he is well on the way to his G4 ticket. Alan, you almost had me in tears! Lastly, but certainly not the least, 13-year-old **Paul Burgess** of Lowestoft, Suffolk, has started off with a Heathkit AR3 valve set, but is concerned that it does not have a variable b.f.o. as he is keen on c.w. Hooray. If anyone can help with a manual or info write to Paul at 3 Andrew Way. With letters from 15 "newcomers" this month it ought to produce a couple of new licences at least, in due course!

Club News

Stevenage and District ARS meet first and third Thursdays at British Aerospace, Gunnels Wood Road, Stevenage, Herts, at 8pm. Programme arranged to August which gives us poor reporters a chance to get items in print in due time. Wish other clubs would do likewise! April 5 sees G3AGP talking on the problems of mobile operators, with a junk sale on the 19th. Newcomers, don't despise a junk sale, you'll never get better bargains anywhere! Sec. **Trevor Tugwell** G8KMV at 11 The Dell, Stevenage, for more info.

Southdown ARS meets on first Monday of the month (ex-Bank Holidays) at Chaseley Home for Disabled, Bolsover Road, South Cliff, Eastbourne at 1930 hours. Cyril Minns G3YSZ has ascended to the presidency and Dave Morgan G4FDW now handles the society's Newsletter. Copy please! Cyril Collins G8SC, prog. sec. would like to hear from anyone able to give talks, lectures, etc. Contact **Dick Jeffries** G8KQN, 16 James Avenue, Herstmonceux, East Sussex.

West Kent ARS have G4BWH talking on the engineering involved in the recent BBC programme changes, on March 16. On the 30th Tony Tory lectures on microprocessors in amateur radio. Meetings at the Adult Education Centre, Monson Road, Tunbridge Wells at 8pm, plus alternate Tuesdays at 8pm, at the Drill Hall, Victoria Road. More info from **Brian Castle** G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent.

Wessex AR Group (sec. ed. **Geoff Cole** G4EMN, 3a Cavendish Road, Bournemouth) has a very special meeting at the lecture theatre, Bournemouth School, East Way, at 7.30pm on Friday March 16, when L. Moxon G6XN, aerial expert par excellence, will talk on Aerials and Propagation, Multi-banding of Aerials and Miniaturised Beams. Next day, on to skittles and social evening at the Moose Centre, Malmesbury Park Road, Bournemouth with special prizes for the ladies. Info on this from **Archie Hoggan** G8ASX on Bournemouth 427582.

Thames Valley ARTS are in for a treat when Dr. A. McGregor talks to them about Radio Astronomy on March 6 at usual meeting place, Giggs Hill Green Library, Thames Ditton. Meetings there first Tuesday every month. Contact **R. Blasdell** G3ZNW, 92 Bridge Road, Chessington, Surrey.

Remember, logs, letters by 15th of the month and allow for strikes, delays and other tribulations!

Log Extracts

W. Rendell:—80m CT2QN KG4W TF1AW W0MC ZL4KE **20m** C5ABK EA8LS FK8CU (New Caledonia) JY5MC P29JS VK9XW 8P6IB 9Y4OV **15m** C5ABK KZ5AS OX3WO 9J2TJ

L. Bennett G4HLN (worked):—**20m** C31OZ CT2AO FP0EE HC1BU J28BA OY81 PJ8CO YI1BGO

G. Duffy:—20m HR3JJ YN1CR 9N1MM **15m** FY7AWZ KZ5RO OX3GW SU1CR TI2JV VP9JO YS1FAF ZL1BD 8P6FX 9L1AB 6W8AR

R. Bell:—20m ZL4HB ZL4LZ

I. Marquis:—160m (c.w.) K1PBW W1BB/1 **80m** CN8DO D4CBK EP2SL JA4BCW TU2FH ZL4KE 5B4HD **20m** JY9DI VK9XW **15m** VS6HG XT2AV **10m** FR7ZL HZ1SH SU1DP TR8GDC

All s.s.b. except where stated otherwise.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

A DXer in the Shetland Islands, **Arthur Tate,** writes to say that he has modified his m.w. loop to work on the long waves simply by fitting a fixed capacitor (no value given) in parallel with the loop's tuning capacitor. Arthur asks for comments about this arrangement which works very well with BBC Radio 4 on 200kHz. Radio 4 incidentally, appears to have become semi-DX in the Shetlands since the great change around last November.

Modifying a Loop for the Long waves

The disadvantage of Arthur's method is the very restricted tuning range that is obtained. With my 40 inch loop, a parallel capacitor of 2000pF tunes it to 300kHz, but the tuning capacitor would only adjust the frequency through a range of about 20kHz! At the l.f. end of the band the situation is worse. A fixed capacitor of 6700pF tuned the loop to 155kHz, but this time the tuning control had little effect.

To cover the band, a capacitance range of 2500pF to 7200pF is required which is obviously impracticable. None-the-less, this method is of value if you want to tune the loop to a single frequency as Arthur did. Fitting "in parallel" means joining one wire of the fixed capacitor to one terminal of the tuning capacitor on the loop and joining the other end to the other terminal. No need to disconnect anything, you just bridge the fixed capacitor across the variable one.

A better method is to insert a fixed inductor in series with the loop's main winding. Disconnect one of the two wires to the tuning capacitor. Connect this wire to one end of the inductor and run a wire from the other end of the inductor to the tuning capacitor in place of the disconnected wire. You may have to put the inductor inside a metal box, which should be earthed, in order to prevent it acting as an aerial. The inductor should have a value of about 2000μH, i.e. 2 millihenries, and the loop should now tune over the long-wave band. The secondary winding of a long-wave tuning coil would have about the right value of inductance. If the loop will not tune to a low enough frequency then more inductance is required. If it will not tune high enough, then remove some turns from the inductor or use one of a lower value.

Long-wave Loops

Both of these methods of modifying a m.w. loop are at best a makeshift, but they do enable the DXer to try out the long waves without too much effort. Anyone seriously interested in DXing on this band should construct a l.w. loop. It will certainly have greater pick-up than a modified m.w. loop. Pick-up is proportional to the number of turns and to the size of the loop. A 40 inch l.w. loop will have about $3\frac{1}{2}$ times the number of turns of a 40 inch m.w. loop, and therefore will have $3\frac{1}{2}$ times the pick-up.

It is difficult to specify the exact number of turns that are required as the self-capacitance of such a winding will be high. For a 40 inch loop the number should lie between 22 and 28, and if you start with the higher figure you can remove turns one at a time until the desired range is achieved. The type of wire to use is not important so long as it is insulated and rigid when wound. A 500pF tuning capacitor or thereabouts, should be adequate as the frequency ratio (highest to lowest) on the l.w.s is approx 2:1 instead of 3:1 on the m.w.s.

Readers' Letters

An interesting letter from **N. Soar,** who lives near Sheffield, and is the author of *50 Circuits using Germanium, Silicon and Zener Diodes* published by Babani. He describes how to boost the performance of a transistor portable, by placing it close to a crystal set tuning coil which in turn is connected to an aerial. If the receiver is tuned to a weak signal and the crystal set coil is tuned to the same frequency, then the coil will feed extra signal to the receiver by induction which greatly improves reception. With this set-up he was able to pick up Radios Manchester, Blackburn and Nottingham. Reception was good enough to listen to the programmes.

This method will be of interest to DXers who use a transistor portable that does not have an aerial socket, and it works on the same principle as mounting the receiver on a shelf fixed to a m.w. loop as described in this column in the December 1978 issue. You can also boost the signal by wrapping the aerial lead round the receiver two or three times, but you will boost all stations not just the one you are tuned to and this may cause overloading. It does help on some occasions though.

The well-known R1155 receiver is in use by **Chris Marcroft** at Ramsbottom, who obtained one for £3 and modified it along the lines described in an article I wrote for the March 1967 issue of *PW*. When connected to a 130ft long wire and a.t.u., this rig pulled in WINS on 1010kHz, WNEW on 1130 and VOCM 690, CJYQ 930 which are located in New York City and St John's in Newfoundland. Chris prefers his long wire to a m.w. loop as the pick-up is much greater, which is what one would expect. If you have a long wire and a loop, then it is worthwhile fixing a switch so that you can try each aerial in turn, to see which gives the best results with any particular station.

Reader **Andrew Roger** is puzzled by the number of layers in the ionosphere and how they affect DXing. So far as the medium and long waves are concerned, only the bottom two layers, the D and the E are of interest. The D layer, which absorbs l.f. signals, is maintained by the sun and disappears after dark to allow DX to be heard. The E layer, which also is created by the sun, does not disappear entirely after dark and this is the layer that reflects the DX on the medium and long waves. In mid-winter the D layer may only appear around mid-day and consequently some DX can be heard at times during daylight hours of winter mornings and afternoons.

DX Heard

Our long-wave DXer Andrew Roger of Bristol reports hearing the USSR 1st programme on 173kHz, Tebessa Algeria on 251kHz, Lahti in Finland on 254, an unidentified station behind Czechoslovakia on 271 (Novosibirsk Siberia?) and Minsk on 281. Reception was during the evening, using a Vega Spidola with internal aerial, and Andrew draws attention to the English programme from Tebessa which is on 251kHz daily from 2000 to 2030.

Some Spanish DX comes from **Bob Bell** (Blyth) who used his Yaesu Musen FRG-7 and 20 inch mini-loop to pull in Seville on 683kHz, Malaga 729, San Sebastian 774, Seville? on 792, Murcia 1179 and La Linea on 1314. Spanish stations have been conspicuous since last November, but there has been quite a shuffling about of frequencies and you have to listen for the identification to be certain.

Chris Mancroft asks about Radio Beacons on the medium waves and he reports hearing "MW" in Morse on 1008kHz and "RO" on 1012, which appear to be at their strongest when DX conditions to North America are good. The medium waves are supposed to be used exclusively for broadcasting, though in practice some radio beacons are to be found within the band below 800kHz. It has also been the practice in some countries to leave their m.w. transmitters on the air after the programmes finish and to key the transmitter with some sort of identification. Sottens in Switzerland, now on 765kHz, used to transmit "SOT" during the night, though whether this was for navigation purposes or just to keep the frequency occupied and deter intruders, was not clear. Morse signals on the medium waves are very likely the harmonics of long-wave radio beacons. Such beacons would be of considerable value to the DXer if their locations were known as they could be used as a guide to propagation. Unfortunately it is not too easy to track down many of them.

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Readers often comment on the current state of the short-wave bands which are dominated by high-power broadcasts of political propaganda and jamming. **T. W. G. Eltenham** complains that smaller countries do not get a look-in, while **George Rose** comments on the increasing number of harmonics observed on the higher frequencies, caused no doubt by a combination of super-power transmitters and beam antennas. In my opinion it is an absolute waste of time to write to the offenders, who have no interest in DXers or in the hobbyist s.w. listener, but there are several things that can be done to get round the problem. After all, if DXing were all that easy then it would cease to be attractive!

When to Listen

Not every band is dominated by high-power broadcasts all of the time. Generally speaking the higher frequencies are in use during the day and lower ones at night, but there is DX to be found when the bands are quiet. Latin Americans for example, are on the 19m and 25m bands during the late evening as the path to that area is still open then. Mixed paths of daylight and darkness can also produce signals on unexpected frequencies, usually at the middle of the spectrum. Low frequencies can yield interesting catches during the day.

Out of Band Stations

As a result of overcrowding there is an unofficial spreadout, up to 100kHz beyond the limits of each s.w. band. Some of the late arrivals to international broadcasting are to be found here. Typical is Kuwait on 12 085kHz which is outside the h.f. limit of the 25m band. This station has European-style programming and is widely reported. Countries to be found around the edges of the 49m, 41m, 31m, 25m and 19m bands are Israel, Andorra, Egypt, Iran, Pakistan, Vietnam, Saudi Arabia, India, Bangladesh, Austria and Guinea, so that it is always worthwhile tuning near the upper and lower limits of each band and investigating weak signals.

Another area where interesting DX is to be found is in the spaces between the international bands, though telegraph QRM can be troublesome. Israel broadcasts its domestic service on approx 9020kHz, which is well away from the 31m band. Out-of-band transmissions appear to be used mainly for domestic broadcasting, particularly by China but also by India, Iran, Israel, Mongolia, Korea, Turkey and on the l.f. side of the 49m band by Peru, Indonesia, Bolivia and Honduras. Always check a weak signal as real DX seldom comes roaring in.

The B40 Receiver

Many thanks to *PW* readers **G. A. Cartwright, John Markey**, D. **Porter** and **Bill Hentall,** for responding to Roderick William's request in the January issue for suggestions for a suitable replacement for the output valve in his B40 wartime communications receiver. The B40 was used by the Navy and although bulky and heavy it is quite presentable in appearance. It has its own speaker and can be plugged straight into the mains and used without modification. It is the only set I have come across that has an anti-crossmodulation control which works by adjusting the bias to the control grid of the first r.f. valve. There were a number of variants of the B40 indicated by a suffix letter. There was also the B41, a low frequency version covering 15kHz to 720kHz in five bands—not much use for broadcast band DX as it stands.

A number of readers have referred to the B40 recently. **Robert Round** remarks wryly: "My first receiver was a B40, and to be honest I think I was a fool to get rid of it." I can sympathise Robert, I feel the same way about my old much-modified CR100 which was disposed of some time ago. **G. Stainton** is desperate for a manual for his B40. Try Brooks, Farrant House, Winstanley Road, London SW11 2EJ who supply reprints of many manuals. John Markey would like to fit an antenna trimmer to his B40. Connect a small variable capacitor of about 50pF in parallel with the first r.f. section of the main tuning capacitor, if you can locate it. John would like to contact readers who have done any "mods" to the B40, replies direct to John please at 4 Harrison Way, Lydney Gdns, Gloucester GL4 5BN. Perhaps someone will start a club for B40 owners!

11 Metre Band

This band (25 605–26 095kHz) is gradually opening up now that increasing solar activity is bringing higher frequencies into use. **Harold Brodribb** of St. Leonards-on-Sea (AR88) reports hearing Radio RSA on 25 790kHz (also announcing 21 535 and 15 220) and Radio France on 25 630, both stations logged during the afternoon. **K. H. Smith** of Ross-on-Wye picked up the Voice of America in the early evening on his home-brew receiver on 26 040 and **Mark Hallam** of Hereford (Realistic DX160 plus long wire) logged Radio RSA on 25 790 from 1100–1200 and again between 1300 and 1530 with a very strong signal and English programming.

Other stations reported recently were Radio Liberty on 25 690 and IBA Jerusalem on 25 605kHz. 11 metres is a daytime band and worldwide reception is possible when it is open. Broadcasters will be tempted onto 11 metres to escape from the congestion on lower bands, even though it is outside the range of many domestic receivers. If your receiver will tune as high as 11 metres then it is worth giving the band a try.

Tropical Bands

The main tropical band is 60 metres which extends from 4750 to 5060kHz. Unlike the main s.w. bands, 60m is shared with commercial users and is only reserved for broadcasting in tropical areas and parts of Asia. As a result there is a lot of telegraph QRM on 60m and the newcomer to the band, especially if he listens at the wrong time of day, may not hear any broadcasting stations at all. A path of darkness between Tx and Rx is required before reception is possible, so it is a waste of time looking for DX on 60m in the middle of the day. A good outdoor aerial is an advantage, though many of the better portables will deliver DX with their internal aerial.

A good log of 60m DX comes from **Bob Bell** who lives in Blyth and uses an FRG-7. He reports hearing Radio Universo in Venezuela on 4800kHz at 0200, Benin on 4870 at 1825, Radio Casa Ecuador on 4930 at 0215, Radio Ecos Venezuela on 4980 at 0225 and two out-of-band catches, one in Chinese on 4380 at 1750 and an unidentified station in English on 4385 at 1805. **L. Lewis** (Pensilva in Cornwall) used his Realistic DX160, long wire and a.t.u. to pull in Radio Guatapuri in Colombia on 4817kHz at 0535, and Radio Garoua in Cameroon on 5010, with a programme in English at 1830. **Mark Hattam** picked up Radio ELWA Liberia on 4779 at 2200 and Radio Nigeria on 4990 at 1800 both in English.

DX Reported

A Trio 9R59D plus Joystick are in use at Mackworth near Derby by **Roy Patrick** who reports hearing Kabul, Afghanistan on 11 805 with a programme in English at 1900, Radio Nacional Chile on 11 720 at 2205, Radio Australia on 11 870 (replacing 11 855) from 1500 to 1700. Roy mentions that Radio Monitors International DX programme from SLBC Sri Lanka is on the air on Sundays at 1100 on 11 835, 15 120, 17 850 and again at 1900 on 9720, 11 870, 15 115 and 17 850.

From RSA-land comes a log from **David Webb** who lives in Sunnyside, Pretoria and who uses an old domestic receiver of unknown origin together with a wire put round the picture rail. With this set-up he has managed to pull in Tirana on 9500 at 1930, Australia on 9570, 11 940 at 1500, Algiers on 9500 at 1915 in English and Radio Sweden on 15 240 at 1845. A Racal 117E and 80ft long wire are in use by **V. Frankl** of Rotherham, who reports hearing out-of-band Pyongyang on 6576kHz at 2000, South Korea on 7550 at 1615 and Radio Athens on 9930 at 1920. **Andrew Rogers** of Bristol (Vega Spidola and whip) heard Amman in Jordan on 9560 at 1500 and Riyadh, Saudi Arabia on 6075 at 2110. **Roger Shepherd** of Whitstable has had his National Panasonic RF1105 for only two months, and during this time he has heard programmes in English from Turkey on 9515 at 0105, Israel on 9435 at 2005 and Spain on 9505 at 2030. **J. Pritchard** (Warsop) now has an ITT Touring CD108 with digital readout which picked up Pakistan on 17 665 at 1104 and the Voice of Nigeria on 15 185 at 1849.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

VHF BANDS

by Ron Ham BRS15744

One of the most exciting things about the radio frequency spectrum above 30MHz is that unexpected natural disturbance which can suddenly occur and take the most experienced v.h.f. enthusiast by surprise and, as my readers have shown, 1979 began in just that way.

Solar

Early in 1978, we observers of the sun were confidently expecting the then high level of sunspot activity to continue throughout the year, but, how wrong we were. Having recorded radio noise from the "active" sun on 108 out of the first 212 days (compared with 106 days for all of 1977), the count fell drastically to only 24 "active" days from the remaining 153, which means that, in future, we should consider sunspot activity on a day-to-day basis. At 1036 on December 31, **John Branegan** GM8OXQ, Saline, Fife, heard a strong burst of solar noise covering a wide frequency range, and **Cmdr Henry Hatfield,** Sevenoaks, Kent, and myself, recorded several individual bursts of solar noise, at 136 and 146MHz, on January 3 and 4, and

10 to 16, inclusive. These bursts were associated with about eight groups of sunspots, some with four and six spots, seen by Henry with his spectrohelioscope. On the 6th he saw five plages, on the 11th a small flare, and a bright active area was visible on the 12th and 13th.

Aurora

Considering this solar activity, it was not surprising that ionospheric disturbances were reported by the BBC World Service on January 5 and 6, and John Branegan noted auroral events on the 4th and 7th. Between 1810 and 1817 on the 4th, John heard tone "A" signals from the 2m beacons in Wrotham, GB3VHF and Kiel, DL0PR, and although the auroral signals faded out on 2m around 1820 they persisted on Band I TV until 1907. During the event, several of John's fellow GMs worked London stations on 2m. Following an auroral alert from **John Matthews** G3WZT, near Horsham, Sussex, around 1900 on the 7th, **John Cooper** G8NGO, Cowfold, Sussex, heard a French station working a GM on 2m s.s.b. and, in turn, phoned **Alan Baker** G4GNX, Newhaven, who heard some weak s.s.b. signals bouncing off the auroral display, while in nearby Lancing, **Roy Bannister** G4GPX, heard GM4DSZ. Alan also confirmed a report from **Cecil Sadler** G3JEO, Brighton, that signals in the 40m band were being influenced by the aurora. Between 1500 and 2000 on the 7th, John Branegan received auroral signals from European TV in Band I, f.m. broadcast stations in Band II, strong 2m signals from stations in DL, EI, G, GI, GM, GW, LA and SM and from beacons around the UK, in Cornwall, GB3CTC, Northern Ireland, GB3GI, Lerwick, GB3LER and Kent, GB3VHF. John also had three contacts through OSCAR-8J during the event and was told by SM5FUR that, the aurora was affecting all Sweden.

The 10 Metre Band

Mark Hattam, Hereford, using his Realistic DX-160 receiver and a long wire aerial, says that signals from Radio South Africa and Voice of America, in the 11m band, were "pounding in" on January 9, and in the 10m band he heard UN3CEY in QSO with an American station, and a harmonic of a Radio Moscow transmission around 28·750MHz. **Michael Mrzyglod,** Wallingford, Oxford, who is in the process of joining the RSGB, reports hearing several European and Russian amateurs on 10m around noon on December 26. From December 15 to January 17 I received signals, almost daily, from the International Beacon Project stations in Bahrain, A9XC, Germany, DL0IGI and Cyprus, 5B4CY and less frequently from Bermuda, VP9BA and Florida, N4RD. The majority of these signals were received on my FR101 with a long wire aerial and averaged around 539.

DX Television

At 0910 on December 19 I heard strong television sync pulses on 49·75MHz with my R216, fed by a dipole aerial, which alerted me to switch on my JVC3060, also fed by a dipole, and there on Ch. R1, for a short while was a test card from YLE-HK1, Finland. Between 0800 and 0920 on the 20th both **Ian Rennison,** Horsham, using a JVC3040, and myself, received a very strong test card from Poland (Fig. 1), on R1, accompanied by the sound, which I received on the R216, on 56·25MHz. From 0745 until about 0930 on January 4, Ian and myself received strong pictures from both Poland and Hungary on R1 (Fig. 2), and at times both signals were fighting for predominance on our receivers.

During the afternoon of the 7th, John Branegan, using his Eddystone 770R, heard video signals on 48·25, 49·75 and 61·8MHz and TV sound, in Spanish, on 53·75 and 60·75MHz. John reports that the m.u.f. was up around 44MHz to the USA on January 5, 6 and 7 and, at 1450 on the 6th, he received French TV sound on 41·25MHz and, "strangely enough," says John, "the aerial seemed to peak around 270°".

Tropospheric

Despite the poor conditions on December 26, Roy Bannister heard signals from the new Norfolk repeater, GB3FR, on R7 when the London repeater, GB3LO, was quiet, and, during a spell of good conditions on December 18, signals from the Burnley repeater, GB3RF, also on R7, were received by **Don Campbell** G5SD, in Clymping, on the Sussex coast. A mild tropospheric opening occurred on January 6 when the atmospheric pressure, which had reached 30·4in, began to fall. Throughout the day, I received strong signals from more than a dozen Continental f.m. stations in Band II and during the evening, Ian Rennison received a strong picture from the French TV station at Lille.

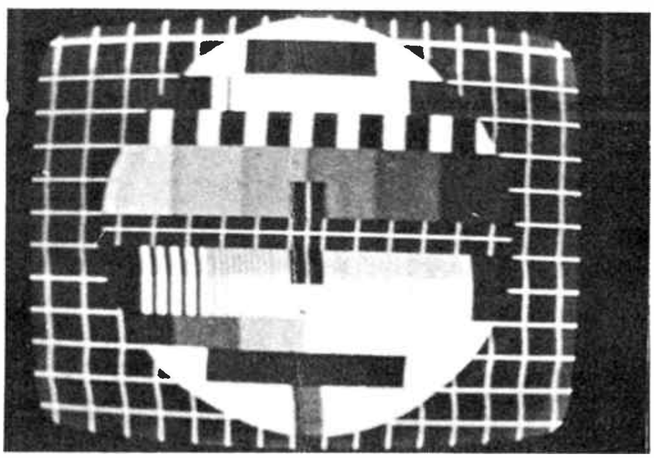


Fig. 1: Test card from Poland on 49·75MHz, received in Sussex on 20 December 1978

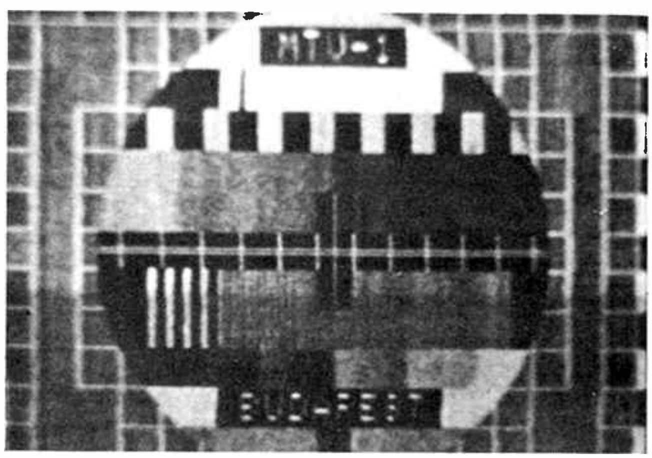


Fig. 2: Test card from Hungarian Television on 49·75MHz, received in Sussex on January 4

Around 1300, while I was receiving strong pictures from the IBA transmitter at Lichfield, Ch. 8, 189MHz, Alan Baker worked F1BBQ on 2m c.w. and later had QSOs through the French repeater, FZ2THF, on R9. During another pressure drop, at 2030 on the 3rd, **Fleming Jul-Christensen** G8RMA (ex OZ1EVA), Eastbourne, using a TS700-S, heard OE5KEJ on 2m s.s.b.

Microwaves

John Tye G4BYV, Dereham, Norfolk, is active on both 13 and 23cm with home-brew equipment into a 4ft dish aerial on both bands. During the second half of 1978 he had 10 QSOs with G stations, 11 with PA0 and 1 DK on 13cm, and 33 with G, 40 with PA0, 22 in Germany, 3 ON and 1 GW on 23cm which is a fine effort. John has now built a converter for 9cm and is waiting for the right conditions to use it.

Satellites

To celebrate the new year, John Branegan had Hogmanay QSOs with WB2OXJ and WB2SBW, both in New Jersey, just a few minutes before midnight on OSCAR-8J. All-told, John worked 16 stations in 8 countries, DB, G, GM, HB, I, PE, SM and W via 8J on New Year's Eve, and with only 4 days operating during December he had 60 QSOs on 8J, 7 of them transatlantic, including W2GEZ and WB2SBW which are new ones for him. John now has a QSL card confirming his 8J contact with C31QO, Andorra and has now worked CN8AK, Morocco on OSCAR-8A.

Tail-piece

Congratulations to **Ern Hoare** G8BDJ, Brighton and **Alec Painter** G8EAQ, Worthing, on passing their Morse tests. They will, no doubt, soon be sporting their new callsigns.

I received a Christmas card from **Frank Luman** who, while on holiday with his parents in Denver, Colorado, is studying the DX-TV situation over there.

While on a round trip to Birmingham on January 10, Alan Baker worked through eight of the 2m repeaters, GB3BC, BM, LO, MH, PI, SN, SR, and WH, showing that mobile operators need never be alone on their journeys through and around the UK.

What do the VHFs have to offer? Part 3

No one should harbour the idea that the v.h.f. bands have little excitement to offer the radio enthusiast. In fact, there is still so much to learn about the behaviour of radio waves between 1 and 10 metres that they are a haven for the DX hunter, experimenter and home constructor. To be successful in the world of v.h.f., one must pay great attention to detail, such as taking extra care when selecting components, keeping wiring as short as possible, soldering all joints, and making sure that aerials are securely mounted, and have a good-quality feeder. Remember, it is easy to ruin the performance of an expensive piece of v.h.f. gear with a poor aerial, badly-connected mains lead, loose loudspeaker, and microphone connections or an intermittent aerial plug.

The Home Station

Before equipping a v.h.f. station, the operator, whether a licensed amateur, broadcast or short-wave listener, radio-astronomer, satellite enthusiast or TV DXer, must decide first where to locate his shack and then where to put his aerials. These, ideally, should be as close to the shack as possible to avoid unnecessarily long and therefore lossy feeders. The choice and size of aerial depends upon the band being used and the space available, in some cases the consent of the local planning authority is required, it is best to play safe and get this point clarified.

The Transmitting Amateur

The holder of a class B transmitting licence (G8-plus-3-letter callsign) may only use the 2m band within the v.h.f. spectrum, whereas the holders of a "full" licence (those who have passed the Morse test in addition to the RAE) may also use the 4m band. A typical aerial installation for the DX hunter is an 8-element Yagi for 2m and a 3-element Yagi for 4m, both horizontally polarised and mounted on an aerial rotator. The majority of amateurs are in favour of the VHF Band Plan, published by the RSGB, which recommends that c.w. contacts are made between 70·025 and 70·150MHz and 144·00 and 144·150MHz, and s.s.b. contacts on 70·200MHz and between 144·150 and 144·500MHz.

Operators soon learn the possible range of QSOs on each band from their location, under normal atmospheric conditions, but the real DX comes during the sporadic-E season on 4m and a tropospheric opening or aurora on 2m. Apart from the sheer thrill of working v.h.f. stations at almost impossible distances, it is advisable to exchange QSL cards to confirm contacts, because these cards are the evidence required by RSGB members who wish to claim the "Four Metres and Down" certificates offered by the Society for confirmed QSOs from: 3 Countries and 20 Counties on 4m; 5 Countries and 30 Counties on 2m. Senior awards are also offered.

Under abnormal conditions it is possible to work DX through the national and European 2m repeater network; these signals are frequency modulated and vertically polarised, so aerials such as dipoles, ground planes or crossed Yagis are normally used. Repeater contacts do not qualify for the RSGB certificates.

The Broadcast Listener

The v.h.f. hunting ground for the broadcast listener is the f.m. broadcast band, 88-108MHz, which is full of Continental broadcast stations during a tropospheric opening. East-European broadcast stations are often heard in the UK between 65 and 73MHz during the sporadic-E season. Many of my readers use a rotatable, multi-element Yagi for the broadcast DX in Band II, especially if they wish to resolve full stereo from the incoming signal.

The VHF Listener

The v.h.f. listener should make sure that his aerials are as efficient as those used by the transmitting amateurs. Listening on v.h.f. is very rewarding, especially during an atmospheric disturbance, when there is a host of DX signals about and a great opportunity to get a QSL card, from stations in rare Counties, which cannot be heard under normal conditions. To earn a QSL card, from either an amateur or a beacon keeper, the listener's report must be useful and contain such information as date, time, signal

strength, any interference, beam headings, and mention the callsigns of other signals heard from the same area. Don't forget to enclose s.a.e.

Artificial Earth Satellites

A large cross-section of the v.h.f. fraternity are interested in receiving signals from both commercial and amateur radio satellites. A 10-element crossed Yagi with an alt/azm (altitude and azimuth) mount is ideal for listening to or working through the amateur satellites. Although this aerial is specifically designed for the 2m band it will suffice for receiving signals from the commercial birds in the 136/137MHz band. A permit from the Home Office is required to receive signals from commercial satellites. Both the AMSAT and Russian amateur radio satellites have uplink frequencies around 145·900MHz and downlinks around 28·400MHz. The latest information about these satellites can be obtained by listening to the AMSAT net at 1015 on Sunday on 3·780MHz.

Radio Astronomy

Briefly, a radiotelescope consists of a high-gain aerial directed toward the celestial source being observed, a sensitive receiver tuned to the observational frequency, and a recording instrument—usually a pen recorder. Radio waves from heavenly bodies are very similar to the background noise of a radio receiver, therefore the telescope must be able to distinguish between the two.

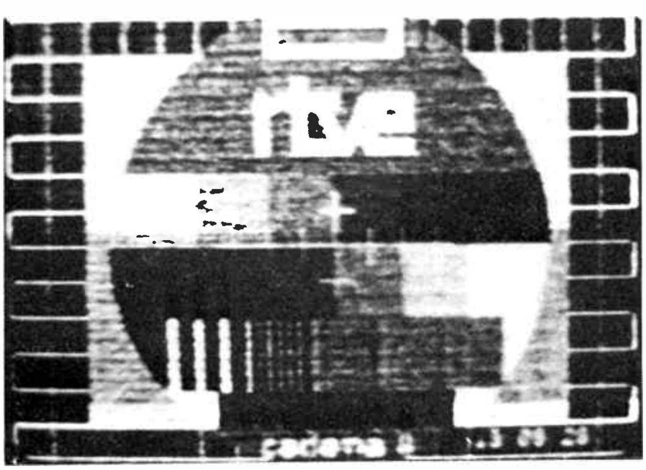
The usual practice is to connect a local noise source to the aerial socket and see how far it deflects the pen, then disconnect it, couple the aerial and measure the difference between the noise source and the incoming celestial waves. The sun, which affects our daily communications around the world, is a very powerful transmitter of radio waves when sunspots are present. For solar radio observers there is the day-to-day excitement of never knowing when this nuclear furnace, 93-million miles away, is going to send off a flare and emit radio waves between 100 and 200MHz. Radio astronomy presents a challenge to the home constructor who wishes to build v.h.f. aerials, low noise pre-amplifiers, converters and d.c. amplifiers to drive a pen recorder.

DX Television

It is well-known that the normal range of v.h.f. television signals is, subject to the terrain between the transmitter and receiver, about 50 miles. However, to receive signals at a greater distance, a large aerial system plus mast-head pre-amplifiers are required. Long-distance television reception is possible during an atmospheric disturbance which can affect both v.h.f. and u.h.f. signals over a wide area.

Within the UK, v.h.f. transmissions of the BBC are in Band I, 41–76MHz, and the IBA in Band III, 176–215MHz, both 405-line. Continental, African, Icelandic and Russian v.h.f. transmissions, which are the targets for the TV DXer, fall in two frequency ranges, 48–68MHz and 175–225MHz. The lower range is subject to sporadic-E and the higher range to tropospheric disturbances. Pictures from Russia can be received on Ch.R1, 49·75MHz and R2, 59·25MHz.

For super DX, which is not outside the bounds of possibility, there are American (525-line), Australian and New Zealand TV who also transmit between 46 and 68MHz. Detailed information about international television is published in *World Radio and TV Handbook*.



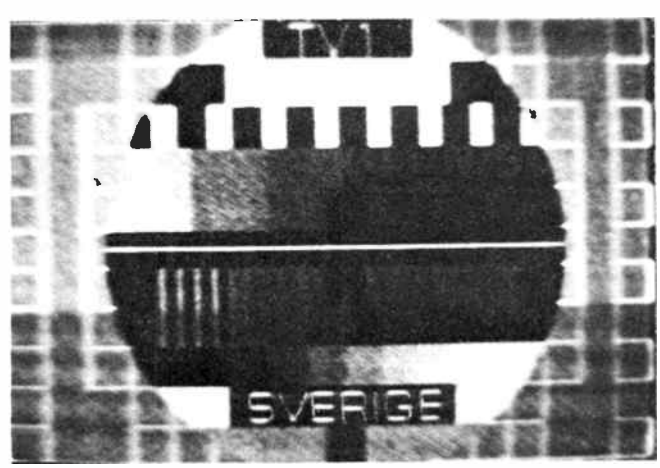


Fig. 3: Pictures from Spain and Sweden received by the author during the 1978 sporadic-E season with only a dipole aerial feeding a JVC 3060 receiver. Both stations can be received on Channels E2 (48·25MHz), E3 (55·25MHz), and E4 (62·25MHz). In each case the sound is 5·5MHz higher than the vision frequency

VHF PERSONALITY

GUY STANBURY *by RON HAM*

For Christmas, 1963, the 9-year-old Guy Stanbury received a Philips electronic kit. Soon after, he was borrowing copies of *Practical Wireless* from his local library, and in 1968 he became a regular reader.

Guy's interest in v.h.f. began in 1971, when he visited Bob Dewick, a keen Band II DXer at Bradwell-on-Sea, Essex, and saw Bob's Hacker receiver which could be fed from either a Rhombic aerial or four Jaybeam 4-element Yagis stacked vertically and horizontally. Very soon, Guy, at his home in Chelmsford, began experimenting with v.h.f. aerials, starting with an Antiference 4E, mounted on a cable-controlled rotating spindle, then a 6-over-6 array on a rotator followed by various long Yagis. His current installation is two Fuba UKa Stereo 8 aerials, stacked and phased according to the instructions and mounted on a Stolle rotator.

His receivers progressed from a Rigonda "Symphony" stereogram, to a PW "Sandown", which he constructed in 1975, and used for about a year until he purchased his present equipment, a tuner and i.f. modules from Ambit International. In his station, Guy has both reel-to-reel and cassette recording facilities, a frequency counter which he is trying out, an oscilloscope, and all the tools needed by the home constructor. Although he is a Band II specialist, with signals heard from stations in Greece, Italy, the low countries, Western Germany and Yugoslavia, via sporadic-E and tropospheric propagation, Guy plans to expand into the field of u.h.f. DX-TV, using a Wolseley Colour King or Colour Prince aerial.

Guy is currently on an HNC course in Electrical and Electronic Engineering, and enjoys corresponding with his fellow Band II enthusiasts, and his many friends in the world of v.h.f. radio.

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4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	85p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4056	135p	4521	236p		

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	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7407	38	
7408	17	24
7409	17	24
7410	15	24
7411	20	24
7412	17	24
7413	30	52
7414	51	130
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7422	24	24
7423	27	
7425	27	
7426	36	27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7433	40	32
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	
7448	56	99
7449		99
7450	17	
7451	17	24
7453	17	
7454	17	24

	'N'	'LSN'
7455	35	24
7460	17	
7463		
7470	28	
7472	28	
7473	32	
7474	27	38
7475	38	40
7476	37	
7478		
7480	48	
7481	86	
7482	69	
7483A		
7484	97	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495A	65	99
7496	58	120
7497	185	
74100	119	
74104	63	
74105	62	
74107	32	38
74109	63	38
74110	54	
74111	68	
74112	88	
74113		38
74114		38
74116	198	
74118	83	
74119	119	
74120	115	
74121	25	
74122	46	
74123	48	
74124		
74126	38	44

	'N'	'LSN'
74126	57	44
74128	74	
74132	73	78
74133		29
74136		40
74138		60
74139		60
74141	56	
74142	265	
74143	312	
74144	312	
74145	65	
74147	175	
74148	109	
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161	92	78
74162	92	130
74163	92	78
74164	104	
74165	105	
74166		
74167	20	
74168		
74169		200
74170	230	200
74172	625	
74173	170	
74174	87	120
74175	87	110
74176	75	
74177	78	
74180	85	
74181	165	350
74182	160	
74183		210
74184	135	

	'N'	'LSN'
74185	134	
74188	275	
74190	115	92
74191		
74192	105	180
74193	105	180
74194	105	187
74195	95	137
74196	99	110
74197	85	110
74198	150	
74199	160	
74248		90
74249		93
74251		90
74253		105
74257		108
74258		153
74259		420
74260		153
74261		353
74266		40
74273		124
74275		312
74279		52
74283		120
74290		90
74293		95
74296		120
74298		100
74324		157
74325		242
74326		247
74327		237
74352		100
74353		100
74362		715
74365		49
74366		49
74367		43
74368		49
74373		77
74374		77
74375		60

	LSN
74377	124
74378	93
74379	130
74386	37
74390	140
74395	139
74396	133
74398	180
74399	150
74445	92
74447	90
74490	140
74668	110
74670	249

MISCELLENY

NE555	30p
NE556	78p
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ICM7217	950p
ICM7208	1495p
ICL7106CP - LCD DVM IC	955p
LCD DVM KIT	2480p
3½ digit LCD display	1150p
ICL7107 LED DVM kit	2065p
ICM7216 - 8 digit 10MHz OFM/timer (for LED C.Cath)	£19.82

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8629 150MHz divide by 100	420p
95H90DC	780p
11C90DC	1400p
8618 -new-divide by 100 or 10 for 120/60MHz	450p

The ICL7216BIPI is still the cheapest way to make a full 8 digit/ 10MHz frequency counter/timer, and with 10 external components + display - it is also one of the simplest. For £19.82, it takes a lot of beating. The mains filters have been extended now to include a 6amp IEC version at £5.10, and with the amount of electronic noise on the average supply (next door's fridge, for instance) it is a really worthwhile addition to any sensitive equipment. LPSN TTL now includes many more of latest types, all - of course - are absolutely prime first quality types. And don t forget our range of OPTO displays includes Hewlett Package high efficiency 0.43" types in all colours - renowned as the finest quality in the market. For other types of component - discrete LEDs, radio and audio devices, tuner modules, kits etc., see our other advertisement for more details - or send for the AMBIT catalogue system. Part one (45p) includes details of our background 'standard' items, and the new part two includes all the latest introductions and developments, plus a rundown on OSTS.

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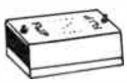

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2¼" (57mm) LOUDSPEAKER BARGAIN

This ever popular many project loudspeaker. Only while stocks last. 65p + 12½% VAT.

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5W 8 ohm good quality car stereo loudspeakers. Still only £3·75 + 12½% per pair.

HEAVY DUTY XOVER 2 WAY 8 OHM

A 2 way 8 ohm H/D Xover suitable for L/S systems up to 100 watt. Fitted with screw terminals for input and a three position 'HF LEVEL' switch which selects either Flat, −3dB or −6dB.

ONLY £3·00 + 8% VAT

A CRESCENT 'SUPERBUY'

Goodmans 5" 8 ohm long throw H/D loudspeaker. Mounting plate is integral with L/S chassis and has fixing holes with centres spaced at 5¼" (diagonally).

ONLY £5·00 + 12½% VAT

CR. 3000. SCREWDRIVER SET

£1.75p. + 8% VAT

In neat plastic case. Consists of:- awl, jewellers screwdriver, watchmaker's screwdriver, radio screwdriver, phillips screwdriver. All fit into master swivelling handle.

CR. 4110. DESOLDERING PUMP

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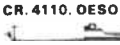

High suction pump with automatic ejection. Knurled, anti corrosive casing. Teflon nozzle.

CR. LV1. 12v DRILL

£12.00p. + 8% VAT

BRITISH MADE "Versadrill". 12 volts DC. Compact battery operated power tool, sufficiently powerful to perform all the operations associated with 240v drills. Dimensions:- 150 × 50mm (dia.)

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Essential equipment for the showroom, workshop, factory, laboratory, home and hobby bench, the 'Keynector' provides quick, efficient and safe temporary mains connection.

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Export orders are not subject to the addition of Value Added Tax.

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OUR RANGE

10kHz 50kHz 100kHz 500kHz 1MHz 100MHz 250MHz

PLEASE INDICATE CLEARLY THE FREQUENCY RANGE OF YOUR INTEREST
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TELEX 46264 FRQNCY G

ambit® international

The PW Sandbanks Metal Locator: a kit based on this recently published design for this uniquely effective type of metal locator is available for only £35.00 + 8% VAT. The kit closely resembles the appearance as published, except that a close fitting injection molded housing replaces the vacuum molded electronics box · to improve the enviromental suitability of the construction. Carriage for complete kits £1.

The New Catalogue · "Tecknowledgey Part 2"
Part 2 of the catalogue: by the time this advert reaches the press, part 2 should be on sale. Sorry it's late, but it contains so many new and interesting things that we felt we had to hold up production to include them. Part three by the autumn ·and already there are many new items to go in! Part one 45p, part 2 50p. (inc PP etc).

Radio ICs

TDA1062	HF/VHF tunerhead	1.95
TDA1083	One chip AM/FM rx	1.95
TDA1090	One chip HiFi am/fm	3.35
TDA1220	One chip am/fm rx	1.75
HA1197W	HiFi AM tuner IC	1.40
CA3123E	AM tuner IC	1.40
TBA651	AM tuner IC	1.81
CA3089E	Famous FM IF system	1.94
CA3189E	As 3089+ deviation mute AF preamp, adj, agc	2.75
HA1137W	Improved S/N 3089	2.20
TBA120	limiting amp+detector	0.75
TBA120S	high gain	1.00
MC1350P	agc'd IF preamp	1.20
MC1330P	synch AM/video detector	1.35
KB4406	Cascode IF preamp	0.65
uA753	limiting FM preamp	1.95

Communications circuits

SD6000	DMDS RF/Mixer pair	3.75
KB4412	Bal mixers, IF+agc	2.55
KB4413	AM/SSB det. squelch,agc	2.75
KB4417	mic processor	2.55
MC3357	best thing in NBFM yet	3.12
MC1496P	popular double bal mixer	1.25

Multiplex decoders + noise blanker

MC1310P	popular PLL decoder	2.20
uA758	buffered 1310	2.20
CA3090AQ	RCA PLL decoder	3.25
HA1196	improved PLL decoder with stereo preamps	3.95
HA11223	19kHz pilot cancel, low distortion, high S/N	4.35
KB4437	as HA11223 with remote VCD kill facility	4.55
KB4438	stereo MUTING preamp for post decoder mute	2.22
KB4423	impulse noise blanker	2.53

Discrete devices: more than ever:

BF960	800MHz/2.8dB nf mosfet	1.60*
BF961	200MHz/2.0dB nf ..	0.80*
40822	FM RF amp	0.43*
40823	FM mixer	0.51*
40673	Famous MDSFET	0,55*
2SJ49/2sK133	120v/100W MDSPOWER output devices	10.50*

LEDS: the best value today

	3mm	5mm	2.5x5mm
Red	0.14	0.14	0.17
Green	0.18	0.16	0.20
Yellow	0.18	0.15	0.20
Orange	0.22	0.29	0.24

100 off mix, 25% discount. All are AEG first grade types · absolutely no junk. 5mm clips for panel mounting 0.03 each

Misc. ICs for radio/audio applications

U237B	5 LED bargraph driver	0.80*
SAS6610	4 station touch tune IC	1.48*
SAS6710	adds 4 stations to 6610	1.48
MSM5523/4	LW,MW,SW and FM digital frequency readout plus clock, timers, stopwatch	£14 *
MSM5526	LW/MW/FM DFM with direct drive for LCD	£11 *
TCA730	DC volume control	3.50
TCA740	DC tone control	3.50
TDA1028	DC input switch	3.50
TDA1029	DC mode switch	3.50

Radio and Tuner modules
We cannot really list all the details we would like to here · but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this new range.

TERMS etc: CWD please, VAT on Ambit Items is generally 12½%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays .

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi · just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb . A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else.............

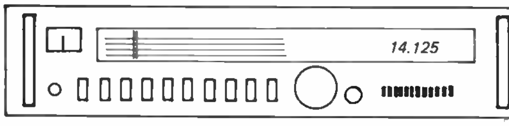
- ★ Exceptionally high performance · exceptionally straightforward assembly
- ★ Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- ★ Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- ★ Matching both the style and design concepts of the MkIII HiFi FM tuner
- ★ Hitachi VMOS power fets · characterized especially for HiFi applications
- ★ Power output readily multiplied by the addition of further MDSFETs
- ★ VU meters on the preamp · not simply dancing according to vol level
- ★ Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester·LW,MW,SW,& FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



With styling and dimensions to fit in with the rest of AMBIT's new range of tuner & audio equipment.

When the new range of OKI digital frequency display ICs was announced, the original prototype of the Dorchester had been made · but since so many of you wanted to use the OKI frequency counterdisplay system with the Dorchester, we quickly designed a unit to incorporate the necessary facilities. The Digital Dorchester is designed in 19 inch form, and forms a perfect match for the other units in the range. If you don't want to go to the expense of the full Ambit DFM1 module, with AM/FM/Time/Timers, then the MA1023 clock module can be used instead ·

The Dorchester has been described in PW Dec., Jan. and Feb. issues · but for those of you who may have missed it · it is an All Band broadcast tuner, covering LW/MW/SW and FM stereo in 6 switched ranges. Construction is very straightforward, with all the switching being PCB mounted · and the revolutionary TDA1090 IC used for AM/FM.

The electronics for the radio section of the Dorchester remain unchanged at £33.00, with 12.5% VAT. The hardware package, of case, meter, PSU now costs £33.00 + 8% with the MA1023 available for an extra £5 only.
For the fully digital version, with Ambit DFM1, the price is £56.50 + 8% VAT.

2 Gresham Road, Brentwood, Essex.

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Ideal for the DIY enthusiast building up a complete disco system. 4/6 ch. mono. inc. LED indicators, connections via phono sockets at rear. Bargain price, including PSU
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PIEZO HORNS
FANTASTIC SPECIAL OFFER TO READERS OF PRACTICAL WIRELESS
Tweeters for your disco, PA system or Hi-Fi. Frequency range 5K-20K
No X over required. They can be used in any PA system up to 100W Why pay more?
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£65.00 + VAT attachments extra

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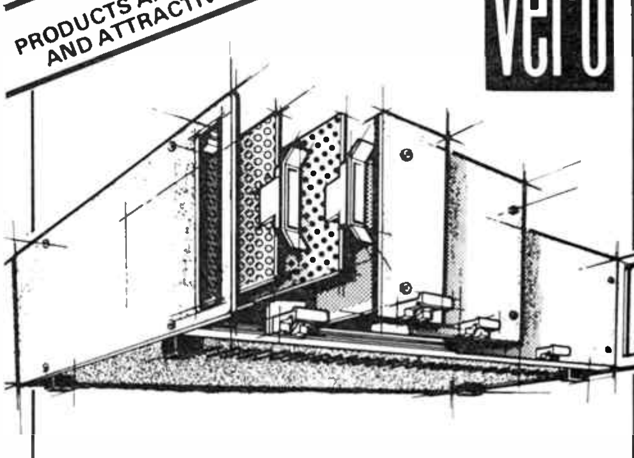

Our new catalogue lists a card frame system that's ideal for all your module projects – they used it on the ETI System 68 Computer. And we've got circuit boards, accessories, cases and boxes – everything you need to give your equipment the quality you demand. Send 25p to cover post and packing, and the catalogue's yours.

VERO ELECTRONICS LTD. RETAIL DEPT.
Industrial Estate, Chandlers Ford, Hants. SO5 3ZR
Telephone Chandlers Ford (04215) 2956

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8C107/8/9, 8C147/8/9, 8C157/8/9, BF194 & 7—**9p.**

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6* with trigger	**80p**	LDR sim ORP12	**50p**	Diac	**20p**
8A*	**80p**	Neon	**8p**	2N6027	**34p**
* isolated tab				AY-5-1230	**£4·50**

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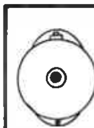

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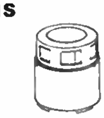

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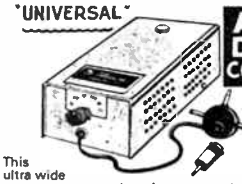

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500pF	165p	00 208/176	285p
6:1 Ball Drive 4511/DAF	115p*	.. .. with slow motion drive	325p
Dial Drive 4103 6:1/36:1	650p*	C804-5pF; 10; 15; 25; 50pF	175p*
Drum 54mm	30p*	100, 150pF	215p*
0-1-365pF	245p	'L' 3x310pF	495p
00 2 365pF	275p	00-3x25pF	430p

TRANSISTORS

	p
AC107*	28
AC117*	35
AC125*	20
AC126*	20
AC127*	20
AC128*	20
AC141*	24
AC141K*	38
AC142*	24
AC142K*	38
AC176*	20
AC187*	20
AC188*	20
ACY17	35
ACY18	40
ACY19	40
ACY20	40
ACY21	35
ACY22	40
ACY28	40
ACY39	78
AD149*	70
AD161*	42
AD162*	42
AF106	50
AF114*	30
AF115*	30
AF116*	30
AF117*	30
AF118*	55
AF121*	48
AF124*	55
AF125*	35
AF126	50
AF127*	35
AF139*	35
AF178*	70
AF180*	70
AF239*	42
AFZ12	128
ASY26*	40
ASY27*	45
ASY50*	95
ASY76*	95
BC107*	9
BC107B*	10
BC108*	9
BC108B*	10
BC108C*	12
BC109	9
BC109B*	12
BC109C*	12
BC113	20
BC114	20
BC115	20
BC116	19
BC117	20
BC118	20
BC119*	28
BC134	20
BC135	20
BC136	18
BC137	20
BC140*	35
BC142*	30
BC143*	30
BC147	8
BC147B	10
BC148	8
BC148B	10
BC148C	10
BC149	8
BC149C	10
BC153	27
BC154	27
BC157	10
BC158	11
BC159	11
BC160*	42
BC167A	11
BC168C	12
BC169C	14

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BC170	18
BC171	11
BC172	11
BC173	12
BC177*	18
BC178*	16
BC179*	18
BC182	9
BC183	9
BC184	9
BC182L	11
BC183L	10
BC184L	11
BC186	21
BC187*	28
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BC212L	11
BC213	11
BC213L	12
BC214	12
BC214K	14
BC214L	13
BC307B	20
BC308	13
BC308B	20
BC327	15
BC328	15
BC338	12
BC441*	36
BC461*	36
BC477*	25
BC547	12
BC548	12
BC549C	13
BC557	13
BC558	16
BC559	20
BCY30*	57
BCY34*	75
BCY39*	80
BCY40*	78
BCY42	48
BCY43	85
BCY58	22
BCY59*	22
BCY70*	15
BCY71*	20
BCY72*	20
BCY78*	25
BCZ10	145
BCZ11	145
BD112	95
BD115*	65
BD121*	78
BD123*	98
BD124*	116
BD131*	45
BD132*	46
BD133*	43
BD135*	38
BD136*	36
BD137*	36
BD138*	50
BD139*	40
BD140*	36
BD142*	59
BD144*	198
BD145*	198
BD181*	35
BD205*	110
BD222	60
BD378*	65
BD434	42
BD517*	65
BD695A*	65
BD696A*	65
BDY11	220
BDY17*	195
BDY56*	156
BDY60*	110
BDY61*	165
BF115*	34
BF154*	25
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BF160	30
BF161	60

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BF173*	25
BF177*	24
BF178*	25
BF179*	30
BF180*	35
BF181*	35
BF182*	35
BF183*	35
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BF195	12
BF196	12
BF197	14
BF198	18
BF199	18
BF200*	32
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BF244	29
BF244B	30
BF256*	60
BF257*	30
BF258*	30
BF259*	30
BF336	35
BF394	27
BF594	40
BF595	38
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BFR40	26
BFR41	28
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BFX84*	24
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BFX88*	28
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BFY50*	20
BFY51*	20
BFY52*	20
BFY53*	28
BFY55*	45
BFY64*	40
BFY71*	20
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MJE371*	60
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MPSA56	25
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MPSU06	56
MPSU52	65
MPSU55	53
MPSU56	60
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OC46*	28
OC70*	28
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OC72*	30
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OC76*	38
OC77*	68
OC79*	76
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OC82D*	40
OC83*	48
OC84*	44
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OC123*	48
OC139*	110
OC140*	110
OC141*	110
OC170*	40
OC171*	40
OC200*	48
OC201*	75
OC202	95
OC203*	85
OC204*	85
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TIP30C	65
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TIP31B*	40
TIP31C*	65
TIP32*	55
TIP32A*	55
TIP32B*	70
TIP32C*	75
TIP33*	80
TIP33A*	80
TIP33B*	100
TIP33C*	110
TIP34*	85
TIP34A*	85
TIP34B*	110
TIP34C*	110
TIP35*	219
TIP35A*	225
TIP35B*	240
TIP35C*	270
TIP36*	280
TIP36A*	280
TIP36B*	280
TIP36C*	325
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TIP41B*	73
TIP42A*	64
TIP42B*	82
TIP2955*	65

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TIS45	45
TIS46	45
TIS47	50
TIS48	50
TIS49	50
TIS50	47
TIS60	45
TIS62	45
TIS74	47
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TIS91	24
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ZTX302	20
ZTX303	25
ZTX304	24
ZTX311	17
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ZTX320	30
ZTX326	30
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ZTX501	16
ZTX502	19
ZTX503	15
ZTX504	25
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ZTX550	26
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40251*	97
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40313*	125
40315*	55
40316*	85
40317*	52
40319*	71
40320*	56
40323*	60
40324*	85
40326*	52
40327*	62
40347*	80
40348*	105
40360*	43
40361*	45
40362*	45
40406*	65
40407*	52
40408*	75
40411*	295
40412*	65
40467*	95
40594*	90
40595*	98
40603*	66
40636*	125
40673*	68
2N697*	25
2N698*	44
2N699*	54
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2N707*	39
2N708*	19
2N914*	32
2N916*	27
2N918*	40
2N920*	51
2N1131*	22
2N1132*	22
2N1303*	50
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2N1307*	50
2N1308*	46
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2N2220A*	26
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2N2222A*	20
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2N2907*	22
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2N3054*	49
2N3055*	48
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2N3704	11
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2N3706	11
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2N3820	45
2N3823*	65
2N3824*	70
2N3866*	90
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2N3904	18
2N3905	18
2N3906	17
2N4037*	52
2N4041*	80
2N4058*	17
2N4061	17
2N4062	17
2N4064*	120
2N4069	45
2N4236	145
2N4286	20
2N4289	20
2N4427*	75
2N4859	65
2N4922*	56
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2N5136	42
2N5138	20
2N5172	25
2N5179*	60
2N5180*	60
2N5191*	70
2N5305*	40
2N5457	32
2N5458	32
2N5459	32
2N5485	35
2N5642*	750
2N5777	45
2N6027	40
2N6109	50
3N128	112
3N140	112

Matched Pair 10p extra

TRIMMERS mini 2.5pF; 3-10pF; 3-30pF; 10-40pF 22p; 5-25pF; 65pF 88pF 30p

COMPRESSION 3-40pF; 10-80pF 22p; 25-200pF 33p; 100-500pF 45p

AUDIBLE Warning Buzzers 6V or 12V 65p*

RF CHOKES 1μF, 4.7, 10, 22, 47, 100, 220, 470, 750, 1mH, 2.5, 5, 10mH 35p

CRYSTALS

100kHz	385p
455kHz	385p
1MHz	323p
1.80MHz	385p
1.6MHz	395p
3.2768MHz	323p
4.0MHz	323p
4.032MHz	323p
4.433619M	135p
5.0MHz	355p
8.083333M	275p
18MHz	395p

TRANSFORMERS* (Mains Prim. 220-240V) 6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 100mA 95p.
6VA type: 6V-.5A 6V-.5A; 9V-.4A 9V-.4A; 12V-.3A 12V-.3A; 15V-.25A 15V-.25A 195p.
12VA: 4.5-1.3A 4.5V-1.3A; 6V-12A 6V-1.2A; 12V-5A 12V-5A; 15V-.4A 15V-.4A 20V-.3A 20V-.3A 220p (20p p&p)
24VA: 6V-1.5A 6V-1.5A; 9V-1.2A 9V-1.2A; 12V-1A 12V-1A; 15-.8A 15-.8A; 20V-.6A 20V-.6A 290p (45p p&p)
50VA: 6V-4A 6V-4A; 9V-2.5A 9V-2.5A; 12V-2A 12V-2A; 15V-1.5A 15V-1.5A; 20V-1.2A 20V-1.2A; 25V-1A 25V-1A; 30V-.8A 30V-.8A 350p (50p p&p)
100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2.5A 20V-2.5A; 30V-1.5A 30V-1.5A; 40V-1.25A 40V-1.25A; 50V-1A 50V-1A 650p (60p p&p)
(N.B. P&P charge to be added above our normal postal charge.)

DENCO COILS

Dual Purpose 'DP'		B9A Valve Base	25p
VALVE TYPE		RDT2	92p
Ranges: 1-5 Bl. Yl.		RFC 5 chokes	91p
Rd. Wht.	86p	RFC 7(19mH)	96p
6-7 8, Y, R	76p	IFT 13/14/15/16 17	85p
1-5 Green	92p	IFT 18/1-6	92p
'T'-type (Transistor Tuning).		IFT 18/465	104p
		TOC1	86p
Ranges: 1-5 Bl. Yl.		MW 5FR	82p
Rd. Wht.	93p	MW/LW 5FR	103p

LINEAR IC'S

702	75
709C 8 pin	35
723* 14 pin	45
741* 8 pin	22
747C 14 pin*	78
748C 8 pin	36
753 8 pin*	150
810	159
AY-1-0212	580
AY-1-1313A*	315
AY-1-1320	305
AY-1-5050	180
AY-1-5051	145
AY-1-6721/6	195
AY-3-1015*	560
AY-3-8500*	390
AY-5-1013*	450
AY-5-1224A*	260
AY-5-1230*	450
AY-5-1315	560
AY-5-1317A	630
AY-5-3500*	510
AY-5-3507	
AY-5-4007D	650
AY-5-8100*	735
CA3011*	82
CA3012*	
CA3014*	137
CA3018*	68
CA3020	170
CA3023	170
CA3028A*	80
CA3035	240
CA3036	110
CA3043	190
CA3045*	140
CA3046*	71
CA3048	200
CA3075	175
CA3080E*	80
CA3081*	190
CA3089E	210
CA3090AQ	398
CA3123	200
CA3130*	85
CA3140*	70
ICL7106*	752*
ICL7107*	975
ICL8038CC*	340
ICM7205*	1150
ICM7215	

ICM7217*	790
LO130*	452
LF365*	98
LM301A*	30
LM308T*	110
LM311H*	120
LM318H*	205
LM318S*	195
LM324A*	79
LM339	80
LM348*	95
LM349*	125
LM379*	375
LM380	95
LM381N	145
LM381AN	248
LM382	125
LM732	125
LM1458*	50
LM3900*	60
LM3909N*	70
LM3911*	125
M252AA*	750
M253AA*	795
MC1303	88
MC1304P	260
MC1310P	150
MC1312PQ	195
MC1495	390
MC1496L*	92
MC1710	79
MC3340P*	120
MC3360P	120
MC3401	52
MC3403*	
MEM780	205
MFC4000B	85
MFC6040*	97
MK50253*	
MK50362*	650
MK50398*	635
MM5307*	
MM57160*	620
NE543K	210
NE544	185
NE555*	29
NE556DB*	60
NE560*	325
NE561*	395
NE562B*	410
NE564*	425
NE565A*	120

NE566*	160
NE567V*	170
NE570TBA	
NE571	450
RC4136D	120
SAD1024*	1450
SG3402*	295
SN72710*	43
SN72733*	125
SN76003N	170
SN76013N	140
SN76013ND	120
SN76018*	148
SN76023N	140
SN76023ND	120
SN76033N	175
SN76115N	215
SN76131*	110
SN76227N	115
SN76477*	225
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TAA621AX1	228
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TAA960	320
TAD100	150
TBA120S	70
TBA540	215
TBA550Q	330
TBA641-A12/BX1 or BX11	250
TBA651	180
TBA800	90
TBA810S	95
TBA820	70
TBA920Q	260
TCA965*	120
TDA1022	575
TDA1024*	1450
TDA2020	320
TL061C*	76
TL062CP*	125
TL064CN*	199
TL071CP*	76
TL072CP*	125
TL074CN*	199
TL081CP*	48
TL082CP*	96
TL084CP*	130
UAA170	198
ZN414	90
ZN424E	130
ZN425E*	415

TTL 74* (TEXAS)

7400	13	7475	38	74153	64	74265	63
7401	13	7476	38	74154	96	74273	320
7402	14	7480	48	74155	53	74278	240
7403	14	7481	86	74156	80	74279	119
7404	14	7482	69	74157	85	74283	173
7405	18	7483	72	74159	185	74284	385
7406	38	7484	95	74160	82	74285	395
7407	38	7485	106	74161	92	74290	125
7408	17	7486	31	74162	92	74293	125
7409	17	7489	210	74163	92	74297	238
7410	15	7490	33	74164	105	74283	173
7411	20	7491	75	74165	105	74284	385
7412	17	7492	38	74166	140	74285	395
7413	30	7493	32	74167	200	74290	125
7414	51	7494	78	74170	185	74293	125
7416	30	7495	65	74172	625	74297	236
7417	30	7496	57	74173	120	74298	185
7420	16	7497	189	74174	87	74365	128
7421	29	74100	119	74175	87	74366	118
7422	24	74104	62	74176	75	74367	124
7423	27	74105	62	74177	78	74368	124
7425	27	74107	29	74178	153	74390	184
7426	36	74109	54	74179		74393	184
7427	27	74110	54	74180	85	74490	198
7428	35	74111	68	74181	165	75150	175
7430	17	74112	125	74182	88	75491	92
7432	25	74116	198	74184	135	75492	92
7433	40	74118	83	74185	135		
7437	30	74119	149	74188	275		
7438	33	74120	115	74190	95		
7440	17	74121	25	74191	95		
7441	74	74122	46	74192	98		
7442	68	74123	48	74193	98		
7443	115	74125	38	74194	98		
7444	112	74126	57	74195	98		
7445	94	74128	74	74196	93		
7446	94	74132	73	74197	80		
7447	82	74136	65	74198	150		
7448	56	74141	56	74199	150		
7450	17	74142	209	74221	132		
7451	17	74143	314	74246	204		
7453	17	74144	314	74247	204		
7454	17	74145	65	74248	240		
7460	17	74147	175	74249	204		
7470	28	74148	109	74251	125		
7472	25	74150	99				
7473	32	74151	64				
7474	27						

CMOS*

4000	15	4021	95	4072	21	4507	55		
4001	15	4022	85	4073	21	4508	298		
4002	16	4023	22	4075	23	4510	99		
4006	93	4024	66	4076	85	4511	150		
4007	18	4025	19	4077	40	4512	98		
4008	82	4026	180	4078	21	4513	206		
4009	38	4027	45	4081	20	4514	265		
4010	38	4028	81	4082	21	4515	299		
4011	18	4029	99	4085	74	4516	120		
4012	18	4030	58	4086	73	4517	382		
4013	42	4031	205	4089	150	4518	102		
4014	80	4032	100	4093	85	4519	55		
4015	82	4033	145	4094	190	4520	108		
4016	45	4034	116	4095	105	4521	228		
4017	82	4035	111	4096	105	4522	149		
4018	87	4036	335	4097	372	4526	149		
4019	48	4037	100	4098	110	4527	152		
4020	99	4038	108	4099	145	4528	99		
		4039	320	4160	109	4529	145		
		4040	105	4161	109	4530	85		
		4041	80	4162	109	4531	135		
		4042	75	4163	109	4532	115		
		4043	94	4174	110	4534	575		
		4044	95	4175	99	4536	365		
		4045	145	4194	108	4538	142		
		4046	128	4408	720	4539	105		
		4047	87	4409	720	4541	135		
		4048	58	4410	720	4543	155		
		4049	48	4411	958	4549	375		
		4050	48	4412V	1380	4550	398		
		4051	72	4415F	795	4554	150		
		4052	73	4415V	795	4556	72		
		4053	72	4419	280	4557	451		
		4054	110	4422	545	4558	105		
		4055	128	4433	995	4559	375		
		4057	1950	4435	825	4560	210		
		4059	480	4440	1275	4561	65		
		4060	115	4450	295	4562	533		
		4061	1425	4451	295	4566	155		
		4062	995	4452		4568	268		
		4063	110	4490F	695	4569	280		
		4066	58	4490V	525	4572	26		
		4067	380	4501	19	4580	594		
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		4071	21			4584	63		
						4585	105		

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IB3GT	0·65	6AX4GTB	1·00	6CY5	1·00	12AT6	0·60	ECF200	0·90	EM84	0·60	PCL81	0·65	PY82	0·55	UCC84	0·75
IR5	0·50	6AX5GT	1·30	6CY7	1·00	12AT7	0·50	ECF201	0·90	EM87	1·00	PCL82	0·80	PY83	0·70	UCC85	0·55
IX2B	1·20	6BA6	0·45	6DQ6B	1·45	12AU6	0·65	ECF801	0·95	EY81	0·50	PCL84	0·75	PY88	0·75	UCF80	0·75
5AT8	0·80	6BE6	0·48	6DT6	0·80	12AU7	0·47	ECF802	0·95	EY87	0·50	PCL86	0·85	PY500A	1·30	UCH42	0·90
5T4	0·75	6BF5	0·85	6DT8	0·80	12AV6	0·85	ECH42	1·10	EY88	0·55	PCL805	0·75	TT21	7·80	UCH81	0·65
5U4G	0·60	6BF6	0·75	6DW4	0·90	12AV7	1·00	ECH81	0·55	EY500A	1·50	PD510	3·35	TT22	7·80	UCL81	0·70
5U8	0·75	6BG6G	0·30	6ES5	1·00	12AX7	0·55	ECH200	0·80	EZ80	0·50	PL36	1·10	U25	1·00	UCL82	0·75
5V4G	0·60	6BH6	0·85	6EV5	1·50	12AY7	0·85	ECL80	0·60	EZ81	0·50	PL81	0·80	U26	1·00	UCL83	0·80
5X4G	0·80	6BJ6	1·20	6EW6	0·80	12BA6	0·65	ECL81	0·75	GY501	0·90	PL82	0·55	UABC80	0·58	UF41	1·00
5X8	0·90	6BJ7	0·65	6GH8A	0·80	12BF6	0·67	ECL82	0·60	GZ30	0·65	PL83	0·50	UAF41	0·80	UF80	0·50
5Y3GT	0·65	6BK4B	1·40	6GK5	0·70	12BH7A	0·75	ECL83	1·15	GZ32	0·65	PL84	0·75	UBC41	0·70	UF85	0·50
5Z4GT	0·65	6BN4A	0·90	6GK6	0·90	12BL6	0·70	ECL84	0·70	GZ33	3·80	PL504	1·05	UBC81	0·60	UL84	0·85
6AB7	0·60	6BN6	0·80	6J4	1·20	12BQ6	0·90	ECL85	0·65	OA2	0·55	PL508	1·30	UBF80	0·60	UM80	0·60
6AC7	0·80	6BQ7A	0·65	6J5GT	0·80	12BY7A	0·80	ECL86	0·85	OA3	0·75	PL802	2·80	UBF89	0·60	UM81	0·75
6AD8	0·60	6BR8A	1·20	6J6	0·55	12CU6	0·90	EF80	0·40	OB2	0·60	PY81	0·70	UBL21	0·85	UM84	0·45
6AF4A	0·80	6BS7	2·30	6J7	0·80	19AQ5	0·75	EF85	0·48	OB3	0·75						
6AG5	0·65	6BU8	0·85	6K5GT	0·75	19BG6G	0·50	EF86	0·60	OC2	1·40						
6AG7	0·85	6BW7	1·00	6K6GT	0·85	35A3	0·70	EF92	0·75	OC3	0·75						
6AH6	0·95	6BZ6	0·65	6L6GT	0·85	35B3	0·65	EF97	0·70	OD3	0·75						
6AJ5	0·65	6BZ7	0·70	6N7GT	0·85	35C5	0·70	EF98	0·90	PABC80	0·45						
6AK5	0·55	6C4	0·55	6Q7	0·90	50C5	1·00	EF183	0·70	PC86	0·85						
6AK6	0·75	6C5GT	0·60	6SA7	0·80	50EH5	0·85	EF184	0·70	PC88	0·85						
6AK7	0·85	6C6	0·50	6SG7	0·80	DAF96	0·60	EFL200	1·20	PC96	0·50						
6AL5	0·40	6C8G	0·60	6SK7	0·80	DF96	0·60	EH90	0·60	PC97	0·95						
6AM6	0·70	6CB6	0·55	6SL7GT	0·70	DK92	1·00	EL33	2·50	PC900	1·00						
6AM8	0·70	6CG7	0·70	6SN7GT	0·70	DL96	0·60	EL36	0·95	PCC84	0·50						
6AN5	2·50	6CG8A	0·75	6SQ7	0·80	ECC84	0·60	EL81	0·65	PCC85	0·60						
6AN6	0·85	6CM7	0·80	6SR7	0·80	ECC85	0·48	EL82	0·60	PCC88	0·65						
6AQ5	0·85	6CN7	1·20	6V6GT	0·65	ECC86	1·25	EL83	0·60	PCC89	0·75						
6AS6	1·00	6CQ8	0·75	6X4	0·60	ECC88	0·75	EL84	0·45	PCC189	1·00						
6AS7G	1·20	6CS7	0·85	6X5GT	0·60	ECC89	0·80	EL86	0·75	PCF80	0·65						
6AT6	0·75	6CU5	1·00	6X8	0·80	ECC189	0·80	EL95	0·70	PCF82	0·45						
6AU6	0·50	6CU6	1·00	12A6	0·60	ECF80	0·60	EL504	0·80	PCF84	0·65						
6AV6	0·75	6CW4	3·75	12AL5	0·65	ECF82	0·55	EM80	0·65	PCF86	0·75						
6AW8A	0·75	6CX8	1·00	12AQ5	0·60	ECF86	0·80	EM81	0·60	PCF806	1·00						

OSCILLOSCOPE TUBES

current production. Made in USSR

One inch Tube Type 3LO 11. This tube is a good replacement for 1CP31. Tube characteristics are identical with those of 1CP31. As the connections are different the tube is supplied complete with base, connection diagram and technical data **£12·00*. Three-inch tube Type 3BP1.** This well known tube used in "PURBECK" Oscilloscope can be supplied for **£7·50.*** 14-pin base for the above **£0·80.***

VAT is not included. Please add 12½% on all items except those marked with asterisk, on which VAT is 8%. Postage and packing charges are **£0·10** per £ subject to a minimum of **£0·30.** Minimum order charge for Approved Credit customers **£20·00.** Minimum Transaction Charge for mail orders £1·00.

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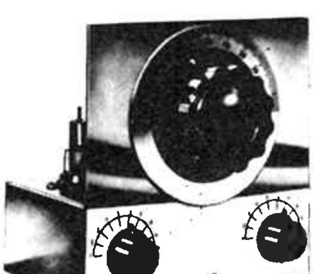

"H.A.C." well known by amateur constructors for its Short Wave receivers, now offers a complete range of kits and accessories to suit the novice and the expert.

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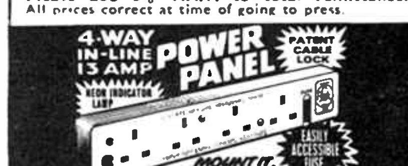

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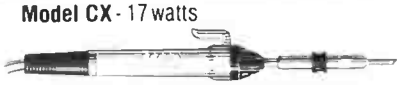
Model TCSU1 Soldering Station

CTC 35watt

The TCSU1 soldering station with either the XTC 50watt – 24/26 volt soldering iron or the CTC 35watt – soldering iron for pin point precision and exceptionally fast recovery time We have put at least twice as much power into irons which are already well known for good recovery time The temperature control stops them from over heating the fail-safe electronic circuit provides protection even if the thermocouple fails TCSU1 soldering station **£ 38 10** XTC and CTC irons **£14.85** inclusive of VAT and P & P

Model CX - 17 watts

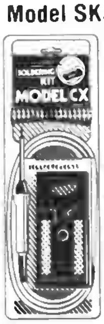


a miniature iron with the element enclosed first in a ceramic shaft then in a stainless steel Virtually leak free Only 7½ long Fitted with a 3 32 bit **£4·37** inclusive of VAT and P & P Range of 5 other bits available from ¼ down to 3 64

Model X25 - 25 watts

A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation Fitted with 1/8 bit and priced at **£4·37** inclusive of VAT and P & P Range of 4 other bits available

Model SK3 Kit



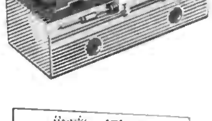
Contains both the model CX230 soldering iron and the stand ST3 Priced at **£6·21** inclusive of VAT and P & P It makes an excellent present for the radio amateur modelmaker or hobbyist

Model SK4 Kit

With the model X25/240 general purpose iron and the ST3 stand this kit is a must for every toolkit in the home Priced at **£6·21** inclusive of VAT and P & P

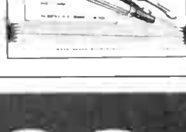
Model SK1 Kit

This kit contains a 15watt miniature soldering iron complete with 2 spare bits a coil of solder a heat sink and a booklet How to solder Priced at **£6.48** inclusive of VAT and P & P



Model MLX Kit

The soldering iron in this kit can be operated from any ordinary car battery It is fitted with 15 feet flexible cable and battery clips Packed in a strong plastic envelope it can be left in a car a boat or a caravan ready for soldering in the field Price **£4.83** inclusive of VAT and P & P



Now heat to any level

between 145° - 400°c

(with accuracy of 2%)

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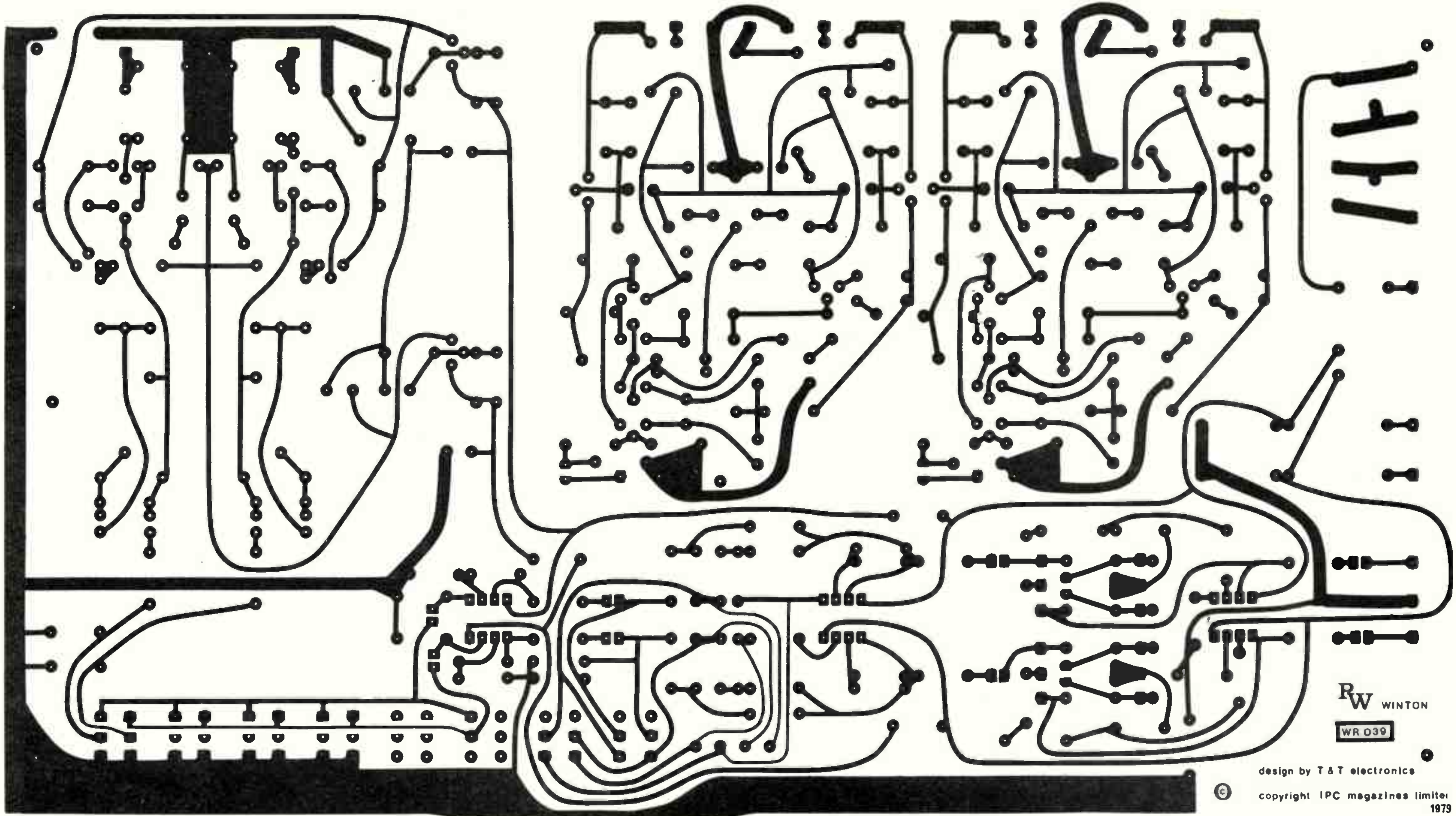
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