

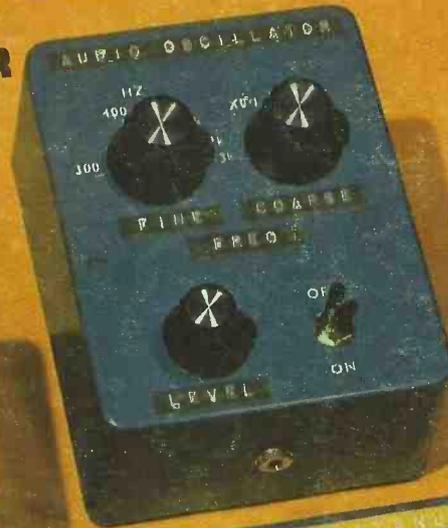
PRACTICAL WIRELESS

JULY
1972

20p

audio test trio

SIGNAL GENERATOR
TEST OSCILLATOR
ATTENUATOR BOX



also: TWO METRE F.E.T. CONVERTER
DX'ERS A.F. PROCESSING UNIT

BROADWAY ELECTRONICS

92 MITCHAM ROAD, TOOTING BROADWAY,
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SPEAKERS

E.M.I. 13½ x 8in, 3 ohm £2.50, 15 ohm P. & P. 30np. E.M.I. 13½ x 8in, fitted two 2½in. tweeters, 15 ohm £4.70. P. & P. 30np. E.M.I. 13½ x 8in. (15 ohm) Hi-Fi quality £6.25. P. & P. 30np. Bakers 12in. 25 watt 8 and 15 ohms £7. P. & P. 30np. Eagle Crossover 98p. P. & P. 7p.

CARTRIDGES-Stereo

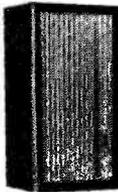
Sonotone 9TA H/C Diamond £2.40, Ronette S105 Medium Output, £1.40. S106 High Output £1.40. Acos GP93/1 Sapphire, £1.90. GP94 1 Sapphire, £2. TA700 equivalent to B.S.R. SXIM, £1.75. Japanese equivalent to B.S.R. TC8s, £1.75. P. & P. 7np on each.

CARTRIDGES— Mono

GP.91 Stereo Compatible £1.25. Acos GP67/2 will replace Collaro and Garrard Mono cartridges, 95np. T.T.C. Crystal High Gain, 75np. B.S.R. TC8H Jap. equivalent £1.25. P. & P. 7np.

FARRA- DAY

5½" x 11" x 4½" covered in White, Green or Black rexine or Teak cloth with Silver coloured metal front 3ohm ex. tv speaker. £2.90 P & P 25p

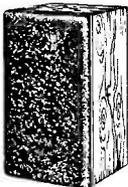


VYNAIR

Widths from 50 to 54in., 75np yd. off roll. P. & P. 10np, ½ yard 40np. P. & P. 10np. Send 5np stamps for samples.

ELF

An extension speaker of quality; 9 x 5½ x 3½in. veneered in natural teak with smart gold and mottled Vynair front 3 ohm ex. tv speaker. The baffle is half inch thick. A real bargain at £1.92½. Post and packing. 37½p.



SPEAKER MATCHING

TRANSFORMERS 3, 7, 15 ohms,
8 watt, 70np. P. & P. 17np.

HI-FI STEREO HEADPHONES

Padded ear cushions seal out room noise. Perfect coupling between reproducer and ears assure full response impedance 8 ohms. frequency range 30-15,000 Hz 6ft. cord and standard stereo plug. Only £2.57½. P. & P. 27½p.



STEREO HEADPHONE JUNCTION BOX

Simple unit connects direct to amplifier and speakers to give attenuated headphone output has 3 position switch to give headphones only, speakers only, speakers and headphones. Only £1.50. P. & P. 13p.

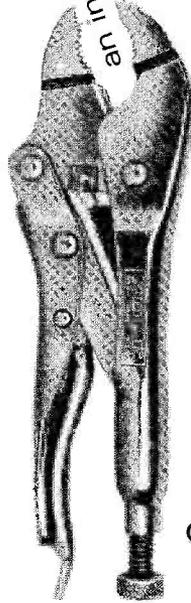


NOCTURNE 73 STEREO SYSTEM

6w. per channel speech and music rating complete with Garrard 2025/TC with Acos stereo cartridge £54.75 P&P £1.



an invaluable aid to practical wireless enthusiasts



The pocket size dimensions and versatility, of the MINI MOLE Wrench, makes it 'just the job' for intricate difficult-to-get-at components situated in awkward corners.

The steel jaws lock-on with a positive grip, and a flick of the lever releases their grip instantly.

Available from Hardware and Motor Accessory Shops.

MINI MOLE SELF GRIP WRENCH

only 80p



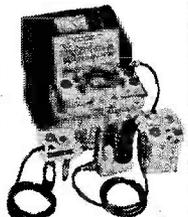
M. MOLE & SON LIMITED, NEWPORT, MON. NPT 5XZ.

GEIGER COUNTERS

(FOR MAINS OR PORTABLE BATTERY USE)

Latest Home Office release and probably the last, of this well known Contamination Meter No. 1, this very useful instrument is used for the measurement of Radio-Activity. Indicated on an Internal Meter scaled 0-1 to 10 milli Rontgens/Hour, a socket is also provided for additional sound Monitoring on Headphones. This instrument is housed in a Strong light Alloy Case, placed in a carrying Haversack with shoulder strap. Containing Cable and Hand held Probe, Instruction Card, plus the latest plug in Vibrator Power Unit, which uses current small Transistor Radio Batteries (4 Mallory Long Life RML12 or 4 EverReady H.P.7 or equivalent makes).

For Mobile use anywhere. (Cost Gov. approx. £70 each). Supplied Brand New in Carton only £5.60 carr. 50p. An additional plug in Power Unit for Laboratory use, operating from 100-120 volts or 200-250 volts A.C. Mains is available. Supplied Brand New in Carton at only £2.50 post 25p. Headphones (not necessary) if required £1.50. A few Geiger Counters as above but not boxed in cardboard cartons, available at only £4.50.



Meter Dose Rate Portable Trainer No. 1

This was used to train in the use of Geiger Counters. A very compact self-contained Geiger Counter, being very sensitive, Radiation indicated on Internal Meter scaled 0 to 3 Rontgens/Hour x 10-4. Unit contained in Waterproof Alloy Case, which is hand held. Uses Internal Batteries (4 EverReady H105 and 1 U2 or equivalent makes) Not Supplied. These have had little or practically no use, supplied as New in Cartons. Few only £8.50 carr. 50p.

Due to Warehouse clearance, we have for disposal few only Trans-Receiver No. 62 MK2. Made by Pye for the Navy and Army. Using a total of 11 Valves, 1 RF and 2 I.F. stages, A.V.C., BFO, covering 1.5 mc/s to 10 mc/s (approx 200 to 30 metres), in two switched Bands. Can be used on RT or CW M.O. or Crystal. A very good Internal ATU made of a rotating Silver wire coil. Tunesable over the complete range, suitable for Aerials 4ft to 100ft, Internal P.U. for 12 volt DC. A meter is fitted for checking voltages A.V.C. etc. Housed in a Metal Waterproof Case approx size 18" x 10" x 12". Supplied in very good condition with Headphones & Mike two spare Valves, circuit boxed, only at £12.50. Carr. £1. Air Tested £1 extra. A few Grade 2 sets £9.50. Carr. £1. Air Tested £1 extra. CRYSTAL CALIBRATOR No. 10. Range 500 Kc/s to 10 mc/s, up to 80 mc/s on Harmonics. Size 7" x 7½" x 4". Power 300 volts HT, 12 volts LT. The Calibrator can plug into a Power Socket on the 62 Trans-Receiver which it was normally used with. Supplied in Good used condition with circuit £2.50. Post 50p or Brand New in Carton with operating Manual & Circuit Connectors to set £5.00. Post 50p.

JOHNS RADIO Dept. D, 424 Bradford Road,
Batley, Yorks. Phone Morley 69696

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

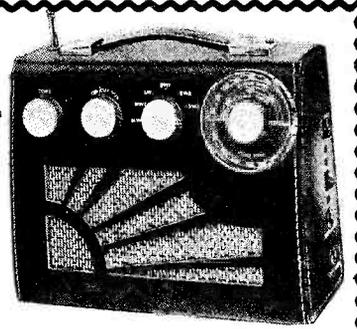
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated Telescopic Aerial, for peak short wave and VHF listening. Push pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" x 2 1/2" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost

£8.50

P. P. & Ins. 50p

(Overseas P. & P. £1)

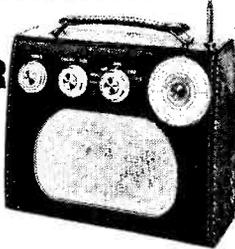


ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 6" x 2 1/2" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

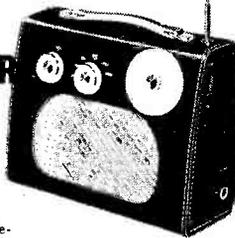
Total building cost **£6.98** P.P. & Ins. 41p. (Overseas P. & P. £1)



ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 8" x 2 1/2" speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

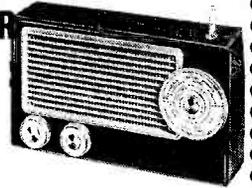
Total building costs **£5.98** P.P. & Ins. 41p. (Overseas P. & P. £1)



ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—8 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

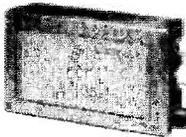
Total building costs **£3.98** P.P. & Ins. 26p. (Overseas P. & P. £1)



POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 6 1/2 x 1 1/2 x 3 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2.23** P.P. & Ins. 21p. (Overseas P. & P. 62p)



TRANSONA FIVE

5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2.50** P.P. & Ins. 22p. (Overseas P. & P. 63p)

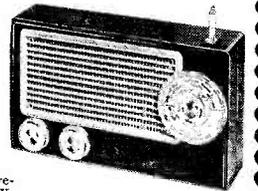


TRANS EIGHT

8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£4.48** P.P. & Ins. 31p. (Overseas P. & P. £1)



NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE:

Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 4x2 1/2" Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 1/2" Knobs. Units once constructed, are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction

All parts including **£5.50** P.P. & Ins. 31p. (Overseas P. & P. £1)

RADIO EXCHANGE CO

61 HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £..... please send items marked

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| ROAMER TEN | <input type="checkbox"/> | ROAMER SEVEN | <input type="checkbox"/> |
| ROAMER EIGHT | <input type="checkbox"/> | TRANS EIGHT | <input type="checkbox"/> |
| TRANSONA FIVE | <input type="checkbox"/> | ROAMER SIX | <input type="checkbox"/> |
| POCKET FIVE | <input type="checkbox"/> | EDU-KIT | <input type="checkbox"/> |

Parts price list and plans for

Name

Address

FULL AFTER SALES SERVICE

* Callers side entrance Barratts Shoe Shop
* Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.

PW43

COMET

HI-FI DISCOUNT WAREHOUSES

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COMET for after-sales service

THROUGHOUT THE U.K.
 Pictured, Service Dept. at Clough Rd., Hull also at Leeds, Stockton, Goole, Wakefield, Doncaster, Bridlington, Birmingham, Edinburgh, Leicester and Rochdale

	Rec. Price	Retail Price	Comet Price
STEREO AMPLIFIERS			
ALBA UA 700	37-93	34-95	
ALPHA 212 B Highgate	37-75	35-95	
AMSTRAD Stereo 8000 Mk 2	27-95	14-95	
AMSTRAD I.C. 2000	42-95	27-50	
ARMSTRONG 521	59-00	44-95	
DULCI 207M	32-00	19-50	
FERROGRAPH F307 Mk. II (cased)	64-00	46-95	
FERROGRAPH F307 Mk. II (Metal case)	60-00	42-95	
GODDMANS Maxamp	54-00	34-95	
LEAK Delta 30 (cased)	65-00	48-25	
LEAK Delta 70 (cased)	79-50	58-95	
METROSOUND ST20E	39-50	24-95	
METROSOUND ST60	70-00	46-25	
PHILIPS RH 681	79-00	53-95	
PHILIPS RH 590	52-00	35-50	
PHILIPS RH 580	29-00	19-95	
PIONEER SA500A	45-50	39-95	
PIONEER SA600	89-60	58-95	
PIONEER SA800	119-85	75-95	
PIONEER SA900	133-83	90-95	
PIONEER SA1000	147-83	95-95	
PIONEER QL650 Quadraphonic converter	94-43	65-55	
PIONEER Reverberation 202W	51-05	34-95	
RANK Rotel 210	34-90	24-95	
RANK Rotel 310	47-50	32-95	
RANK Rotel 650	74-50	49-50	
ROGERS Ravensbourne	64-50	45-50	
ROGERS Ravensbourne (cased)	69-50	49-50	
ROGERS Ravensbrook Mk. II	50-50	35-95	
ROGERS Ravensbrook (cased) Mk. II	55-50	39-95	
SINCLAIR 8000	35-00	24-25	
Project 60/2 x Z30/PZ5	23-90	15-95	
Project 60/2 x Z50/PZ8/trans	34-85	21-95	
Project 605	29-95	20-25	
AFU	5-98	4-25	
Neoteric	61-95	42-93	
3000	45-00	29-50	
307	33-00	22-95	
TELETON SAQ 200	33-00	19-50	
GA202 15 watt RMS P Chan. Spec. Price	28-50	25-50	
WHARFEDALE Linton Amplifier	60-00	42-95	

All take both ceramic and magnetic cartridges

	Rec. Price	Retail Price	Comet Price
TUNERS			
*ARMSTRONG 523 AM/FM	52-68	39-50	
*ARMSTRONG 524 FM	40-97	30-95	
ARMSTRONG M8 Decoder	9-50	6-95	
*DULCI FMT.7 FM	24-43	17-50	
DULCI FMT.7S Stereo	32-89	24-50	
GODDMANS Stereomax	75-74	46-95	
LEAK Delta FM	73-00	53-95	
LEAK Delta AM/FM	87-00	65-95	
PHILIPS RH 690	44-15	33-50	
PHILIPS RH 691	83-40	67-25	
PIONEER TX500 AM/FM	70-93	52-50	
PIONEER TX600 AM/FM	100-37	77-95	
RANK ROTEL 320	53-38	38-50	
ROGERS Ravensbourne chassis	57-95	42-50	
ROGERS Ravensbourne In teakcase	62-63	47-25	
ROGERS Ravensbrook chassis	42-14	31-25	
ROGERS Ravensbrook (cased)	48-00	35-25	
SINCLAIR 2000	45-00	33-50	
SINCLAIR 3000	45-00	34-25	
SINCLAIR Project 60 tuner (stereo)	25-00	19-95	

All above Tuners are complete with MPX Stereo Decoder except where starred.

	Rec. Price	Retail Price	Comet Price
TUNER/AMPLIFIERS			
AKAI AA 8500	228-34	169-95	
AKAI 6600	145-26	105-50	
AKAI 6300	125-83	92-50	
AKAI 6200	97-09	72-50	
ARENA 2600	111-30	59-95	
ARMSTRONG M8 Decoder	9-50	6-95	
ARMSTRONG 525	90-14	67-95	
ARMSTRONG 526	102-72	77-50	
GODDMANS Module 80, 35w. RMS	89-02	67-75	
GODDMANS Module 80 Compact	160-38	125-95	
GODDMANS Module 110 FM/MW/LW/SW 100W RMS	131-22	104-95	
LEAK Delta 75	160-00	127-95	
MIDLAND 19/542	49-56	36-75	
PHILIPS RH 790	134-00	74-95	
PIONEER SX770 AM/FM	135-80	104-95	
PIONEER SX440 AM/FM	101-60	79-95	
ROGERS Ravensbrook Chassis	96-57	77-95	
ROGERS Ravensbrook (cased)	105-35	82-95	
ROTEL RX150	67-93	51-95	
TANDBERG 1171 MPX	103-08	84-95	
TANDBERG TR200 MPX	96-23	79-95	
TELETON F2000	51-50	27-25	
TELETON CR55	125-26	68-50	
TELETON R8000 AM/FM	42-16	21-95	

All the above take magnetic cartridges except Teleton F2000 and 8000 which take ceramic only.
 All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra as listed.

	Rec. Price	Retail Price	Comet Price
CARTRIDGES			
AUDIO TECHNICA AT66	6-47	4-20	
GOLDRING G850	6-10	3-45	
GOLDRING G800	12-21	5-80	
GOLDRING G800E	17-67	9-70	
GOLDRING G800 Super E	24-41	14-40	
*GOLDRING CS90 Stereo	4-88	4-20	
*GOLDRING CS91/E	7-33	6-20	
EMPIRE 1000Z/E/X	50-12	45-95	
EMPIRE 999VE/X	42-14	33-25	
EMPIRE 999TE/X	24-58	19-50	
EMPIRE 999SE/X	19-90	15-60	
EMPIRE 999E/X	15-57	11-70	
EMPIRE 909E/X	12-12	9-40	
EMPIRE 909E/X	9-37	7-15	
ORBIT Magnetic NM 22	27-60	22-95	
SHURE M3DM	6-10	4-20	
SHURE M31E	11-63	8-50	
SHURE M32E	10-73	7-85	
SHURE M32-3	9-84	7-65	
SHURE M44-5	8-30	5-65	
SHURE M44-G	8-30	5-65	
SHURE M44-7	7-90	5-40	
SHURE M-44C	7-90	5-40	
SHURE M44E	8-60	5-80	
SHURE M55E	9-70	6-80	
SHURE M75G	14-70	9-70	
SHURE M75-6	13-60	8-25	
SHURE M75EJ	15-40	10-50	
SHURE M75E	19-00	12-70	
SHURE M75E/95G	20-80	14-60	
SHURE V15-11	39-40	26-95	
SONOTONE 9TAHC Diam/Saph.	3-75	1-95	

Starred cartridges above are ceramic. All others are magnetic.

	Rec. Price	Retail Price	Comet Price
PICK-UP ARMS AND HEADS			
GOLDRING Lenco 75	13-51	9-30	
GOLDRING Lenco L69	9-77	6-40	
SME 3009 with S2 Shell	32-34	24-50	
SME 3012 with S2 Shell	34-44	26-50	

	Rec. Price	Retail Price	Comet Price
TURNABLES			
The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.			
GARRARD SP25 Mk III with Goldring G.800			
Special Price £219-50			
GARRARD SP25 Mk III with Shure M.44/7			
Special Price £20-50			
GARRARD SP25 Mk III with Shure M.44/E			
Special Price £21-95			
GARRARD AP76 with Goldring G800			
Special Price £29-90			
GARRARD AP76 with Shure M55E			
Special Price £32-95			
GARRARD AP76 with Shure M75EJ			
Special Price £34-95			
GARRARD 2025 with Sonotone 9TAHC			
Special Price £18-90			
GOLDRING 705/P with G850	£26-00	£10-95	
GOLDRING GL75 with G800			
Special Price £39-95			
THORENS 150 AB complete with TX11 cover Shure M55E cartridge	£60-46	£47-95	
GARRARD SP25 Mk III	16-17	10-25	
GARRARD SL65B	20-93	13-95	
GARRARD SL95B	49-21	32-75	
GARRARD 401	39-04	27-50	
GARRARD SL72B	32-60	22-95	
GARRARD Zero 100A	57-42	39-95	
GARRARD Zero 100S	52-83	38-95	
GARRARD WB4 base Mk II/2 to fit Zero 100 & Zero 100S	6-55	4-95	
Base and Cover to fit GARRARD AP75, SL55, SL65B		Spec. Price £3-60	

	Rec. Price	Retail Price	Comet Price
TURNABLES—continued			
GARRARD 40B	13-63	10-95	
GARRARD AP76	28-44	19-50	
GOLDRING GL69 MKII	26-86	18-50	
GL69P Mk. II	35-23	25-25	
GL75	39-06	28-25	
GL75P	47-43	35-25	
Covers for 69P and 72P	4-36	3-75	
Cover for 75P Deluxe	4-88	3-95	
C99-plinth and cover for G99	10-75	9-75	
GOLDRING C99	27-90	19-50	
GOLDRING G101P/C	27-90	22-50	
GOLDRING GL72 Chassis	27-90	20-95	
GOLDRING GL72P	36-27	29-25	
GOLDRING GL85	61-03	46-50	
GOLDRING GL85P	70-80	54-75	
LEAK Delta	67-50	54-75	
McDONALD MP60	14-80	10-25	
610	18-79	14-50	
HT70	20-68	15-25	
HT70 Inc. plinth and cover	29-89	22-50	
Base and Cover for MP60 and 610	Spec. Price	£3-95	
PHILIPS 202 Electronic	64-65	51-75	
PHILIPS 308 transcription unit complete with base and cover	36-55	28-25	
PIONEER PL12AC with base & cover	47-15	36-25	
THORENS TX25 cover	8-26	6-60	
THORENS TD125	73-78	58-25	
THORENS TD125AB	112-14	91-95	
THORENS TD150 Mk. II	33-64	28-75	
THORENS TD150A Mk. II	43-09	33-50	
THORENS TD150AB Mk. II	46-63	38-25	
THORENS TX11 Cover	4-13	3-75	
WHARFEDALE Linton with base and cover and Shure M44-7 cart.	34-50	27-25	

	Rec. Price	Retail Price	Comet Price
SPEAKERS			
AKAI SW 155	59-50	39-95	
AMSTRAD 138 (pair) 13" x 8" twin cone teak	26-00	15-95	
B & W Model 70	159-50	111-95	
B & W DM2	62-50	51-95	
B & W DM3	63-00	47-95	
B & W DM1 (pair)	75-20	59-95	
CELESTION COUNTY	23-97	19-50	
CELESTION Ditton 120 (pair)	56-40	42-95	
CELESTION Ditton 15	37-60	26-50	
CELESTION Ditton 25	65-00	44-95	
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GODDMANS Havant (pair)	54-42	42-95	
GODDMANS Minister (pair)	50-62	36-95	
GODDMANS Magister	65-63	41-95	
GODDMANS Double Maxim	32-07	25-25	
GODDMANS Mezzo 3	35-70	23-95	
GODDMANS Magnium K2	46-20	30-95	
GODDMANS Dimension 8	72-44	49-95	
GODDMANS DIN 20NT kit	12-19	9-70	
KELETRON KN400 2-speaker System (pair)	15-88	12-50	
KN800 3-speaker System (pair)	26-46	17-50	
KN800 3-speaker System	15-90	10-25	
KN1100 4-speaker System	20-40	13-95	
KN1800 3-speaker System	25-20	15-95	
KN2100 3-speaker System	30-60	20-45	
LEAK 150 (pair)	49-00	37-00	
LEAK 205 (pair)	63-00	46-50	
LEAK 609	49-50	34-50	
METROSOUND RS 103 (pair)	29-21	23-50	
METROSOUND 202	21-50	15-25	
METROSOUND Duplex 15	32-00	23-95	
METROSOUND Duplex 25	52-00	36-95	
METRO 100 4-speaker System	44-70	27-20	
PHILIPS RH 402 (pair)	34-00	28-20	
PHILIPS 406	8-98	6-95	
PHILIPS Q16	25-00	16-95	
STE-MA 450	25-00	16-95	
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TANDBERG Tan 11 (pair)	36-94	31-20	
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Melton Mark II	35-00	24-45	
Dovedale 3 Mark I	45-00	30-50	
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Unit 3 Speaker Kit	12-00	9-25	
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CHASSIS SPEAKERS

	Rec. Price	Retail Price	Comet Price
GOODMANS Twin-Axiom 8	8-65	7-10	
Twin Axiom 10	9-58	7-75	
Axiom 401	17-68	12-25	
Axiom 85	5-20	4-15	
Axiom 10P	5-67	4-70	
Axiom 12P	13-00	9-90	
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Axiom 18P	35-70	25-95	
Axiom 100 40 watts din.	12-00	9-50	
ARJ 172	4-50	3-20	
Axiom 100	13-50	6-90	
Mixex 650	13-50	9-30	
Attenuator	3-75	2-70	
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WHARFEDALE 8in. Bronze/RS/DD	4-50	3-40	
Super 8/RS/DD	8-00	6-60	
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WMT1 Matching Transformer	0-84	0-70	

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HMV 2451	115-95	89-95
HMV 2452	63-90	49-95
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STEEPLETONE stereo system	41-75	31-95
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AKAI 4000D 4-track stereo deck	93-65	60-95
AKAI CR80D 8-track stereo deck	85-02	58-45
AKAI CR60 8-track stereo recorder	106-39	74-00
AKAI X200D	157-93	100-45
AKAI 1800SD	162-79	102-30
AKAI 2000SD	289-07	223-30
AKAI GXC 40D Cassette Tape Deck	92-26	68-25
AKAI GXC 40 Cassette recorder	111-75	83-25
BUSH Discassette DC70	20-62	16-55
BUSH TP 66 Batt./Mains Cassette Recorder	28-18	21-95
BUSH TP70 Cassette, battery/mains tape recorder	28-13	21-95

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	Rec. Price	Retail Price	Comet Price
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EKCO 351 Battery/Mains Cassette	23-23	18-45	
FERGUSON 3245 Twin track	36-70	25-95	
FERGUSON 3246 4-track	42-15	30-95	
FERGUSON 3247 4-track	47-95	34-95	
FERGUSON 3248 4-track	53-75	39-95	
FERGUSON 3252 4-track	100-52	74-95	
FERGUSON 3253	43-55	31-95	
FERGUSON 3258 4-track	72-40	53-95	
FERGUSON 3262	30-15	23-95	
FERROGRAPH 702-2-track tape deck	224-43	170-65	
FERROGRAPH 704/W 4-track deck	224-43	170-65	
FERROGRAPH 722	262-03	190-15	
FERROGRAPH 724	262-03	190-15	
GRUNDIG C200 De Luxe Cassette	37-55	27-95	
GRUNDIG TK 121 twin track	56-25	39-95	
GRUNDIG TK 141 4-track	62-10	45-75	
GRUNDIG TK 146 4-track Auto	66-95	49-95	
GRUNDIG TK 147 4-track Auto	93-05	71-95	
GRUNDIG C410 Cassette recorder	42-50	32-95	
PHILIPS R.R. 392 MW/VHF Radio and Cassette Recorder	49-95	36-55	
2202 cassette	22-85	17-95	
2204 cassette, battery/mains	29-10	22-90	
3302 cassette	20-35	15-95	
4307 4-track	48-65	34-95	
4308 De Luxe 4-track	56-85	41-45	
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4407 4-track stereo recorder	108-50	73-95	
4500 4-track stereo tape deck	124-30	91-65	
2400 stereo cassette less L/S	66-10	51-95	
PYE 9109 cassette	20-37	16-95	
PYE 9118 Stereo cassette	66-10	51-60	
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TANDBERG 1841 4-track stereo tape deck	66-09	48-75	
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TANDBERG 4021X twin track stereo	169-12	135-50	
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TANDBERG 6041X 4-track stereo	129-73	102-95	
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THORENS TX25 (for TD125AB)	8-26	6-60

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SME Plinth System 2000 with motor-board	46-20	37-00	
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AKAI ASE9	6-90	5-25	
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DULCI SH 650 D	Sp. Price	2-50	
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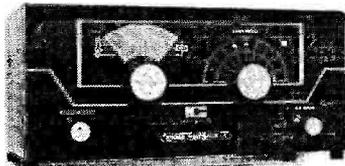
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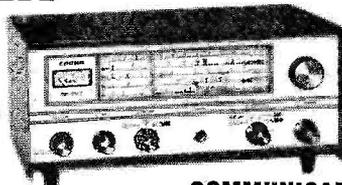
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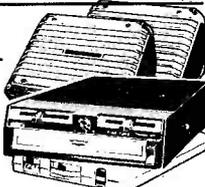
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8 TRACK STEREO CARTRIDGE PLAYER
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Stereo Car Player
Accepts all standard stereo cartridges. Features include automatic head cleaner, channel select and channel repeat push buttons, slider type volume and tone controls, balance control, Tech spec. max output 10W (5 watts per channel), frequency response 50Hz-10KHz. Output imp. 4 ohms, size 4 1/2"(W) x 1 1/2"(H) x 6 1/2"(D) in. Operates in 12V DC negative earth. Beautifully styled with black ivory and chrome trim finish.
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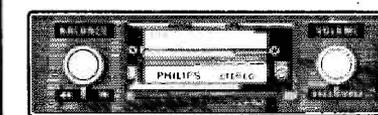
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PZ5 power supply £4.15 extra.



PHILIPS N2602

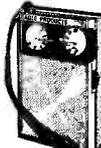
CAR STEREO CASSETTE PLAYER



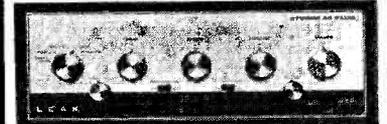
A top quality stereo cassette car player. This neat, handsome model has its own built-in amplifiers, giving perfect stereo playback without interference. This player as a black impact resistant polystyrene outer casing, illuminated on-off indicator, stereo balance, volume on/off controls and a 3-position tone switch with an automatic tape stop. Supply voltage: 12 volt DC neg/pos. Freq. res: 60-10,000 Hz. S/N ratio better than 45dB. Output power: 4 watts per channel. Cabinet Size: 7 1/2" x 2 1/2" x 7 1/2".
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LEAK BARGAINS STEREO 30 PLUS amplifier (cased)



List Price **£62.50** LASKY'S PRICE **£45.00** C & P £1.00

STEREO 70 amplifier (cased)

List Price **£75.00** LASKY'S PRICE **£55.00** C & P £1.00

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Teak or Rosewood cases for Stereo 30 or Stereo 70, please state which is required.
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Teak case for Stereofetic tuner only.

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Double case for 30 or 70 and stereofetic tuner.

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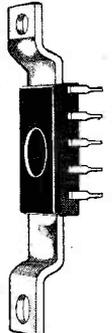
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LASKY'S PRICE **£47.50** C & P £1.50

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KA2000A 16 + 16W Stereo Amplifier 10 1/2" x 4 1/2" x 9 1/2". TEAK SLEEVE AS ILLUSTRATED.
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LASKY'S Plinth and cover ... £4.75
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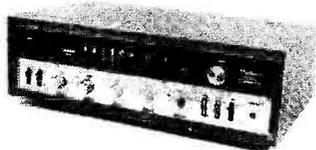
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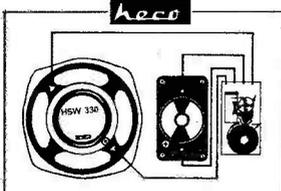
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3V4	-47	30F5	-64	EBC33	-40	EM87	-34	PCL86	-28	UBF89	-82
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6AM6	-13	30P4	-57	ECC83	-35	EZ30	-34	PL81	-44	UCL83	-35
6AQ5	-22	30P12	-72	ECC85	-34	EZ32	-40	PL81A	-47	UF41	-56
6AT6	-20	30P19	-57	ECC804	-54	EZ34	-48	PL82	-31	UF89	-30
6AU6	-20	30PL1	-60	ECP80	-31	KT41	-77	PL83	-33	UL41	-67
6BA6	-20	30PL13	-89	ECC82	-26	KT61	-35	PL84	-30	UL84	-30
6BE6	-21	30PL14	-65	ECH35	-55	KT66	-78	PL500	-82	UM84	-22
6BJ6	-41	35L6CT	-45	ECH42	-59	LN319	-63	PL604	-63	UY41	-80
6BW7	-52	36W4	-25	ECH81	-28	LN329	-72	PM84	-33	UY85	-25
6F14	-40	35Z4GT	-25	ECH83	-40	LN339	-63	PX25	-65	VPA8	-77
6F23	-68	807	-45	ECH84	-36	N78	-87	PY32	-55	W77	-43
6F25	-58	AC/VP2	-77	ECL80	-35	PAC80	-34	PY33	-55	Z77	-22
6J7G	-24	B349	-65	ECL82	-31	PC86	-47	PY81	-25	Transistors	
6K7G	-12	B729	-62	ECL86	-32	PC88	-47	PY82	-25	AG107	-17
6K8G	-17	CCH35	-67	EF39	-38	PC96	-42	PY83	-28	AC127	-18
6Q7G	-35	CY31	-30	EF41	-30	PC97	-39	PY88	-33	AD140	-37
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25L6GT	-19	DY86	-24	EL90	-26	PCF805	-81	U301	-38	OC8D	-12
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14 watts per channel into 3 to 4 ohms (suitable 3-15 ohms). Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within ±1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Tone controls and filter characteristics: Bass +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max.)—P.U.1 and radio -65dB. P.U.2 -53dB. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13½in x 9in x 3½in.

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Size approx. 17in x 10½in x 6½in. Drive unit 13in x 8in with parasitic tweeter. Max. power 10 watts, 8 ohms. Simulated Teak cabinet. £14 pair + £2 p&p.

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See opposite page for address

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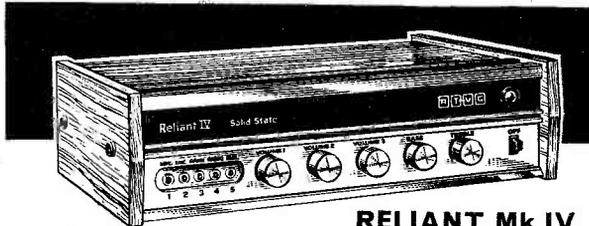
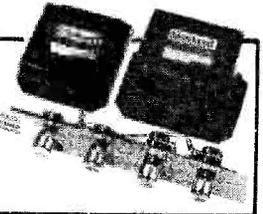
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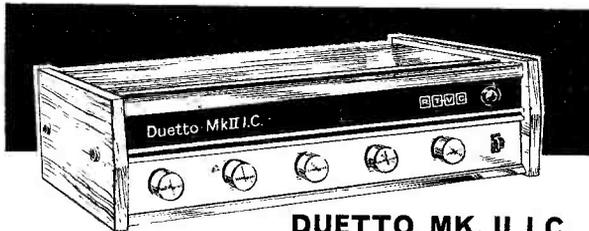
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Switched stereo headphone socket with power correction.

CONTROLS:—Mono/stereo switch, selector switch, treble, bass, volume, balance and on/off switch, Neon Indicator.

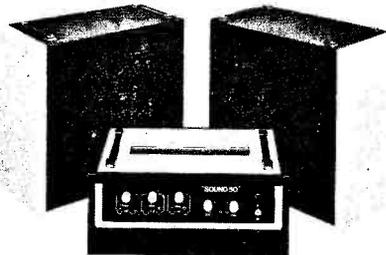
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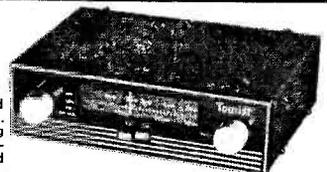
R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

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SET OF PARTS

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See opposite page for addresses

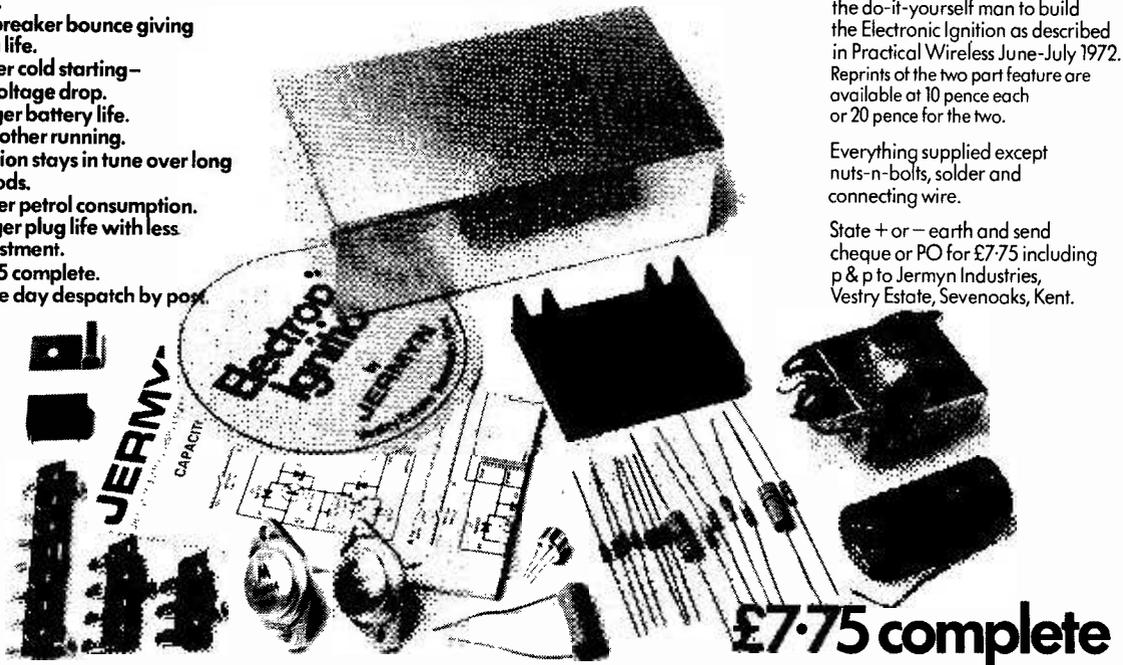
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Listens in to AIRLINES, PRIVATE PLANES, JETPLANES. Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the distinctive noises hiding tenseness on talk downs. Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, BIRMGHAM, PRESTWICK, ETC. ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument can be built by anyone over nine in under two hours. No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHATSOEVER NEEDED.** SEND **ONLY £2-85 + 20p p. & p.** for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. **IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX,**—then build this fantastic Relaxatron. Once used you will never want to be without it—**TAKE IT ANYWHERE.** Uses standard PP3 batteries (current used so small that battery life is almost self-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering. **£2-75 + 20p p. & p.** Parts available separately

BUILD 5 RADIO AND ELECTRONIC PROJECTS

ONLY £2-45
Amazing Radio Construction set! Become a radio expert for £2-45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeakers, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. Send **£2-45 + 20p p. & p.**

SHORTWAVE TRANSISTOR RADIO

ONLY £2-75
Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 74 stations logged on rod aerial in 30 mins.—Brazil, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4 1/2" x 1 1/2" **ONLY £2-75 + 20p p. & p.** Kit includes cabinet, screws, instructions, etc. (Parts available separately).

INGENIOUS ELECTRONIC SLEEP INDUCER

ONLY £3-25
CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated— but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. **No soldering necessary.** Works off standard batteries, extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. Kit includes case, nuts, wire, screws, etc. **SEND £3-25 + 20p p. & p.** (parts available separately).

ELECTRONIC ORGAN

ONLY £3-25
Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELF CONTAINED LOUDSPEAKER.** Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne", etc. etc. You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary. Simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* **ONLY £3-25 + 25p p. & p.** for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

ONLY £4-95
FULLY TRANSLATORISED PRINTED CIRCUIT METAL DETECTOR MODULE. Ready built and tested—just plug in a PP3 battery and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EARLY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **So sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND!** **GIVES CLEAR SIGNAL ON ONE COIN!** £4-95 + 30p carr. etc. (High quality Danish Stethoscope head-phones £2-75 extra if required). **EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

SEW PANEL METERS

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

- LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

TYPE SW.100
100 x 80 mm.



50μA	\$2-60	20V. D.C.	\$2-10
50-0-50μA	\$2-45	50V. D.C.	\$2-10
100μA	\$2-45	300V. D.C.	\$2-10
100-0-100μA	\$2-35	1 amp. D.C.	\$2-10
500μA	\$2-20	5 amp. D.C.	\$2-10
1mA	\$2-10	300V. A.C.	\$2-10
		VU Meter	\$2-75

BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts



50μA	\$2-90	50V. D.C.	\$2-60
50-0-50μA	\$2-10	300V. D.C.	\$2-60
100μA	\$2-10	1 amp. D.C.	\$2-60
100-0-100μA	\$2-00	5 amp. D.C.	\$2-60
500μA	\$2-75	300V. A.C.	\$2-60
1mA	\$2-60	VU Meter	\$2-37
20V. D.C.	\$2-20		

"SEW" CLEAR PLASTIC METERS

TYPE MR.55P. 4 1/4 in. x 4 1/4 in. fronts.



50μA	\$2-60	200mA	\$2-80
50-0-50μA	\$2-10	100mA	\$2-80
100μA	\$2-10	500mA	\$2-80
100-0-100μA	\$2-10	1 amp.	\$2-80
200μA	\$2-30	5 amp.	\$2-80
500μA	\$2-30	15 amp.	\$2-80
500-0-500μA	\$2-80	20 amp.	\$2-80
1mA	\$2-80	50V. D.C.	\$2-80
5mA	\$2-80	150V. D.C.	\$2-80
10mA	\$2-80	300V. D.C.	\$2-80
		15V. A.C.	\$2-80
		300V. A.C.	\$2-80
		8 Meter 1mA	\$2-87
		VU Meter	\$2-60
		1 amp. A.C.*	\$2-80
		5 amp. A.C.*	\$2-80
		10 amp. A.C.*	\$2-80
		20 amp. A.C.*	\$2-80
		30 amp. A.C.*	\$2-80

TYPE MR.52P. 2 1/2 in. square fronts.

50μA	\$2-10	10V. D.C.	\$2-00
50-0-50μA	\$2-60	20V. D.C.	\$2-00
100μA	\$2-60	50V. D.C.	\$2-00
100-0-100μA	\$2-10	300V. D.C.	\$2-00
500μA	\$2-30	15V. A.C.*	\$2-10
1mA	\$2-00	300V. A.C.	\$2-10
5mA	\$2-00	8 Meter 1mA	\$2-10
10mA	\$2-00	VU Meter	\$2-20
50mA	\$2-00	1 amp. A.C.*	\$2-00
100mA	\$2-00	5 amp. A.C.*	\$2-00
500mA	\$2-00	10 amp. A.C.*	\$2-00
1 amp.	\$2-00	20 amp. A.C.*	\$2-00
5 amp.	\$2-00	30 amp. A.C.*	\$2-00

TYPE MR.55P. 2 1/2 in. x 3 1/2 in. fronts.

50μA	\$2-37	10V. D.C.	\$2-20
50-0-50μA	\$2-75	20V. D.C.	\$2-20
100μA	\$2-75	50V. D.C.	\$2-20
100-0-100μA	\$2-85	150V. D.C.	\$2-20
200μA	\$2-60	300V. D.C.	\$2-20
500μA	\$2-40	15V. A.C.*	\$2-30
500-0-500μA	\$2-20	50V. A.C.*	\$2-30
1mA	\$2-20	150V. A.C.*	\$2-30
5mA	\$2-20	300V. A.C.*	\$2-30
10mA	\$2-20	500V. A.C.*	\$2-30
50mA	\$2-20	300V. A.C.	\$2-37
100mA	\$2-20	VU Meter	\$2-37
500mA	\$2-20	50mA A.C.*	\$2-20
1 amp.	\$2-20	100mA A.C.*	\$2-20
5 amp.	\$2-20	200mA A.C.*	\$2-20
10 amp.	\$2-20	500mA A.C.*	\$2-20
15 amp.	\$2-20	1 amp. A.C.*	\$2-20
20 amp.	\$2-20	5 amp. A.C.*	\$2-20
30 amp.	\$2-20	10 amp. A.C.*	\$2-20
50 amp.	\$2-20	20 amp. A.C.*	\$2-20
5V. D.C.	\$2-20	30 amp. A.C.*	\$2-20

***MOVING—IRON ALLOTHERS MOVING COIL**
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SEW EDUCATIONAL METERS



TYPE ED.107. Size overall 100mm x 90mm x 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The easily accessible to demonstrate internal working. Available in the following ranges:

50μA	\$5-00	20V d.c.	\$4-80
100μA	\$4-85	50V d.c.	\$4-40
1mA	\$4-40	300V d.c.	\$4-40
50-0-50μA	\$4-85		
1-0-1mA	\$4-40	Dual range	
1A d.c.	\$4-40	500mA/5A d.c.	\$4-85
5A d.c.	\$4-40	5V/50V d.c.	\$4-85
10V. d.c.	\$4-40		

"SEW" BAKELITE PANEL METER

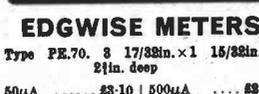
TYPE MR.55. 3 1/2 in. square fronts.



25μA	\$2-60	1 amp.	\$1-95
50μA	\$2-75	2 amp.	\$1-95
50-0-50μA	\$2-35	5 amp.	\$1-95
100μA	\$2-35	15 amp.	\$1-95
100-0-100μA	\$2-25	30 amp.	\$1-95
500μA	\$2-20	50 amp.	\$1-95
1mA	\$1-95	5V. D.C.	\$1-95
1-0-1mA	\$1-95	10V. D.C.	\$1-95
5mA	\$1-95	20V. D.C.	\$1-95
10mA	\$1-95	50V. D.C.	\$1-95
50mA	\$1-95	150V. D.C.	\$1-95
100mA	\$1-95	300V. D.C.	\$1-95
500mA	\$1-95	30V. A.C.*	\$1-95
		50V. A.C.*	\$1-95
		150V. A.C.*	\$1-95
		300V. A.C.*	\$1-95
		500mA A.C.*	\$1-95
		1 amp. A.C.*	\$1-95
		5 amp. A.C.*	\$1-95
		10 amp. A.C.*	\$1-95
		20 amp. A.C.*	\$1-95
		30 amp. A.C.*	\$1-95
		50 amp. A.C.*	\$1-95
		VU Meter	\$2-10

EDGWISE METERS

TYPE PE.70. 3 1/2 in. x 1 1/2 in. x 2 1/2 in. deep



50μA	\$2-10	500μA	\$2-75
50-0-50μA	\$2-00	1mA	\$2-45
100μA	\$2-00	300V. A.C.	\$2-45
100-0-100μA	\$2-00	VU Meter	\$2-40
500μA	\$2-00		

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

MULTIMETERS for EVERY purpose!



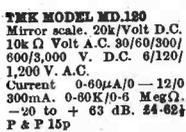
HIOKI MODEL 7201
20,000 O.P.V.
Overload protection
5/25/100/500/1000 VDC.
10/50/250/1000 VAC.
50mA/250mA. 20K/2 meg ohm. -5 to + 62db.
\$4-97. P. & P. 15p.



MODEL LT.101 1000 O.P.V.
0/10/50/250/1000 V. D.C.
0/10/50/250/1000 V. A.C.
0/1/100 M.A. 0/1/10 K ohms.
\$1-97. P. & P. 15p.



MODEL FL.436
20kΩ/Volt D.C.
8kΩ/Volt A.C.
Mirror scale.
-5/12/30/120/600V
D.C. 5/30/120/600V
A.C. 50/500mA/60/600 mA 10/100K/1 MegΩ
1 MegΩ
-20 to +46db. \$4-97 P & P 12p



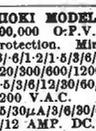
TME MODEL MD.180
Mirror scale. 20k/Volt D.C.
10kΩ/Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1200 V. A.C.
Current 0-60μA/0-12/0-300mA. 0-60K/0-6 MegΩ.
-20 to + 63 dB. \$4-82 P & P 15p



MODEL 5025 57 Ranges, Giant 5 1/2 in. Meter, Polarity Reverse Switch.
Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: -125, -25, 1-25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1-5, 5, 10, 25, 50, 125, 250, 500, 1,000V. 1200 V. A.C.
D.C. Current: 25, 601A. 2-5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: -20 to +85 dB. \$12-50. P. & P. 17p.



MODEL 500 3000 O.P.V. with overload protection mirror scale 0/5/2/5/10/25/100/250/500/1,000V. D.C. 5K/10,000V. A.C. D.C. Volts: -5, -2.5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA. 2-5, 10 100MEGΩ. Decibels: -10 to +49 db. Plastic Case with Carrying Handle. Size: 7 1/2 in. x 6 1/2 in. x 3 1/2 in. \$18-90. P. & P. 25p



HIOKI MODEL 700K
100,000 O.P.V. Overload protection. Mirror scale. 3/6/1-21/5/8/6/12/30/60/120/300/600/1200VDC 1.5/3/6/12/30/60/150/300/600/1200 V. A.C. 15/30μA/3/6/8/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm -20 to +63 db \$18-50. P. & P. 20p.



TTK LAB TESTER. 100,000 O.P.V. 6 1/2 in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: -5, -2.5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA. 2-5, 10 100MEGΩ. Decibels: -10 to +49 db. Plastic Case with Carrying Handle. Size: 7 1/2 in. x 6 1/2 in. x 3 1/2 in. \$18-90. P. & P. 25p

ROUND SCALE TYPE PENCIL TESTER MODEL TS.48



Completely portable, simple to use pocket sized tester. Ranges: 0/5/30/200V AC and DC 0-2000 ohms. Resistance 2-20K ohms. ONLY \$1-97 P. & P. 13p

RUSSIAN 22 RANGE MULTIMETER

Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2-5/10/50/250/500/1000V D.C. 2-5/10/50/250/500/1000V A.C. DC Current 100 μA/1/100mA/A. Resistance 300 ohms/3/30/300K/3MΩ. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE \$25-97 P. & P. 26p.



TO-3 PORTABLE OSCILLOSCOPE



3 in. tube, Y amp. Sensitivity 0.1 v. p-p/CM. Bandwidth 1-5 cps-1.5 MHz. Input Imp. 2 meg Ω 25pF X amp. sensitivity 0.5v. p-p/CM. Bandwidth 1-6cps -800KHz. Input Imp. 2 meg Ω 20pF. Time base. 6 ranges 10 cps-300KHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 15 1/2 lb. 220/240V. A.C. Supplied brand new with handbook. \$40-00. Carr. 50p.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output, Xtal socket for calibration. 220/240V. A.C. Brand new with instructions \$15. Carr. 37p. Size 140 x 215 x 107 mm.

TE22 SINE SQUARE WAVE AUDIO GENERATORS



Size: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. \$17-50. Carr. 37p.

TE-20RF SIGNAL GENERATOR

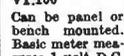


Accurate wide range signal generator covering 120 kc/s-250 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V A.C. Brand new with instruction \$15. P. & P. 37p. S.A.E. for details.



240° Wide Angle 1mA Meters MW1-6 60mm square \$27/7 MW1-8 80mm square \$47/7 P. & P. extra

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ±0.2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus four overrange digit. Overrange: 100% (up to 1.999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100V. D.C. Input: Fully floating (3 poles). Input power: 110-230V. A.C. 50/60 cycles. Overall size: 6 1/2 in. x 3 1/2 in. x 8 3/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. \$49-97. Carr. 60p.

G. W. SMITH & CO (RADIO) LTD. Also see next two pages.

SEMI-CONDUCTORS / VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors		2N3415		2N4548		BC114		15P		BFW90		22P		NKT219		30P	
2N301	20P	2N3416	22P	2N4549	35P	BC115	15P	BFW91	20P	BFW91	20P	NKT220	22P	FJH111	70P	SN7437	64P
2N302	20P	2N3417	27P	2N4550	35P	BC116	15P	BFW92	20P	BFW92	20P	NKT221	22P	FJH112	25P	SN7440	20P
2N303	20P	2N3418	130P	2N4551	25P	BC117	15P	BFW93	20P	BFW93	20P	NKT222	22P	FJH113	25P	SN7441	20P
2N304	42P	2N3419	97P	2N4552	25P	BC118	15P	BFW94	20P	BFW94	20P	NKT223	22P	FJH114	25P	SN7442	75P
2N305	42P	2N3420	130P	2N4553	25P	BC119	15P	BFW95	20P	BFW95	20P	NKT224	22P	FJH115	25P	SN7443	87P
2N306	42P	2N3421	130P	2N4554	25P	BC120	15P	BFW96	20P	BFW96	20P	NKT225	22P	FJH116	25P	SN7444	100P
2N307	42P	2N3422	130P	2N4555	25P	BC121	15P	BFW97	20P	BFW97	20P	NKT226	22P	FJH117	25P	SN7445	100P
2N308	42P	2N3423	130P	2N4556	25P	BC122	15P	BFW98	20P	BFW98	20P	NKT227	22P	FJH118	25P	SN7446	100P
2N309	42P	2N3424	130P	2N4557	25P	BC123	15P	BFW99	20P	BFW99	20P	NKT228	22P	FJH119	25P	SN7447	100P
2N310	42P	2N3425	130P	2N4558	25P	BC124	15P	BFW100	20P	BFW100	20P	NKT229	22P	FJH120	25P	SN7448	100P
2N311	42P	2N3426	130P	2N4559	25P	BC125	15P	BFW101	20P	BFW101	20P	NKT230	22P	FJH121	25P	SN7449	100P
2N312	42P	2N3427	130P	2N4560	25P	BC126	15P	BFW102	20P	BFW102	20P	NKT231	22P	FJH122	25P	SN7450	100P
2N313	42P	2N3428	130P	2N4561	25P	BC127	15P	BFW103	20P	BFW103	20P	NKT232	22P	FJH123	25P	SN7451	100P
2N314	42P	2N3429	130P	2N4562	25P	BC128	15P	BFW104	20P	BFW104	20P	NKT233	22P	FJH124	25P	SN7452	100P
2N315	42P	2N3430	130P	2N4563	25P	BC129	15P	BFW105	20P	BFW105	20P	NKT234	22P	FJH125	25P	SN7453	100P
2N316	42P	2N3431	130P	2N4564	25P	BC130	15P	BFW106	20P	BFW106	20P	NKT235	22P	FJH126	25P	SN7454	100P
2N317	42P	2N3432	130P	2N4565	25P	BC131	15P	BFW107	20P	BFW107	20P	NKT236	22P	FJH127	25P	SN7455	100P
2N318	42P	2N3433	130P	2N4566	25P	BC132	15P	BFW108	20P	BFW108	20P	NKT237	22P	FJH128	25P	SN7456	100P
2N319	42P	2N3434	130P	2N4567	25P	BC133	15P	BFW109	20P	BFW109	20P	NKT238	22P	FJH129	25P	SN7457	100P
2N320	42P	2N3435	130P	2N4568	25P	BC134	15P	BFW110	20P	BFW110	20P	NKT239	22P	FJH130	25P	SN7458	100P
2N321	42P	2N3436	130P	2N4569	25P	BC135	15P	BFW111	20P	BFW111	20P	NKT240	22P	FJH131	25P	SN7459	100P
2N322	42P	2N3437	130P	2N4570	25P	BC136	15P	BFW112	20P	BFW112	20P	NKT241	22P	FJH132	25P	SN7460	100P
2N323	42P	2N3438	130P	2N4571	25P	BC137	15P	BFW113	20P	BFW113	20P	NKT242	22P	FJH133	25P	SN7461	100P
2N324	42P	2N3439	130P	2N4572	25P	BC138	15P	BFW114	20P	BFW114	20P	NKT243	22P	FJH134	25P	SN7462	100P
2N325	42P	2N3440	130P	2N4573	25P	BC139	15P	BFW115	20P	BFW115	20P	NKT244	22P	FJH135	25P	SN7463	100P
2N326	42P	2N3441	130P	2N4574	25P	BC140	15P	BFW116	20P	BFW116	20P	NKT245	22P	FJH136	25P	SN7464	100P
2N327	42P	2N3442	130P	2N4575	25P	BC141	15P	BFW117	20P	BFW117	20P	NKT246	22P	FJH137	25P	SN7465	100P
2N328	42P	2N3443	130P	2N4576	25P	BC142	15P	BFW118	20P	BFW118	20P	NKT247	22P	FJH138	25P	SN7466	100P
2N329	42P	2N3444	130P	2N4577	25P	BC143	15P	BFW119	20P	BFW119	20P	NKT248	22P	FJH139	25P	SN7467	100P
2N330	42P	2N3445	130P	2N4578	25P	BC144	15P	BFW120	20P	BFW120	20P	NKT249	22P	FJH140	25P	SN7468	100P
2N331	42P	2N3446	130P	2N4579	25P	BC145	15P	BFW121	20P	BFW121	20P	NKT250	22P	FJH141	25P	SN7469	100P
2N332	42P	2N3447	130P	2N4580	25P	BC146	15P	BFW122	20P	BFW122	20P	NKT251	22P	FJH142	25P	SN7470	100P
2N333	42P	2N3448	130P	2N4581	25P	BC147	15P	BFW123	20P	BFW123	20P	NKT252	22P	FJH143	25P	SN7471	100P
2N334	42P	2N3449	130P	2N4582	25P	BC148	15P	BFW124	20P	BFW124	20P	NKT253	22P	FJH144	25P	SN7472	100P
2N335	42P	2N3450	130P	2N4583	25P	BC149	15P	BFW125	20P	BFW125	20P	NKT254	22P	FJH145	25P	SN7473	100P
2N336	42P	2N3451	130P	2N4584	25P	BC150	15P	BFW126	20P	BFW126	20P	NKT255	22P	FJH146	25P	SN7474	100P
2N337	42P	2N3452	130P	2N4585	25P	BC151	15P	BFW127	20P	BFW127	20P	NKT256	22P	FJH147	25P	SN7475	100P
2N338	42P	2N3453	130P	2N4586	25P	BC152	15P	BFW128	20P	BFW128	20P	NKT257	22P	FJH148	25P	SN7476	100P
2N339	42P	2N3454	130P	2N4587	25P	BC153	15P	BFW129	20P	BFW129	20P	NKT258	22P	FJH149	25P	SN7477	100P
2N340	42P	2N3455	130P	2N4588	25P	BC154	15P	BFW130	20P	BFW130	20P	NKT259	22P	FJH150	25P	SN7478	100P
2N341	42P	2N3456	130P	2N4589	25P	BC155	15P	BFW131	20P	BFW131	20P	NKT260	22P	FJH151	25P	SN7479	100P
2N342	42P	2N3457	130P	2N4590	25P	BC156	15P	BFW132	20P	BFW132	20P	NKT261	22P	FJH152	25P	SN7480	100P
2N343	42P	2N3458	130P	2N4591	25P	BC157	15P	BFW133	20P	BFW133	20P	NKT262	22P	FJH153	25P	SN7481	100P
2N344	42P	2N3459	130P	2N4592	25P	BC158	15P	BFW134	20P	BFW134	20P	NKT263	22P	FJH154	25P	SN7482	100P
2N345	42P	2N3460	130P	2N4593	25P	BC159	15P	BFW135	20P	BFW135	20P	NKT264	22P	FJH155	25P	SN7483	100P
2N346	42P	2N3461	130P	2N4594	25P	BC160	15P	BFW136	20P	BFW136	20P	NKT265	22P	FJH156	25P	SN7484	100P
2N347	42P	2N3462	130P	2N4595	25P	BC161	15P	BFW137	20P	BFW137	20P	NKT266	22P	FJH157	25P	SN7485	100P
2N348	42P	2N3463	130P	2N4596	25P	BC162	15P	BFW138	20P	BFW138	20P	NKT267	22P	FJH158	25P	SN7486	100P
2N349	42P	2N3464	130P	2N4597	25P	BC163	15P	BFW139	20P	BFW139	20P	NKT268	22P	FJH159	25P	SN7487	100P
2N350	42P	2N3465	130P	2N4598	25P	BC164	15P	BFW140	20P	BFW140	20P	NKT269	22P	FJH160	25P	SN7488	100P
2N351	42P	2N3466	130P	2N4599	25P	BC165	15P	BFW141	20P	BFW141	20P	NKT270	22P	FJH161	25P	SN7489	100P
2N352	42P	2N3467	130P	2N4600	25P	BC166	15P	BFW142	20P	BFW142	20P	NKT271	22P	FJH162	25P	SN7490	100P
2N353	42P	2N3468	130P	2N4601	25P	BC167	15P	BFW143	20P	BFW143	20P	NKT272	22P	FJH163	25P	SN7491	100P
2N354	42P	2N3469	130P	2N4602	25P	BC168	15P	BFW144	20P	BFW144	20P	NKT273	22P	FJH164	25P	SN7492	100P
2N355	42P	2N3470	130P	2N4603	25P	BC169	15P	BFW145	20P	BFW145	20P	NKT274	22P	FJH165	25P	SN7493	100P
2N356	42P	2N3471	130P	2N4604	25P	BC170	15P	BFW146	20P	BFW146	20P	NKT275	22P	FJH166	25P	SN7494	100P
2N357	42P	2N3472	130P	2N4605	25P	BC171	15P	BFW147	20P	BFW147	20P	NKT276	22P	FJH167	25P	SN7495	100P
2N358	42P	2N3473	130P	2N4606	25P	BC172	15P	BFW148	20P	BFW148	20P	NKT277	22P	FJH168	25P	SN7496	100P
2N359	42P	2N3474	130P	2N4607	25P	BC173	15P	BFW149	20P	BFW149	20P	NKT278	22P	FJH169	25P	SN7497	100P
2N360	42P	2N3475	130P	2N4608	25P	BC174	15P	BFW150	20P	BFW150	20P	NKT279	22P	FJH170	25P	SN7498	100P
2N361	42P	2N3476	130P	2N4609	25P	BC175	15P	BFW151	20P	BFW151	20P	NKT280	22P	FJH171	25P	SN7499	100P
2N362	42P	2N3477	130P	2N4610	25P	BC176	15P	BFW152	20P	BFW152	20P	NKT281	22P	FJH172	25P	SN7500	100P
2N363	42P	2N3478	130P	2N4611	25P	BC177	15P	BFW153	20P	BFW153	20P	NKT282	22P	FJH173	25P	SN7501	100P
2N364	42P	2N3479	130P	2N4612	25P	BC178	15P	BFW154	20P	BFW154	20P	NKT283	22P	FJH174	25P	SN7502	100P
2N365	42P	2N3480	130P	2N4613	25P	BC179											

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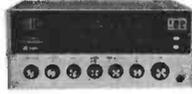
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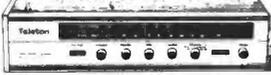


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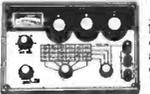


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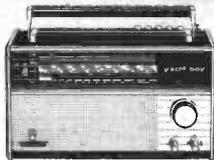
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ROC PRICE
£42.00

Including two pencil microphones and all connecting leads
Normal Price £65.00



ROC PRICE
£70.99

Including connecting leads
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REALISTIC HI-FI 36-WATT STEREO CONCERTMASTER FM-AM RECEIVER SYSTEM, MODEL 12-894

Brilliantly designed tuner/amplifier with two matching speakers. All three units in beautifully finished walnut cabinets with smart aluminium vertical trims. The tuning dial is fronted by unique black glass. Figures light up behind it in green when the unit is on. Separate easy-to-operate Left and Right volume controls. Stereo/mono selector. Programme selector. Separate bass and treble controls. Headphones socket on front panel for easy access. Single tuning knob for FM and AM. Built-in aerials, facilities for external FM aerial. Illuminated dial. Stereo broadcast indicator light. Each speaker has 6 1/2" bass and 3" treble units. Output: 9 watts r.m.s. per channel into 8 ohms. Frequency response: 30 to 20,000 Hz. FM: frequency range 80-108 MHz, sensitivity 2.5µV, stereo separation 30dB, image rejection 40dB. AM: frequency range 550-1605 kHz, sensitivity 100µV. Sizes: speakers 8" wide, 12" high and 9 1/2" deep; receiver 8" wide, 12" high and 9 1/2" deep. And their sophisticated appearance matches the excellence of the specification.

ROC PRICE
£59.55

Normal Price £95.00

As reviewed in "POPULAR HI-FI" February 1972



REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

A superb hi-fi amplifier with all the features you've ever wanted - for under £46.00. Saving over £10.00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls - magnetic phono (high/low) tuner, aux. mono. monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz ± 1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs: phono 2.5mV and 5mV RIAA; tuner/aux 250mV. Hum. and noise: phono - 50db, tuner/aux - 65db. Size 14 1/2" wide, 3 1/2" high, 10 1/2" deep.

ROC PRICE
£31.20

Normal Price £50.00

Ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivities: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz. Image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.



OLSON RA-310 AM/FM/MPX STEREO TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivities: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz. Image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.

ROC PRICE
£31.20

Normal Price £49.00



OLSON AM-395 40-WATT STEREO AMPLIFIER

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide x 3" high x 5 1/2" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/line enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

ROC PRICE
£12.45

Normal Price £21.00

tuner and power on/off slide switches.

8-TRACK HOME STEREO CARTRIDGE PLAYER MODEL E1

With this unit, you can play any standard 8-track cartridge on the market - at a fraction of the normal retail value! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The E1 has separate tone, balance and volume controls, giving you complete freedom to select the sound you want to hear. Tape speed is 3 3/8 ips, and wow and flutter are both less than 0.3%. Size: 11 1/2" wide, 5 1/2" high, 11" deep.

ROC PRICE
£27.55

Normal Price £42.00



PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16

This is one of the lowest priced stereo tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received - that's the time to switch to 'Stereo'! The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much - separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz, AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.

ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317

This exclusive ROC Stereo Chassis is completely self-contained, and it costs £2-25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5 1/2" wide, 13" high and 8 1/2" deep. It contains its own mains power supply, and has a ganged tone control and separate volume controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB; output 3.5 watts music power, per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.

ROC PRICE
£5.50

Normal Price £7.75



REALISTIC TM-100 AM/FM/MPX STEREO TUNER

Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges - FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities: FM 5µV; AM 250µV. Image rejection 50dB.



ROC PRICE
£17.55

Normal Price £28.00

OLSON AM-357 16-WATT STEREO AMPLIFIER

Here's a really good amplifier at a really down-to-earth price - nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you - reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12 1/2" wide, 3 1/2" high, 7 1/2" deep.



ROC PRICE
£17.80

Normal Price £25.00 per pair

R.446 3-WAY MATCHED SPEAKERS

These will do justice to your amplifier - and to your pocket. At only £17.80 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6 1/2" deep.



ROC PRICE
£24.10

Normal Price £39.50

It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3-0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well - sounds even better!

OLSON AM-357 4-WATT STEREO AMPLIFIER

Here's marvellous value for someone just starting to set themselves up in audio! At only £9.00 you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for tunable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz ± 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2 1/2" high, 4 1/2" wide.

ROC PRICE
£15.10

Normal Price £25.20



OLSON AM-372 16-WATT STEREO AMPLIFIER

Here's a really good amplifier at a really down-to-earth price - nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you - reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12 1/2" wide, 3 1/2" high, 7 1/2" deep.

ROC PRICE
£9.00

Normal Price £14.70



units at lowest prices?..."

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R.328 STEREO HEADPHONE
If you're starting in hi-fi, and you discover the need for a pair of really good stereo headphones. The R.328 is ideal, at a price you can afford. They have padded ear cushions, a 6-foot cord and jack plug. Frequency range 30-15,000 Hz. Impedance 8 ohms per channel. **ROC PRICE £2-95**

Every item shown here is the best of its kind within its price range. Buy them separately or all at the same time as the other top-value audio products listed.



R.188 STEREO HEADPHONE JUNCTION BOX
If you want easy, fingertip control of headphones and loudspeakers, here's the ideal solution to the problem. All you do is connect it to your speakers and amplifier, plug in your headphones - and you're ready to take over! At the flick of a side switch, you can have headphones alone, or speakers alone, or both together. Input: suitable for use with amplifiers rated up to 20 watts. Size: $2\frac{1}{2}'' \times 3\frac{1}{2}'' \times 1\frac{1}{2}''$. **ROC PRICE £1-50**

EAGLE SE-30 STEREO HEADPHONE

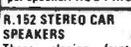
This model is for the more discriminating listener. For a start the frequency range extends from 30 to 16,000 Hz. And you can adjust the volume of each earpiece independently. There's also a mono/stereo switch. For maximum comfort, the ear cushions are covered in soft leathers. **ROC PRICE £7-05**



TEC HR-007 HEADPHONE RADIO
When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW. Normal Price £9-45 **ROC PRICE £5-80**



R.151 STEREO CAR SPEAKERS
Smart black, tough, plastic cases, each containing a high flux 110mm diameter speaker unit. Just what you need to go with the CS.8 Cartridge Player or any other car stereo system. Fitted with over three yards of connecting cable. Dimensions: $6\frac{1}{2}'' \times 5\frac{1}{2}'' \times 3\frac{1}{2}''$. Impedance: 8 ohms per speaker. Rating: 5 watts max per speaker. **ROC PRICE £3-72**



R.152 STEREO CAR SPEAKERS
These sloping front speakers match the CS.8 Cartridge Player or any other car stereo system. Fitted with high flux 110mm diameter speaker unit, and over three yards of connecting cable. Dimensions: $6\frac{1}{2}'' \times 3\frac{1}{2}''$. Impedance: 8 ohms per speaker. Rating: 5 watts max. per speaker. **ROC PRICE £4-96**



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For fabulous reproduction at a very low price, you'll find it hard to beat. 0-7 mil diamond stylus. Output: 6mV per channel. Frequency range: 30-18,000 Hz. Channel balance: $\pm 1.5dB$. Channel separation: 20dB. Recommended stylus pressure: 2.4 grams. Compliance: 9×10^{-6} cm/dyne. **ROC PRICE £4-75**



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SAQ-501 50-WATT SOLID STATE STEREO AMPLIFIER A really powerful unit with all the facilities you need for home entertainment - inputs for magnetic cartridge, tape, radio tuner and auxiliary. Controls for bass, treble, balance and volume. Headphone socket on the front panel for easy access. Loudness switch. Rumble and scratch filters. Specifications: 25 watts rms per channel into 8 ohms. Inputs Magnetic, Tuner, Tape/Aux, Tape play. Frequency response 20-20,000 Hz ($\pm 1dB$). Size: 333mm x 102mm x 285mm. Normal Price £33-60. **ROC PRICE £26-40**



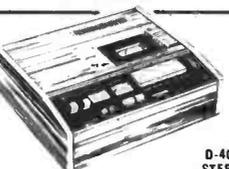
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R-200 20-WATT AM/FM/MPX STEREO TUNER AMPLIFIER What more could a hi-fi enthusiast want! The R-200 gives you top quality reproduction of both AM and FM programmes, including all the stereo broadcasts now available on FM. And you have built-in facilities for recording your favourite programmes on an external tape recorder. The front panel is carefully designed, with the latest slider controls for bass, treble, volume and balance. Alongside the dial are a meter for accurate tuning and a stereo indicator lamp that automatically lights up when you're tuned in to a stereo signal. Dozens of other brilliant facilities including main and remote speaker terminals. Specifications: 10 watts rms per channel into 8 ohms. Frequency response: 25-40,000 Hz ($\pm 2dB$) Inputs: Magnetic, Ceramic, Tape, Aux. Tape Play. Size: 398mm x 267mm x 106mm. Normal Price. £50-00. **ROC PRICE £42-00**



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D-400B STEREO CASSETTE DECK Precision engineered for trouble-free performance, this Stereo Cassette Deck has a fantastic range of facilities, making it a real value-for-money unit. Left and right level meters for recording, the latest slider controls for record level, switchable playback noise filter, aux/mic switch, mic input sockets, piano-key controls for record, rewind, play, fast-forward, and stop/eject. Index counter with reset button. Specifications: Frequency response: 35-12,000 Hz. Wow and flutter less than 0.25%. Inputs: Mike, Aux, Din Socket. Size: 345mm x 300mm x 100mm. Normal Price £39-50. **ROC PRICE £34-00**



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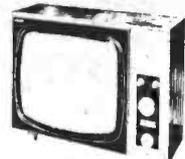
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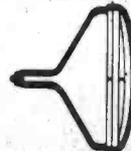
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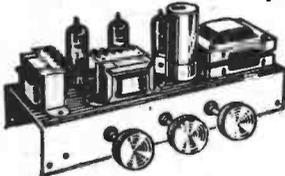
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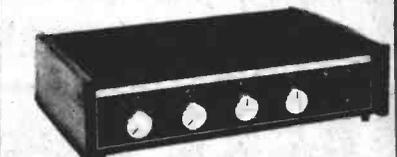
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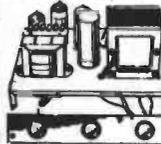
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HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £3-98. P. & P. 40p.

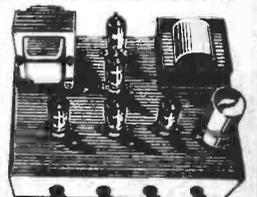
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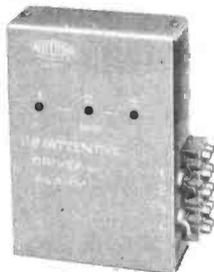
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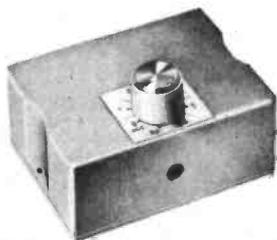
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PRACTICAL WIRELESS

VOL 48 NO 3

Issue 785

JULY 1972

First Class Post

YOU could regard the relationship between P.W. and the readership as that between a horse and its rider. In case this is seen as an insult, let us say that we are the horse; we provide the motivation but the direction is controlled by the readers—or should we say riders. If the direction into which we have been led appears wrong we sometimes feel that we know the route better than the rider (we have been over it many times) and can bring him back on course but that is not our main function; we prefer to be guided. How is this done, you may ask? It is not always easy but there are ways.

Our main source of information is the postbag. Each and every day a huge pile of letters arrives in the P.W. offices and, despite the views of the cynics, each and every one is read. Criticism, comment and opinions are all noted and we genuinely welcome constructive letters. It would be foolish to say that we act on all requests; if we did the contents would take on a truly weird character.

Readers sometimes get cross with us because they can't buy the components for a particular project. We take a lot of care to ensure that components are available when we prepare an article but we have little control over the commercial suppliers. However, most of these letters ask for sources of the most common components which more often than not are advertised in the same issue. The advertising pages not only enable P.W. to sell for 20p (instead of possibly 40p without them) but they can tell the constructor where to get his components—and at the keenest price. Even if the components are not themselves advertised, they are usually included in the catalogues which are available.

Although the valve-transistor battle has now become a bit of a bore, it shows no sign of letting-up. We could fill our letters page every month with this topic alone. But such letters must not be considered wasted. The valve-lovers/transistor-haters are certainly no insignificant part of our readership and we shall continue to cater for them as long as they let us know that they exist.

The most welcome letters are those which directly suggest ideas for articles or criticise those that we publish. We do not have the space to publish all of these but we certainly take note of them—even the nasty ones.

Returning to our analogy, it sometimes helps if the rider either gives the horse a lump of sugar or digs in the spurs. These cement the relationship. Both the sugar and the spurs are represented by the postbag. Continue to add your voice to that of the other readers. We do listen.

W. N. STEVENS—*Editor*.

NEWS AND COMMENT

Leader	215
News . . . News . . . News . . .	216
On the Short Waves <i>by Malcolm Connah and David Gibson, G3JDG</i>	225
Electronotes <i>by S. Ginsberg</i>	242
Letters to the Editor	243
Practically Wireless <i>by Henry</i>	244
MW Column <i>by Charles Molloy</i>	246

CONSTRUCTIONAL

DXers AF Processing Unit <i>by Halvor Moorshead</i>	218
Audio Test Trio, No. 1, Signal Generator <i>by J. N. Watt</i>	229
The Texan 20 + 20W IC Stereo Amplifier, Part 3, <i>by Richard Mann</i>	236
FET Converter for 2 Metres <i>by F. G. Rayer G3OGR</i>	247
Take 20, No. 38, 9V Power Supply <i>by Julian Anderson</i>	250
Constructing the P.W. Electronic Ignition System, Part 2, <i>by D. G. Fripp</i>	253

OTHER FEATURES

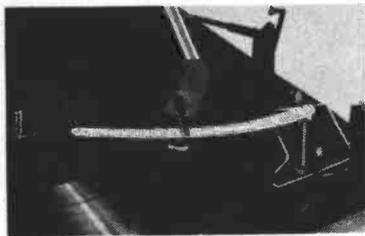
IC of the Month, SGS TBA651 AM Receiver Module <i>by L. A. J. Ireland</i>	245
Going Back <i>by Colin Riches and Arthur Dow</i>	258

Transistor Circuitry for Beginners (part 9) has been held over due to pressure on space.

**AUGUST ISSUE WILL BE
PUBLISHED ON JULY 7th**

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Bib's latest



The Bib record Cue & Swinger Detector is suitable for use on a record deck which is fitted with a cartridge arm lift. The device, overcomes the difficulty which is often experienced with modern cartridges of indicating a reasonably precise position on a record when it is desired to start playing a record at a pre-determined position or when it is required to move the cartridge back by a pre-determined amount in order to hear again a section of the record.

The device may also be used for detecting a "swinger"—a record which is being played in such a way that the pick-up cartridge swings from left to right and vice versa due to grooves in the record not being concentric with the turntable pin. Price is £1.49.

Mini Neon

Remember the Q neon, believed the smallest neon in the country, well West Hyde Developments have now made a neon indicator even smaller. It requires only a 5.75mm hole in the panel and is made from a chromium plated case with sintered glass pressings for the lens and base piece.

It can work down to 110 volts a.c. or 240 volts a.c. supply with the use of the appropriate external resistor, supplied with the neon. This neon, like all West Hyde neons, has an average life of 25,000 hours and you can get 16 to the square inch. The price is 19p each for 10 off down to 15p each for 10,000 off. The photograph shows how much smaller the new S neon is to the Q neon.

Available from: *West Hyde Developments Limited, Ryefield Crescent, Northwood Hills, Northwood, Middlesex. HA6 1NN.*

Chadacre Modules

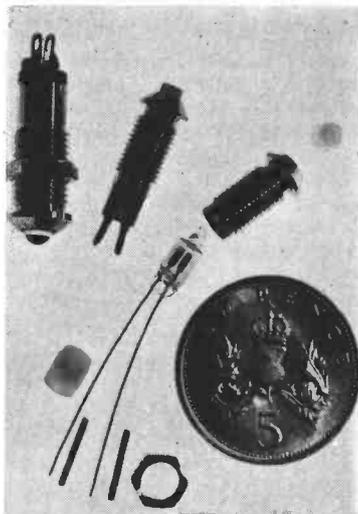
In an effort to meet the ever increasing demands of the modern sound studio technology, Chadacre Electronics, have developed a number of audio modules which may be readily combined to produce control consoles for any number of applications.

The competitive pricing, also enables the amateur, to construct professional equipment, previously only available to the professional user.

The Chadacre technique of developing special circuits on standard printed circuit boards so that they may be applied to a wide variety of uses, enables quantity production, yet retains the facility of an efficient, competitive, and reliable product at a realistic price.

The ever expanding range of modules, have been designed to cover the fields of closed circuit television audio support, portable broadcast and studio recording, public address and discotheque requirements.

Chadacre Electronics specialise in custom-built sound mixing equipment, and take pride in developing systems to specific requirements. They will also undertake to manufacture non-standard Modules, in small quantities. *Chadacre Electronics, (Audio Division), 43 Chadacre Avenue, Clayhall, Ilford, Essex. Telephone 01-550 7119.*

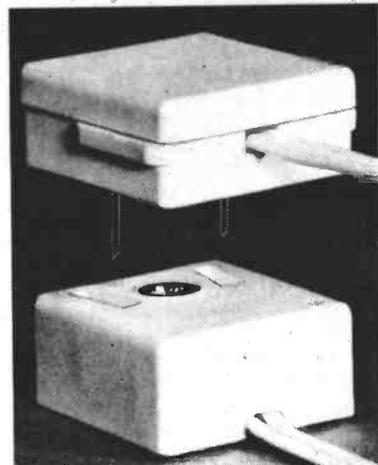


Plug and socket

Senate's Miniature Two-Pin Plug and Socket is neat, compact and of modern design. Despite its small size of 15cc (0.9in³), it is rated at 25A.

This high rating and correspondingly low contact-resistance of 1.4 milliohms is achieved by reinforcing the pressure between receptacle and flat-pin by a tin-plated carbon-steel spring, which also connects the wire without use of screws or solder to ensure a quick and reliable, vibration-proof connection.

Mouldings are in white Nylon and incorporate a novel cable-grip of high retaining force which requires no clamping screws. The surface-mounting socket is secured by a single fixing screw and anti-rotation lug. The H.V. test is 5000V between terminals and 2000V to a metal mounting.



Price is quantity dependent: a guide to the recommended price is 25p for the plug and socket complete in display pack with socket fixing screw, and 14p each for 1,000 order quantity. *Senate Engineering Ltd., 77 Cotes Road, Barrow-on-Soar, Loughborough, Leicestershire.*

News items

If you have any items that you would like considered for inclusion in the "NEWS" pages send details to Colin Riches, *Practical Wireless, Editorial, Fleetway House, Farringdon St., London EC4A 4AD.*

Movie sound Synchrodek



For those readers who have 8mm. movie projectors, the following notes will be of interest.

Many readers may have heard of the Synchrodek in its original form but now Harry Garlick, its inventor has made certain modifications and announced the Automatic Synchrodek Mk. 2.

So that a tape recorder and a projector can be synchronised, it is necessary to compare the speed of one with the speed of the other, and apply corrections to either when it appears to be getting out of step.

The Synchrodek is an electrical and mechanical device—a flexible drive is connected between the projector's main shaft. This drives an indicator needle round a dial which is marked in movie film frames. A free-running rubber-rimmed pulley is fitted to the top of the Synchrodek and the recording tape is passed round this, driving the wheel round.

This causes the indicator needle to be driven in the opposite direction by means of a differential gear.

The diameter of the rubber pulley fitted to the Synchrodek governs the projector's running speed. This pulley is normally supplied for 16 or 18 frames per second at a tape speed of $3\frac{3}{4}$ ips according to the customer's order, but a pulley for 24 fps can be supplied to special order provided a tape speed of $7\frac{1}{2}$ ips is used.

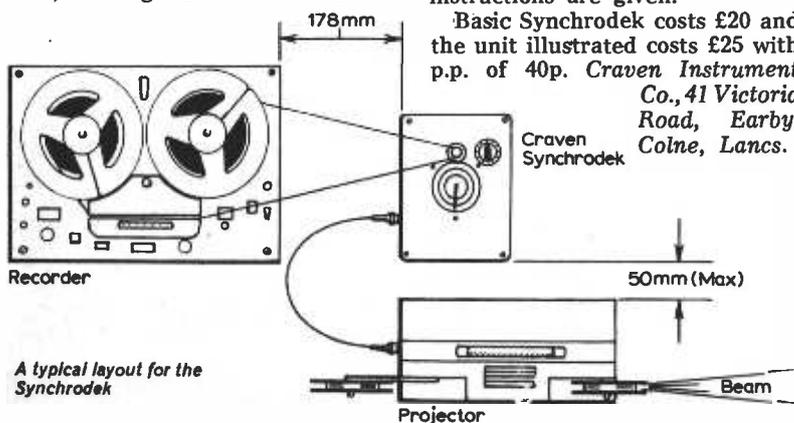
Should the projector start to speed up, a resistance is switched in by the Synchrodek until the needle remains stationary—meaning that tape and film are synchronised again.

Apart from the mechanical fittings on the P.W. Staff Eumig "DL" projector (fitting the flexible drive shaft to the inching knob shaft) an electrical connection had to be made. The motor field windings had to be interrupted and it was only necessary to cut the motor wire and join the leads to the brown and blue wires of the Synchrodek lead which then plugged into a socket on the side of the unit.

Due to the extremely light load of the recording tape round the rubber pulley wheel, an accuracy of better than one second in half an hour can be obtained.

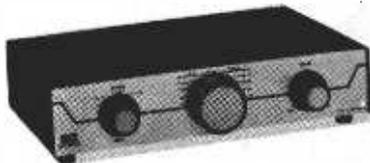
A list of suitable projectors is published by the Craven Instrument Company, each projector listed having been carefully checked as to its suitability for use with the Synchrodek. In all cases the modification can be carried out by the user in a few minutes, and full and detailed instructions are given.

Basic Synchrodek costs £20 and the unit illustrated costs £25 with p.p. of 40p. Craven Instrument Co., 41 Victoria Road, Earby, Colne, Lancs.



A typical layout for the Synchrodek

Preselector



The PR40 solid state r.f. pre-selector is the transistorised version of the PR30 preselector which it now supercedes.

It employs FET 2N3833E front end followed by silicon 2N3565/BC108 broad band r.f. amp and, is said to substantially improve receiver performance, with an increase in gain upto an overall average of 30dB plus improved image rejector and signal/noise ratio.

An exclusive feature is the air spaced "Codarcoil" inductor in use on all bands. This precision wound coil has extremely low loss with high "Q" and contributes to the high gain. A selector switch is provided on the rear of the unit to enable optimum coupling to be selected for either single wire or dipole aerials.

Frequency range is continuous coverage from 1.5 to 35MHz in three switched bands:—

1.5—4.5MHz

4.5—12.0MHz

12.0—35.0MHz

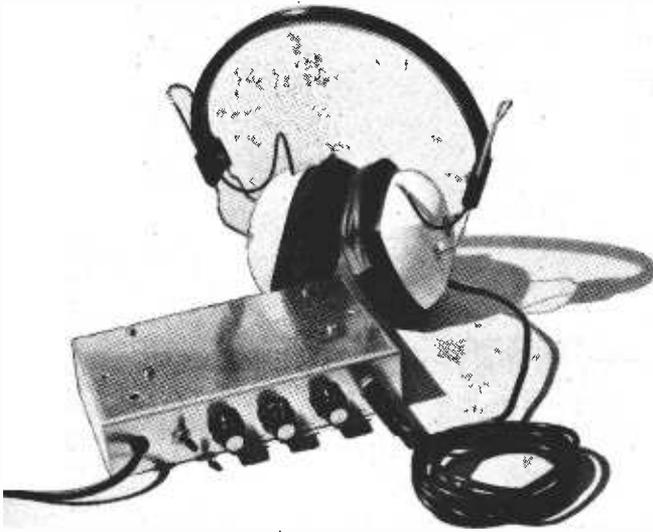
The unit is housed in a hand-some low slim line styled cabinet, $9 \times 5 \times 2\frac{1}{2}$ in. finished in charcoal grey with front panel white with black markings.

The PR40 uses a standard 9 volt Ever Ready PP6 or equivalent and current consumption is 10mA.

The unit is supplied complete with co-ax cable and plug (less battery), with 12 months guarantee against faulty materials/workmanship. Price is £8.50 with p.p. 30p. Codar Radio Co., Unit 2, Burrell Buildings, Churchill Industrial Estate, Lancing, Sussex.

Another Rally

September 24—Harlow & District Amateur Radio Society annual Rally at Magdalen Laver Village Hall. Further details from V. Heard, 106 Vicarage Wood, Harlow, Essex.



DX'ERS A. F. processing unit

HALVOR MOORSHEAD

THOSE readers who followed the recent Apollo 16 Moon mission must have been impressed by the remarkable TV pictures sent back. Previous pictures have been good but they did suffer from noise and smearing. The reason for the improvement was nothing to do with better transmissions but was entirely due to a computer in Hollywood, "cleaning up" the pictures electronically before feeding these to Mission Control and to the World TV Networks.

We are not here presuming to compete with a highly sophisticated (and presumably very expensive) process but in a modest fashion the project described here operates in much the same way; that is, it cleans up the audio of a poor radio signal once the conventional stages have finished with it. It will not improve all signals and, the higher the quality of the original signal, the less effective will be the improvement. However, for signals that are swamped in noise and mixed with an audio heterodyne, the results are remarkable. In an extreme case a crystal clear signal can be resolved from an unholy mess but the effectiveness will depend largely on the content of the original.

The unit can be inserted directly between the output socket and the headphones themselves or it can be built into a receiver as a permanent fixture. In the former case no circuit mods at all are necessary and it doesn't matter if the receiver is valve or transistor operated. Constructional details are given for the separate unit as construction will depend on the space available if it is to become a built-in feature. Slight mods will be necessary for a built-in unit; these are described later. If built-in, it would be as well to include a bypass switch to enable the circuit to be switched out.

In its described form, apart from the cleaning up process, the unit also provides a low impedance output.

The headphones socket in the existing receiver can come from one of several points; some are fed from the speaker output while others come from earlier stages in the audio chain—it will depend entirely on the design of the receiver. In fact it doesn't matter where the output comes from, the unit will handle a wide range of inputs.

Having a low impedance output will enable the

use of those very comfortable, smart looking and good quality headphones that are normally sold for HiFi systems. Even the cheapest of these (selling for about £2.50) are very much better than the older types of headphones which are usually of higher impedance and cannot be used with certain types of receivers. Any type of headphones can be used with this circuit as the low impedance output does not preclude the use of high impedance types.

The unit also has a measure of gain. This will not always be needed but a number of receivers (including one of the author's) have only just sufficient output for comfortable listening; this facility is useful for such receivers.

There are two main sections in the circuit. The first is an audio filter which provides a very sharp rejection over a narrow band of audio frequencies. The rejection measured on the prototype is at least 30dB (only 3 per cent of the level of the other frequencies) and this will all but eliminate any heterodynes. It also has another use which will be described later. The rejection notch is tuneable from about 100Hz to about 25kHz which will cover any conceivable heterodyne. At the high frequency end this part of the circuit has no effect at all (being outside the audio range) and it is taken out of the circuit by setting at the high frequency end, this obviates the need for a switch. Fig. 1 shows a diagram of the operation with a notch set at 1kHz; as will be seen, the "skirts" are not too wide and the

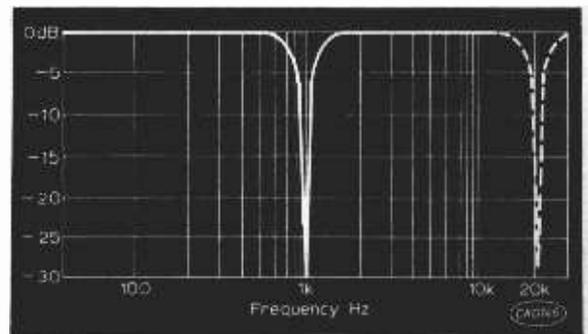


Fig. 1: The effect of the notch filter at 1kHz and at just over 20kHz. The rejection at the primary frequency should be very high.

rejection at the primary frequency is very high. The dotted line shows the filter out of circuit, i.e. at the high frequency end.

The second section is the noise limiter. This is much more efficient than those normally built into receivers as the clipping level is set manually. This eliminates all peaks in the signal level above a preset level and when correctly set it will virtually eliminate noise enabling you to listen to signals that would normally be under the noise, without ruining your eardrums!

THEORY

A block diagram showing the chain of operation is shown in Fig. 2.

The input is applied to a variable level control which determines the level through the whole chain. Very low signals can be handled, or very high ones. The first stage is the audio filter. This is best matched to a high impedance and so this is fed to an emitter follower stage. The signal is then further amplified and passed to the noise limiter. The level applied to this is critical and the control for this is the first level control before the filter. The preset performs another function which will be described later.

The output from the noise limiter will always be at about the same level (just under 600mV) and it is necessary to re-insert the volume control facility before feeding this to the final stage which is a conventional amplifier feeding an output transformer with a low impedance secondary.

Below the various stages in Fig. 2 are shown the typical waveforms that have actually been observed on a 'scope. At point A the heterodyne, which will have pretty well the same level at all times, is predominant with some noise peaks above the general level. At point B the heterodyne has been eliminated but the noise peaks remain, as do some others which

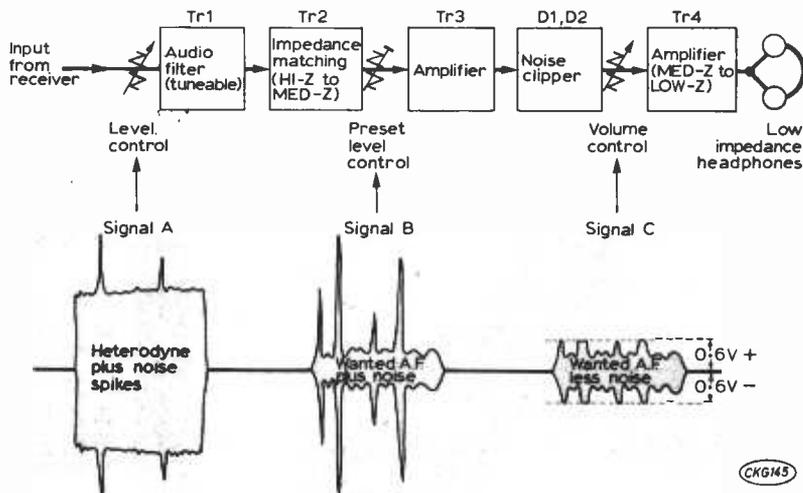


Fig. 2: A block diagram of the operation showing waveforms at various parts of the circuit. The levels of these signals are arbitrary.

were previously swamped by the heterodyne. At point C we have the wanted audio signal remaining and the only unwanted parts are the remnants of the noise peaks.

THE CIRCUIT

The complete circuit is shown in Fig. 3. The input is applied to VR1 which controls the level of the signal through the chain. This is set so that the voltage swing which is developed at the collector of Tr3 will be just below 600mV for the wanted audio.

The slider of VR1 is connected to the base of Tr1 via the d.c. blocking capacitor, C2. R1 and R2 provide the bias for the first transistor. The operation of this stage is not simple but there is no need to understand it. It forms part of a Wien Bridge network with the two sections of VR3 in conjunction with C3 and C4. These form a frequency selective filter, the rejected frequency depending on the setting of VR3.

At the sliders of VR3 the output will be very nearly zero for one particular frequency. At adja-

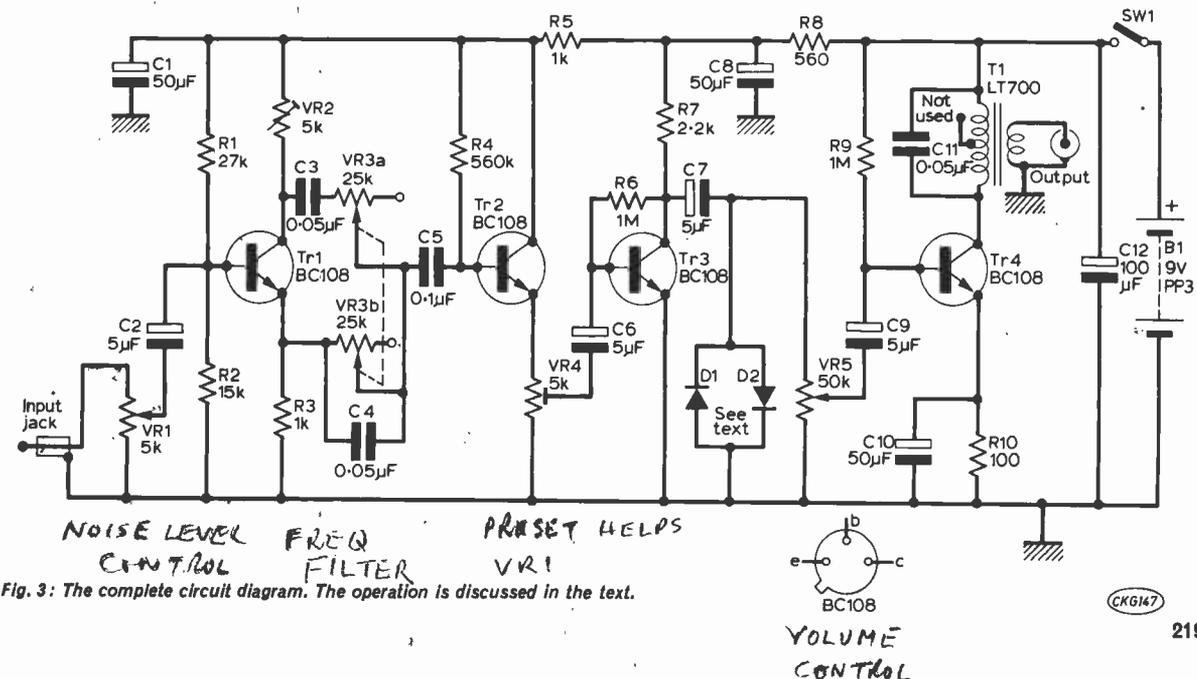


Fig. 3: The complete circuit diagram. The operation is discussed in the text.

cent frequencies there will be a degree of attenuation but other parts of the audio spectrum will be unaffected.

The output is coupled to the high impedance input of Tr2 which is connected as an emitter follower with a preset control in the emitter leg. C5 d.c. blocks the input with R4 providing the base bias. The preset gives control over the level at this point; it will only need to be set once. In certain applications the input to VR1 may be very high and in this case only a tiny part of the track will be used. Unless the filter stage is overloaded, the actual level through it doesn't matter very much, but the inclusion of VR4 enables VR1 to operate over a sensible part of the track without over-driving the limiter stage.

The output from the preset is then fed to a further amplification stage, Tr3, and the output from the collector is taken to the pair of silicon diodes, one connected each way around. These have no d.c. bias applied and neither will conduct until the voltage swing exceeds about 600mV. Below this level the signal is unaffected and the diodes appear only as very high value resistors. Above this level the diodes conduct and short the excess peaks to chassis. Two diodes are needed, one to get rid of the positive peaks, the other to get rid of the negative ones. D1 and D2 can be any type of silicon diode—*germanium types will not do*—and a cheap one of these is the 1N914, though even big rectifier diodes such as the BY100 were tried and worked well. The d.c. path necessary for the operation is provided by VR5 which also acts as the volume control. The level of the wanted audio here should always be approaching 600mV.

If the circuit is to be built into a receiver as a permanent fixture, the final stage will not be needed. In this case VR5 should be the existing volume control in the receiver and VR1 should be of the same value and wired in its place. It will not matter even if the value is as high as 1M Ω ; it will not affect the circuit operation. Another way of looking at it is to wire the unit between the slider of the

★ components list

Resistors

R1 27k Ω	R6 1M Ω
R2 15k Ω	R7 2.2k Ω
R3 1k Ω	R8 560 Ω
R4 560k Ω	R9 1M Ω
R5 1k Ω	R10 100 Ω

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

VR1 5k Ω log. pot.
VR2 5k Ω skeleton preset
VR3 25k Ω + 25k Ω linear ganged pot.
VR4 5k Ω skeleton preset
VR5 50k Ω log. pot.

Capacitors

C1 50 μ F 12V min.	C7 5 μ F 12V min.
C2 5 μ F "	C8 50 μ F "
C3 0.05 μ F Mylar Film	C9 5 μ F "
C4 0.05 μ F "	C10 50 μ F "
C5 0.1 μ F "	C11 0.05 μ F Mylar Film.
C6 5 μ F 12V min	C12 100 μ F 12V min. ..

Semiconductors

Tr1-Tr4 BC108
D1, D2 1N914 or similar, see text.

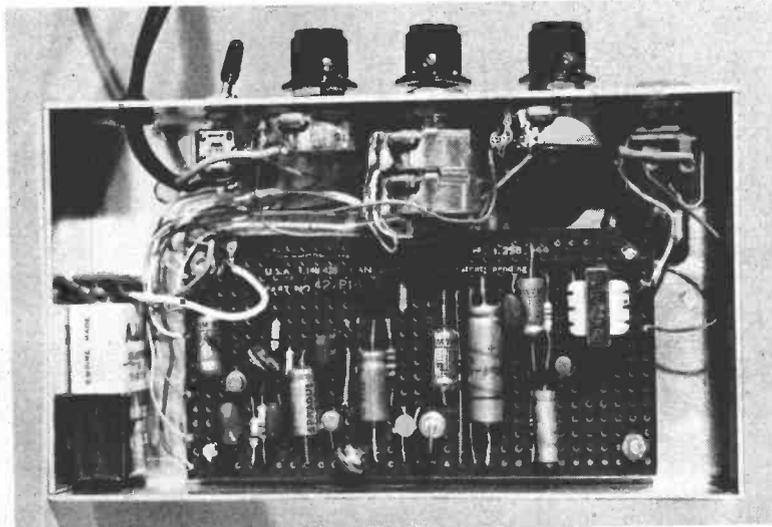
Miscellaneous

T1, LT700 transistor output transformer (Eagle); SW1, On-off toggle or slide switch; Standard jack plug and socket; Veroboard 0.15in. matrix, 5in. x 2 $\frac{1}{2}$ in. (standard size); Aluminium chassis 7in. x 4in. x 1 $\frac{1}{2}$ in. (H. L. Smith Ltd., 287/9 Edgware Road, London W.2., 33p plus 10p postage and packing); PP3 battery and battery clip; 4BA mounting bolts and nuts.

existing volume control and the point to which the slider previously went.

If built as a separate unit, the output from VR5 is fed to the amplifier which has T1 in the collector. This is a transistor output transformer (an Eagle LT700 in the prototype, but others will do just as well). The primary of this is provided with a centre tap; this should be ignored. The inclusion of the capacitor in parallel with the primary will eliminate any high frequencies and smooth off the sharp edges produced by the noise limiter. The secondary of the transformer feeds to the output socket, one side of which is automatically connected to chassis. The headphones mentioned earlier are stereo types and here will, of course, be used for mono reception. This is accomplished by using a stereo jack socket with the ring and tip connections wired together.

Suitable decoupling of the positive line is provided by C1, C8, C12, R5 and R8. The current consumption is quite low and will be easily handled by a small battery of the PP3 type. Those building the circuit into a receiver may wish to take this supply through a dropping resistor from the h.t. line.



An underside view of the prototype.

CONSTRUCTION

All the components, apart from the controls, are mounted on a piece of Veroboard with a 0.15in. matrix, 5in. \times 2 $\frac{1}{2}$ in.—this is a standard size and need not be cut. Four holes are drilled out in the corners for later mounting. The output transformer T1 specified has two small mounting tabs which should also be fitted through drilled holes, bent over and soldered to an adjacent strip.

The skeleton preset controls will fit nicely into the 0.15in. matrix if mounted at an angle as shown. Note that one break is needed in the conducting strip between two holes under VR4. A number of other breaks are needed, these are shown in Fig. 4 with the component layout.

All entry points to the board appear at the ends and Veropins can be inserted as firm anchoring points for the wires to the controls.

If wired directly into a receiver, suitable space must be found for mounting this board and the controls.

If used as a complete unit, the board is mounted inside the small aluminium chassis mentioned in the components list. Fig. 5 shows the wiring from the

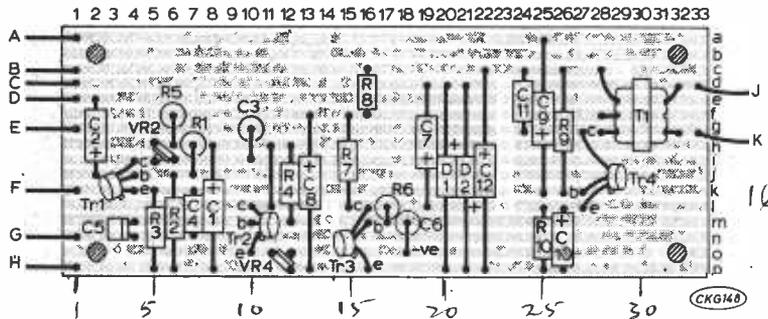
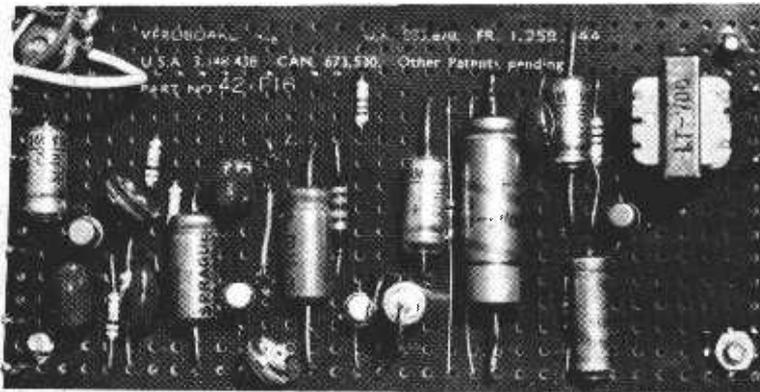


Fig. 4: The component layout on veroboard.



A close-up view of the circuit board. Compare this with Fig. 4.

board to the controls—these are coded with capital letters. The main chassis connecting point is made to a solder tag fitted to one of the mounting screws on the board.

OPERATION

When the circuit is complete it may be tested. With no input applied there should be only a gentle "ssshh" in the headphones, this will be the noise

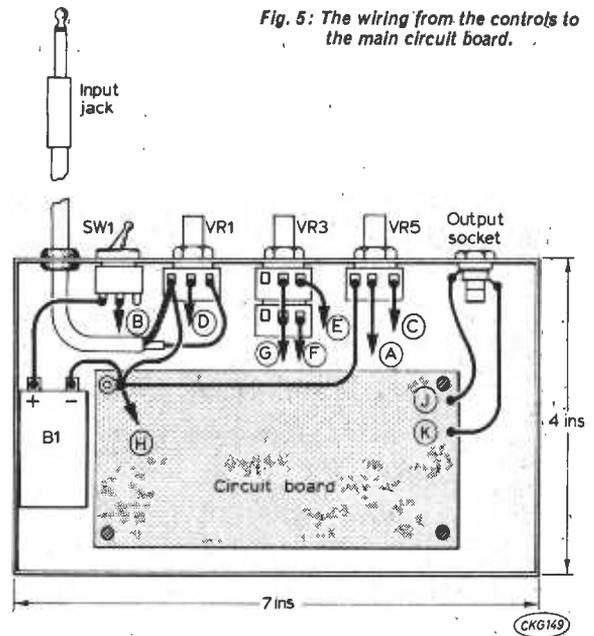
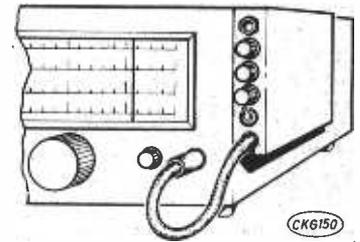


Fig. 5: The wiring from the controls to the main circuit board.



The completed unit fits nicely onto the side of a communications receiver.

generated by the transistors. Touching the tip of the input jack should produce a "click" in the phones.

The receiver's volume control should initially be set for a comfortable listening level and the unit plugged in. VR5 should then be adjusted for a good listening level.

Next try to tune in a heterodyne or any steady tone. Considering the state of the broadcasting bands this should not be difficult! If an audio signal generator is available this could of course be used.

VR3 should then be carefully adjusted until the level of this tone is reduced. At this stage the reduction may not be very marked but once the setting is found, VR2 should be adjusted for minimum level—this should produce a considerable drop in the level. Recheck that VR3 is at the best null point and readjust VR2 for the lowest obtainable level. Note that the setting of VR2 will vary very slightly with frequency but in practice, once set, it need never be touched again.

The tuning of VR3 is very sharp and it is easy to miss the null point by tuning through it. The tuning of VR3 is rather cramped. The extremes of settings on the prototype were 100Hz and 25kHz but the midpoint setting is only 250Hz. Unfortunately the two tracks of VR3 have to be closely matched and this precludes the use of a logarithmic pot which would give a more linear scale. However this cramping is not as serious as it sounds and with a little practice it is possible to find the correct setting very quickly.

Once the filter has been checked we can progress to the noise limiter. The control for this is VR1; set this at a low level and bring up VR5 to compensate—at this setting there will be very little, if any, clipping.

Find a noisy signal and increase the level of VR1 until the wanted audio distorts slightly, then back it off a bit. VR5 can be readjusted at any point for comfortable listening level—its setting in no way affects the circuit operation.

When this setting is found the limiter will be working and the noise peaks will be virtually eliminated. If it is found that VR1 is always operating at the lower end of the track this can make the clipping level hard to adjust. In this case the slider of VR4 can be set to the "earthy" end of the track making VR1 more functional and more easily set.

The frequency filter is very sharp and it will of course only deal with the fundamental frequencies of a tone. Harmonic distortion may be produced at the detector or in the earlier stages of the receiver and, although this should be at quite a low level, it may represent 5 per cent, or even more, of the basic tone. You may well notice that at the null point that the frequency appears to go up an octave—this will be due to the harmonic distortion produced in the receiver and there is very little you can do about it except modify the receiver's circuit. Even so the level will be only a tiny fraction of the original heterodyne and the rejection will be very marked indeed.

There is another use to which the filter can be put. Frequently it will be the case that there are two stations of similar level on the same frequency, with one transmitting speech while the other carries music. Setting the filter at the higher audio frequencies will tend to attenuate the music to a certain extent and vice versa, making one signal more easily readable.

Both speech and music can still be clearly identified even if the notch is set right in the middle; signals take on a rather weird "hollow" sound, this is hard to describe but very easily identified.

The noise limiter can also be put to other purposes than for its obvious one. If two stations are on top of one another, the weaker of the two can sometimes become more readable if the powerful one is severely over-driven. In between the gaps between words or sentences of the more powerful signal the weaker one can be heard since its level can be brought up to that of the powerful one without causing discomfort to the eardrums. A certain degree of experimenting will be necessary to make use of the unit in this way.

All in all, by filtering and limiting the signal as we have described, you should be able to hear many signals that previously were unreadable. A little bit of experimenting may be necessary before you become fully aware of the potential. ■



Practical Wireless Designer's Trophy 1972

To encourage new authors, entries for the 1972 Trophy will be restricted to readers who have not previously had an article published in PW. This leaves the field wide open for those wanting to try their hand at writing technical constructional articles. Contestants will not be in competition with well-known authors, only with other newcomers, so the cup can only be won by a new writer. It **Could Be You.**

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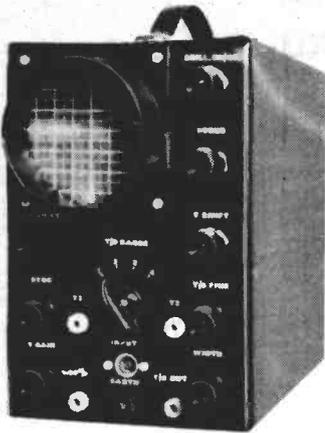
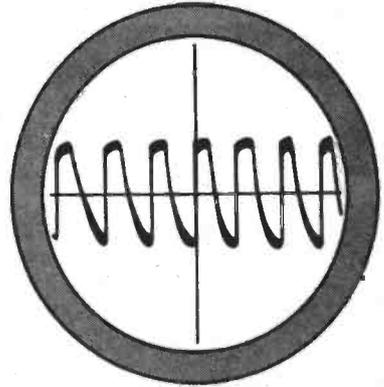
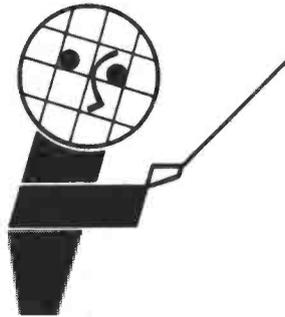
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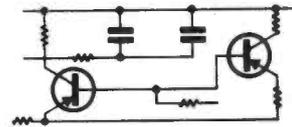
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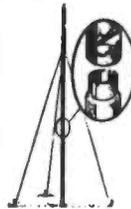
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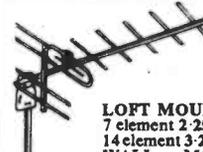
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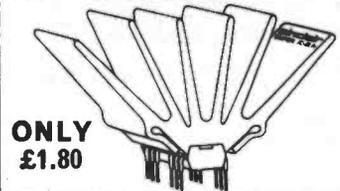
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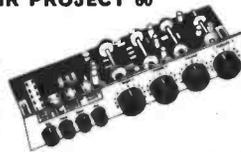
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MONTHLY NEWS FOR DX LISTENERS

THIS month I would like to write a few paragraphs which I hope will be of use to newcomers to the hobby. The subject that I want to deal with is that of frequency measurement which seems to present problems to most beginners.

The simplest, but most expensive method of accurately determining the frequency of a station is by using a digital frequency meter. This instrument is connected to the local oscillator in the receiver, the local oscillator frequency is compared with an accurate frequency standard inside the counter and the former frequency is displayed on digital indicators.

The only problem is that the local oscillator frequency is the sum of the frequency of the station and the intermediate frequency (i.f.) of the receiver. The user must, therefore, remember to subtract the i.f. to obtain the frequency of the station.

Digital Frequency Meters are available from many manufacturers and prices start at around £80. However, digital integrated circuits are now available to amateur constructors and these can easily be used to make a simple frequency meter. The main advantages of constructing your own meter are the cost savings and the fact that you can arrange for the meter to subtract the i.f. and display the frequency of the station with no need for correction.

Another method of measuring frequencies is to use a heterodyne frequency meter. The best known of these is the BC221 which is available on the surplus market for around £20 complete with calibration charts. This meter is tuned to the same frequency as the station, the frequency is then determined by reference to the calibration charts.

A third method of obtaining the frequency of a station is by using a crystal calibrator. As its name implies this instrument consists of a crystal in a circuit which generates many harmonics of the crystal fundamental. The output of the calibrator is coupled into the aerial circuit and is used to provide marker pips throughout the Short Wave band.

A comprehensive crystal calibrator can be used to generate markers at intervals of 1MHz, 100kHz and even 10kHz. Again, now that digital integrated circuits have become readily available it is possible to build such a calibrator very cheaply.

Next month I will describe the cheapest method of all—the only equipment required being a few sheets of graph paper, a receiver with a bandspread control and a small amount of patience.

The first report this month comes from **Michael Berry** in Dewsbury, his equipment consists of an Eddystone EB35 receiver and a 15 foot vertical aerial and his log included:

4825 R. *Ashkabad* in Turkmenian at 0100.

9510 R. *Barquisimeto*, Venezuela at 2255.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

9635 R. *Nacional*, Colombia in Spanish at 0015.

11805 R. *Globo*, Brazil in Portuguese at 2150.

11950 *FEBA*, *Seychelles* in English at 1730.

15105 R. *Rural*, Brazil in Portuguese at 2235.

15150 R. *Corporacion*, Chile in Spanish at 2330.

15190 R. *Inconfidencia*, Brazil at 2130.

Ian Howes of Lowestoft has again used his R209 Mk.II and TV antenna to good effect hearing:

3240 R. *Baghdad*, Iraq in Arabic at 2320.

3905 *AIR*, *Delhi* in English at 2325.

4765 R.*TV Congolaise* in French at 2010.

4790 R. *Ondas Portenas*, Venezuela at 0030.

4890 R. *Diff*, *Venezuela*, Spanish at 0313.

4980 *Ecos del Torbes*, Venezuela at 2335.

4994 R. *Omdurman*, Sudan at 1947.

9545 *Accra*, Ghana in English at 2125.

11930 *VOA*, Okinawa in Chinese at 2215.

15150 R. *Corporacion*, Chile in Spanish at 2150.

Roger Hunter of Carmarthen has used his Codar CR70A with an 80 metre dipole to log the following:

9515 R. *Ankara* with news in English at 2200.

9630 R. *Nacional de Colombia* at 0034.

11710 *RAE*, Argentina at 2346.

11805 *VOA*, Greenville at 1945.

11955 *Voice of the Lebanon* at 0240.

15280 *4VEH*, Haiti in English at 0015.

Terry Gibbs of Swindon used his B845 and a 50 inch telescopic aerial to hear the following stations:

11740 R. *Ceylon* in English at 1100.

11835 *4VEH*, Haiti at 0130.

15295 *WINB*, Red Lion, U.S.A. at 2200.

15435 R. *Tanzania* in Portuguese at 1830.

Julian V. Moss of Rayleigh used his Meridian receiver and 60 foot long-wire antenna to hear:

9670 R. *Damascus*, Syria in English at 2030.

9745 R. *Baghdad*, Iraq, news in English at 2000.

11875 *Trans World Radio*, Bonaire in French at 2206.

11920 R. *Abidjan*, Ivory Coast in English at 1940.

11925 R. *Kuwait* in English at 2100.

11925 R. *Bandeirantes*, Brazil at 2130.

11930 *WIBS*, Grenada in English at 2100.

Fred Wall of Walthamstow used his PR155 receiver with a 20 foot long-wire to hear the following:

9520 R. *New Zealand* with news at 0900.

11735 R. *TV Morocco* in Arabic at 1630.

11780 R. *New Zealand* with news at 0755.

11785 R. *Afghanistan* in English at 1805.

11870 *VOA*, Rhodes, sign—on at 1400.

15450 R. *Nacional*, Brazil at 2035.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

HATS off, eyes down, let us have one long minute of silence for ten metres—or should we? “No”, say a large number of happy DX-ridden logs received this month.

Many listeners never bother to drape an earhole on 28MHz. Perhaps it is that they hear all those tales about ten metres being affected by the sunspot count and being “completely dead” for weeks on end. If you didn’t take a peep on this segment last month, then you missed the chance to log some real goodies.

More queer callsigns in the offing. **Martin Cafferty** (Bath) writes in to tell harrowing tales of wierd U.S. callsigns which are to be used for special stations on special occasions. Things like WS3 and WJ are mentioned. There seems to be a special callsign for almost any excuse these days. Just wait until ol’ 3JDG’s birthday and see what callsign I use on that best-forgotten day. (How about MOON?).

This months' logs

No two metre logs this month (shame on you all, are the G8’s a dying breed?) Letter from **Paul Austin** informs that GW8FTA will be signing /P and is hidden high up in the Welsh mountains (there’s lovely now). Just to make GW8FTA a bit easier to find on 144MHz, the frequency in use will be 144.338MHz. Reports from listeners will be appreciated especially if further than a fifty kilometre radius. Exact location is not specified but is 1,883ft. a.s.l. in North Monmouthshire. QSL via the bureau or direct to 26, Cwrtglas, Croesyceiliog, Cwmbran, Mon. (Fancy sending that in c.w.).

“I have read your Amateur Bands column for a couple of years”, admits **Richard Osborne**. (It must be jolly good which one was it?). Richards finds 3.5MHz very good round about midnight. Gear is the P.W. general coverage receiver (March/April 1970) plus the G3TYJ preselector. Antenna is a 100ft. end fed which digested 80 metre s.s.b. signals from; CN8BB, CR4BC, CT2AK, EA8HA, JY1/B, OD5HB, OX3JW, OY7JD, PJ2CW, PY7BLV, VE1MF, VP2MM, VQ9R, W5ILR/P/TF, ZL4AV, 5B4JS, 5X5NA, 9H1BW.

Richard Kell (Seahouses), R109 plus a.t.u. and 15 metre dipole at 25ft. pruned out the European stations from his eighty metre log to leave; MP4BJG, OX3JW, OX4UN, YV5RS, 4X4AF, 4X4JN. Richard’s log was on airmail paper which, of course, got him off to a flying start. (Oh Gawd!).

Malcolm Piper uses a one-vale t.r.f. and reports numerous G stations on topband. On eighty his best was HB9CM and YU2NZ. Aerial is 150ft. end fed and the earth is a metal bucket sunk some four feet down. Wait until you get that JR—500-SE OM.

It was the fault of Santa Claus that **Roger Hunt**

(Carmarthen) got a CR-70A receiver. It was Roger’s fault that he heard these on 14MHz s.s.b.; CT3AR, HK4PQZ, HP1DV, KV4CR, KZ5LZ, LU2FAO, PY4CSV, VE1AVN, VK3EB, VK3MO, YV5DHD, ZL1AH, 5K4LR, 4U1ITU, 6Y5GB, 7X2BK, 8RIU, 8RIW.

Bernard Hughes (Worcester) has popped up again with a tri-band log of goodies bagged with the aid of his trusty JR-310, dipoles, and a 66ft. end fed. Twenty metres; A51TY, CR3ND, FG7TD, FL8DA, HS1ABF, JY6BM, FW0AB, KG6SW, KS4BH, KH6HNR, KJ6CW, KP4DLW, W9CFM/KL7, MP4MBC, PZ6AA, TU2DJ, VK4AD/KS6, VK9XI, VU2KV, VE0NEC, VE8MC, VQ9MC, VP2LY, 3Z5MG, 5X5NA, 9V1QW, 9Q5CP, 9M2DW, 3A0GA.

Bernard’s best on 21MHz were; KP4BCL, TR8MC, VE7YS, VE7MT, VP9GE, WA7GQA, 3D6AP, 4M7AV, 4N0DX, 5R8BC, 5T5DY, 5H3MU, 6D4FFC, 9H3B. Just to round off with, the following were logged on 28MHz; CR6TP, G3MUL/CE3, HK4DF, HR2RF, HS5AFD, WA6FSC/HR1, KZ5JF, KV4AD, PZ1DR, PJ3EC, SV1GA, TG9DX, VU2HLU, YB0AAG, W0EUI, XE1IJ, ZD8RR, 5K4RCA, 5B4ES, 5H3LV, 7Q7AA, 9J2RO, 9Q5BC. All stations on these three bands were s.s.b.

It’s 28.5 to 28.6MHz as far as **Michael Shields** (Abergavenny) is concerned. A tremendous log arrived from which the pickings are; CP6FG, CR6OP, CR7AF, CX1EU, CX2AAH, EA7DJ, EL2DF, ET3DS, HK3CJD, HR2RS, JW7FD, KV4CM, LU6AHI, OD5FA, PY2PA, PZ5CW, RB5MGB, SV0WU, VP8MM, VU2JM, VQ9N, many W stations, ZC4BJ, ZD8J7, ZE3JO, ZE4JH, ZS1WS, ZS5OV, ZS6BHL, 5B4IS, 6Y5CV, 7Q7LZ, 9H1DA, 9H1BX. Receiver is a JR500-SE and the antenna a 70ft. long wire.

Fred Wall (Walthamstow) writes of great things on 28MHz. Things like; A2ACY, CP6FG, CR6IY, CT3AS, HK3AVK, HS1AFJ, JA6BZI, KZ5PY, LU4HUO, LU8MS, PJ3EC, PY2BBO, PZ5PW, PZ6AA, T2GL, VU2HLU, VU2JM, YN2DX, YV4EF, ZC4B, ZS6OH, 4X4GV, 5B4IS. Equipment: a PR155 and a 20ft. end fed.

Mobile rallies

Peeping into the immediate future, the 3JDG crystal ball (frequency 38.721GHz) reveals the following mobile rallies: June 11, Elvaston Castle Countryside Park (Near Derby); 18, Suffolk Show Ground (Ipswich); 25, Longleat (Warminster Wilts.); July 2, South Shields Rally; July 9, Cornish ARC at Truro.

Logs, in alphabetical order please, to arrive by the 15th of the month to:

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2B3704	NPN	Low power	10p
AC188	Ger. PNP	Small sig./driver	25p
AC188	PNP	Low power	20p
AC176	NPN	Low power	16p
AD149	PNP	High power	58p
*AD161	NPN	Med. power	33p
*AD162	PNP	Med. power	30p
BC108	SH NPN	Small signal	11p
BC109	NPN	Low noise	12p
BC168	NPN	Small signal	10p
BC189	NPN	Low noise	11p
BF194	NPN	RF amp.	14p
BF151	NPN	Med. current	20p
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FLH211 (7404)	25p	FLH221 (7480)	68p
FLH271 (7405)	25p	FLH231 (7482)	87p
FLH381 (7408)	25p	FLH241 (7483)	83p
FLH391 (7409)	25p	FLH341 (7486)	32p
FLH111 (7410)	30p	FLJ161 (7480)	80p
FLH361 (7413)	30p	FLJ221 (7481)	AN
FLH121 (7420)	20p	FLJ171 (7492)	85p
FLH131 (7430)	20p	FLJ181 (7493)	80p
FLH141 (7440)	24p	FLJ231 (7494)	1.18
FLH101 (7414)	1.22	FLJ191 (7486)	87p
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FLH371 (7444)	1.45	FLJ281 (74104)	65p
FLH161 (7450)	20p	FLJ271 (74107)	62p
FLH171 (7453)	20p	FLK101 (74121)	48p
FLH181 (7454)	30p	FLJ201 (74180)	1.80
FLV101 (7456)	20p	FLJ211 (74191)	1.80
FLJ101 (7470)	45p	FLJ241 (74192)	1.74
FLJ111 (7472)	32p	FLJ251 (74193)	1.74

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Code	Power	Tolerance	Range in ohms	Values 1 to 9	10 to 99	100 up
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C	1/4W	10%	4.7-10M	E12 1-2	0-8	0-7
C	1/2W	5%	4.7-10M	E24 1-2	1	0-9
C	1W	5%	4.7-10M	E12 2-5	2	1-9
MO	1/2W	2%	10-1M	E24 4	3	2 nett
WW	1W	10%	0.22-3.9	E12 7	7	6
			+1/20Ω			
WW	3W	5%	10Ω-10K	E12 7	7	6
WW	7W	5%	10Ω-10K	E12 9	9	8

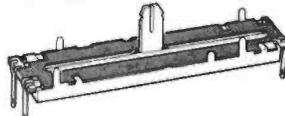
Codes: C—carbon film high stability low noise
MO—metal oxide Electrocoat TR5 ultra low noise
WW—wire wound Pleesey

Values: E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 72, 91 and their decades. Prices are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1p on total value of resistor order).

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0-18; 0-22; each 5p.
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47/50; 47/63; 100/35; 470/10 each 7p.
100/50; 220/35; each 9p; 100/82; 470/25; 100/10 each 10p.
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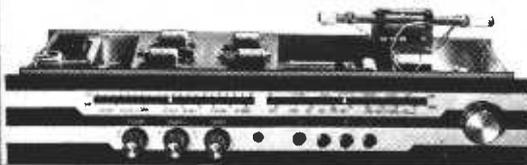
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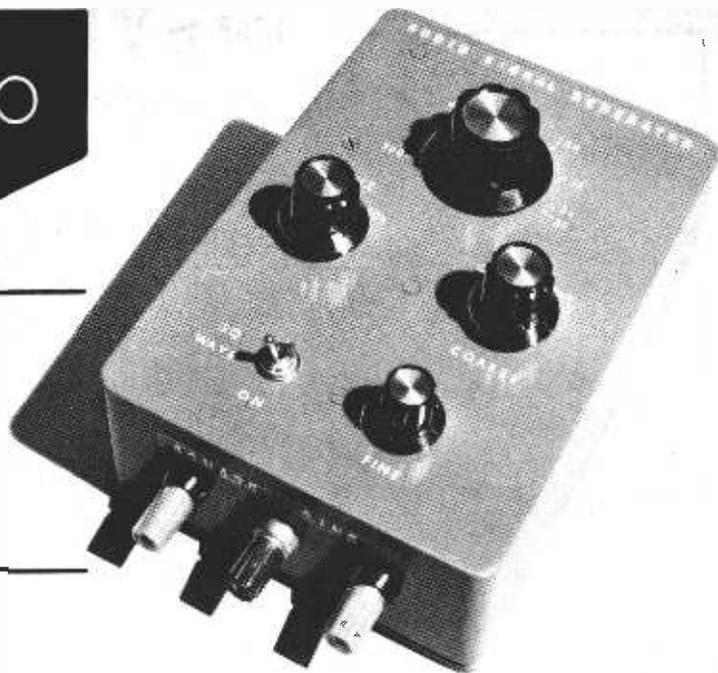


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Specification

Frequency ranges: 30 - 300Hz
300 - 3kHz
3 - 30kHz
with some range overlap.
Output level, sine wave: 1V, 100mV, 10mV,
continuously variable.
Output level, square wave: 1V peak to peak.
Output impedance: 600Ω
Output amplitude held to ± 1 dB (sine wave).
Power supply: 18V from two self contained batteries.
Power consumption: 7mA (sine wave and square
wave output).
5mA (sine wave output only).

A SEARCH through back issues of *Practical Wireless* showed that although a number of designs for audio signal generators have been published, of varying complexity, two basic features were almost without exception, employed in their construction:—

(a) a Wien bridge network was used for the determination of the frequency of oscillation, and
(b) a thermistor was used for the stabilisation of the amplitude of oscillation.

Automatic control of output amplitude is essential, for otherwise any variation of the gain of the amplifier employed will tend to result in either amplifier saturation (and hence a square wave instead of a sine wave) following a gain increase, or decay and then cessation of oscillation altogether, following a gain decrease.

Taking point (a) first, a Wien bridge, Fig. 1, has the useful property of giving an exact 180° phase

change at one frequency only, such a condition being obtained with a voltage attenuation of only times three. Further, for a variation of the frequency at which this 180° phase change takes place, only two components need to be altered simultaneously; other possible networks, such as the twin T, necessitate the alteration of three components, adding considerably to the cost and complexity of any unit so constructed.

Accordingly, the audio signal generator presented here uses a Wien bridge for determination of frequency.

However, the other feature of past audio signal generators, mentioned under (b) above, namely the use of a thermistor for amplitude stabilisation, is not followed in the present design.

For a thermistor to exercise any control it must dissipate power; it is this dissipation, leading to a warming of the thermistor, that results in a resistance change, which, by the proper utilisation of negative feed-back, stabilises the amplifier gain as required. The dissipation of this power, in a battery driven device, is considered by the author to be very wasteful, hence the use, in the present design, of an f.e.t. as a control element, dissipating no power. Thus, battery consumption is at a minimum, permitting the incorporation of the smallest possible batteries resulting in a very compact instrument.

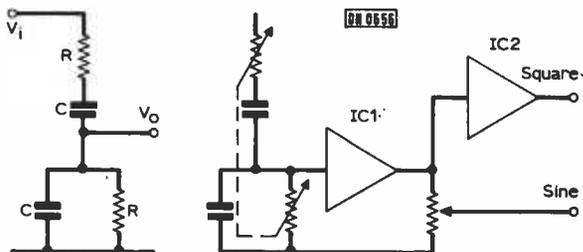


Fig. 1: left, shows the basic Wien network where $f=1/2\pi RC$ and $V_0=1/3 V_1$. Fig. 2: right, is the block diagram of the signal generator.

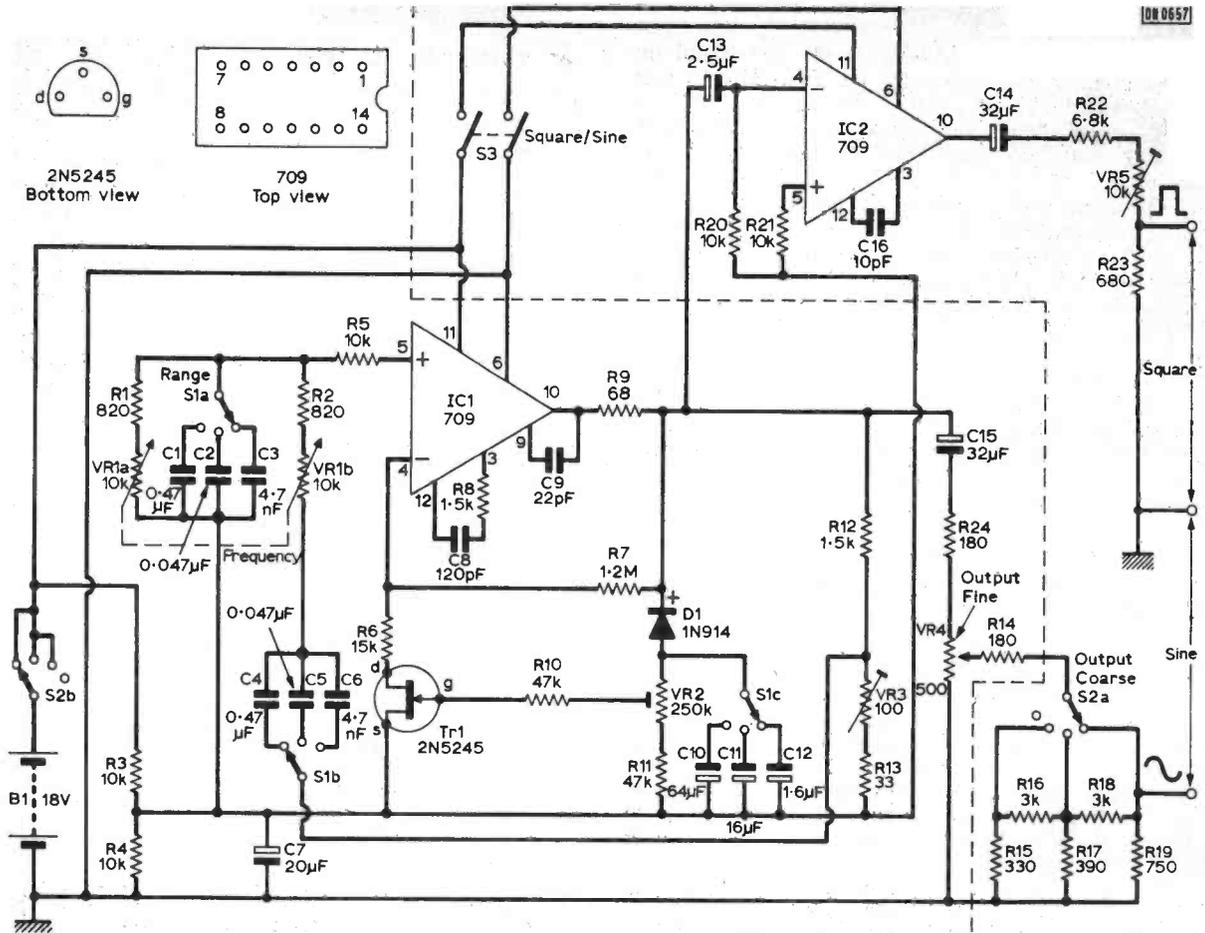


Fig. 3: Circuit of the signal generator with f.e.t. and i.c. lead-out connections. The components to the right of the dotted line are omitted in the simplified version of the signal generator, to be described next month.

Further reduction in unit size, weight and power consumption is obtained by the use of a cheaply available integrated circuit to give the voltage amplification required to overcome the losses in the Wien network. This results in a design which the author believes to be as compact as any available, at the same time requiring the minimum amount of setting up and giving an output waveform of high purity.

A second integrated circuit generates a square wave of excellent rise time, mainly for the convenience of those audio enthusiasts who favour such a waveform for testing purposes.

CIRCUIT

The block diagram of the generator is shown in Fig. 2 and the full circuit diagram in Fig. 3.

The first i.c. amplifier has two feedback paths, one positive and one negative. Consider first the positive feedback path; assume the amplifier and its associated components to be already giving a sine wave output.

A certain fraction of the output voltage is derived by the divider R12, VR3 and R13, fed to the Wien network and thence to the non-inverting input of the i.c. Due to the 180° phase change provided by the Wien network the phase of the signal at the non-inverting input is such as to maintain oscillations. Note, however, that with the attenuation given by the divider network and the attenuation of three

given by the Wien network, a total attenuation of about forty is present.

Accordingly, the feedback around the other, negative, feedback loop is arranged to give a voltage amplification equal to this attenuation, so cancelling it out and giving an overall gain of unity. This is the condition for sine-wave oscillations to be maintained at the frequency set by the Wien network.

In order to keep the resulting overall gain at exactly unity, R6 and R7 and the f.e.t. are employed in the following manner. The output of the amplifier is detected by D1 and the resultant d.c., after being smoothed by VR2, R11 and the appropriate capacitor (see later), is then fed to the gate of the f.e.t. Any alteration in output level will be reflected in a change in gate voltage, so altering the effective resistance of the f.e.t. in such a way as to combat the original change in output level. Consequently, good stable gain conditions obtain and a very pure sine wave is available.

As will be seen from the specification, three ranges of frequency are provided, the appropriate frequency being selected by S1a and S1b; fine frequency control is given by VR1a and VR1b, so arranged that there is some overlap on each range. More or less of such overlap can be obtained by decreasing or increasing the value of R1 and R2.

Note that the third pole on the range switch, S1c brings in an appropriate value of smoothing capacitor in the amplitude stabilisation circuitry. If a single capacitor was used here on all ranges, either too

long a settling time would be produced, should the chosen capacitor be too large, or "squegging" would occur should it be too small.

No satisfactory compromise value to cover all ranges could be found, so the scheme shown was adopted.

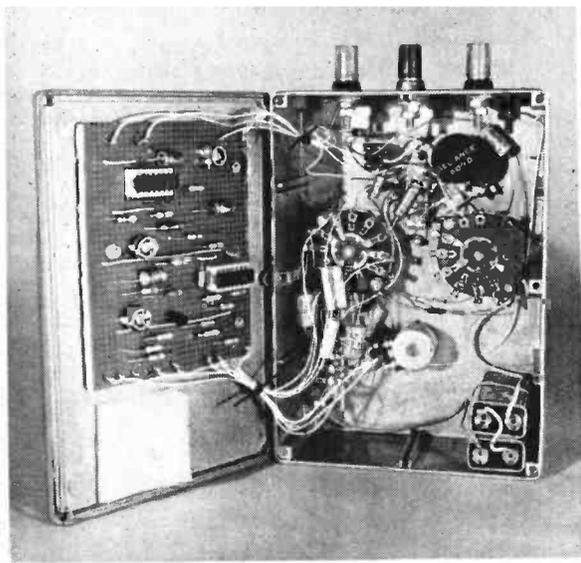
The output level depends on the actual values of the components and especially on the characteristics of the particular specimen of f.e.t. used. Accordingly, VR2 is used to adjust the proportion of feedback voltage applied to the f.e.t. gate so that the correct level of signal is available at the upper end of the fine output control VR4.

Note that the actual gain of the 709 type integrated circuit itself is unimportant, for the overall amplification is maintained at the desired value by the two feedback loops already described. Consequently, quite large changes in supply voltage can occur before stable operation ceases and in fact the battery voltage can range from 18V down to 10V or so without alteration of sine wave output level or frequency. Therefore, no provision is made to run the unit from a regulated supply, thus giving a further reduction in power consumption, for all stabilised power supplies necessarily dissipate some power.

Two further points in the sine wave oscillator section require explanation.

A glance at the data for the 709 type i.c. reveals that operation is recommended from equal voltage positive and negative supplies, up to 15V each side. Operation from dual 9V rails has been found to be quite satisfactory, but for several reasons a single supply of 18V is desirable—operation from a single external supply, if required, is easier, and, further, differential ageing and exhaustion of two separate internal 9V batteries is then no problem.

However, the two inputs of the 709 type i.c. should lie close to the mid-point of the two supply rails, which in this instance is accomplished by means of the potential divider R3 and R4, decoupled by C7. With the 709 inputs now at equal d.c. voltages its output lies at about mid-supply potential, which enables C15 to be an electrolytic capacitor the lower side of the signal output being at battery negative and chassis.



General view of the signal generator with the circuit board bolted to the lid of the box.

★ components list

Resistors

R1 820Ω	R 9 68Ω	R17 390Ω
R2 820Ω	R10 47kΩ	R18 3kΩ
R3 10kΩ	R11 47kΩ	R19 750Ω
R4 10kΩ	R12 1.5kΩ	R20 10kΩ
R5 10kΩ	R13 33Ω	R21 10kΩ
R6 15kΩ	R14 180Ω	R22 6.8kΩ
R7 1.2MΩ	R15 330Ω	R23 680Ω
R8 1.5kΩ	R16 3kΩ	R24 180Ω*

All resistors $\frac{1}{4}$ W 5% * see text.

VR1 10kΩ+10kΩ lin.	VR3 100Ω pre-set
VR2 250kΩ pre-set	VR4 500Ω lin.
	VR5 10kΩ pre-set

Capacitors

C1 0.47μF 10%	C7 20μF 16V	C13 2.5μF 16V
C2 0.047μF 10%	C8 120pF	C14 32μF 10V
C3 4.7nF 10%	C9 22pF	C15 32μF 10V
C4 0.47μF 10%	C10 64μF 10V	C16 10pF
C5 0.047μF 10%	C11 16μF 10V	
C6 4.7nF 10%	C12 1.5μF 25V	

Switches

S1 3 pole 3 way wafer	S2 2 pole 4 way wafer
S3 2 pole on/off toggle	

Miscellaneous

IC1-IC2, Type 709 Integrated circuit (see text) with holders. Tr1, 2N5245. D1, 1N914. Die cast box $6\frac{1}{2} \times 4\frac{1}{2} \times 2\frac{1}{4}$ in. Veroboard, 0.1in. matrix, $4\frac{1}{4} \times 3\frac{1}{4}$ in. with pins. Terminals, red (2), earth (1). Knobs.

The resistor/capacitor combination R8, C8 and the capacitor C9 have been selected to provide good stable operation of IC1 at the same time giving sufficient gain at the frequencies concerned. The need for these compensation components is a characteristic of this type of integrated circuit; further details, such as the values suggested for other gains and bandwidths, are to be found in the type 709 data sheets.

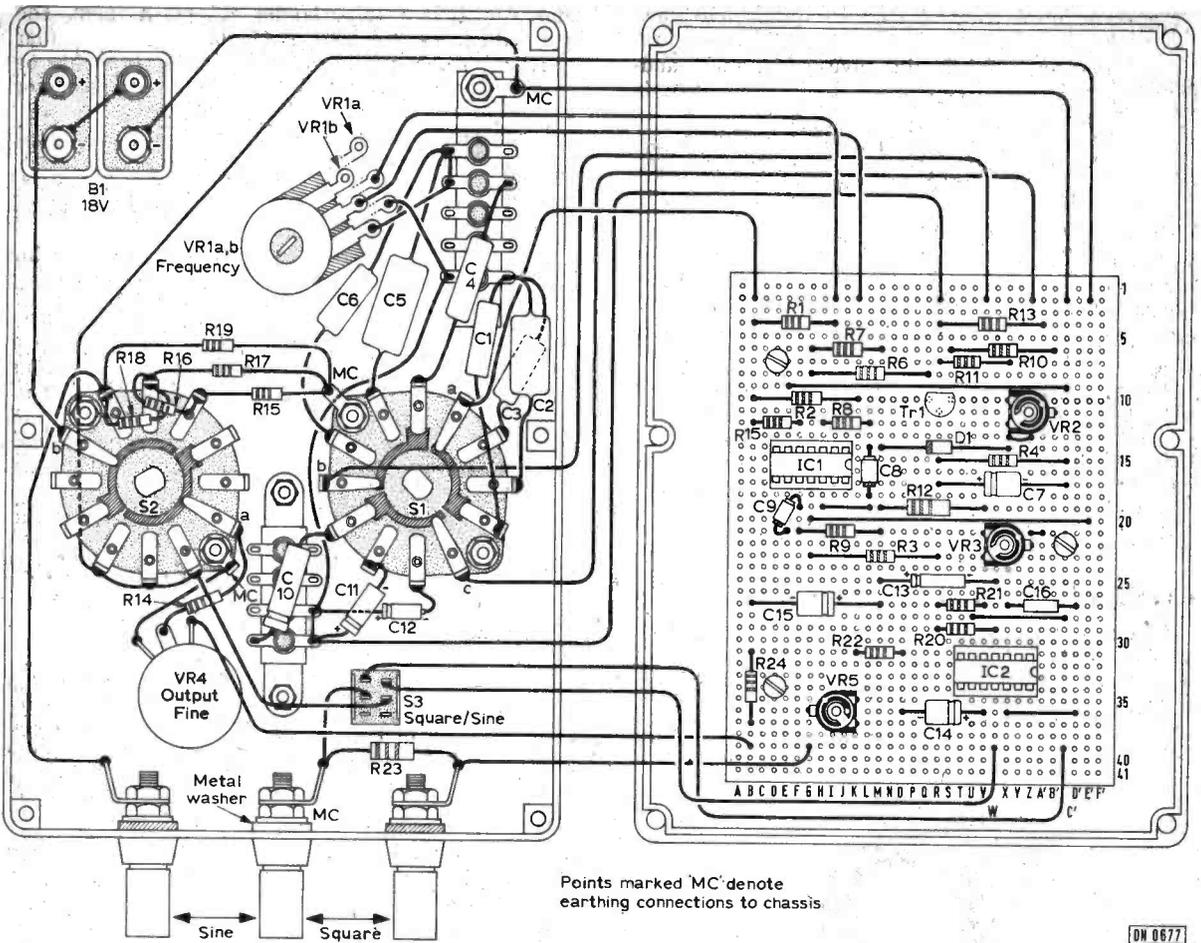
Similarly, R9 in series with the output of IC1 is included, following the manufacturer's recommendation that this should be done when a capacitive load is being driven. In the case of the audio generator, with the large value capacitor used to couple the output of IC1 to the attenuator, it was thought desirable to include R9 as a precaution. Note that since R9 is within the negative feedback loop, it does not affect the output impedance of IC1.

The output impedance of the 709 is very low, so that the fine output level control, VR4, can be fed directly from it (or via a small resistor for level adjustment purposes); the 180Ω resistor R14 then passes the signal, at the correct impedance, to the ladder attenuator which, with VR4 at maximum, gives outputs of 1V, 100mV and 10mV, all at 600Ω output impedance.

What has so far been described is a self-contained audio signal generator which can be built, as such, in a very compact form.

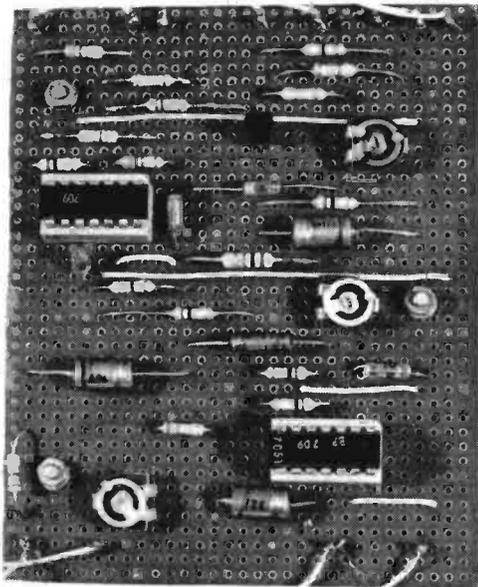
However, many audio enthusiasts prefer to use a square wave for amplifier testing and it is very simple to generate excellent square waves using a second 709 i.c.

For this application, IC2 is used open loop, that is, no feedback resistors are employed and the extremely high voltage gain then present (typically 45,000) ensures that IC2 is driven to saturation in

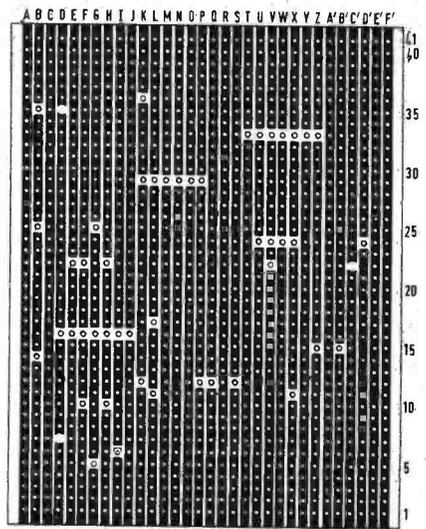


DN 0677

Fig. 4: Layout and connections for the components mounted inside the box, left, with interconnections to the circuit board, right.



Photograph of the finished circuit board which may be compared with the layout diagram, Fig. 4, above right.



DN 0676

Fig. 5: Before mounting components on the circuit board the copper rails must be broken as shown above.

either direction very rapidly indeed, by the sine wave input from IC1. Note the absence of some compensation components on IC2; this gives maximum bandwidth so that the rise time of the square wave is excellent and is in fact of the order of $1\mu\text{s}$.

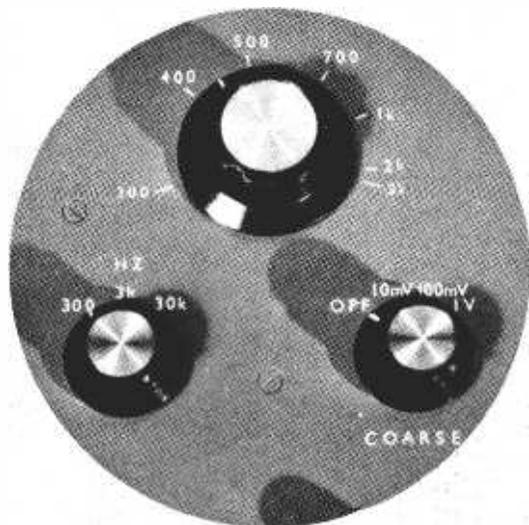
The two inputs of IC2 are returned, so far as d.c. is concerned, to mid-supply potential via R20 and R21 while the sine wave signal from IC1 is applied to the inverting input.

Control of square wave output is obtained by switching the supply to IC2. Note that both sides of the supply must be switched, for should the positive rail only be removed, the voltage still present at the input could exceed the maximum permitted, with respect to the negative rail.

The square wave output of IC2 is of approximately 17V peak-to-peak with a battery supply of 18V. It is divided down to a nominal 1V peak-to-peak by R22, R23 and VR5. It was not thought worthwhile to incorporate any form of stabilisation for this output, which consequently falls slightly in level with falling battery voltage.

CONSTRUCTION

Practical construction makes use of the properties of die-cast boxes, namely, good solid manufacture providing electrical screening and mechanical strength, combined with ease of working with simple tools and the capability of accepting either a polished natural finish or aerosol spray paint.



Close-up of the coarse and fine frequency controls and coarse output/on-off switch.

The five external controls, coarse frequency switch S1, fine frequency VR1, combined on/off and coarse output level switch S2, square wave on/off switch S3 and fine output level R4, are mounted on the box itself. The Veroboard holding most of the components is fixed to the lid, with a piece of expanded polystyrene about $\frac{1}{2}$ in. thick acting as insulation between board and lid. Such foam is easily cut using a fine bladed hacksaw or sharp knife.

Note that the Veroboard must be of 0.1in. pitch, in order to carry the i.c. holders. These are of 14-pin construction and accept the type 709 integrated circuits in dual-in-line (DIL) configuration, in much the

same way that a valve holder accepts a valve. The i.c.'s called for are also available in T099 (similar to T05) encapsulation, and these could probably be employed, without holders, provided the constructor is prepared to adapt the component layout to suit. The 709 type i.c. is advertised under various type numbers, such as SN709, BP709 etc.

A board layout found suitable in the prototype is given in Fig. 5, while Fig. 4 gives the front panel layout.

The Veroboard is small enough to be fixed to the box lid as described and still leave room at one end for the two PP3 9V batteries to be held in place, vertically, by the clamping action of the lid, with a scrap of foam plastic cemented to the lid to prevent the terminals from being shorted out. Since the batteries can be expected to last for some time, due to the low power consumption of the unit, direct solder connections are made to their terminals, there being no room for the usual snap-on connectors.

The capacitors used in the Wien network and in the amplitude stabilisation circuitry are mounted on the switches and potentiometers concerned and on small tag strips fitted to the box itself.

TESTING

With construction complete, before plugging in the two i.c.s, use a voltmeter to check that, at each of the input pins of both of the holders, i.e. pins 4 and 5, there is half supply volts. These readings should with two new batteries, be +9V or so, relative to battery negative (chassis). Any large departure from this value indicates the presence of a fault of some kind; correction must be carried out before insertion of the i.c.s.

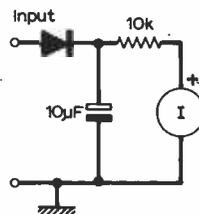


Fig. 6: Temporary test set-up for measuring the output of IC1.

Now fit IC1 and check its output potential at pin 10. It should lie close to +9V relative to chassis. If all is well, VR3 can be adjusted for optimum performance.

To do this, the test set-up of Fig. 6 is required to monitor the output of IC1. S1 is set to the middle range and VR1 to mid travel. With VR3 in its extreme anti-clockwise position, advance it slowly until the meter starts to indicate. Further advancement will give a rising meter reading which will start to level off as VR3 is rotated further; stop at this point.

Now swing VR1 over its total range whilst continuing to monitor IC1 output. The reading should be constant, indicating a good setting of VR1 but if the meter reading is not constant, slight re-adjustment of VR3 is called for. The specification calls for the output level to be within $\frac{1}{2}$ dB either way which amounts to a total permitted variation in meter reading of about 11% as VR1 is swung from one end to the other.

The actual level of the output signal depends on the particular values of the components employed, especially the specimen of f.e.t. used. Accordingly, transfer the test set-up to the output terminals, which should be loaded with 600Ω . Set VR4 to maximum output and S2 to the 1V range; adjust VR2 for a reading of $80\mu\text{A}$ indicating a level of 1V r.m.s. With some specimens of the f.e.t. called for, it may not be possible to obtain 1V r.m.s. in this way, in which case a slight alteration in the value of R24 should enable the correct level to be arrived at.

With IC1 functioning correctly, an oscilloscope can be used, if available, to examine the output sine wave. It should be excellent at all settings of the controls.

Lack of output, or a large rise in output, at any setting of VR1, other than that used when setting up VR3 probably indicates a fault in the amplitude stabilisation circuitry.

The frequency determining capacitors used in the prototype were of 10% tolerance and one frequency scale was used on the front panel to cover all three ranges. Since two capacitors are employed on each range and their errors may well tend to cancel, any frequency error so introduced could perhaps be only 4 to 6%, which the author considers to be sufficiently accurate for all but the most critical work. It is the order of accuracy of some of the cheaper commercial generators.

If highly accurate scale markings are required, then 1 to 2% tolerance capacitors will have to be obtained (at correspondingly greater expense of course), and, most important, an accurate signal source employed for comparison purposes.

Calibration of the frequency scale can be done by comparison with an existing audio signal generator, either by means of a Lissajou figure on an oscilloscope or by listening simultaneously to both generators. It is possible to determine when both signals are at the same frequency by this latter means, especially if the operator has some musical appreciation.

Audio signals of a very high degree of frequency accuracy are available to everyone with a radio or TV set.

On television, during colour bar and test card transmissions, steady tones are often transmitted; on BBC1 this tone is 1kHz and on BBC2 it is 440Hz.

On sound radio, 440Hz is transmitted before the start of programmes on Radios 1, 2, 3 and 4; 1kHz on Radio 3 from four minutes after closedown to five minutes after closedown and on Radio 4 from four minutes to 34 minutes after closedown; and 250Hz on Radio 3 from five to 35 minutes after closedown.

The BBC point out that not all these tones are transmitted, many of their transmitters being operated by time switches set to operate 20 minutes before and after programmes.

Note that nearly all TV sets and some radio sets have a direct connection to the mains and the appropriate safety precautions must be taken when using such sets as a source of calibration signal.

Now plug in IC2. With S3 in the square-wave position, pin 10 of IC2 should lie close to +9V relative to chassis, and an oscilloscope check should reveal the presence of a large amplitude square wave of extremely fast rise and fall times. Adjust VR5 to give 1V peak-to-peak at the square wave output terminal.

Again if no oscilloscope is available, the circuit of Fig. 6 can be used. A reading of $22\mu\text{A}$ indicates that a 1V peak-to-peak square wave is present.

In use it will be found that rapid frequency changes, caused by swift rotation of VR1, result in some amplitude bounce on the lowest range, due to the long time constant employed in the stabilisation circuit on that range. This is no disadvantage in practical use since the amplitude stabilises within a second or two and the effect is not apparent on the higher two frequency ranges. Note that all thermistor stabilised generators have an amplitude bounce also, but with a greater settling time, which occurs on all frequency ranges.

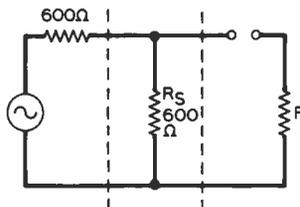


Fig. 7: Use of an external resistor to provide correct loading of the signal generator.

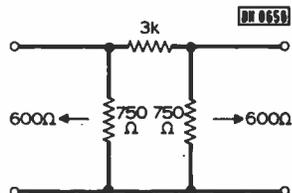


Fig. 8: Attenuator providing a known attenuation of 20dB.

The output impedance of the sine wave signal is, as noted earlier, 600Ω ; this is a very convenient value for a number of applications, and the output levels quoted, namely 1V, 100mV and 10mV are correct assuming that the generator is loaded with 600Ω . Should a higher impedance load be driven, e.g. a valve amplifier or f.e.t. input amplifier, then a greater signal level than indicated by the audio generator controls will in fact be present. In such cases, either a shunt resistance should be employed to bring down the impedance level or else allowance made for the larger signal present. The arrangements for employing a shunt resistance are shown in Fig. 7.

THE SECOND AUDIO SIGNAL GENERATOR AND CALIBRATED ATTENUATOR, SHOWN ON THE COVER, WILL BE DESCRIBED NEXT MONTH.

Back Numbers

We regret to inform readers that owing to the closure by the Company of the department concerned it will no longer be possible to supply back numbers of Practical Wireless or Television.

To ensure obtaining regular copies of these magazines readers are strongly urged to place a regular order with their local newsagent, or to take out an annual postal subscription.

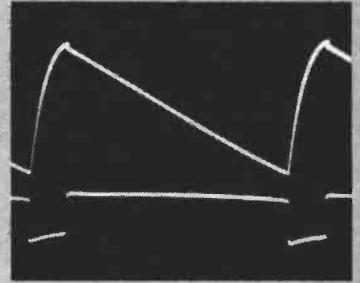
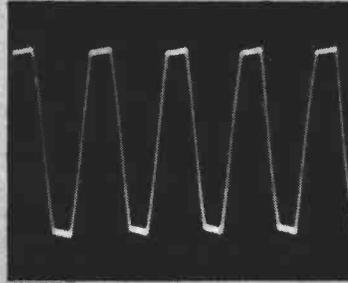
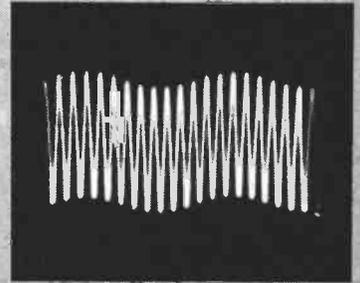
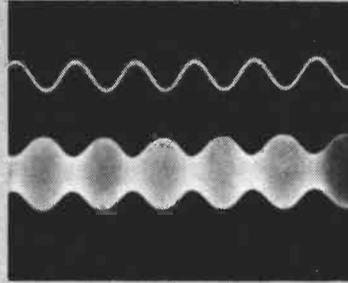
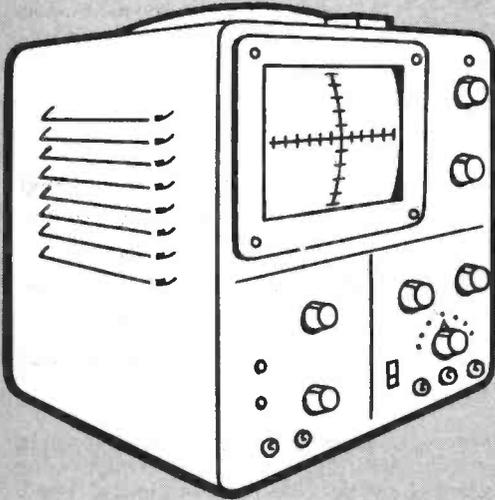
Reference to past issues of the magazines may sometimes be obtained at certain public libraries who may hold bound volumes. A few libraries are said to offer a photostat service. Alternatively, we are always willing to insert a free request for specific back numbers in our "CQ" column which appears in most issues.

IN NEXT MONTH'S

PRACTICAL WIRELESS

THE OSCILLOSCOPE at work

Do the waveforms below mean anything to you? If not you probably do not appreciate what a useful piece of test equipment a 'scope is. It's one of those items that you will never be able to do without once you get hooked. One of the difficulties in understanding electronics is that you normally can't see electricity. A 'scope overcomes this—you can literally see what is going on inside a circuit but the information is in the form of a simple code. This heavily illustrated article with dozens of actual 'scope traces will help you to break that code.



INSTALLING YOUR CAR RADIO

Since the abolition of the radio licence, the number of car radios has increased dramatically and there can be few readers who have not installed one in their own car or been asked to do so for someone else. There are plenty of snags and the job is rarely straight-forward. This feature, written by an expert, goes through the whole chain of installation and gives the answers to all the most likely problems that may present themselves.



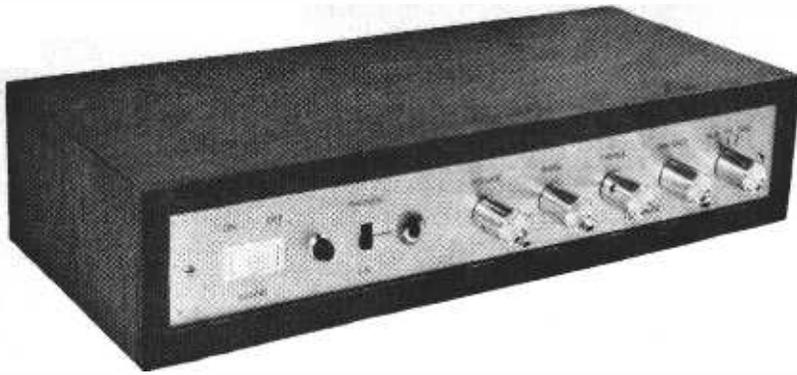
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TOP BAND CONVERTER

If you don't want to build a complete receiver for Top Band then this converter, using only three transistors, will do an effective job ahead of a broadcast receiver. The local oscillator is preset but an alternative circuit using crystal control is also described. A panel switch enables the converter to be by-passed when not required as well as switching off the internal 9V battery supply.



20+20 WATT I.C. STEREO AMPLIFIER

PART 3

RICHARD MANN

In the components list given in part I (May issue), C104 and C106 were listed. They are not required and should be deleted from the components list.

In last month's issue I quoted values for R7, C7 and C8 rounded off to the nearest ten figures for the man who wants to do the job properly. Unfortunately an extra nought crept into the value of C8, which should in fact be $10.87777777nF$ ie $11nF$ give or take a few decimal places! $10nF$ ($0.01\mu F$) is specified in the components list. This is the nearest preferred value.

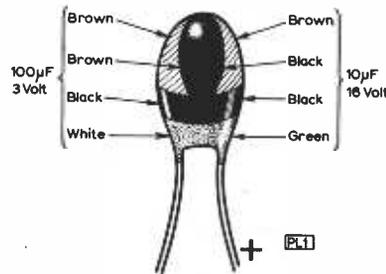


Fig. 26: Tantalum capacitor polarity and colour code identification.

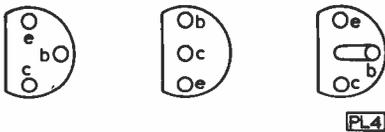


Fig. 24: Transistor base connections (left) BC182/BC212 with TO-18 pin arrangement, (centre) BC182L alternative pin arrangement, (right) BC182K TO-18 (see text).

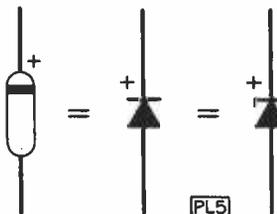


Fig. 25: Diode theoretical and physical representation

Printed Circuit Assembly

All components are mounted on the opposite side to the copper foil.

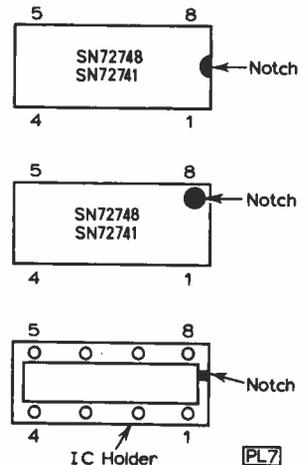
No special assembly order is required for the printed circuit board here except that the switches, controls integrated circuits and power transistors should be left till last.

(4) The use of low-wattage (15-20W) electric soldering iron is recommended. In fact any serious constructor should consider buying himself a thermostatically controlled iron—they really are worth the money (no I don't get a commission).

The assembly of the Texan is fairly straightforward but as with most things it is easier if done in a logical order—such as the one which follows below.

- (1) Mount all the DIN sockets (using 6BA screws) and the mains fuseholder on the back panel. Also insert the grommet for the mains cable.
- (2) Bolt down the mains transformer to the main chassis. Note that 6BA countersunk screws are used so that there are no projections below the bottom of the chassis.
- (3) Screw the double fuseholder for the output fuses F1 and F101 onto the heatsink. Again, 6BA countersunk screws must be used as the heatsink has to be screwed in close contact with the back panel.

Fig. 27: Integrated circuit connections (viewed from above) as used in the "Texan." The "notch" is always between pins 1 and 8. Fit the holders as indicated on the printed circuit layout (Fig. 28). The integrated circuits "notch" must be aligned with the holder "notch".



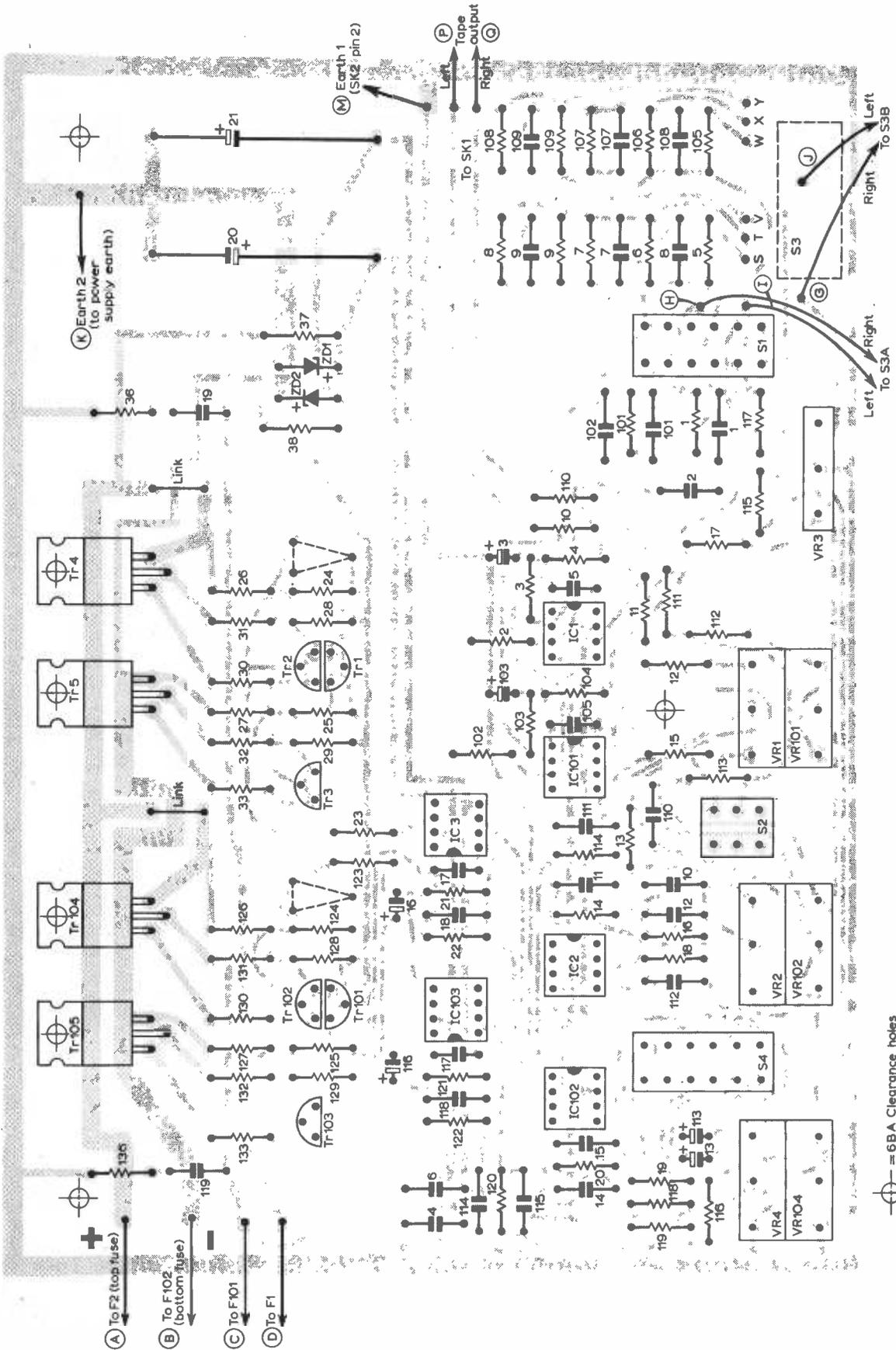


Fig. 28: "Texan" printed circuit board layout

⊕ = 6BA Clearance holes
($\frac{5}{32}$ Drill)

Do not use, or attempt to use any type of plastic solder or Loy metal for making any of the connections. Use only a flux-cored solder—obtainable from your radio component stockist. Do not use any separate fluxes—liquid, paste or powder types are completely outlawed!

Transistor Connections

Also make sure that you get the right pin configuration of BC182 and BC212. These devices come in assorted flavours and have been known to cause confusion. The devices specified are BC182 and BC212 which have a standard TO-18 pin arrangement (Fig. 24 (left)).

There is also a BC182L which looks like Fig. 24 (centre) and a BC182K which looks like a BC182 but has a joggled base lead 24 (right) to make it conform to the TO-18 pin circle. The BC182K can be used if necessary but the BC182L is difficult to use since the board is laid out in such a way that Tr1 and Tr2 have their "flats" adjacent to each other. A good thermal contact between these flats helps the V_{BE} multiplier, Tr1, to track variations in the driver transistor V_{BE} 's. When soldering in Tr1/Tr2 and Tr101/Tr102 it is a good idea to tape them together until the joints are made. Don't forget to place a smear of heatsink compound between the "flats".

It is also easy to get the zener diodes the wrong way round—the end marked with a bar must go to the more positive potential.

Some confusion may arise with capacitors C20, C21, 1,000 μ F 25 volt electrolytics. These components may have a band at one end, and if so it will indicate the negative end. This can be verified by examination of the capacitor. If the lead is part of the aluminium can—it is the negative lead. The positive lead will emerge from the insulated end of the can (usually black). These capacitors must be fitted correctly (see Fig. 28).

Tantalum Capacitors

Tantalum capacitors C3, C103, C13, C113 and C16, C116 are also polarised components and should be fitted correctly. Reference to Fig. 26 will indicate polarity and capacitance.

Switch Fitting

Before fitting the push type switches S1, S2 and S4 to the printed circuit board, examination will reveal that there are mounting leads on both sides! The side *without* the flat copper spring (that lifts and drops as the push switch is operated) should be inserted in the board, i.e., when the switch is fitted correctly the flat copper spring will be visible. When fitting these switches it will probably be noticed that there is a small gap of approx. $\frac{1}{32}$ in. between the underside of the switches and the board. This is quite in order. Having mounted all the smaller components the controls can be added. The potentiometer shafts and that of S3 should be shortened to approximately $\frac{7}{8}$ in. measured from the mounting plate surface. With both the switches and the potentiometers ensure that they are inserted as far as possible or the shafts will not "line up" with the front panels. The switch leads will probably need a bit of alignment with a pair of pliers to ease the insertion. Do not force them in because you might loosen the printed circuit solder pads—this also goes for all soldered joints. The pads, particularly on the integrated circuit-holders are very small and

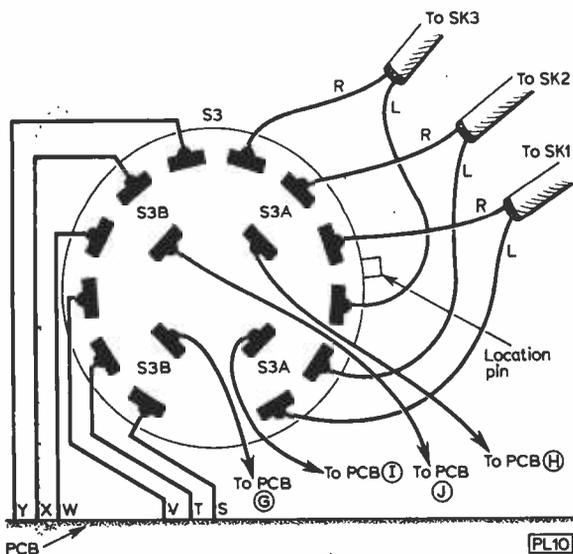


Fig. 29: Selector switch S3 wiring details. Note that the ends of the screened leads must not be joined together or earthed at S3 end.

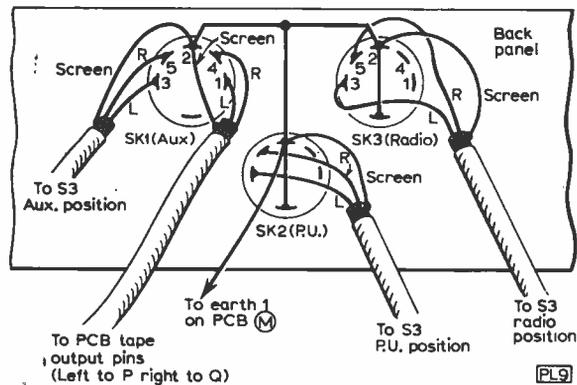


Fig. 30: Wiring to the input DIN sockets. Note that the screening on the leads from S3 are earthed at these input sockets only.

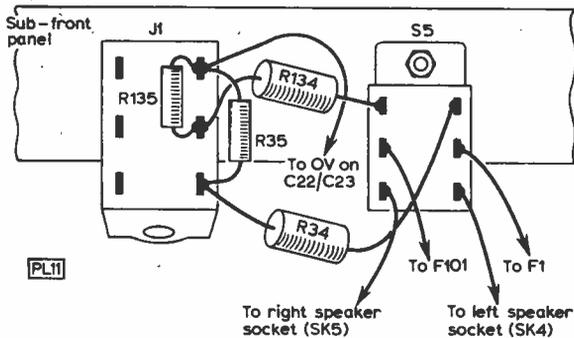


Fig. 31: Wiring details of the headphone jack socket J1 and headphone loudspeaker switch S5. Further wiring details will be given next month.

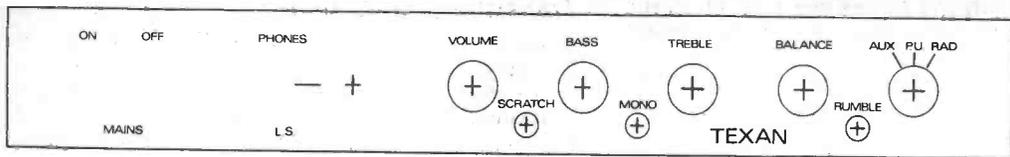


Fig. 32: Front panel legend.

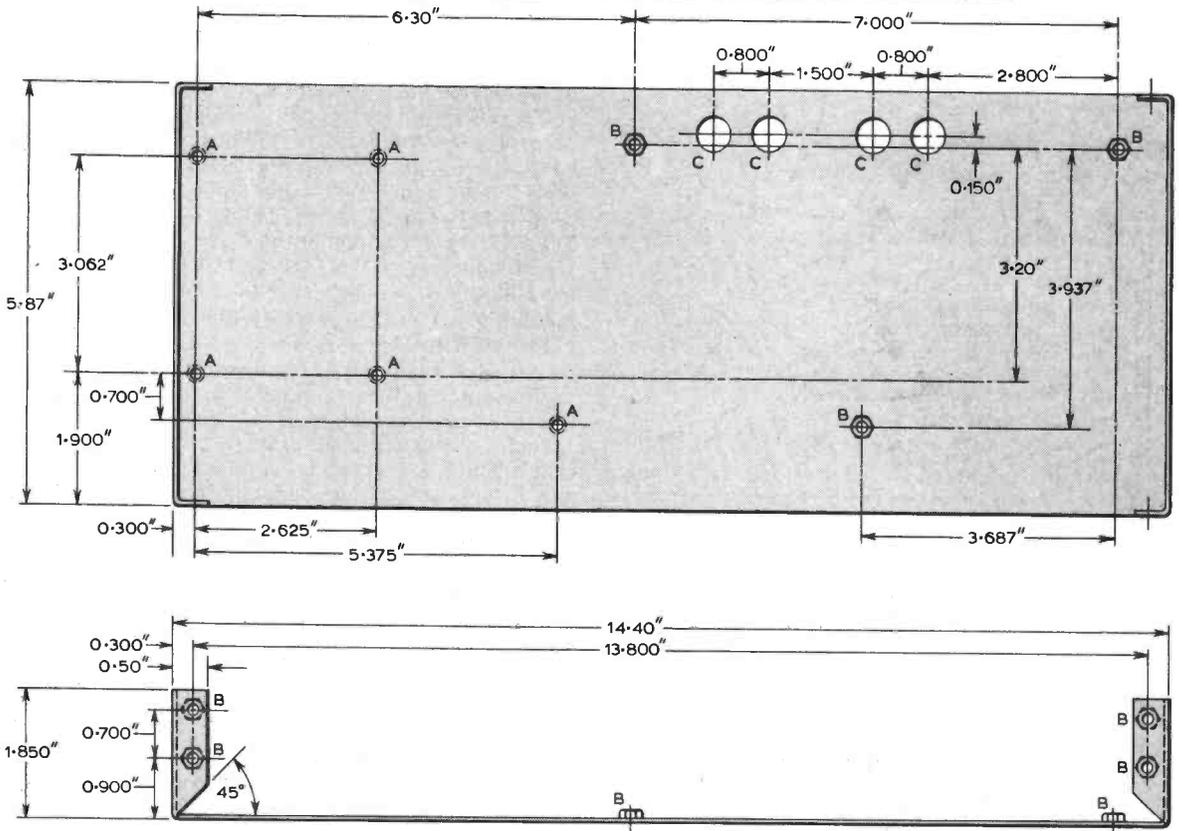


Fig. 33: Complete amplifier chassis. 18 s.w.g. aluminium.

A—5 holes CSK 6BA
 B—11 holes 6BA Hank Bush
 C—4 holes drill $\frac{1}{8}$ in. dia.
 NOTE: Hank Bushes are duplicated on rear flanges.

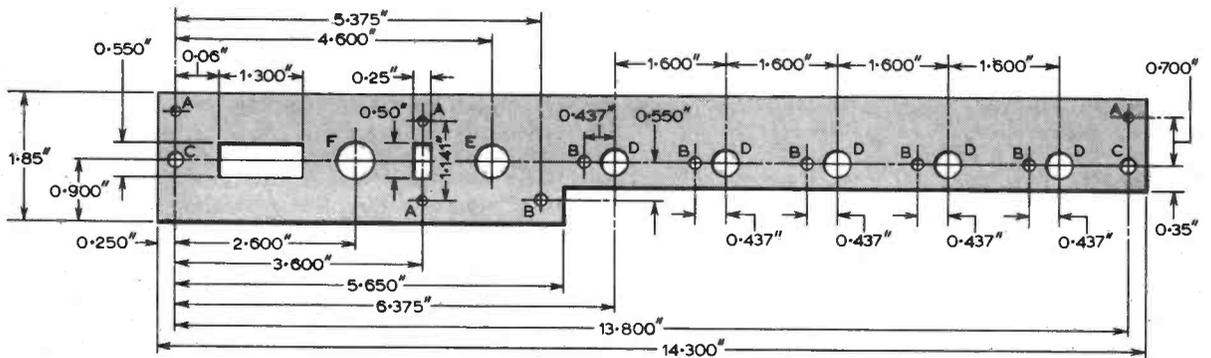


Fig. 34: Sub-front panel. 18 s.w.g. aluminium.

A—4 holes drill No. 30
 B—6 holes drill $\frac{1}{8}$ in. dia.
 C—2 holes drill $\frac{1}{8}$ in. dia.
 D—5 holes drill $\frac{1}{8}$ in. dia.
 E—1 hole drill $\frac{1}{8}$ in. dia.
 F—1 hole drill $\frac{1}{8}$ in. dia.

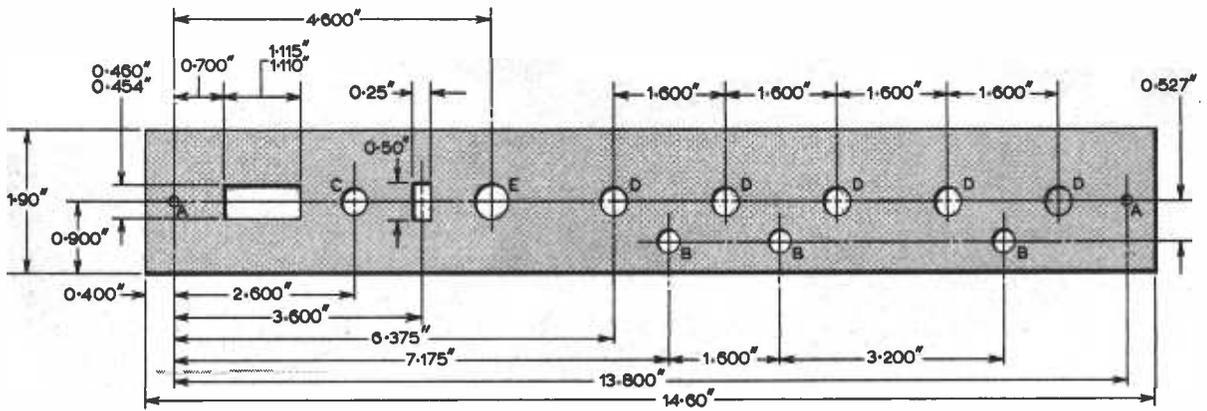
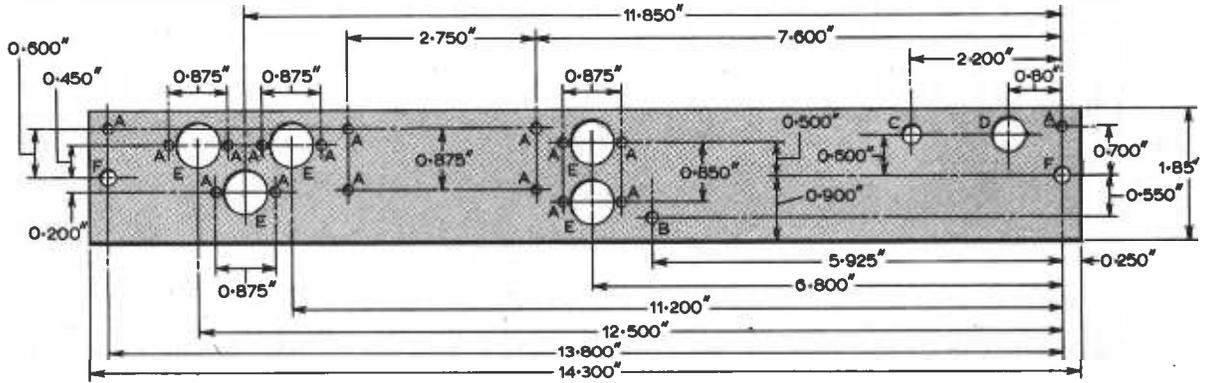


Fig. 35 (above) : Front panel. 16 s.w.g. aluminium.

- A—2 holes drill $\frac{3}{8}$ in. dia.
- B—3 holes drill 8.2mm dia.
- C—1 hole drill 8.0mm dia.
- D—5 holes drill 9.8mm dia.
- E—1 hole drill $\frac{1}{2}$ in. dia.

Fig. 36 (below) : Back panel. 18 s.w.g. aluminium.



- A—16 holes drill No. 30
- B—1 hole drill $\frac{3}{8}$ in. dia.
- C—1 hole drill $\frac{1}{2}$ in. dia.
- D—1 hole drill $\frac{1}{2}$ in. dia.
- Key $\frac{1}{16} \times \frac{1}{16}$
- E—5 holes drill $\frac{3}{8}$ in. dia.
- F—2 holes drill $\frac{3}{8}$ in. dia.

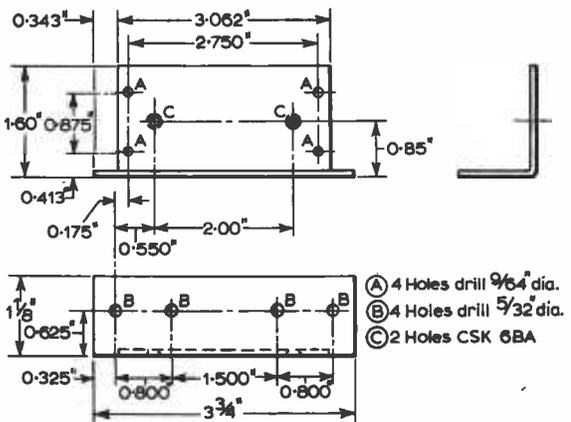


Fig. 37 : Heatsink. 16 s.w.g. aluminium.

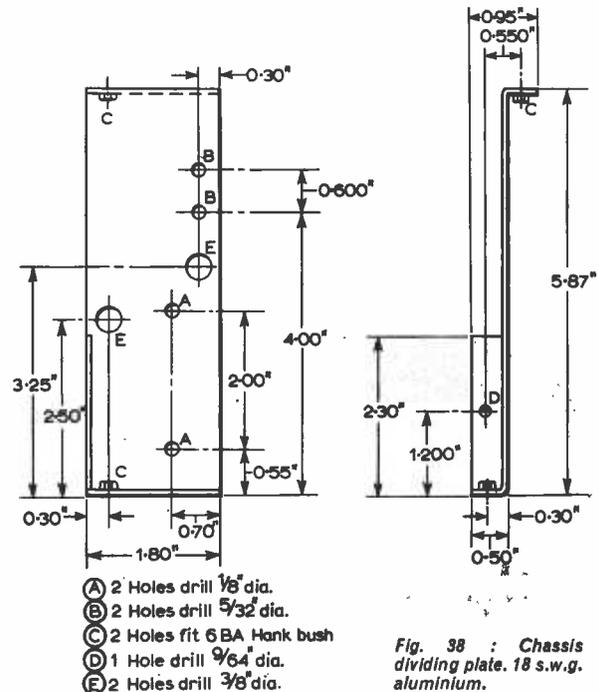


Fig. 38 : Chassis dividing plate. 18 s.w.g. aluminium.

View of completed amplifier in which the positions of some major components may be seen.

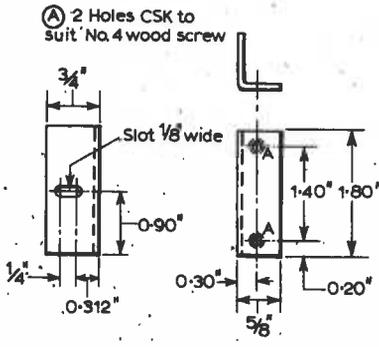
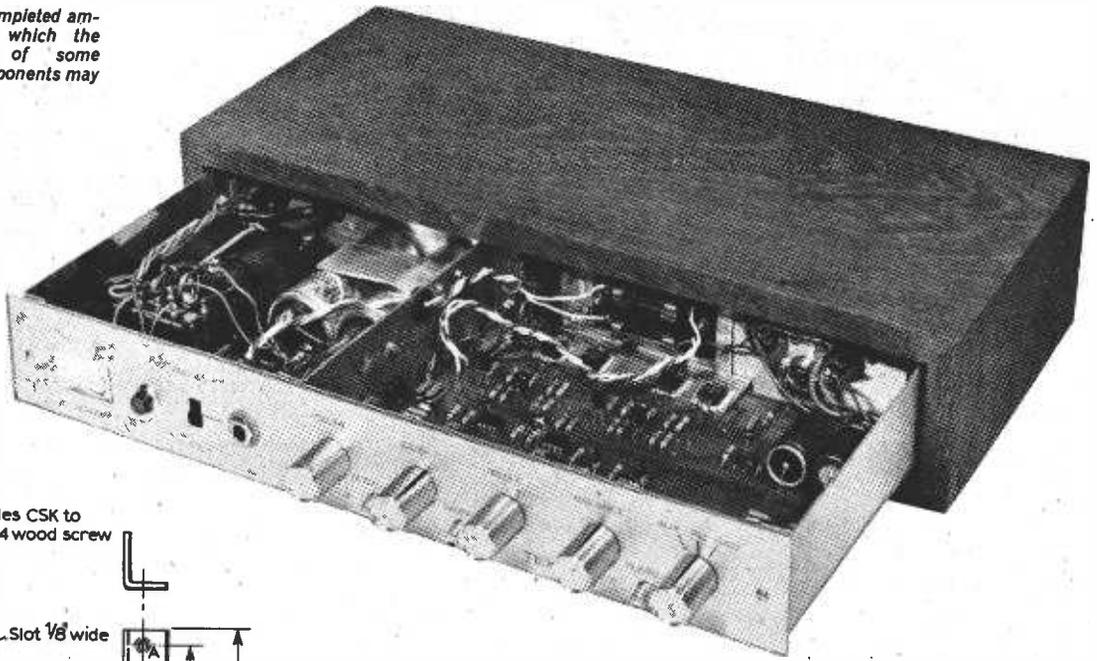


Fig. 39: Chassis fixing bracket. 16 s.w.g. aluminium.

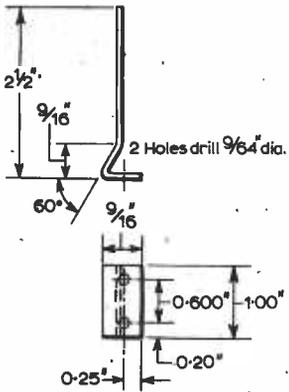


Fig. 40: Capacitor clip for retaining C22/C23.

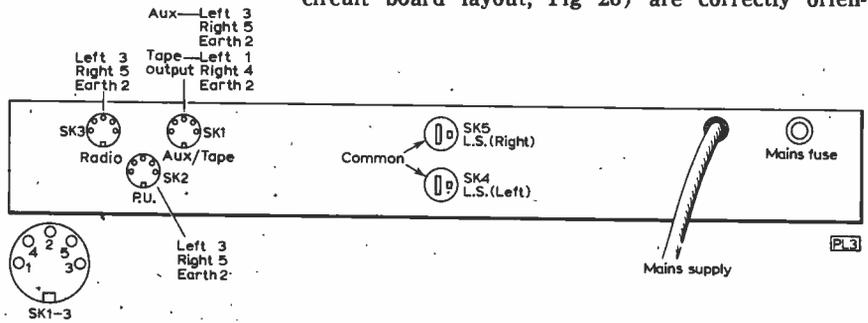


Fig. 41: Rear view of the "Texan" back panel, showing socket connections.

need a delicate touch. Blowlamps should definitely be avoided!

After the controls the power transistors should be mounted. The leads should be bent before insertion to line up with the printed circuit board and the heatsink sandwiched between the printed circuit board and the transistor before soldering to get the correct spacing. The mounting plates of the power transistors are connected to the collectors so a mica washer and a screw insulating washer must be used on each transistor. If possible a thin smear of heatsink compound should be applied to each side of the mica washer. Make sure, also, that the

fixing screws are done up tightly to maintain a good thermal contact.

Holders are used for mounting all of the integrated circuits in the Texan. Careful examination of the integrated circuit holders and the integrated circuits will reveal an indentation or notch at one end of the component. This allows identification of pin 1. (see Fig 27.)

Ensure that the indentations or notches in the holders (indicated as a black blob on the printed circuit board layout, Fig 28) are correctly orient-

tated before soldering in position. When this has been carefully checked, the integrated circuits themselves may be fitted. Ensure that the indentations or notches in the integrated circuits are in the same position as those in their respective holders. Note that IC3/IC103 are rotated 180° in relation to the other integrated circuits.

The last printed circuit board component to be connected is the selector switch, S3. This is not a printed circuit component. But if tinned copper wire (about 20 s.w.g.) is stretched to stiffen it, it is possible to make a very neat self-supporting structure as shown in the switch wiring diagram Fig. 29.

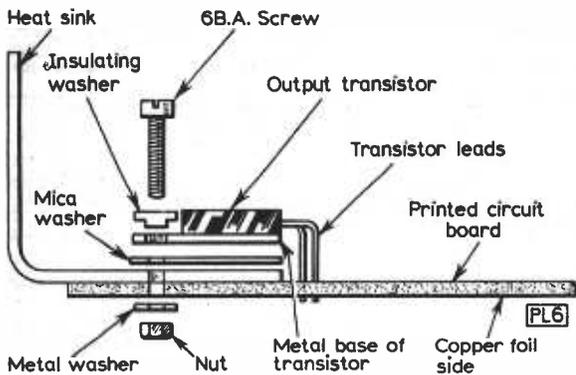


Fig. 42: Side elevation showing exploded view of power output transistor mounting (see text).

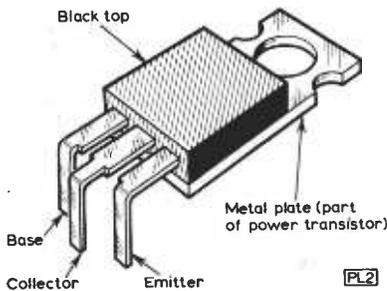


Fig. 43: Details of power output transistor lead connections and formation of leads to facilitate assembly.

Flexible insulated leads will be needed to make the connections to the wiper contacts and these should be soldered to the board before the switch is in position as they are inaccessible otherwise.

Finally pins should be inserted in the board for the connection of the earth lines, power supplies, speaker outputs and tape outputs. If pins are not available a twisted loop of wire can be used instead.

(5) Having finished the printed circuit board assemble the phones/loudspeaker switch S5 onto the sub-front panel and screw the sub-front panel onto the chassis using the lower pair of hank bushes.

(6) Screw the chassis dividing plate to the chassis and the sub-front panel.

(7) Trim off any long leads projecting below the copper side of the printed circuit board and then screw the board in position using the three hank bushes provided and ensure that the 6BA screws do not project below the hank bushes. With the board in position examine it very carefully for clearance between the soldered joints and the chassis. The spacing is small and if in doubt an insulating washer cut out of polythene or P.V.C. sheet could be inserted to be on the safe side.

(8) Screw the back panel to the heatsink—if possible, with a smear of heatsink compound between the surfaces. Again screw up tightly. Then screw the back panel to the chassis using the top pair of hank bushes in the chassis and the hank bush in the chassis dividing plate.

(9) Fix the controls to the sub-front panel with the usual shakeproof washer and nuts.

NEXT MONTH
Further wiring details,
setting-up and testing procedures

Electronotes..

S. GINSBERG

MINUTE quantities are commonly measured in the laboratory by specialised equipment. Glancing through an American magazine I see that one company is marketing a meter which measures current. There are some 18 overlapping ranges and the lowest goes down to one pico Amp which is 10^{-12} A. It looks as though the measurement of minute quantities is no longer restricted to the research labs.

Many i.c. manufacturers have achieved quite remarkable things, such as reducing an electronic calculator onto a chip. Fairchild has now launched the 3814 which sounds harmless enough. It is a p-channel silicon gate m.o.s. chip which costs less than \$20 in the U.S. for 100—off quantities. What makes the 3814 special is that this single chip contains very nearly all the logic for a complete digital voltmeter—a $4\frac{1}{2}$ decade one at that. The b.c.d. outputs are suitable for driving a b.c.d. to nixie decoder or a b.c.d. to seven segment decoder.

While many of these i.c.s are not available to the home constructor, it should be remembered that neither were good r.f. power transistors—at first. The digital clock i.c. chip could also find its way onto the amateur constructor market when production lines hot up.

Another interesting idea which has been around for some time now is liquid crystals which can be used to give a good digital readout and yet consume only a microscopic amount of power. All-electronic wrist watches with digital readout are a certainty here if certain plans go through. The first liquid crystal digital meter has just appeared on the market so it will be interesting to see how they catch on.

Getting back to integrated circuits. It was interesting to see RCA's idea, at the Paris Components Show, for the "electronic" car of the future. More properly, the idea is that all the signals and electrical impulses for the car of the future will be sent over just three wires. Signals will be sorted out at each point by logic circuitry. The RCA exhibit had the "decoding" done by numerous i.c.s and discrete components. Dr. Steve Donohue of RCA pointed out that the next step was to reduce all these items to chip level. Incidentally, he also mentioned that transistors are moving into the automotive industry with a vengeance. RCA averages two transistors for every other motor car which is produced in the U.S.

The U.S. Naval Undersea Research and Development Centre has developed a 10in. dart, powered by a low-voltage battery, which can kill a shark or paralyse it for several minutes. The dart sends an electric shock through the shark's body. It has immobilised a 450-pound, 12-foot tiger shark and killed smaller kinds.

Vintage Radio Society

A particular point I would like to raise concerns the question of vintage equipment. I was particularly sorry to see the adverse comments in "Going Back" that were made regarding the Vintage Radio Society proposed by Mr. Lancaster. He must be quite disappointed with the response. I can back up the statement that certain people have an interest in vintage radio and electrical equipment, only in order to make money. Admittedly, these days any old bits and pieces sometimes fetch a price, but that is no excuse for excessive profit making. I had one chap say to me, 'A theatre group would give me up to £20 for that', even when I complained that the old bright emitter three valver had nothing inside, only the cabinet and ebonite front panel!

I have had an interest in the history of radio for quite some time now and have built up a small private museum. My interest also includes the personalities and events. For instance, Bose and other scientists were radiating and detecting centimetre and millimetre wave signals before the turn of the century. The litigation between Fleming and Lee de Forest is very interesting, although sad it illustrates human stubbornness very well. When did Hartley and Colpitts develop their oscillators? Did they in fact develop those circuits at all?

I wrote and delivered a lecture 'Wireless, the Early Days of Electronics' as an open Colloquium at my University some time ago, with success. The lecture is still available and, time permitting, I may be able to deliver it to any interested audience. Being of the nature of service to the hobby, I would ask only for travelling expenses and a little sustenance perhaps... according to distance from my base.—Ken Smith, G3JIX, (Canterbury, Kent).

Touch of the master

It was gratifying to read the reference in April's Editorial to your 'older' readers. My memories go back to 2LO and 1924. I still have in my junk box Cossor Valves

41MP, 41MHL, and 41MH. The light they emitted would have been useful in the recent power cuts. However, I am still keeping pace with ICs and the other new ideas that come on the market.

It seems remarkable after all these years that there is one very old 'phenomenon' that still puzzles me. I refer to 'Capacity effect on Tuning'. I have a transistor set—a Sharp Model BXL 468—which I think is remarkable for its range. I have identified on the medium wave amongst others—Moscow, Teheran, Greenville N. Carolina, and a number of other American broadcasts—apart from their AFN. The point is however that on some of them the volume is much increased by capacity effect of my hand. I'm very curious to find out what is really happening. Is there a parameter to explain it?—G. A. Porter, (Herts).

Up the transistor

I must take up the cudgels on behalf of the maligned transistor. In the correspondence columns of your April issue you publish a letter from P. Rostgaard of Herts in defence of the valve and stating 'I do not use transistors for any serious project.'

He says—and here I must agree with him in part, if not *in toto*—that listening to a transistor amplifier gives him a headache. True, too often! But I suggest he takes a look at the designs of such purists as John L. Linsley Hood (*vide* Wireless World and Hi-Fi News) where he will see the transistor used properly, and the distortion levels, signal-to-noise ratios and dynamic ranges of transistor amplifiers so much superior to anything a valved circuit can accomplish that he may be tempted to change his mind!

On the score of bashability, I hope Mr. Rostgaard is not trying to kid us that the thermionic valve (vacuum trapped in glass) offers greater reliability than solid-state devices. We don't see many valves in industrial traffic, nautical and extra-terrestrial equipment nowadays—and that's not just a question of economics, believe me! Transistors do not just 'pack up' for no reason. Usually, external causes, such as

a hamfisted operator, are to blame. True, valves and valved equipment can be more flexible in this respect—but is this the criterion, Mr. R? If so, you might as well have your singer hollerin' through a megaphone as the ultimate in reliability—and then he would probably succumb to the hives.

Properly designed transistorised equipment—may I recommend a look at the current series, Transistors for Beginners?—can be very much superior to valves. But, I agree, badly designed solid-state devices are just plain 'orrible.

That's no reason to condemn transistors completely.—H. W. Hellyer (Bristol).

New members

I am writing to thank you for publishing my letter in P.W. for March 1972 concerning the West of Scotland Amateur Radio Society. The response to the letter was far above my expectations. Over 12 interested persons have come along to our Friday meetings as a direct result of the letter. Five of these people have actually become club members. I have also received several letters and phone calls requesting information about our activities.

The response obtained was much greater than that from any publicity given to the club in Short Wave Magazine or Radio Communication.—V. T. Budas, GM3VTB, (Glasgow).

Pat on the head

I am writing to thank you for printing my letter in the C.Q. column of the April issue of P.W. On Saturday, March 11th, I received a letter of advice together with a fault finding diagram from one of your readers in London to whom I am very grateful. I have written to thank this reader and to ask the cost of the diagrams so that I can reimburse him. Once again I say thank you P.W. for enjoyable reading and an excellent service. I wish your magazine every success for the future.—R. Cox, (Walsall).

practically wireless commentary by HENRY

No. 91
Drop-proof
Meter

IT is dark: the works are closed and only an itinerant night-watchman prowls the silent production lines. One almost hears him calling: "Nine of the clock and all's well."

But stay—what light from yonder window breaks?

Sorry—nocturnal scenes always carry Henry away. He cannot believe it is simply some factory operative earning a bit of much-needed overtime. He romanticises. Behind that translucent shade he imagines mad scientists at work, fevered intelligences bending their concentration on devilish new inventions. There, in that attic R & D den, where strange flashes illumine the reflected corner of the ceiling, a mad boffin is dreaming up something outlandish, like the noiseless potentiometer, the motionless tuner, the frictionless pickup, the torqueless motor, the massless loudspeaker . . .

And if you think the foregoing is outlandish, then I suggest you have not been reading the "Product news" or the News . . . News . . . News . . . etc., columns of your favourite magazine.

In the erudite columns of Studio Sound, last month, there appeared a "review" of the Phonograph. It could have been good—it could have been superlative, but the Editor failed to resist a

simple joke line early on. Done with a straight face, the review of pioneering hardware could be received with aplomb by the mass, with acclaim by the aficionados, with snorting derision by those so thick that they could not see they were being got at!

Minus its obvious cod-lines, that review in the S-S would have squeezed past into immortality. Nothing is too outlandish for the enthusiast.

On my own patch, there has landed an esoteric item that I must tell you about. Henry, for his sins, has to report and adjudge test equipment for certain trade magazines. Some of the gear sent for appraisal is out of this world. It is the sort of expensive junk that readers of PW would immediately recognise as a highly polished "con job".

But others, often well-regarded names, offer untold delights. Generators with infinitesimal distortion, with attenuators that prove to be in step with one's measuring devices, oscilloscopes that show the trace, the whole trace and nothing but the trace and, so help me Bob, need only one hand to accomplish this end.

I'm not quite sure in which category to place the latest offering. I mean—which is more important to you, that your meter shall give an accurate reading under the conditions you are likely to use it, or that it is able to survive a fall from the top storey of a high-rise flat complex?

For so many years that I blush to count them, Henry has used a trusty AVO Model 8. It has kicked about in the back of a van, been blessed by dogs, upset by infants, overloaded and abused continually, even had tea upset all over it, and the darned thing refuses to give up the ghost. Just recently, Henry has sported a cool hundred quid on a digital multimeter—whose performance, parameters and potential operability put the poor old 8 to shame. But what's the result?



"Excuse me"

Simply: the Dig.VOM is reserved for special jobs, blinking its red counters into an unregarding corner of the workshop.

It was very nice, this afternoon, for example, to be able to tell an irate customer that his PP9 battery measured 7.41 volts on load and was the cause of his crossover distortion on his radio. But the good old AVO-8 would have served a similar purpose—of measurement, that is, not technical braggadocio.

I am not sure what the Schlumberger Model 660 VOM could be used to do—unless it was to drop on that grumbling customer's head with a muttered: "Excuse me."

You see, the main feature of what is otherwise quite a good meter is that it is—I quote—completely drop-proofed. To quote even further: this is a "custom-ruggedized self-shielded taut-band mechanism". So now you know—yes?

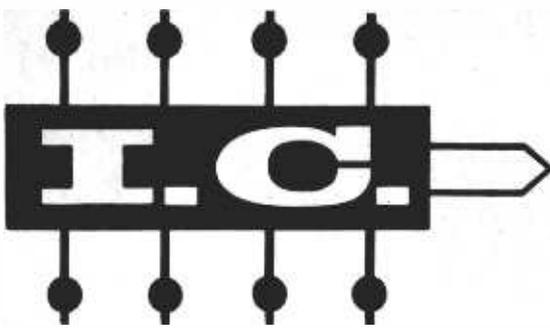
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Mad boffin is dreaming . . .



OF THE MONTH

L.A.J. IRELAND

Number 31

SGS TBA651 A.M. Receiver Module

CIRCUITS designed specifically for that most popular of electronic projects, the a.m. superhet, the old reliable "steam" radio, always arouse considerable interest when reviewed in this column and no doubt the appearance of the TBA651 manufactured by SGS will be no exception.

Capabilities

This unit combines all the high frequency functions of an a.m. radio and is ideal in combination with one of the low power monolithics such as the PA234 audio unit previously reviewed, for an all i.c. broadcast receiver. The circuit has been designed to require the minimum of external components, while at the same time providing high gain, low noise and a very wide a.g.c. range. The circuit will operate from any voltage in the 4 to 18V range; its suitability for car radios is obvious with their standard 12V supply, as well as for battery-powered portable applications. In this connection the built-in voltage regulator is particularly useful, improving decoupling of the r.f. and i.f. stages and stabilising performance with dropping battery voltages.

A feature seldom found in current solid state radios, but which contributes significantly to the performance of the TBA651 is the separate r.f. amplification stage prior to the mixer, though for best advantage this requires a tuned coupling circuit between these stages with a third ganged section on the tuning capacitor.

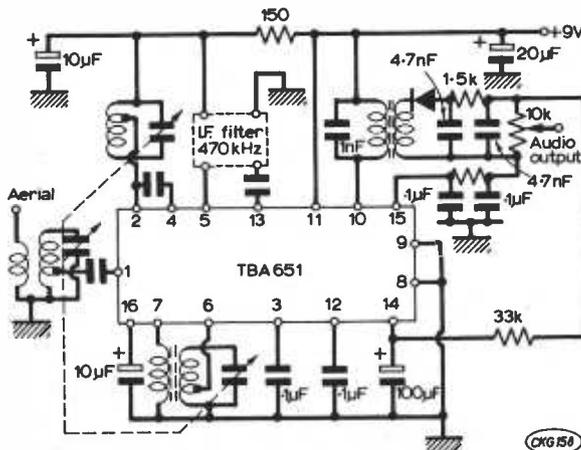


Fig. 1. Coupling circuitry using LC tuned IF filters.

Practical applications

The r.f. stage gain with a tuned coupling as shown in Fig. 1 is approximately 20dB, followed by converter gain of 40dB and i.f. gain of 60dB. Of course not all of this gain is utilised in normal reception as the a.g.c. function comes into operation, limiting the operation of the set to linear amplification to the level necessary for effective demodulation. The resultant audio signal is approx. 500mV for an r.f. input of 20µV. There is an a.g.c. range of 120dB of which 20dB is accounted for in the r.f. stage.

The effectiveness of this function can be gauged from the fact that an 80dB variation in applied signal is required to provide a 10dB change in audio signal delivered to the detector. The overall signal to noise ratio is determined by the characteristics of the r.f. stage, and betters 30dB for a 20µV input signal. Even with a 1µV input, s/n ratio is still 60dB, capable of providing intelligible audio. For small signals less than 100µV the a.g.c. application to the r.f. stage is suppressed, to utilise the high-gain low-noise characteristics; the i.f. stages provide the full a.g.c. performance over that range.

Selectivity

The sensitivity of the circuit being therefore fully adequate, some attention to selectivity is necessary. This must, of course, be provided by external components, at the input and output of the i.f. strip. The TBA651 is well adapted for use with ceramic filters (transfilters) since the loading applied by the circuitry is light. However, despite the convenience of these components, many constructors evidently still prefer the conventional LC tuned filter.

Fig. 2 is provided for the guidance of constructors

R.F. input	1	o ●	o	16	Decoupling	
R.F. output	2	o	o	15	A.G.C. ref.	
Decoupling	3	o	o	14	A.G.C. input	
Mixer input	4	o	TBA	o	13	I.F. input
Mixer output	5	o	651	o	12	Decoupling
Local osc.	6	o	o	o	11	+ve supply
Local osc.	7	o	o	o	10	I.F. output
Earth	8	o	o	o	9	Earth

Pins viewed from above

CKG156

Pin connections for the TBA651, a 16-pin dual-in-line package.

wishing to incorporate this device into a communications type receiver. Such receivers frequently employ double conversion, with a first intermediate frequency of 1.6MHz, followed by a further frequency change to the standard a.m./i.f. of 470kHz. The circuit of Fig. 2 will accept the output of the communications receiver first frequency changer at 1.6MHz. The "r.f." section of the i.c. here acts as the 1.6MHz i.f. amplifier, to be followed by second conversion in the normal way. B.F.O. injection could be experimented with at pin 12.

CHARLES MOLLOY

THE Medium Wave Column

MEDIUM wave stations on the North African coast are often conspicuous after dark in summer. T. Crosbie of Brosely, Shropshire has heard Oran, Algeria on 548kHz and Tunis on 629kHz using his domestic transistor portable. Many others can be logged such as Algiers 890kHz; Agadir, Morocco 935kHz; Tunis 692kHz; El Beida, Libya 1124kHz; Tangiers 1232kHz; Tripoli, Libya 1250kHz. West Africans are capable of being logged after 2300hrs GMT when European interference subsides. Listen for Dakar, Senegal on 764kHz with African music and French announcements until close down at 2345hrs. Bissau, Portuguese Guinea is on 1070kHz until 0100hrs with pop music and announcements and news in Portuguese. Conakry, Guinea is usually a strong signal on 1403kHz with African music and talk in local languages or French. Kinshasa in the republic of Zaire (Congo) is on 692kHz all night and is sometimes strong enough to cause interference with the East German outlet on the same frequency. The latter signs-off at 0100hrs on weekdays but at the weekend there is only a short break in transmission between 0245hrs and 0300hrs GMT.

W. C. Nolan who lives in Athlone sends news of a new low power local radio service in the West of Ireland. Programmes are in Gaelic and transmissions are on 539kHz; 962kHz and 1250kHz. Those on 539kHz and 962kHz might just be audible in the UK at sunset but 1250kHz is already occupied by Cork 10Kw and Dublin 5Kw which radiate the same programme as Athlone on 566kHz.

R. Morris of Bath is interested in obtaining QSL cards from medium wave stations and he asks what sort of information he should include in his reception report. The object of the report is to convince the station that the DXer did actually hear it. Programme details, weather reports, commercials, names of announcers, station identification and slogans, time checks, local news items; these are the type of details that should be mentioned together with the date, time (preferably the local time of the station) and the frequency. Many DXers also enclose details of the receiver used (not the model number but a brief line up, say 1 r.f. plus 3 i.f.). Some information on the receiving aerial can also be included and mention the general reception conditions and other stations heard. The more detailed the report, the more likely you are to get a verification. Always send return postage when reporting to a medium wave station. Unused foreign stamps are obtainable from philatelic dealers but all main post offices sell International Reply Coupons which are valid in most parts of the world. A single IRC is exchangeable for stamps of sufficient value to cover the cost of a reply by surface mail.

Please send logs and information about the medium waves to the author at 132 Segars Lane, Southport PR8 3JG.

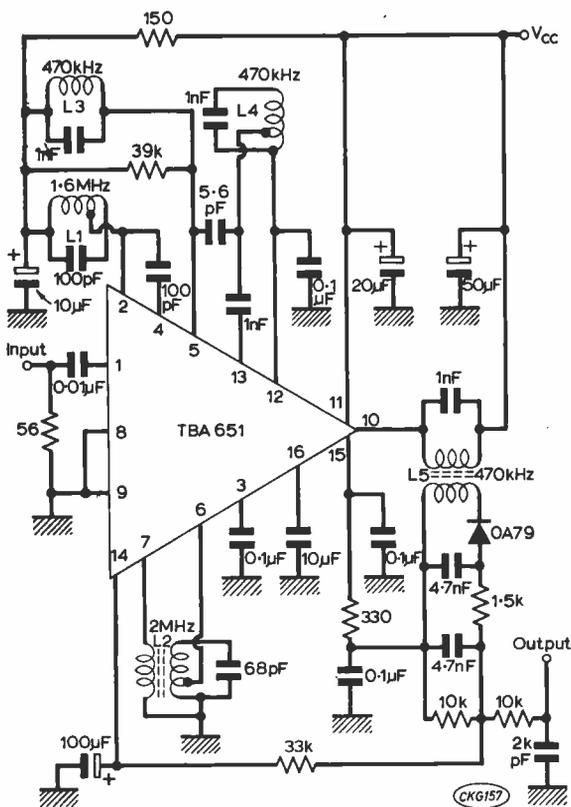


Fig. 2. The TBA651 in a double conversion IF strip for an AM receiver.

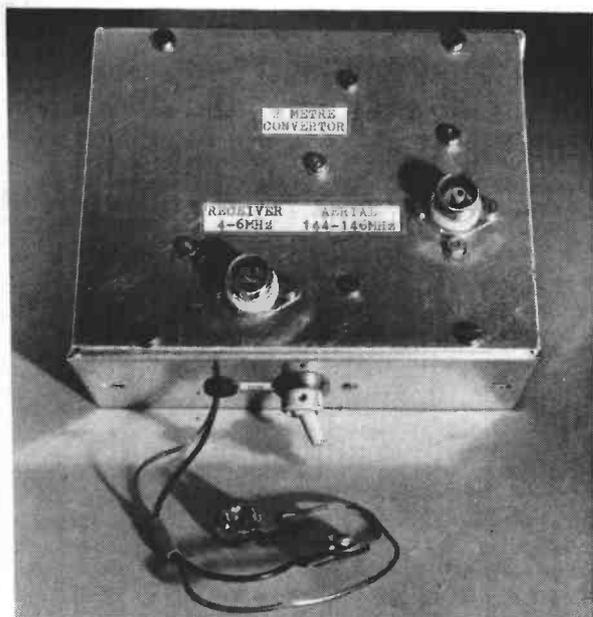
The increasing sophistication of special purpose i.c.'s is well illustrated in this a.m. tuner "chip," and its high performance will be appreciated. However, it must be good to compete with the devices released by R.C.A. and Mullard for similar applications.

DIGITAL CLOCK
April-May 1972

A number of errors occurred in this article, especially in Fig. 7 Part 2: Interconnection of the four decade counter boards. We shall be pleased to send a revised version of Fig. 7 to any reader on receipt of a self-addressed stamped envelope. Mark envelope DC24 in one corner. Do not enclose any other correspondence.

FET CONVERTER FOR 2 METRES

F. G. RAYER G30GR



THIS is a crystal controlled converter, for use with a short wave receiver to allow reception in the 144-146MHz band. It is self-contained, needing only the addition of a 2m aerial and the s.w. receiver, thus offering an easy way of obtaining reception on this band.

With a unit of this kind, there is no variable tuning, and the receiver acts as a "tunable i.f." amplifier. By the use of suitable crystals and multipliers, it is possible to obtain almost any wanted output frequency, over which the receiver must be tuned. To cover 144-146MHz, the receiver must in its turn be tuned over a band 2MHz wide. With the unit described here, a tuning range of 4MHz to 6MHz for the receiver was selected, for several reasons.

Many general coverage communications type receivers have rather cramped scales at the higher frequencies, such as 28-30MHz, and this results in more difficult tuning. Some receivers, quite satisfactory in other respects, do not maintain best efficiency at the higher frequencies, while some surplus receivers do not cover them at all. But most general coverage and surplus receivers of communications type operate well and have a reasonable tuning scale length over the 4-6MHz range.

The use of a crystal controlled converter oscillator and this receiver range also allows direct reading of frequencies in the 2 metre band, on the receiver scale, without changes to the latter. When reading

frequencies on the receiver dial, it is only necessary to assume that "14" is placed before each frequency marking, so that direct readings can be made in the following manner:—

Reception Frequency	Receiver Tuning Scale
144MHz	4MHz
144.5	4.5
145	5
145.5	5.5
146MHz	6MHz

This is achieved by having the oscillator frequency 1.f. of the reception frequency, and using a 35MHz crystal, followed by a doubler and harmonic mixer, so that 144MHz to 146MHz signals emerge as 4MHz to 6MHz for the receiver.

CIRCUIT

This is shown in Fig. 1 where Tr1 is a grounded gate f.e.t./r.f. stage, with input from the aerial and L1 to the source. This has the advantage of simplicity, needing no neutralisation.

The r.f. drain goes to L2, and L2 and L3 form a band-pass circuit, L3 providing input to the gate of the mixer Tr2. Tuning of L1, L2 and L3 is pre-set to give coverage over the 2m band.

Tr3 is the crystal controlled oscillator, and L5 is tuned with an adjustable core to near the crystal frequency. A coupling winding drives the emitter of the grounded base doubler, whose collector circuit is tuned to 70MHz by L6 and the trimmer. A small coupling capacitance to the mixer gate results in 2nd harmonic mixing.

L4 is tuned to about 5MHz and has a secondary which feeds to the input of the receiver through a co-axial lead. Current taken is about 15mA at 9V, from a dry battery.

★ components list

Resistors:

R1 270Ω	R4 1kΩ	R7 560Ω
R2 100kΩ	R5 12kΩ	R8 150Ω
R3 3.3kΩ	R6 5.6kΩ	R9 39Ω

All ½ watt 10%

Capacitors:

C1 1000pF cer. disc	C7 10pF S.M.
C2 1000pF cer. disc	C8 1000pF cer. disc
C3 22pF S.M.	C9 1000pF cer. disc
C4 0.01μF tubular	C10 1000pF cer. disc
C5 10pF S.M.	C11 100pF cer. disc
C6 0.05μF tubular	

TC1, 2, 3, 4 10pF trimmers (Jackson "Tetter")

Semiconductors:

Tr1 MPF102	Tr3 ZTX108
Tr2 MPF102	Tr4 ZTX108

Miscellaneous:

Casework, 4 × 2in. flanged plate CU133 (3), 5 × 2in. CU134 (2), plates 5 × 4in. CU156 (2), (Home Radio). Veroboard, plain, 0.15in, 2½ × 2½in. and 2½ × 1½in. Formers 1½in × ¼in. diameter, one with core. Co-axial sockets (2). L4, 1FT17 (Denco) see text. On-off switch. 35MHz crystal, miniature, type HC18U, (Senator Crystals, 36 Valleyfield Road, London, SW16).

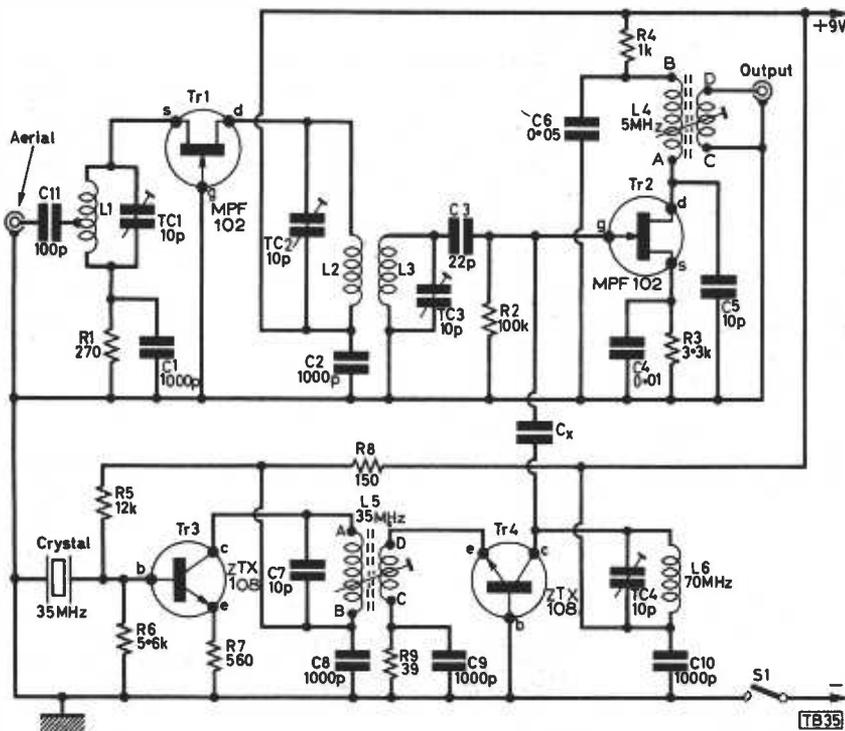
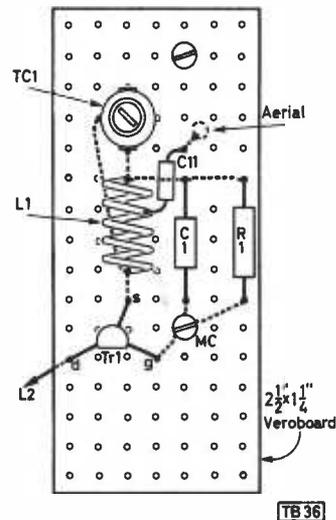


Fig. 1: Circuit of the crystal controlled converter.

Fig. 2: Layout of the f.e.t. grounded gate r.f. stage.



INDUCTORS AND TRANSISTORS

L1, L2 and L3 are wound in the same way, using 20s.w.g. wire. Straighten the wire and wind five turns side by side on any former $\frac{1}{4}$ in. in diameter. Remove the former and stretch the winding so that it is $\frac{1}{8}$ in. long. Bend the ends at right-angles with pliers, shape them to pass through holes in the board, and cut the ends $\frac{1}{4}$ in. long.

L4 is a modified Denco IFT17 transformer. The screening can is removed and the 250pF internal capacitor across the larger winding is carefully unsoldered. The can is then replaced. This change, in conjunction with the small capacitor connected externally, allows the 1.6MHz transformer to cover approximately 4MHz to 6MHz, by adjustment of its core.

The collector transformer L5 has 15 turns for the primary and 5 turns for the secondary, of 24s.w.g. enamelled wire. The winding former is $\frac{1}{4}$ in. diameter, with an adjustable dust core. Anchor the wire at the former base. This is the collector lead, 'A'. Wind 15 turns side by side, and fix the wire with tape or a spot of adhesive, forming the positive lead, 'B'. Wind five further turns in the same direction, the beginning of this section 'C' going to Tr4 emitter bias components, and end 'D' to Tr4 emitter. There is no space between the 15 turn and 5 turn sections.

L6 is made in the same way as L5, but has only ten turns, and there is no core. Tuning is by TC4.

The transistor leads need not be cut shorter than about $\frac{3}{8}$ in. Avoid unnecessary heating of the wires when soldering; if the iron has reached its proper temperature, the joints can be made in a second or so, and the iron should be removed immediately the joint is made. It is as well to fit the transistors last of all.

Transistor leads are more easily identified if small pieces of coloured sleeving are put on, before inserting them.

CONSTRUCTION

Except for the co-axial sockets and switch, assembly is wholly on two plain Veroboards with 0.15in. matrix. The trimmers and coil formers have pins spaced to fit these holes. Holes for L4 have to be drilled or made with a small round file, and other holes are enlarged for the 6BA mounting bolts.

Fig. 2 shows the r.f. board. Leave a wire projecting from the drain of Tr1. Two $\frac{1}{2}$ in. 6BA bolts with extra nuts allow the board to be fixed to the metal case. A nut locks a tag on the board for the negative return MC.

Bolt the co-axial socket to the metal plate so that its central pin comes as in Fig. 2. Snip a little off the pin to clear the board. Solder a wire to the pin, pass it up through a hole in the board, lock the board in place, and solder the wire to C11.

Cut the ends of one 4 x 2in. flanged member so that they will rest inside the 5 x 2in. sides when the case is assembled. Bolt this part to the plate, with the drain lead of Tr1 passing through a clearance hole.

Fig. 3 shows the oscillator, doubler and mixer board. It is wired in the same way. Sleeving is put on leads which cross each other. It is helpful to use red for positive and black for negative (chassis) circuits.

Cx is a bare 20s.w.g. wire running from C3 as shown. An insulated wire runs from L6, and is given three or four turns round the bare wire. When the board is mounted, cut Tr1 drain lead to length and solder it to L2. The output socket is fixed near L4 and connected. Solder on red and black flex for battery leads.

A closed aluminium case is used as complete screening helps reduce breakthrough of signals in the 4-6MHz range. When the insulated boards are fixed as described, the converter can be tested. The

outer flanged members can then be put into position, and bolted together. The plate is screwed to them, forming a box 5 x 4 x 2in. deep.

The on-off switch is mounted on one 5 x 2in. side, and the internal screen is bolted to the 5 x 2in. sides.

The backplate is attached with self-tapping screws. Holes may be punched to allow adjustment of the core of L5 and the trimmers.

OSCILLATOR ADJUSTMENT

The converter cannot operate at all unless Tr3 is oscillating. If Tr3 is oscillating, adjustment of the core of L5 and of trimmer TC4, will produce a peak in battery current, shown by a meter in one battery lead. For reliable working, L5 should be tuned just off the peak, in the manner usual with crystal oscillators.

If the coils are as described, L6 will not tune to any other harmonic than 70MHz. Should individual wiring result in TC4 being fully open, space out the turns on L6.

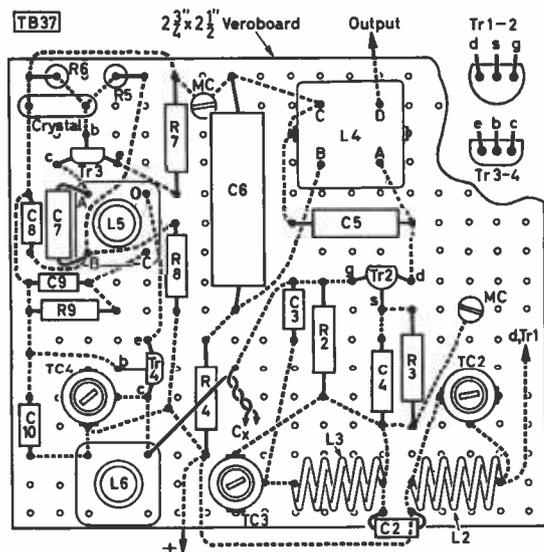


Fig. 3: Layout of the oscillator chain and mixer stage. Wiring below the board is shown dotted.

SIGNAL CIRCUITS

If a signal generator is available, this will prove useful for initial tuning. The second harmonic of a generator tuned to 72MHz may be used. Otherwise it is necessary to find a 2m transmission, to allow trimming. Usage of the band varies enormously. In many areas there is activity at week-ends, sometimes very many signals being available. But in some areas, and especially during the week, there may on occasion be a complete absence of signals. So if no generator is available, look for signals at a week-end or during evening hours. Reception can be of a.m., f.m., c.w. or s.s.b. signals, according to the receiver employed.

With any 2m signal tuned in, adjust the trimmers TC1, TC2 and TC3 for best results, by observing the receiver S-meter or obtaining maximum volume. Tuning of these circuits is not very sharp, but each

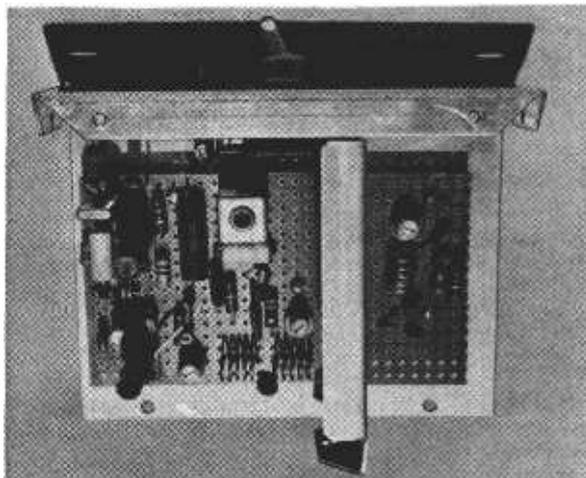
trimmer should have a definite peak. If any trimmer is fully unscrewed, stretch the coil slightly, and re-trim.

It is impossible to give absolutely optimum performance right from 144 to 146MHz, but the trimmers can be peaked up on the chosen section of the band, or slightly staggered. The core of L4 is also peaked at the middle of the band, or for that frequency of most interest.

Aerial coupling can be modified by moving the tapping on L1. C11 is not required with an aerial which does not place a d.c. short across R1 via the feeder and coil. L2 and L3 can be moved in relation to each other, to modify coupling. Changes to the value of Cx will modify injection, and unnecessarily tight coupling will only increase background noise.

AERIALS

For general results with little directivity, a dipole made from 1/4in. diameter or similar alloy tubing, mounted on a light pole, will be satisfactory. It should be 38 1/2in. overall, or have two elements each 19in. long, bolted to an insulated block, or fitted in a



View of the completed converter with part of the case removed.

TV-type connector, from which a 75 ohm or similar co-axial feeder runs to the converter.

The type of receiver generally employed would be a communications receiver in a metal cabinet, usually having provision for a screened or co-axial aerial lead. Use a reasonably short piece of 75ohm co-axial cable from the converter to receiver.

The use of an unscreened receiver, or unscreened leads or connectors, will result in some pick-up of 4-6MHz signals, which will then be heard strongly in conjunction with 2m signals.

NOTES

The same circuit could no doubt be used with a change of oscillator frequency, so that the receiver would be tuned over a different 2MHz sector of its available bands. To do this, it would be necessary to change the crystal, L5, L6, and also the transformer L4, to suit the new frequency. ■

TAKE 20

JULIAN ANDERSON

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

NEARLY all the projects described in this series use a 9V supply and battery operation has been suggested. Using batteries has a number of advantages; they are safe and portable. On the other hand they are limited in the current that they can give and in the long term are a very expensive method of operating a circuit. For a circuit that is used for any length of time and does not have to be portable, the high initial cost of a mains power supply will be quickly recovered.

This month's project may be regarded as a battery eliminator; it will give a bit more than 9V and up to 500mA making it an excellent replacement for batteries of the PP3 or PP9 sizes. If it is built into a compact form the size is not much larger than a PP9 and this circuit could well fit into the space provided for the battery.

A word of warning however. This feature is read by a large number of less experienced constructors and the mains supply can be lethal; if you are not absolutely certain what you are doing it would be best to leave this project alone.

A battery eliminator does three things: it isolates the output voltage from the mains to make it safe, it reduces the voltage to the required level and it rectifies and smooths this low voltage (i.e. it converts the a.c. to d.c.)

A transformer performs the first two functions. Mains transformers are not cheap (they are about the only components which are going up in price) though the ones specified keep the cost within our limit. Two types are mentioned, both about the same price. The one from RSC Ltd. has different connections to that shown in the drawing but details are supplied with it. The MS51 has a 7V secondary and the RSC one is 6.3V, this will make a slight, but unimportant difference to the output voltage. Most local suppliers will stock filament transformers of 6.3V and these can also be used.

The low voltage output from the transformer is rectified by the diodes D1 to D4 which are arranged in a bridge; the a.c. goes in at two points and the rectified negative and positive are taken from two other points as shown in the circuit in Fig. 1. To smooth this signal, a large capacitor with a working voltage of at least 12V is connected across the output. It doesn't matter how high the working voltage is but it must not fall below 12V.

The a.c. signal, when rectified becomes about 9V. This confuses some people. "How on earth," they ask, "can you get a higher voltage out than you put in?" There is a simple explanation; when we are talking about a.c. volts we always refer to the r.m.s. voltage (which is less than the peak voltage). When rectified, unless we are taking too much load, we shall get the peak voltage which is built up across the capacitor.

No. 38 9V POWER SUPPLY

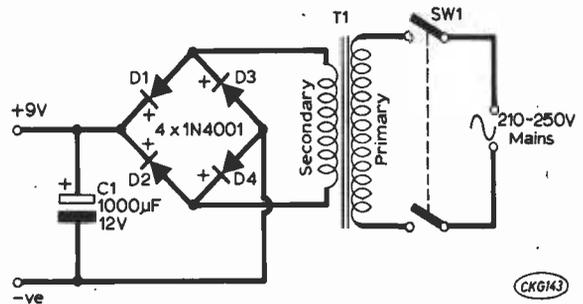


Fig. 1: The circuit of the power supply. The mains earth lead may go to either the positive or negative rail.

★ components list

D1-D4	1N4001 silicon rectifiers at 6p	24p
C1	1000µF, 12V electrolytic	18p
T1	MS51 7V, 0.5A (Henry's Radio) or 6.3V Filament transformer 1.5A (RSC Ltd.)	47p
SW1	Double-pole toggle switch	49p
		10p

Total with MS51 99p

Prices are those recently advertised and may have changed. No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

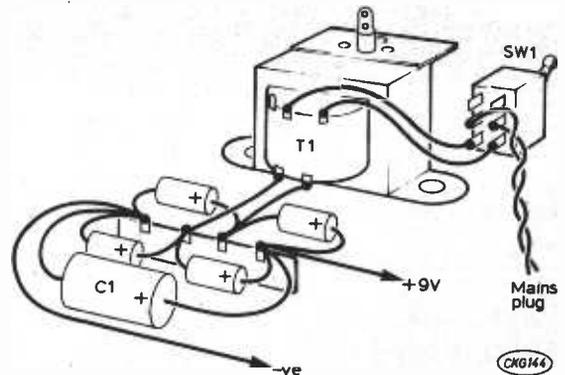


Fig. 2: Suggested wiring and layout of the 9V power supply.

When 7V a.c. (or 6.3V) is treated in this way we will get 1.414 times this as a d.c. output. 7V will give us theoretically 9.9V and 6.3V will become just under 9V. When a current is drawn this voltage falls slightly but not to any significant extent and for all intents and purposes both give near enough 9V d.c. as makes no difference.

A double-pole switch should be fitted in the mains side; single pole types can mean that the primary winding is live even if switched off. Fig. 2 shows the method of wiring up the rectifiers; the positive end of these being normally indicated by a band around the component.

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DISCO-SUPER. A slightly larger version of the Disco-Standard. Fitted individual controls for both mic. and deck inputs plus a cross-fade for deck to deck transfer. A built in P.F.L. cueing system, mic. over-ride, also a V.U. meter gives visual indication of output levels. DJ. 30L (3000w) 3-channel psychedelic light unit is a standard fitting. Deck cut out switches are also featured for ease of cueing. Size 38" x 27" x 10".
DISCO-SUPREME. Has all the facilities of the Disco-Super plus the addition of a third turntable which can be used for Jingles or other effects without using the main deck system. Flexlights are also fitted. Size 50" x 27" x 10".
DISCO-PLINTH. Consists of 2 turntables fitted with high quality ceramic cartridges. The unit has a built in cross-fade rotary control for transferring the sound from left to right decks. The unit has no amplification built in and must be used with amplifiers such as the D.J. 105S or D.J. 708. Size 32" x 14 1/2" x 7" (incl. lid).

PA-DISCO AMPLIFIERS



DISCO-AMP. 100 watt rms. output for 8-16 ohms, 4 channel inputs, 2-mic, 2 decks. Separate volume control plus masters. Response 30Hz -30KHz, distortion less than 1%. Treble/Bass/PFL/Mic over-ride etc. Panel size 16 1/2" x 7".



DJ.70S MIXER/AMPLIFIER. 70 watt rms. output for 8-16 ohms. 2-mic, 2-aux/decks. Master volume/Bass/Treble. Size 15 1/2" x 5" x 6".

DJ.105S. 30 watt rms. version. Size 11 1/2" x 5" x 6".
DISCMASTER SLAVE AMPLIFIER. 100 watt rms. for 8-16 ohms.

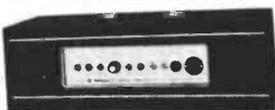
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SPECIFICATION

Output 100 watts r.m.s. \pm 1 db at 8 ohms.
 Frequency Range 20-20,000 Hz \pm 3 db.
 Distortion less than 1% at 70 watts r.m.s. \pm 1 db.
 Signal/Noise Ratio better than - 65 db.
 Input Sensitivity 700 mv at 25K
 Speaker Impedance 8 - 16 ohms.

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50K ohm Stick Microphone with lead & plug

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LIQUIMATIC. 150 watt Q1 with 6" wheel.
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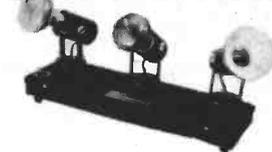
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DJ.101. Battery powered, 6-channel, variable levels, 3 x 50k mic., 1 x 100mV. aux., 2 x 100mV p.u. Output 250mV.

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2G303	20p	2N3414	22p	40312	47p	BCY31	30p	B8X61	32p	NKT402	30p
2G306	45p	2N3415	27p	40314	27p	BCY32	30p	B8X76	22p	NKT403	30p
2G308	20p	2N3416	37p	40315	37p	BCY33	25p	B8X77	27p	NKT404	65p
2G309	20p	2N3417	37p	40323	35p	BCY44	40p	B8Y78	27p	NKT405	75p
2G371	15p	2N3570	11-25	40324	47p	BCY38	40p	B8Y10	27p	NKT406	62p
2G374	20p	2N3572	27p	40326	37p	BCY39	30p	B8Y11	27p	NKT451	62p
2G381	20p	2N3603	27p	40329	30p	BCY40	50p	B8Y24	15p	NKT452	62p
2N404	20p	2N3606	27p	40344	27p	BCY43	15p	B8Y25	15p	NKT453	47p
2N696	20p	2N3607	27p	40347	57p	BCY43	15p	B8Y26	17p	NKT603F	32p
2N697	17p	2N3702	11p	40348	52p	BCY54	32p	BEY27	17p	NKT613F	32p
2N698	25p	2N3703	11p	40360	42p	BCY58	22p	B8Y28	17p	NKT614F	30p
2N706	15p	2N3704	11p	40361	47p	BCY59	22p	B8Y29	17p	NKT615F	30p
2N705A	15p	2N3705	10p	40362	57p	BCY60	27p	B8Y32	25p	NKT713	25p
2N708	15p	2N3706	09p	40370	32p	BCY70	20p	B8Y36	25p	NKT781	30p
2N709	02p	2N3707	11p	40406	57p	BCY71	25p	B8Y37	25p	NKT10419	30p
2N718	25p	2N3708	07p	40407	40p	BCY72	17p	B8Y38	22p	NKT10439	37p
2N726	30p	2N3709	09p	40408	52p	BCZ10	27p	B8Y39	22p	NKT10519	32p
2N727	30p	2N3710	09p	40410	42p	BCZ11	42p	B8Y40	32p	NKT20329	47p
2N714	17p	2N3711	12p	40474A	57p	BD116	11-12p	B8Y51	32p	NKT20339	37p
2N716	17p	2N3715	11-25	40583A	55p	BD121	11-12p	B8Y52	32p	NKT20399	37p
2N718	20p	2N3716	11-20	40606	45p	BD123	85p	B8Y53	37p	NKT20399	37p
2N729	22p	2N3791	22-06	AC107	30p	BD124	60p	B8Y54	40p	NKT20399	37p
2N790	27p	2N3819	35p	AC126	20p	BD181	75p	B8Y56	90p	NKT20399	37p
2N1090	22p	2N3823	27p	AC127	25p	BD182	85p	B8Y78	47p	NKT20399	37p
2N1091	22p	2N3854	27p	AC128	20p	BDY10	11-25	B8Y79	45p	NKT20399	37p
2N1131	25p	2N3854A	27p	AC154	22p	BDY11	11-25	B8Y82	52p	NKT20399	37p
2N1132	25p	2N3855	27p	AC176	85p	BDY90	57p	B8Y90	57p	NKT20399	37p
2N1135	17p	2N3954	27p	AC178	27p	BDY18	27p	B8Y95A	27p	NKT20399	37p
2N1303	17p	2N3856	30p	AC188	37p	BDY19	11-25	B8Y91	42p	NKT20399	37p
2N1304	22p	2N3856A	30p	AC177	27p	BDY20	11-25	B8Y92	42p	NKT20399	37p
2N1305	22p	2N3858	25p	ACY18	25p	BDY88	11-25	C111	75p	NKT20399	37p
2N1306	22p	2N3858A	25p	ACY19	25p	BDY60	11-25	C424	27p	NKT20399	37p
2N1307	22p	2N3859	27p	ACY20	25p	BDY61	11-25	C425	25p	NKT20399	37p
2N1308	22p	2N3860	27p	ACY21	25p	BDY62	11-25	C426	25p	NKT20399	37p
2N1309	30p	2N3860	30p	ACY22	25p	BF115	25p	C428	37p	NKT20399	37p
2N1507	17p	2N3866	11-50	ACY28	20p	BF117	47p	C744	30p	NKT20399	37p
2N1613	25p	2N3877	40p	ACY40	20p	BF163	37p	D16P1	37p	NKT20399	37p
2N1631	25p	2N3877A	40p	ACY41	25p	BF167	15p	D16P2	40p	NKT20399	37p
2N1632	30p	2N3900	37p	ACY44	40p	BF173	15p	D16P3	37p	NKT20399	37p
2N1638	27p	2N3904	40p	AD140	52p	BF177	30p	D16P4	40p	NKT20399	37p
2N1639	27p	2N3900	37p	AD178	47p	BF178	30p	GET102	20p	NKT20399	37p
2N1671B	11-20	2N3903	35p	AD150	62p	BF179	30p	GET113	20p	NKT20399	37p
2N1711	25p	2N3904	35p	AD181	37p	BF180	35p	GET114	20p	NKT20399	37p
2N1889	32p	2N3905	37p	AD182	37p	BF181	32p	GET118	20p	NKT20399	37p
2N1893	37p	2N3906	37p	AF108	42p	BF184	25p	GET119	20p	NKT20399	37p
2N1947	22p	2N4058	17p	AF114	25p	BF186	42p	GET120	52p	NKT20399	37p
2N1948	27p	2N4059	10p	AF115	25p	BF194	17p	GET121	20p	NKT20399	37p
2N2160	47p	2N4060	12p	AF116	25p	BF195	15p	GET122	20p	NKT20399	37p
2N2183	40p	2N4061	12p	AF117	25p	BF196	42p	GET123	20p	NKT20399	37p
2N2183A	42p	2N4062	12p	AF118	62p	BF197	42p	GET124	20p	NKT20399	37p
2N2194A	40p	2N4244	47p	AF119	20p	BF198	42p	GET125	20p	NKT20399	37p
2N2217	27p	2N4285	17p	AF124A	22p	BF200	52p	GET126	20p	NKT20399	37p
2N2219	27p	2N4286	17p	AF125	22p	BF224	14p	GET127	20p	NKT20399	37p
2N2220	27p	2N4287	10p	AF126	22p	BF225	14p	GET128	20p	NKT20399	37p
2N2220	27p	2N4288	17p	AF127	17p	BF237	22p	GET129	20p	NKT20399	37p
2N2221	25p	2N4290	17p	AF133	37p	BF238	22p	GET130	20p	NKT20399	37p
2N2222	30p	2N4291	17p	AF178	42p	BF244	22p	GET131	20p	NKT20399	37p
2N2270	47p	2N4292	12p	AF179	72p	BFW61	47p	GET132	20p	NKT20399	37p
2N2287	27p	2N4308	47p	AF180	52p	BFX12	22p	GET133	20p	NKT20399	37p
2N2368A	17p	2N5027	52p	AF181	42p	BFX13	22p	GET134	20p	NKT20399	37p
2N2369	17p	2N5028	57p	AF239	42p	BFX29	30p	GET135	20p	NKT20399	37p
2N2369A	17p	2N5029	47p	AF279	47p	BFX30	30p	GET136	20p	NKT20399	37p
2N2410	42p	2N5030	42p	AF290	62p	BFX42	37p	GET137	20p	NKT20399	37p
2N2483	37p	2N5172	12p	AF211	32p	BFX44	37p	GET138	20p	NKT20399	37p
2N2484	37p	2N5173	12p	AF212	25p	BFX45	37p	GET139	20p	NKT20399	37p
2N2539	22p	2N5175	25p	AF272	27p	BFX48	32p	GET140	20p	NKT20399	37p
2N2540	22p	2N5176	45p	AF278	27p	BFX55	32p	GET141	20p	NKT20399	37p
2N2613	35p	2N5232	30p	AFY29	27p	BFX86	25p	GET142	20p	NKT20399	37p
2N2614	35p	2N5245	45p	AFY36	25p	BFX87	27p	GET143	20p	NKT20399	37p
2N2646	32p	2N5246	42p	AFY50	25p	BFX88	25p	GET144	20p	NKT20399	37p
2N2696	22p	2N5306	32p	AF126	32p	BFY26	62p	GET145	20p	NKT20399	37p
2N2711	25p	2N5285	22-75	AFY54	32p	BFY38A	27p	GET146	20p	NKT20399	37p
2N2712	25p	2N5286	22-75	AFY86	32p	BFY10	32p	GET147	20p	NKT20399	37p
2N2713	27p	2N5287	22-82	AU103	42p	BFY11	42p	GET148	20p	NKT20399	37p
2N2714	30p	2N5305	37p	AS221	21p	BFY17	42p	GET149	20p	NKT20399	37p
2N2865	62p	2N5306	40p	BC107	10p	BFY18	32p	GET150	20p	NKT20399	37p
2N2901	27p	2N5307	37p	BC108	10p	BFY19	32p	GET151	20p	NKT20399	37p
2N2904A	37p	2N5308	37p	BC109	10p	BFY20	32p	GET152	20p	NKT20399	37p
2N2905	37p	2N5309	62p	BC113	15p	BFY21	42p	GET153	20p	NKT20399	37p
2N2905A	40p	2N5310	42p	BC115	15p	BFY24	45p	GET154	20p	NKT20399	37p
2N2906	25p	2N5354	27p	BC116A	15p	BFY25	35p	GET155	20p	NKT20399	37p
2N2906A	27p	2N5355	27p	BC118	10p	BFY26	30p	GET156	20p	NKT20399	37p
2N2907	30p	2N5356	22p	BC121	20p	BFY29	50p	GET157	20p	NKT20399	37p
2N2923	15p	2N5365	47p	BC122	20p	BFY30	50p	GET158	20p	NKT20399	37p
2N2924	15p	2N5366	32p	BC125	20p	BFY41	50p	GET159	20p	NKT20399	37p
2N2925	15p	2N5367	37p	BC126	20p	BFY43	62p	GET160	20p	NKT20399	37p
2N2926	18p	2N5457	37p	BC140	37p	BFY50	32p	GET161	20p	NKT20399	37p
Green	14p	2B005	75p	BC147	10p	BFY51	30p	GET162	20p	NKT20399	37p
Yellow	12p	2B020	22-00	BC148	10p	BFY52	30p	GET163	20p	NKT20399	37p
Orange	12p	2B102	50p	BC149	12p	BFY53	17p	GET164	20p	NKT20399	37p
2N3011	30p	2B103	85p	BC152	17p	BFY68A	57p	GET165	20p	NKT20399	37p
2N3014	32p	2B104	25p	BC157	20p	BFY75	30p	GET166	20p	NKT20399	37p
2N3053	18p	2B501	32p	BC158	11p	BFY77	42p	GET167	20p	NKT20399	37p
2N3054	46p	2B502	30p	BC159	12p	BFY77	57p	GET168	20p	NKT20399	37p
2N3055	46p	2B503	27p	BC162	10p	BFY80	37p	GET169	20p	NKT20399	37p
2N3133	30p	3N83	40p	BC167	11p	BFW58	27p	GET170	20p	NKT20399	37p
2N3134	30p	3N128	70p	BC168B	10p	BFW39	25p	GET171	20p	NKT20399	37p
2N3135	25p	3N140	72p	BC168C	11p	BFW60	25p	GET172	20p	NKT20399	37p
2N3136	25p	3N141	77p	BC169B	11p	BPX25	21-35	GET173	20p	NKT20399	37p
2N3390	25p	3N142	50p	BC169C	12p	BPX29	21-80	GET174	20p	NKT20399	37p
2N3391	25p	3N143	67p	BC170	18p	BPY10	21-45	GET175	20p	NKT20399	37p
2N3391A	30p	3N152	57p	BC171	15p	BRV39	37p	GET176	20p	NKT20399	37p
2N3392	17p	R.C.A.	57p	BC172	15p	B8X19					

In order to get the most out of any electronic ignition system it is essential that the associated electrical components are themselves in good working order. This month we deal with this problem with particular reference to the PW Electronic Ignition System.

PART 2

ELECTRONIC



IGNITION COILS

Modern ignition coils are marked positive and negative so that they can be used on either positive or negative earthed systems according to how they are wired on the car. These coils are usually more efficient than the older coils marked SW or CB and, as just stated, universal, so the constructor who builds this unit but has one of the older type coils is strongly advised to purchase a modern coil, thus gaining in efficiency and avoiding any confusion.

Sports type coils offer increased kV output but are somewhat dearer and when used with this electronic ignition system the increase in actual car performance noted was less than one might expect, so this decision must be left to the individual. A few words on the so called "Cold Start" coils would not come amiss at this point for would-be users of this electronic ignition system.

There are two methods commonly in use at the present time, that which has a carbon button ballast resistor mounted usually on one of the coil terminals and the other type which has the actual lead from the ignition switch to the ignition coil formed of resistance wire often incorporated in the wiring loom itself. When the ignition switch is turned to the starting position, this resistance is short circuited by relay contacts and the full battery voltage is applied to the primary of the coil which is wound for five or seven volts working according to the value of the resistor specified for use with the coil. This overload condition which considerably boosts the coil output is of only short duration, for as soon as the engine fires, the ignition key is allowed to return to the normal running position, the relay

D. G. FRIPP

contacts open, the ballast resistor is thus reinserted to drop the battery voltage to the correct value for normal running.

"COLD START" COILS

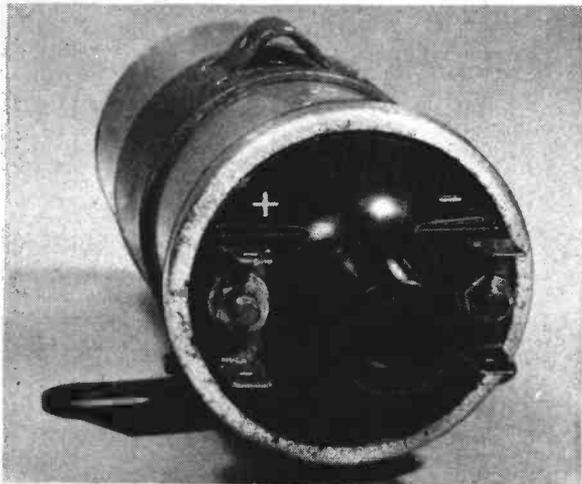
To use the "Cold Start" coil with this electronic ignition system it is essential to ensure that the ballast resistor is NOT in circuit with the battery feed to the unit (Terminal marked IG/SW). Its inclusion in the pulse lead to the coil has no significant effect.

Where the carbon button type ballast resistor is fitted, the lead to this from the ignition switch may be disconnected at the button and used to feed the battery current to the electronic unit, whilst the button may be left *in situ* and the pulse lead connected preferably to the coil side of the button, the leads to the relay being disconnected from the coil and either removed or taped up out of harms way so as to facilitate returning to normal conditions should the owner of the car wish to sell it and retain the electronic unit. These remarks apply to a negative earth system.

For a positive earth system using button resistor the battery feed to the unit may be obtained in exactly the same way, but the pulse lead must then feed to the positive coil terminal from which the original lead to the contact breaker has been removed, and the negative terminal of the coil is then earthed preferably from the coil side of the button. The same remarks apply regarding the relay leads, etc.

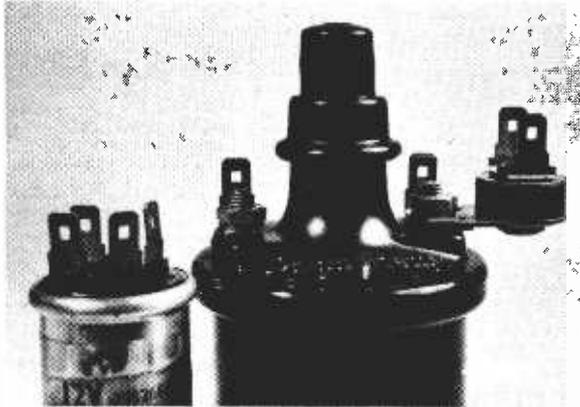
When the ballast resistor is in the form of a resistance wire this must be traced back to its source at the ignition switch from which point a new lead should be installed to feed battery power to the new unit, the original resistance lead being taped up or otherwise made safe as are relay leads as before stated.

There is another type of "Cold Start" coil which is gaining in popularity, and these notes are intended for those readers who have such a coil fitted. These



Standard ignition coil. Solder type tag connections should be replaced with push-on type connectors as shown, to facilitate reversion to normal ignition system.

coils are easily recognised as they have three low voltage connections instead of the usual two; the third connection being on the same horizontal plane, and centrally placed between the usual two in front of the h.t. stack. This third or central connection is usually wired direct to the starter solenoid switch on the starter side so as to bring the diode protected primary into circuit during starting only when used as conventional ignition. When these coils are used in conjunction with the electronic unit the middle connection is completely ignored, that is, no connection is made to it whatever, and that which is already there must be removed, and the coil can then be used as an ordinary coil as



One version of "cold start" coil with button type carbon ballast resistor mounted on one terminal. Also shown is a typical relay which shorts out the ballast resistor on starting.

before mentioned. This procedure does not harm the coil or its cold start facility which of course can be re-used should it be desired to revert at any time to conventional ignition.

PLUGS

When the unit was initially fitted to the car, nothing else was altered, but on road test a marked improvement in all round performance was immediately noticed.

Subsequently the plug gaps were reset for the reason already stated and a further improvement followed; with the car in this condition some 600 miles were covered with an improvement in the miles per gallon of approximately 10%.

At this stage it was decided to conduct tests with electronic car tuning equipment to ascertain if any further improvements could be made, whilst those already achieved were assessed and verified.

The outcome of these tests showed that a leaner mixture would be in order, due no doubt to the higher voltage sparks (8kV under load) and an overall reduction in unburnt exhaust gas of approximately 10% which reflects in the latest miles per gallon increase of almost 14% altogether, which alone, in the author's view, justifies the use of electronic ignition.

Acceleration is improved, though no 'before and after' timed tests have been made, as the author is not primarily interested in going faster, but rather in reliability, flexibility and economy. However, faster acceleration as a bonus is usually acceptable.

Flexibility is much better as the car will now travel at as low as 12 m.p.h. in top gear on a level road without undue fuss should occasion demand, though this is not recommended as a normal mode

of travel. Nevertheless this attribute could prove useful in icy or slippery conditions where one uses the highest gear practicable to obtain traction.

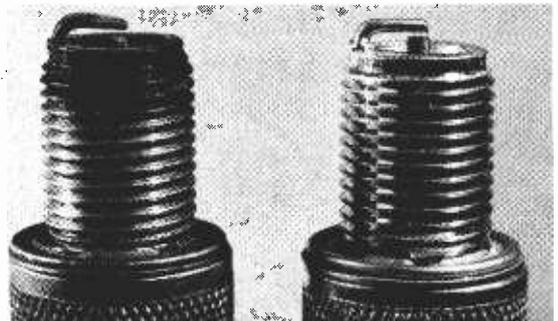
Top speed is slightly higher, but the engine definitely feels smoother in the speed range 60 to 90 m.p.h.; this is probably due to the absence of misfiring at these speeds. It is a fact not generally realized that most cars suffer from misfiring at speeds within this range, unless they are specially tuned, and even then misfiring is not always eradicated.

Hill climbing ability also shows improvement and may best be described by saying that a rather long hill regularly traversed by the author has a much steeper rise near the summit which required the use of third gear. Since using electronic ignition this road has been used on numerous occasions without the necessity for third gear, the car climbing the hill comfortably in top gear with no sign of labouring.

Last but not least of this list of improvements is ease of starting, which so far has been first time even when the car has been purposely left in an exposed position overnight and has had to have frost removed from windows before driving off.

It is not suggested that this is the severest of tests, but it is suggested that the ease of starting under these conditions is indicative of a much better chance of a first time start under even worse conditions.

It must be emphasized that the results obtained by the author on his own car with the electronic ignition unit, may not be exactly reproduced by a constructor of this unit on his own car; there will most certainly be an improvement, but its extent will obviously depend upon the condition of the engine and its ancillary equipment.



The old sparking plug, left, has obviously given of its best and should be replaced. The side electrode is thinned away and the centre electrode rounded and well down in the plug body. Compare with new plug, right, which puts spark gap further into combustion chamber, promoting a healthier spark.

Several of these units have been made and fitted to various cars, 4 cylinder, 6 cylinder and V8 types. They have all shown improved performance, some more, some less than has been related, but as the opportunity for extensive evaluation has not existed, the obvious delight of the various owners has been deemed sufficient evidence of their satisfaction.

TACHOMETERS

Should the vehicle be fitted with a tachometer and it is required to retain this, it should be ascertained whether the operating pulse is basically a voltage or a current pulse. For a voltage pulse operated unit where the pulse is taken direct from the contact breaker the existing pulse feed will

Grey twin screened wire, fig. 8 indiv. lapped screens, 7/0043 conductors, 8p yd. (min. 5 yds.) post 10p any qty. Ferrite rod 4" x 1/2" dia. or slab 4" x 1/2" x 1/2" 5p (4p post) or 5 for 80p post paid either type; potentiometers 5K or 500K less switch (spindle 1" x 1/2" dia.) 8p (4p post), 10 either or mixed 60p post paid; 5K log with sv. 1" x 1/2" spindle 15p (8p post), 5 for 80p post paid.

100 mixed ceramic capacitors 1/2000pf 50p (post 10p), 100 mixed 1/2 & 1/4 W resistors 80p (post 10p); silicon diode B7177 (350V at 1 Amp) 17p (8p post) (10 for £1-50 post pd.). A.M.-F.M. gang with 6:1 reduction drive 3" x 2" x 1 1/2", 400 + 180 + 20 + 20pf 85p post pd. (80 for 6). Electrolytic, 50-50mf 500V, 2" x 1 1/2" dia. 80p (post 5p); 50-50-50mf 300V, 2" x 1 1/2" dia. 80p (5p post); 32 (450V-15mf (300V) 2" x 1" dia. 50p (8p post); 5000mf 30V 2" x 1 1/2" dia. 80p (10p post) 6 for 80 post paid.

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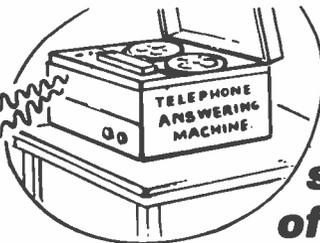
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G3UBO & G3MME

For some months now we have been dishing out words of wisdom like some mountain top oracle. Fine—only one small snag—we've never sold you anything, so for the more serious reader, we mention just a few bits of Amateur Radio that may be of interest. Yaesu Musen FR-50B Receiver. This is an Amateur Band receiver covering the 80, 40, 20, 15 and 10m Amateur Bands. Designed expressly for SSB and imported by us directly from the factory. It offers stability, selectivity, sensitivity and freedom from spurious signals to a far greater extent than the price would suggest. £52 carriage paid. For the real enthusiast, we have its big brother, the Yaesu FRdx400 Super de Luxe. This has just about everything the serious transmitting dx-er would want. Including V.H.F. Amateur Bands. £160 carriage paid. If your pocket won't stretch to the exalted heights of the FRdx400, we always have a wide selection of Amateur Band receivers from about £30 upwards. (If you want something cheaper than this, it can occasionally be done satisfactorily, but only very occasionally—just be sure you don't learn the hard way!)

TVdx A good antenna rotor really makes a difference—we sell rotators handling small VHF beams to dirty great full-size HF beams and for TVdx can thoroughly recommend the CDR model AR22. Complete with remote control/indicator unit it costs £25 carriage paid—a bob or two more than the cheapest, but very well worth it for the extra reliability and long life.

Another useful thing for improving signals is a drop of really good coax. We stock UR67 at 22p per yard (post extra), which is about as cheap as you'll get for brand new factory fresh stuff. For less critical applications we have UR70 at 10p and UR43 at 8p per yard—again factory fresh—again rock bottom price. 300 and 7.5 ohm ribbon 5p per yard. Test Gear. We import a beautiful 30 Mhz counter for £79.50. Runs off both A.C. mains and 12v battery. Come to think of it, as far as I know it's the lowest priced 30 Mhz counter on the market, and yet the quality is absolutely first class.

The above are just samples of our wide range of Amateur Radio equipment—we stock everything from aerials to 'Z' matches for the Amateur Radio enthusiast. Please note, though, that we don't handle domestic equipment, Hi-Fi, small components, surplus junk—just good quality equipment for the Amateur Radio Enthusiast. Equally, we service the stuff we sell and consider we have the best Amateur Radio service department in the country. If you'd care to send us a large s.a.e. with a 6p stamp on it, we'll fill it with guff on all the stuff we sell.

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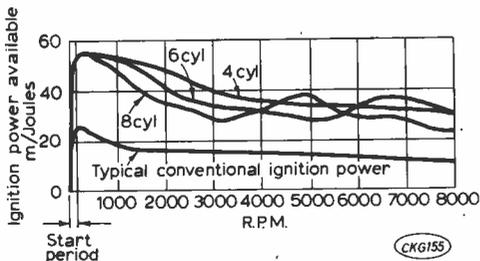
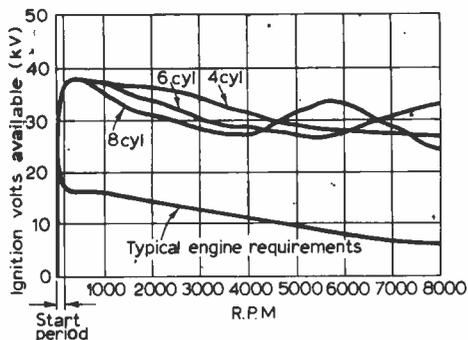
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EBF89	12p	PL81	12p	20P1	15p
ECC81	10p	PL36	20p	20D1	15p
ECC82	10p	PCF32	12p	20P3	10p
ECC83	10p	PY33	10p	30P4	20p
ECL80	7p	Y82	5p	30P12	20p
EF91	4p	PL82	5p	30FL1	20p
EY86	20p	PL83	5p	30F5	10p
EF90	60p per dozen	PCL84	15p	6/30L2	20p



The top graph shows the coil output voltage available using an electronic ignition system compared to typical engine requirements. The bottom graph is related to power requirements, being the power supplied to the ignition coil primary. During the start period the nominal battery voltage of 13.2 dropped to 9.6V.

usually be found to function satisfactorily, although in some instances where an attenuator input is used, the resistor values of the attenuator may require alteration.

With a current pulse feed unit, usually via a transformer, the coupling coil leads may be connected in between the CB tag of the ignition unit and the contact breaker, although it has been found advantageous to rewind the coupling coil where it consists of only one turn with ten to fifteen turns of 28 s.w.g. enamelled copper wire.

Alternatively the coupling coil may be tried connected between IG/SW on ignition unit and the negative terminal of the ignition coil, the lead from the ignition coil negative terminal to coil negative on the ignition unit of course is not required.

NOTES

It has come to the author's notice, that some sporadic triggering of the thyristor can occur under certain circumstances, namely where the battery feed to the unit is exceptionally long or there is a faulty connection somewhere in this lead, possibly in the ignition switch itself but in all cases it can be cured by connecting a 25 μ F 25V working electrolytic capacitor as near to the battery input to the unit as possible, thus preventing any noise surges on the battery line causing erratic triggering.

This capacitor may be mounted externally from unit tag marked IG/SW to chassis, observing polarity; or it may be mounted inside the unit by means of a thin metal clamping band affixed to the centre earthed tag of three-way tag strip between transistor, one end connecting to the band, the other to the white lead going to T1.

The heat sink fin arrangement is more than sufficient to cope with the heat from transistors and transformer and their form does much to stiffen

the unit in a manner which is desirable for the mounting of the transformer, as well as giving some mechanical protection to the transistors and the connecting leads; nevertheless the unit should be mounted in a comparatively cool situation, not on the engine itself or near to exhaust pipes, etc.

Radio interference generated by this unit is nil as it is totally screened furthermore the noise from the pulse lead is considerably less than with a conventional system.

Several of these units have been made and fitted to different cars and each time it has been found advantageous to remove any suppressor capacitor which is connected between the battery live feed to the ignition coil and earth.

TELEVISION

JULY ISSUE

THE SURPRISING SEMICONDUCTORS

Many effects other than rectification and the transistor effect are now known in semi-conductor technology and are being increasingly used in novel semiconductor devices—especially for microwave applications. With the prospect of s.h.f. TV reception in Band VI on the horizon some of these devices may find a place in TV sets of the future. Next month we shall be examining the operation of such devices as the tunnel diode, avalanche diode, impatt diode, trapatt diode, Read diode, Gunn oscillator, step-recovery diode and electroluminescent devices which could eventually form the basis of solid-state TV screens.

STOCK FAULTS

As the years roll on an increasing number of stock faults become apparent in commonly encountered TV chassis. Many of these have inevitably come to light since the original publication of our *Servicing Television Receivers* series and in next month's instalment we are giving a round-up of these common weaknesses.

MORE TV ICs

ICs are increasingly taking over the roll of colour receiver decoder signal processing. Next month we shall be looking at some Mullard ICs which fulfil these operations and could well form an important part of the next generation of colour receivers.

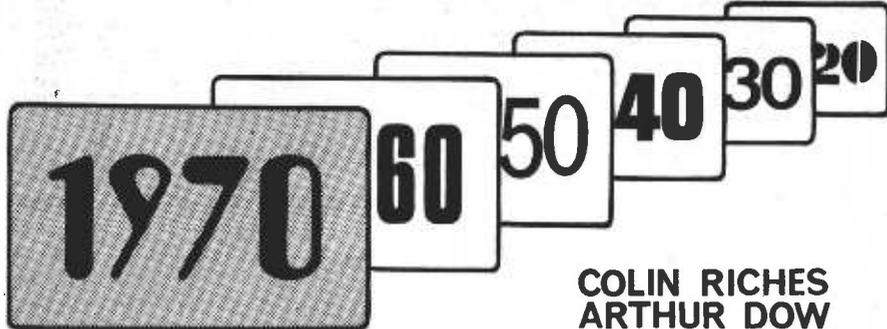
COLOUR RECEIVER PROJECT

Full constructional details for the i.f. strip plus a round-up of queries which are regularly being asked by readers about this project.

PLUS ALL THE REGULAR FEATURES

ON SALE JUNE 19

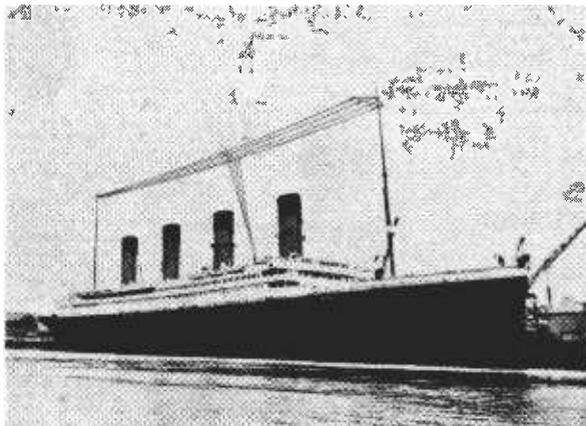
GOING BACK...



COLIN RICHES
ARTHUR DOW



TITANIC DISASTER - PART 3



The Titanic leaving Southampton. The wireless aerial can be clearly seen.

The radio equipment of the *Titanic* was the most powerful possessed by any vessel of the mercantile marine at the time. Its generating plant consisted of a 5kW motor-generator set, yielding current at 300 volts 60 cycles. The motor of the set was fed at 110 volts d.c. from the ship's lighting circuit, normally supplied from steam-driven sets. In addition, an independent oil-engine set was installed on the top deck, and a battery of accumulators was also provided as a stand-by. The alternator of the motor-generator set was connected to the primary of an air-core transformer, and the condenser consisted of oil-immersed glass plates. To eliminate as far as possible the spark-gap and its consequent resistance, which, as well known, the principal cause of the damping of the waves in the transmitting circuit, the ordinary Marconi rotary disc discharger was used, this driven off the shaft of the motor-generator. The guaranteed working range of the equipment was 250 miles under any atmospheric conditions, but actually communication could be kept up to about 400 miles, while at night the range was often increased up to 2,000 miles. The aerial was supported by two masts, 200ft. high, stepped 600ft. apart, and had a mean height of 170ft. It was of the twin T type, and was used for the double purpose of transmitting and receiving. The earth connection was made by insulated cable to convenient points on the hull of the vessel.

The receiver was the Marconi standard magnetic travelling band detector used in conjunction with the multiple tuner, providing for the reception of all waves between 100 and 2,500 metres. The multiple tuner was calibrated to permit the instruments to be set to any prearranged wavelength, and to be provided with a change switch to permit instantaneous change of the circuit from a highly-synthesised tuned condition to an untuned condition (for stand-by) especially devised for picking up incoming signals of widely different wavelengths. By reason of its robust nature the magnetic detector could be employed permanently connected to the transmitting aerial, thus dispensing with all mechanical change over switching arrangements.

Marconi's Comments

Mr. Marconi was called to give evidence of the Board of Trade enquiry and he stated that there were two possibilities whereby a continuous watch could be kept in the wireless room to listen out for S.O.S. signals. The first was to give a member of the crew sufficient training to be able to recognise distress signals and place him on listening watch whenever the wireless operators were not on duty. The second was for the development of a device which would sound an alarm bell whenever an emergency call was received.

Incidentally, it may interest readers to know that this auto-alarm apparatus was eventually proved in experiments and adapted but not until the end of World War I.

Mr. Marconi's comments on the disaster were that he was eternally thankful that over seven hundred persons had been saved by wireless, he knew that others should not have died. He commented that it was worthwhile having lived to make it possible for those people to have been saved, and all those who had been working with him entertained a true feeling of gratitude that wireless had again helped to save human lives. He explained that the *Titanic* call for help was not heard by some ships as they were receiving news bulletins from Cape Cod, and this was something that must be thought about very seriously.

Although the survivors of the *Titanic* disaster marched *en masse* to honour Marconi at his hotel in New York, he always felt that his invention should have done more. He realised that too many ships

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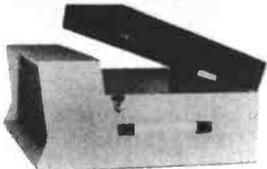


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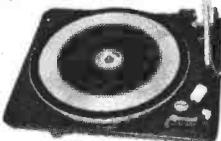
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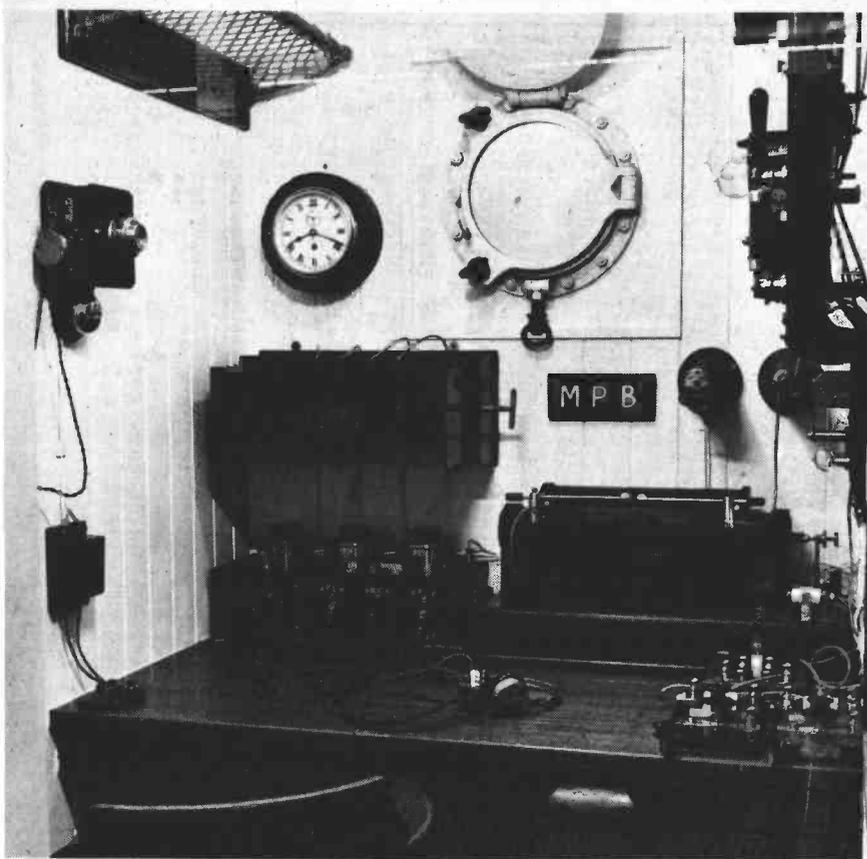
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The Marconi Company made its first commercial installation on a merchant ship in 1900. In 1910, over 100 new installations were made, bringing the total number of Marconi-equipped ships to 250. Communication was exclusively by Morse. The 1.5kW installation shown here was standard for large and medium vessels.

The transmitting apparatus is mostly housed in the "silence cabin" on the right shown here without its sound-proofed door. Considerable noise came from the spark and from the rotary converter that powered it. An emergency transmitter in the main cabin used an induction coil and was powered by accumulators.

A wavelength of 600m was used almost exclusively, though by law the equipment had to be capable of operating at 300m.

During ocean voyages, ships were at times out of reach of shore stations

and messages had to be relayed by other ships.

had wireless equipment far too weak and that certain wavelengths must be set aside exclusively for different kinds of wireless messages.

To facilitate this, Marconi Company issued monthly "Communications Charts" for the main transoceanic routes, showing the passages scheduled for Marconi equipped ships.

This is the kind of radio cabin that Titanic had. Unfortunately we were unable to obtain a picture of the actual apparatus operated by Phillips but the Science Museum kindly let us have a picture of their mock-up radio cabin on display in their Radio Gallery.

Colin Riches and Arthur Dow wish to thank most sincerely those readers who wrote—some anonymously—with information and stories of that fateful night sixty years ago.

CC "6NA"

We recently received a letter from Mr. W. Moorwood, G3CAQ, Chairman of the Wolverhampton Amateur Radio Society.

During the last 12 months he has uncovered a mass of information and pictures relating to the period 1912-1938 and also tracked down a number of "old timers" in the 80-85 years age group. One person he cannot put a name to is the holder of the Call-sign 6NA. The picture shows 6NA and it was taken about 1922-24, so if any readers can help on this one, will they please contact Mr Moorwood at 4, Grafton Place, Bilston, Staffs., WV14 6LH.



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3V4	-46	DL92	-24	EL33	-54	PL83	-31
6/SOL2	-53	DL94	-46	EL84	-22	PL84	-20
6AQ5	-21	DL96	-26	EY81	-35	PL500	-61
6BW7	-60	DY86	-22	EY86	-25	PL504	-61
6F1	-57	DY87	-23	EZ80	-20	PY81	-23
6F23	-67	DY89	-30	EZ81	-21	PY82	-24
6F25	-51	EAB380	-30	KT91	-54	PY800	-23
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30C15	-50	EBF89	-27	PC86	-45	U25	-53
30C17	-75	ECC81	-15	PC88	-45	U26	-55
30C18	-59	ECC82	-18	PC900	-30	U191	-57
30F5	-63	ECC83	-21	PC94	-28	U251	-61
30FL1	-59	ECP82	-26	PC99	-48	U299	-75
30FL14	-67	ECH35	-53	PC189	-47	U801	-76
30L15	-61	ECH42	-28	PCF80	-29	UBF89	-29
30L17	-66	ECH81	-26	PCF86	-48	UC085	-24
30P4	-56	ECL80	-35	PCF801	-27	UCH81	-30
30P19	-56	ECL82	-29	PCF802	-38	UCL82	-31
30PL1	-58	ECL86	-34	PCF805	-59	UF99	-29
30PL13	-67	EF39	-26	PCL82	-30	UL84	-29
30PL14	-63	EF90	-23	PCL83	-55	UY41	-37
DAF91	-21	EF85	-23	PCL84	-29	UY85	-24
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DF91	-14	EF89	-24	PCL86	-27	Z77	-48

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No. of Poles	2 way	3 way	4 way	5 way	6 way	7 way	8 way	9 way	10 way	12 way
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2 poles	40p	40p								
3 poles	40p	40p								
4 poles	40p	40p								
5 poles	40p	40p								
6 poles	40p	40p								
7 poles	70p	70p								
8 poles	70p	70p								
9 poles	70p	70p								
10 poles	70p	70p								
11 poles	70p	70p								
12 poles	70p	70p								

THIS MONTH'S SNIP

1 1/2 AMP TWIN GANG SOCKETS
Offered at less than wholesale price your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched 30p each, separately switched 30p each. Separately switched and with neon on/off indicators 45p each. Less 10% ten or more + 20p postage if order under £5.

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For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price **£2.50**, plus 20p post and insurance.

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PW DIGITAL CLOCK
As featured in this issue. Send S.A.E. for list of parts.

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Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nickel—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace", "weak" or "good". The tester is complete in its case, size 3 1/2" x 6 1/2" x 2" with leads and prods. Price **£1.75 plus 20p postage**.

Where postage is not stated then orders over **£5** are post free. Below **£5** add 20p. Semiconductor add 5p post. Over **£1** post free. S.A.E. with enquiries please.

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Could also be used to open ventilators, doors, valve, damper etc. particularly suitable for remote control. Made by Batchwell. Essentially a reversible motor fitted with internal limit switches to regulate it at the end of its travel. Size approx. 6" x 6" x 5 1/2" and weighing approx. 10 lbs. This is extremely powerful and would lift a heavy door or open a long line of ventilators. To operate this motor you put the 50 cycle supply through a change over switch. For instance a thermostat with changeover contacts could automatically regulate the temperature in a growing house, chicken hatchery etc. An indicator on the motor graduated 0-10 shows the state of open or close. Also internally fitted is a variable resistor, wires from this to a volt meter would give a remote indication of the open or close position. A very expensive motor if both direct from Batchwell, our price complete with step down Transformer is **£15**.

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Batchwell type QX. This is ideal for working with the Batchwell ZPM. Extremely accurate in operation. Modern design in gold finished metal case with external temperature setter. These are set for the range 10°-25° C but the setting is adjustable by an internal screw to make it suitable for other temperature ranges. This is an expensive Thermostat. Our price however is only **£4.50**.

MULLARD THYRISTOR TRIGGER MODULE
This produces pulses for phase control triggering, it has two isolated outputs, no one thyristor or two thyristors (in separate arms of bridge) may be controlled by one module. The timing circuit is synchronised to the mains frequency and control is by an external variable resistor or from a voltage or current source. Provision is made for feed back where automatic control is required. Price **£4.50 each** or 10 for **£40**. Large quantities on special quote.

EDUCATIONAL KITS
—all with pictorial instructions. Educational kits. Japanese made these are excellent value for money. We do not expect to be able to repeat this offer, once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 11 piece balance kit. Price of kits 40p each post paid. Special price for all 7 kits **£2.50** with free balance kit.

KA5 Lens Kit. Eleven parts, including candle, one concave lens, one convex lens, stage and slit frame, etc. Watch light rays bend as they pass through different lenses.

KA6 Water Pump Kit. Thirteen parts. Top of pump is transparent so that operating parts may be observed. Small parts are brightly coloured to be seen easily while working. Three types of pump may be made: Lift pump, Force Pump and Force Pump with reservoir and nozzle.

KA4 Buzzer Kit. Eleven parts. Transparent covers allow the operation of buzzer to be seen. Illustrates and teaches how electromagnetism with an automatic switch results in an operating buzzer.

KA3 3-Pole Motor Kit. Twenty-four parts, including enamel wire, armature and pole piece, etc. Motor operates from 11 volt battery. Illustrates and teaches how electro-magnetism operates a motor.

KA7 Electro-Magnet Kit. Fifteen parts, including compass. Makes two electro-magnets, one with one layer of wire and one with several layers of wire. Picks up tacks, nails and any small metal parts showing how magnetism works.

KA8 Current and Resistance Kit. Twenty-nine parts, including bench and light bulb. Conduct interesting and educational projects to learn the application of "OHMS LAW" and see the difference in current and resistance with different types and lengths of wire.

KA9 Bell Kit. Eight parts, including bell and push button switch. Build a complete electric bell and see how the hammer is triggered to make the bell ring.

PULSE GENERATORS
Sectronic, made by Smiths. Operated by single 1.5 volt battery or transformer and rectifier. Two models, one gives 10 pulses per second the other gives 8. In plastic enclosures, size approx 2" x 1 1/2" x 1 1/2" deep. Price **£2 each**, 10 for **£18**.

HIVAC NUMICATION TUBES
three types available—
XN 3 shows figs. 0-9
XN 14
XN 16
All **£1 each**, 10 for **£9**.

J. BULL (ELECTRICAL) LTD.
(Dept. P.W.), 7 Park Street, Croydon CRO 1YD
Callers to: 102/3 Tamworth Road, Croydon.

RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.
 ★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
 ★ GARRARD SP25 MK III Turntable on Plinth with cover
 ★ GOLDRING G850 Magnetic cartridge with diamond stylus
 ★ PAIR OF STANWAY II Speaker Units
 Special Total Price **£86.95**
 Carr. £1.50

Terms: Deposit £11.95 and 9 monthly payments £9.37 (Total £96.28).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
 ★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
 ★ Goldring Magnetic P.U. Cartridge
 ★ Pair of Stanway II speaker units.
 Special Total Price **£98.63**
 Carr. £1.50

Terms: Deposit £13.63 and 9 monthly payments £10.62 (Total £109.21).



ATTRACTIVE TEAK OR AFORMOSIA VENEERED CABINETS AND PLINTHS
 Send S.A.E. for coloured brochure showing other money saving offers.

Matching as recommended for optimum performance.

★ TA12 AMPLIFIER
 6.5 + 6.5 watt in veneered housing
 ★ GARRARD SP25 MK III Player unit on Plinth
 ★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
 ★ PAIR OF DORCHESTER

Loudspeaker Units
 Special Total Price **£58.33**
 Or Deposit £8.33 & 9 mthly payments £6.25 (Total £64.58). Carr. £1.25
 Trans. Plastic Cover £3.15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1.25
 Or Deposit £7.45 and 9 monthly payments £5.58 (Total £57.67)
 Trans. Plastic cover £3.15 extra.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25 x 14 x 10in. approx. COMPLETE KIT **£23**
 ★ Response 30-20,000 c.p.s. Impedance 15 ohms Carr. 65p
 ★ Performance comparable with units costing considerably more.
 Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8 x 6in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4.60 and 9 monthly payments £2.47 (Total £28.83).

DEMONSTRATIONS AT ALL BRANCHES

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeakers output impedances of 3 to 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs.



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11.50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £14.99 or Dep. £2.80 and 9 monthly payments £1.70 (Total £17.50).

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction.
 OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6.95** Carr. 30p



AUDIOTRINE HIGH FIDELITY SPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "TP" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-16 ohms. PLEASE STATE CHOICE.

Exceptional performance at low cost.				
HF908T	8" 10W	£2.88	HF180D 8" 15W	£4.75
HF102D	10" 10W	£3.40	HF186D 12" 15W	£5.50
HF120	12" 16W	£4.25	HF186D 12" 15W	£5.90

FANE 807T HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-16 Ω. PLEASE STATE IMPEDANCE WHEN ORDERING **£3.85**



HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.
 DORCHESTER (Illustrated) Size 16 x 11 x 9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Filled High flux 13 x 8in. **£9.45** Carr. 40p.
 DUST One speaker. Imp. 3 or 15 ohms.
 STANWAY II Size 20 x 10 1/2 x 9 1/2 in. appr. Rating 10 watts. Inc. 13 x 8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for **£17.85** illustration

R.S.C. TA12 MKIII 6.5 + 6.5 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
 HIGH FIDELITY OUTPUT OF 6.5 WATTS PER CHANNEL
 Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. - 20dB ★ Harmonic Distortion 0.3% at 1,000 c.p.s. Hum and Noise - 70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome Silver Facia plate & Knobs. COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. **£15.50** Carr. Factory built with wiring diagrams & instructions. **£19.50** Dep. £3 and 9 mthly pymts £2.15 (Total £22.85). Or in Teak veneer housing Dep. £3 & 9 mthly payments £2.65 (Total £25.95). Send S.A.E. for leaflet. **£23**



HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc.
 JEB Size 16 x 11 x 9in. SE8 For optimum performance with any 8in. Hi-Fi spkr, Size 22 **£6.47**
 8in. Hi-Fi speaker. **£5.35** 15 x 9in.
 SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter Size **£7.87**
 25 x 16 x 10 1/2 in.



R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BML. All dry-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2in. approx. Completely replaces batteries supplying 1.5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available. COMPLETE KIT **£3.25** ASSEMBLED READY **£3.75** WITH DIAGRAM FOR USE

R.S.C. TA6 6 Watt HI-FI AMPLIFIER

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. - 2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9 1/2 x 7 1/2 x 5 1/2 in. Attractive brushed silver finish facia plate 10 x 3 1/2 in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7.75** Carr. 40p
 OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE **£10.95**



R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.

Only high grade components by leading manufacturers. COMPLETE KIT OF PARTS **£25** Carr. 65p
 OR FACTORY BUILT WITH 12 months guarantee. Dep. £5.75 and 9 monthly payments £3.50 (Total £27.25). **£33.75**
 OR FACTORY BUILT in cabinet as illustrated. Dep. £7 and 9 monthly payments £3.92 (Total £24.91) **£38.75**



PRINTED CIRCUITRY TWENTY SILICON TRANSISTORS. FOUR DIODES. FOUR RECTIFIERS

★ SATIN SILVER METAL FACIA with black lettering. Black edged knobs with bright silver centres.
 ★ PUSH-BUTTON SELECTOR SWITCHING
 ★ NEON INDICATOR
 ★ JACK SOCKET FOR HEADPHONES
 ★ CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC. REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms. HARMONIC DISTORTION: -65dB Full Vol. FREQUENCY RESPONSE: -3dB 7Hz to 70kHz 0.1% at 1000 Hz 10 Watts TREBLE CONTROL: -16dB to +12dB at 14kHz CROSS TALK -58dB BASE CONTROL: -17dB to -16dB at 40Hz SENSITIVITIES: Disc Mag. 2.5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV. REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC DISCOTHEQUE EQUIPMENT

50 WATT SPEAKER



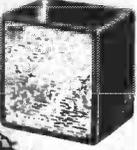
100 WATT AMPLIFIER



HEADPHONES MICROPHONE



50 WATT SPEAKER



SAVINGS ON PACKAGE OFFER

- (1) FAL FG1/2A Console
- (2) 100W Power Amplifier
- (3) Pair High Quality Headphones
- (4) Matching Dynamic (Moving Coil) Microphone fitted to Headphones
- (5) Pair 50W Speakers black rexine covered Size approx. 18" x 18" x 8"
- (6) Carrying Strap for Console

TOTAL COST OF ALL ILLUSTRATED UNITS Carr. £2-50

Terms: Deposit £30 and 18 monthly payments of £7-50 (Total £165)

All units available separately

FAL

F.G.1/2A DISCO CONSOLE

Incorporating twin Garrard SP95 Mk.III turntables and Ceramic Cartridges with diamond stylus. Separate Vol. controls for turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid.

Carr. £1-25

Carrying strap £1-25

extra if required.

Terms: Deposit £13-25 & 9 monthly payments of £6-75 (Total £74-00)

SEND S.A.E. FOR DISCO LEAFLET

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 16 Ohms covered in Rexine and Vynair

TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C48S 25-30 WATTS

Fitted four 8" high flux 8 watt speakers

Overall size approx. 48 x 10 x 5in.

Terms: Dep. £3 and 9 monthly payments £2 (Total £21)

Carr. 50p.

TYPE C412S 50 WATTS

Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 x 14 x 9in

Terms: Dep. £4 and 9 monthly payments £3-37 (Total £24-33) Carr. 75p.

TYPE C4100 100 WATTS

inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 x 16 x 10" Acoustically filled and pressurised. Terms: Dep. £11 and 9 mthly. pmts. £8-75 (Total £71.75). Carr. £1

FANE ULTRA HIGH POWER LOUSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE

High flux ceramic magnets. All carr. free.

'POP' 100	'POP' 60	'POP' 50
18" 100Watt 14,000 gauss 8/15Ω	15" 60 Watt 14,000 gauss 8/15Ω	12" 50 Watt 13,000 gauss 15Ω
£22-95	£12-90	£10-90

Dep. £6 and 9 mthly payments £2-20 (Total £25-80)

Dep. £3-30 and 9 monthly payments £1-30 (Total £15).

FOR BASS GUITAR, ELECT. ORGAN, ETC.

Dep. £2 and 9 monthly payments £1-20 (Total £12-80)

PAIR SUITABLE ALL PURPOSES

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output, Hum level -70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF85, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 35 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes. 200-250V. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1-80. Or factory built with EL34 output valves and 12 months' guarantee for £19-75

Terms: Dep. £4 and 9 monthly payments of £2-10 (Total £22-90). Send S.A.E. for leaflet.

FANE 'SPEAKERS' 'POP' 25/2 12 in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ)

£6-75 Carr. free

or Dep. £1 and 9 mthly payments 75p (Total £7-75)

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and interleaved where necessary.

Primarys 200-250V, 50c/s. Screened

MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 in.

250V, 60mA, 6-3V, 2A	99p
250-0-250V, 60mA 6-3V, 2A	£1-05

FULLY SHEATHED UPRIGHT MOUNTING

250-0-250V, 60mA, 6-3V, 2A, 0-5-6-3V, 2A	£1-40
250-0-250V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-20
300-0-300V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-20
300-0-300V, 130mA, 6-3V, 4A, c.t., 6-3V, 1A	£2-20

For Mullard 510 Amplifier

300-0-350V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-55
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425-0-425V, 200mA, 6-3V, 4A, c.t., 5V, 3A	£4-95
425-0-425V, 200mA, 6-3V, 4A, 6-3V, 3A, 5V, 3A	£5-10

TOP-SHEATHED 250mA, 6-3V, 4A, c.t., 5V, 3A £5-50

400-0-400V DROP-THERO TYPE

250-0-250V, 70mA, 6-3V, 2A, 0-5-6-3V, 2A	£1-85
250-0-250V, 100mA, 6-3V, 3-5A	£1-55
250-0-250V, 100mA, 6-3V, 2A, 6-3V, 1A	£1-60
350-0-350V, 80mA, 6-3V, 2A, 0-5-6-3V, 2A	£1-85
350-0-350V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-20
300-0-300V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-20
300-0-300V, 130mA, 6-3V, 4A, c.t. 6-3V, 1A	£2-20

Suitable for Mullard 510 Amplifier

350-0-350V, 100mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-80
350-0-350V, 150mA, 6-3V, 4A, 0-5-6-3V, 3A	£2-80

FLAMELET OR TRANSISTOR POWER PACK

Types 6-3V, 1.5A 49p; 6-3V, 2A 54p; 6-3V, 3A 76p; 6-3V, 4A 130; 12V, 1A 56p; 12V, 3A 24; 1.5A £1-35; 0-9-18V 1.5A £1-10; 0-12-25-42V 2A £1-78.

CHARGER TRANSFORMERS 0-9-15V, 1.5A, 99p

2.5A, £1-10; 3A, £1-25; 5A, £1-45; 6A, £1-55; 8A, £2-00

AUTO (Step Up/step Down) TRANSFORMERS

0-110/120V, 200-230-250V, 50-80 watts £1-10, 150 watts, £1-90 250 watts £2-75; 500 watts £5-75

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p

Push-Pull 8 watts EL84 to 3 or 15 Ω or 15 Ω 83p

Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω

Push-Pull EL84 to 3 or 15 Ω 0-10-12 watts £1-35

Push-Pull Ultra Linear for Mullard 510, etc. £2-20

Push-Pull 15-18 watt, sectionally wound £1-6, KT66, etc. for 3 or 15 Ω £1-99

Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω £3-80

SMOOTHING CHOKES 150mA, 7-10H, 250 Ω 70p; 100mA, 10H, 200 Ω 60p; 80mA, 10H, 350 Ω 50p; 60mA, 10H, 400 Ω 25p.

SELENIUM RECTIFIERS F. W. (Bridged)

All 6V, D.C. output. Max. A.C. input 18V.

1A, £2p, 2A, 35p, 3A, 50p, 4A, 65p, 5A, 80p.

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER	£34-95	PACKAGE PRICE
PR. FANE POP 25/2 25W L/SPEAKERS	£13-50	
Terms: Deposit £6-50 and 9 monthly payments of £4-72 (Total £48-98)	£48-45	Carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER	£34-95	PACKAGE PRICE
PR. FANE POP 50 L/SPEAKERS	£21-80	
Terms: Deposit £10 and 9 monthly payments of £2-25 (Total £27-85)	£52	Carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER	£34-95	PACKAGE PRICE
PAIR L12/25 25W L/S in cabinets	£23-90	
Terms: Deposit £10 and 9 monthly payments of £4-50 (Total £59-50)	£59-55	Carr. £1-25
F.A.L. PHASE 100 AMPLIFIER	£61-95	PACKAGE PRICE
4 FANE POP 50 L/SPEAKERS	£43-80	
Terms: Deposit £15-95 and 9 monthly payments of £10-50 (Total £110-45)	£99-95	Carr. £2

HIGH QUALITY LOUSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH

L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. 75p.

Or deposit £4-50 and 9 monthly pmts. of £3-82. Total £37-08

L12/25 12" 25 WATT L13/13" x 8" 10 Watt 10,000 lines £11-95

10,000 lines 3 or 15 ohms. State impedance required. Carr 40p

£5-25

FAL PHASE 50 MK.III AMPLIFIER 50W

Solid state. 4 Separately controlled inputs Plus master vol. control. Inrd. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" x 7 1/2" x 7 1/2" Carr. £34-95

200-250V. A.C. mains Output 50 watts rms rating. Or deposit £7-25 & 9 monthly payments £3-50. Total £38-75.

R.S.C. Branches listed below open all day Sat.

BRADFORD 10 North Parade (Half-day Wed.). Tel. 253349

BLACKPOOL (Agent) O & C Electronics, 227 Church Street

BIRMINGHAM 30/31 Great Western Arcade, Tel. 021-235 1279 (Half-day Wed.)

DERBY 26 Osmaston Rd., The Spot (Half-day Wed.). Tel. 41361

DARLINGTON 18 Priestgate (Half-day Wed.). Tel. 68043

EDINBURGH 101 Lothian Rd. (Half-day Wed.)

GLASGOW 326 Argyle St. (Half-day Tues.). Tel. 248 4158

HULL 91 Paragon Street (Half-day Thurs.). Tel. 20505.

LEICESTER 32 High Street (Half-day Thurs.). Tel. 56420

LEEDS 5-7 County (Mecca) Arcade, Briggate (Half-day Wed.). Tel. 28252

LIVERPOOL 73 Dale Street (Half-day Wed.). Tel. 236 3573

LONDON 238 Edgware Road, W.2. (Half-day Thurs.). Tel. 723 1629

MANCHESTER 80A Oldham Street, (Half-day Wed.). Tel. 236 2778

MIDDLESBROUGH 106 Newport Rd. (Half-day Wed.). Tel. 47096

NEWCASTLE UPON TYNE 41 Blackett Street (Half-day Wed.). Tel. 21469

NOTTINGHAM 19/19A Market Street (Half-day Thurs.). Tel. 48068

SHEFFIELD 13 Exchange Street (Castle Market Bldg.) (Half-day Thurs.). Tel. 20716

SUNDERLAND 5 Market Square

Opp. W. H. Smiths

NOW TWO NEW BRANCHES

19/19A MARKET STREET

NOTTINGHAM

Also 5 Market Square

SUNDERLAND

Opening late July

AND NOW MUCH LARGER PREMISES AT 101 LOTHIAN ROAD, EDINBURGH

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HI-FI CENTRES LTD.

MAIL ORDERS & EXPORT ENQUIRIES TO:—

AUDIO HOUSE, HENCONNER LANE, LEEDS, 13. Tel: Pudsey (09735) 77681.

TERMS C.W.O. or C.O.D. No C.O.D. under £1.

POSTAGE 25p EXTRA UNDER £2. 30p EXTRA OVER £2 OR AS QUOTED. TRADE SUPPLIED.

S.A.E. PLEASE WITH ENQUIRIES. SUPPLIERS TO GOVERNMENT DEPARTMENTS, EDUCATION AUTHORITIES, SCHOOLS, HOSPITALS, H.M. FORCES ETC.

MAIL ORDERS MUST NOT BE SENT TO SHOPS

RSC BASS-REGENT 50 WATT AMPLIFIER

A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit optional horizontal or vertical mounting.

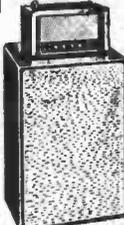
★ Two extra heavy duty 12in. Loudspeakers.

★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls.

Credit Terms: Deposit £16 & 9 monthly pmts of £6-08 Carr. £1-50

Send S.A.E. for leaflet.

£63



RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group.

A 4 input, 2 vol. control HI-FI 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. fascia. Neon indicator. For 200-250V. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet.

Terms: Deposit £4-30 and 9 monthly payments of £2-80 (Total £25-90).

£22-50 Carr. 65p



NEW FROM

LINEAR

Representing really exceptional value

TWO STEREO AMPLIFIERS

IN ELEGANT TEAK FINISH CASES!



LINEAR 606
6+6 WATTS
Recommended Retail Price
£22.50

0-200-230-250v. 50 Hz
A.C. mains operation.
Inputs for magnetic or
Ceramic Pickup, Tape
or Radio Tuner.

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.
Treble Control ± 12 dB at 14 KHz.
Sensitivities Mag. P.U. 3.5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K. Radio Tuner. 400 m.v. into 400K ohm, Crosstalk 53 dB.
Hum and Noise -75 dB min. vol. -65 dB max. vol.
Total Harmonic Distortion 0.1% at 1 watt into 15 ohms.
Output (per channel) 6.5 watts I.H.F.M.

- ★ Individual Bass and Treble Controls.
- ★ Frequency Response $\pm 1\frac{1}{2}$ dB 20 Hz to 65 KHz.
- ★ Outputs for Speaker Impedances between 3 and 15 ohms.
- ★ Stereo/Mono Switch.
- ★ Input Selector Switch.
- ★ Solid State Circuitry.
- ★ Attractive silver finished metal facia and matching control knobs.

- ★ A modestly priced solid state unit.
- ★ The Silver Facia with black lettering enhanced by matching control knobs, provides a high standard of appearance.
- ★ Suitable for crystal Gram. Pick-up cartridges and Radio input.
- ★ A wide range of tone variation is provided by the separate Bass and Treble 'lift' and 'cut' controls.
- ★ A selector switch permits instantaneous selection of Gram. or Radio.
- ★ Speaker impedances between 3 and 15 ohms are suitable.

TECHNICAL DETAILS

Frequency Range 20 Hz to 20 KHz
Output (per channel) 5 watts I.H.F.M.
Bass Control ± 12 dB at 60 Hz.
Treble Control ± 14 dB. at 14 KHz.

PRINTED CIRCUIT CONSTRUCTION
EMPLOYING 10 TRANSISTORS



LINEAR 505 5+5 WATTS
Recommended Retail Price

£17.50

0-200-250v. 50 Hz A.C. mains operation

Wholesale and Retail enquiries to the Manufacturers

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FELSTEAD ELECTRONICS (PW 58)

LONGLEY LANE, GATLEY, CHEADLE, CHES. SK8 4EE

Selection from our List, sent free for stamped addressed envelope. (Free overseas). Cash with Order only—No C.O.D. or Caller service. Changes (Min. 6p) in brackets after all items apply to G.B. & Eire only. Regret Orders under 25p plus charges unacceptable. S.A.E., please, for enquiries or cannot be replied to. Overseas Orders welcomed.

RECORDING TAPE: Finest quality/value British Mylar available: STANDARD 5" 600ft. 36p; 5 1/2" 900ft. 50p; 7" 1200ft. 56p; LONG PLAY 5" 900ft. 50p; 5 1/2" 1200ft. 56p; 7" 1800ft. 80p. (7ip on 5" and 5 1/2", 9p on 7"). Other sizes, Cassettes and accessories in List.

CARTRIDGES: All with standard fittings and stylus. Stereo-compatible Mono GP91/BC 11.10; STEREO GP93 11.40; Stereo Ceramic GP94 21.95. (All 1" 6p each.) Comparatives shown in List, with more types incl. Sonotone 9TAHC, Stereo Ceramic Diamond 11.97; (6p) DIAMOND STYLII: single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST; COLLARO O. P. and DC284, GARRARD GC2, GC8, GC810, GCE12, RONETTE BF40, O. P. and T. PHILIPS 3301 (3060, 3066, 3302, 3304), 3010/12/13/16, SONOTONE 19T/20T ALL AT 40p each (6p). SAPPHIRE 17ip (6p). Double-tip turn-over types (78 sep. on other side): For ACOS GP73, GP81 (for cartridges GP93, GP94 etc.) GP91SC (for stereo-compat. types) GP104 BSR 8T4 (8T3, 8T5), 8T9, (8T8), 8T12/14/15. SONOTONE 8TA, 9TA, 9TAHC, PHILIPS 3306 (3310, 3224, 3228/22, GP290). GARRARD GCM21, 22, GC823, GK825 and 26, GCM21T and 22T, GKM24T, GC823T, GK828T8, & 26T, GCM31, GC83, GC835, GC838, KR40A, KS41B ETC. ALL AT 75p (6p). SAPPHIRE 35p (6p). DOUBLE DIAMOND STYLII: (Same dia. tip each side: no 78) All types 11.50 (6p). SAPPHIRE DOUBLE ST/LP, TIPPED 40p (6p). PICK-UP WIRE: Super thin twin flex screened, sheathed, 6p per yard (Up to 6 yds., 6p over charges paid). MICROPHONES: CRYSTAL LAPEL 1 1/2", clip/hand, lead 3.5mm jack plug 82ip (7ip). CM20 Cream Plastic hand 52ip; "STICK" 60 1/2 02: CM70 "PLANET" Metal, tapered, with neck cord, adaptor for stand 11.47; "MIC 91" hand/deck 81p; "MIC 45" Curved metal hand grip 11.00. ALL with leads (all 9p). MICROPHONE INSERTS: 0-9" 27ip (Up to 6 for 6p). DYNAMIC: 209 Cardioid Ball. 50K/6000 1/2 built-in volume control, on/off switch, special 20ft. lead, the best value anywhere at 26.80; UD130, uni-dir. mesh ball 50K/600 1/2 jack plug, cable, adaptor, 24.80; DM160, omni-dir. Ball mesh, 50K, cable adaptor jack plug 23.87; (27ip each). SPEAKERS: Very popular 12" ROUND, fitted tweeter, 3, 8 or 15 ohms (state which) 11.87; (27ip)—or pair for stereo 24.25, charges paid. SMALL 2 1/2" 3 1/2 or 8 1/2 (state which) 37ip (6p). More speakers in List. HEADPHONES: High resistance 2000 1/2 adjustable: 92ip (10ip). EARPIECES: With lead and min. 2.5mm or 3.5mm (state which) jack plug, MAGNETIC 9p. CRYSTAL (3.5mm plug only) 24p (Up to 3 for 6p any type). SOLDERING IRON: Shim, modern, British high speed, 8 1/2", all parts replaceable, highest quality fully guaranteed 11.17 (10p). TRANSFORMERS: Sub-min 1 1/2 x 1 1/2 x 1 1/2mm. OUTPUT (3 for OC72, etc.) 14p or DRIVER 15p (Up to 12 for 6p). CONNECTING WIRE: Packs of 5 coils, each coil 5 yds. ass'd. coils. SOLID CORE 14p. FLEXIBLE or SUPER THIN for transistor wiring, etc. either 15p. (Any pack 6p). REPAIRABLE FLEXIBLE LEAD (CUBES): With phone plug, each end, 6ft 28p. 12ft 38p. With phone plug/phone socket other end 6ft. 25p. 12ft. 42ip (6p lead any type). VIBRATORS: 12v/4 pin non-synch 12HD4, 2 1/2" ex pins, 27ip. SAME but 3 1/2" ex pins USA. 20p. 12v/7 pin, synch. (12BR7) 2 1/2" ex pins, 62ip (6ip any type). TRANSISTORS, etc. AC/126 12ip, AF115 20p, AF116 15p, AF117 20p, OA5 10p, OA10 10p, OA81 10p, OC44 14p, OC46, OC71, OC72, OC76, OC81D, OC82D, all at 18ip each, OC81 15p. OC170 20p, OC171 20p. BY 100/800 pin 14p. Many more incl. power type thyristors, etc. in List (6p up to 12). MAINS LEAD (5 pin). TEST SCREWDRIVER (pocket tester) 17ip (6p either). MAINS BATTERY ELIMINATOR. Input 240v-A.C. Output 3, 4, 6, 7 1/2, 9 and 12 volt D.C. by switch selector. On/off switch, pilot lamp, leads, plug to suit most cassette recorder. 23.75 (25p).

OUR CURRENT LIST (see heading) sent free with all orders if requested, includes more details of all above plus cartridge replacement table, unrepeatable Special Offers and many types of radio and T.V. aerials, bulbs, cable, electrolytics, meters, plugs, prods, sockets, switches, stereo phones, etc. &c.

SPECIAL NOTICE: WE WILL BE CLOSED FROM TUESDAY, JUNE 27th UNTIL MONDAY, JULY 31st INCLUSIVE, DURING WHICH PERIOD NO ORDERS OR LISTS WILL BE DESPATCHED AND NO MAIL DEALT WITH.

TRANSISTORS

A SELECTION FROM OUR LIST

AA430	10p	BD115	75p	OC16	50p	2N1303	18p
AA432	10p	BD123	85p	OC20	85p	2N1304	22p
AA4213	10p	BD124	80p	OC22	50p	2N1305	22p
AA4215	10p	BD131	75p	OC23	60p	2N1306	25p
AA4217	10p	BD132	80p	OC24	60p	2N1307	25p
AC107	35p	BDY11		OC25	40p	2N1308	25p
AC126	80p			OC26	25p	2N1309	25p
AC127	25p	BDY17		OC28	50p	2N1613	20p
AC127Z	50p			OC29	60p	2N1417	75p
AC128	20p	BDY38	65p	OC35	50p	2N2147	75p
AC176	80p	BDY60		OC36	60p	2N2160	60p
AC187	25p			OC42	40p	2N2217	25p
AC188	25p			OC43	50p	2N2218	20p
AC17	30p	BF116	25p	OC44	15p	2N2218A	
AC17	30p	BF154	25p	OC45	12p		
AC17	30p	BF158	15p	OC70	12p	2N2219	20p
AC270	20p	BF159	35p	OC71	12p	2N2219A	
AC271	20p	BF180	35p	OC72	20p		
AC272	10p	BF194	15p	OC75	25p	2N2220	25p
AC273	50p	BF195	15p	OC76	25p	2N2221	20p
AC274	50p	BF196	15p	OC77	40p	2N2221A	
AC27	45p	BF197	15p	OC81	20p		
AC27	45p	BFX13	25p	OC81D	20p	2N2222	20p
AD140	50p	BFX29	25p	OC81Z	40p	2N2222A	
AD149	50p	BFX30	25p				
AD161	35p	BFX84	25p	OC84	25p	2N2369	15p
AD162	35p	BFX85	20p	OC139	25p	2N2369A	
AF114	25p	BFX86	25p	OC140	40p		
AF116	25p	BFX87	25p	OC141	60p	2N2644	40p
AF117	20p	BFX88	20p	OC170	25p	2N2904	20p
AF118	20p	BFY18	20p	OC171	30p	2N2904A	
AF124	25p	BFY51	20p	OC200	40p		
AF125	20p	BFY52	20p	OC201	75p	2N2905	25p
AF126	20p	BFY53	15p	OC202	80p	2N2905A	
AF127	20p	BFY90	65p	OC206	95p		
AF129	20p	BFY90	65p	OC206	95p	2N2906	20p
AF180	40p	BFY90	65p	OC206	95p	2N2906A	
AF181	45p	B8Y27	15p	OC206	95p		
AF185	60p	BT896A	12p	OC206	95p	2N2907	25p
AF186	40p	B8Y95	12p	OC206	95p	2N2907A	
AF239	40p	BU106	22.25p	OC206	95p		
AF239	40p	BU106	22.25p	OC206	95p	2N2925	15p
AF239	40p	BU106	22.25p	OC206	95p	2N2925A	
AF239	40p	BU106	22.25p	OC206	95p	2N2926	10p
AF239	40p	BU106	22.25p	OC206	95p	2N2926A	
AF239	40p	BU106	22.25p	OC206	95p	2N2927	70p
AF239	40p	BU106	22.25p	OC206	95p	2N2927A	
AF239	40p	BU106	22.25p	OC206	95p	2N2928	20p
AF239	40p	BU106	22.25p	OC206	95p	2N2928A	
AF239	40p	BU106	22.25p	OC206	95p	2N2929	20p
AF239	40p	BU106	22.25p	OC206	95p	2N2929A	
AF239	40p	BU106	22.25p	OC206	95p	2N2930	20p
AF239	40p	BU106	22.25p	OC206	95p	2N2930A	
AF239	40p	BU106	22.25p	OC206	95p	2N2931	20p
AF239	40p	BU106	22.25p	OC206	95p	2N2931A	
AF239	40p	BU106	22.25p	OC206	95p	2N2932	70p
AF239	40p	BU106	22.25p	OC206	95p	2N2932A	
AF239	40p	BU106	22.25p	OC206	95p	2N2933	20p
AF239	40p	BU106	22.25p	OC206	95p	2N2933A	
AF239	40p	BU106	22.25p	OC206	95p	2N2934	100p
AF239	40p	BU106	22.25p	OC206	95p	2N2934A	
BA100	15p	BZ11	30p			2N3525	
BA102	30p	BZ12	30p	TR843	30p		1.00
BA110	30p	BZ13	25p	TR860	10p	2N3614	55p
BA115	7p	BZ14	12p	TR871	12p	2N3702	10p
BAX13	5p	GT102	35p	TR880	15p	2N3703	10p
BAX16	7p	GT103	25p	TR890	18p	2N3704	12p
BAY31	7p	GT111	45p	TR861	20p	2N3705	10p
BAY38	15p	GT113	25p	TR862	20p	2N3707	12p
BC107	10p	GT114	20p	V405A	25p	2N3708	10p
BC108	15p	GT115	40p	V405B	35p	2N3714	
BC109	10p	GT116	30p	W01	30p		22.00
BC109C	12p	GT1880	45p	W06	45p	2N3715	22.00
BC113	10p	GT1882	20p	ZTX107	15p		22.20
BC114	20p	GX66		ZTX108	12p	2N3716	
BC115	20p			ZTX109	15p		22.85
BC116	20p	GM378A	25p	ZTX100	12p	2N3717	
BC116A	20p	MAT101	35p	ZTX301	15p		22.00
BC117	20p	MAT121	25p	ZTX302	20p	2N3772	
BC118	20p	MC724F	60p	ZTX303	20p		22.05
BC119	30p	MJ420	80p	ZTX304	25p	2N3773	
BC124	20p	MJ421	80p	ZTX500	15p		22.35
BC130	15p	MJ2801		ZTX501	15p	2N3791	
BC136	20p	MJ2901	1.10	ZTX502	20p	2N3819	35p
BC137	20p	MJ2901	1.10	ZTX503	17p	2N3820	55p
BC138	20p			ZTX504	40p	2N3823	50p
BC147	12p	MJE340	50p	ZTX531	25p	2N3825	50p
BC148	10p	MJE370	20p	IN914	7p	2N3824	95p
BC149	15p	MJE371	50p	IN916	10p	2N3903	50p
BC153	20p	MJE372	50p	IN4148	7p	2N3906	25p
BC154	20p	MJE521	70p	1844	4p	2N4058	12p
BC157	15p	MJE2985		18921	7p	2N4061	12p
BC189	12p			18922	8p	2N4062	12p
BC189C	15p	MJE3085		2G301	25p	2N4289	12p
BC177	20p			2G302	30p	2N4290	12p
BC178	20p	MPSA40	25p	2G303	35p	2N4871	85p
BC179	20p	MPSA48	20p	2N404	20p	2N4877	30p
BC182L	10p	MPSA70	15p	2N698	15p	2N4888	35p
BC183L	10p	MPSU06	50p	2N697	15p	2N4889	40p
BC184L	12p	MPSU56	55p	2N698	30p	40250	50p
BC212	12p	NKT214	20p	2N706	10p	40360	40p
BC213	12p	NKT215	20p	2N708A	12p	40361	40p
BC214L	15p	NKT403	75p	2N708B	12p	40362	40p
BCY30	35p	NKT404	55p	2N930	20p	40430	1.00
BCY31	40p	OA5	25p	2N987	40p	40543	65p
BCY32	60p	OA10	25p	2N1171	25p	40584	21.05
BCY33	30p	OA47	10p	2N1132	25p	40585	21.05
BCY34	35p	OA70	10p	2N1302	15p	40636	1.00
BCY38	45p	OA79	10p				
BCY39	1.00	OA81	8p				
BCY40	50p	OA90	8p				
BCY70	10p	OA91	7p				
BCY71	20p	OA95	7p				
BCY72	15p	OA202	10p				

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DEVICES MAY BE MIXED TO QUALIFY FOR QUANTITY PRICES

No.	Description	1-11	12-24	25-99	100+	250+
7400	Quadrate 2-input NAND gates	20p	14p	14p	14p	12p
7401	Quad 2-input open collector NAND gates	20p	18p	18p	14p	12p
7402	Quad 2-input NOR gates	20p	18p	18p	14p	12p
7403	Quad 2-input open collector NAND gates	20p	18p	18p	14p	12p
7404	Hex inverter	20p	18p	18p	14p	12p
7405	Hex inverters with open collector outputs	20p	18p	18p	14p	12p
7410	Triple 3-input NAND gates	20p	18p	18p	14p	12p
7413	Dual 4-input Schmitt triggers	20p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	18p	14p	12p
7430	Single 8-input NAND gates	20p	18p	18p	14p	12p
7440	Dual 4-input NAND buffer gates	20p	18p	18p	14p	12p
7441	BCD-Decimal decoder/Nixie driver	75p	72p	70p	60p	55p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder/TTL outputs	1.00	85p	80p	70p	
7447	BCD-Decimal 7 seg. decoder/indicator driver	1.75	1.60	1.45	1.30	1.15
7448	BCD-Decimal 7 seg. decoder/indicator driver TTL O/P	1.75	1.60	1.45	1.30	1.15
7451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	18p	14p	12p
7453	Quad 2-input 2-wide AND-OR-INVERT gates	20p	18p	18p	14p	12p
7454	4-wide 2-input AND-OR-INVERT gates	20p	18p	18p	14p	12p
7460	Dual 4-input expanders	20p	18p	18p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7472	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7473	Dual J-K flip-flop	40p	37p	35p	32p	30p
7474	Dual D flip-flop	40p	37p	35p	32p	30p
7475	Quadrate bistable latch	45p	42p	40p	38p	35p
7476	Dual J-K flip-flops with Preset and Clear	40p	37p	34p	31p	28p
7480	Gated Full Adder	80p	78p	77p	69p	55p
7481	16-bit read/write memory	1.25	1.15	1.10	1.00	90p
7482	2-bit binary Full Adder	87p	80p	70p	65p	60p
7483	4-bit binary Full Adder	1.00	90p	85p	80p	75p
7484	16-bit RAM with write inputs	90p	85p	80p	75p	71p
7486	Quadrate 2-input Exclusive OR gates	45p	41p	38p	35p	32p
7490	BCD decade counter	75p	70p	65p	60p	55p
7491	8-bit shift register	1.00	85p	80p	70p	
7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual 2-input 4-bit shift register	80p	75p	70p	65p	60p
7495	4-bit up-down shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/in/out shift register	1.00	97p	95p	90p	83p
74100	8-bit bistable latch	22.50	22.30	22.00	21.75	21.50
74118	Hexuple Set-Reset latches	1.00	95p	90p	80p	70p
74121	Monostable multivibrators	60p	55p	50p	45p	41p
74141	BCD-Decimal decoder/Nixie driver	1.00	95p	90p	80p	70p
74145	BCD-Decimal decoder (1-4-line) TTL O/P	1.50	1.40	1.30	1.10	1.00
74150	16-bit data selector/multiplexer	22.50	22.30	22.00	21.75	21.50
74151	8-bit data selector/multiplexer	11.00	95p	90p	80p	70p
74153	Dual 4-line to 1-line data selector/multiplexer	11.35	11.27	11.20	11.15	11.10
74154	16-bit decoder/demultiplexer	22.00	21.75	21.50	21.30	21.05
74155	Dual 2-line to 4-line decoder/demultiplexer	11.55	11.47	11.35	11.10	11.05
74156	Dual 2-line to 4-line decoder/demultiplexer	11.55	11.47	11.35	11.10	11.05
74190	Sync decade up-down counter, 1-line mode	11.95	11.85	11.75	11.60	11.50
74191	Sync 4-bit up-down counter, 1-line mode	11.95	11.85	11.75	11.60	11.50
74192	Sync decade up-down counter, 2-line mode	22.00	21.90	21.80	21.65	21.55
74193	Sync 4-bit up-down counter, 2-line mode					

Sinclair Project 60



Project 605

The easy way
to buy and
build
Project 60



Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with
comprehensive manual, post free

£29.95

All you need for a superb 30 watt high fidelity
stereo amplifier.

Sinclair Radionics Ltd, London Road, St. Ives,
Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

sinclair

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.

Performance characteristics are so good they hold their own with any other available system irrespective of price or size.

Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control, etc.	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	£9.45
12 W. RMS continuous sine wave stereo amp. for average needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	£23.90
25 W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.90
80 W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60 W. RMS into 8 ohms)	2 x Z.50s, Stereo 60 PZ.8, mains transformer	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

F.M. Stereo Tuner (**£25**) & A.F.U. Filter Unit (**£5.98**) may be added as required.

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**



The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. Tuning range: 87.5 to 108 MHz. Capture ratio: 1.5dB. Sensitivity: $7\mu\text{V}$ for lock-in over full deviation. Squelch level: $20\mu\text{V}$. Signal to noise ratio: $>85\text{dB}$. Audio frequency response: 10 Hz – 15 KHz ($\pm 1\text{dB}$). Total harmonic distortion: 0.15% for 30% modulation. Stereo decoder operating level: $2\mu\text{V}$. Cross talk: 40dB. Output voltage: $2 \times 150\text{mV R.M.S.}$. Operating voltage: 25-30 VDC. Indicators: Stereo on; tuning. Size: $93 \times 40 \times 207\text{mm}$.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**



Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve $\pm 1\text{dB}$: 20 to 26,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. Output: 250mV. Signal to noise ratio: better than 70dB. Channel matching: within 1dB. Tone controls: TREBLE + 12 to –12dB at 10 KHz; BASS + 12 to –12dB at 100Hz. Front panel: brushed aluminium with black knobs and controls. Size: $66 \times 40 \times 207\text{mm}$.

A.F.U. High & Low Pass Filter Unit

Built tested and guaranteed. **£5.98**



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28KHz to 5KHz. L.F. cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) 0.02% at rated output. Size: $66 \times 40 \times 90\text{mm}$.

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. Z.30 **£4.48** Z.50 **£5.48**



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8 Ω) and all lower outputs. Whether you

use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications).

Power Outputs

Z.30 15 watts R.M.S. into 8 ohms using 35 volts:

20 watts R.M.S. into 3 ohms using 30 volts.

Z.50 40 watts R.M.S. into 3 ohms using 40 volts:

30 watts R.M.S. into 8 ohms using 50 volts.

Frequency response: 30 to 300,000Hz $\pm 1\text{dB}$.

Distortion: 0.02% into 8 ohms.

Signal to noise ratio: better than 70dB unweighted.

Input sensitivity: 250mV into 100 Kohms (for 15w

into 8 Ω)

For speakers from 3 to 15 ohms impedance.

Size: $14 \times 80 \times 57\text{mm}$.

Power Supply Units



Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 30 volts un stabilised **£4.98**

PZ.6 35 volts stabilised **£7.98**

PZ.8 45 volts stabilised

(less mains transformer) **£7.98**

PZ.9 mains transformer **£5.98**

Guarantee

If within 3 months of purchasing Project 60 modules you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 3 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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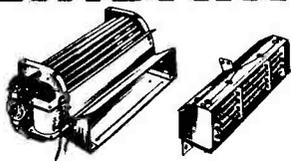
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0A3	.30	6BW6	.75	6SA7GT	.35	128H7	.15	85A2	.45	EB91	.10	EL34	.44	KTW62	.63	PL84	.38	UF90	.35	AC127	.17	BCY4A	.33	OC29	.19
0B2	.30	6BW7	.50	6SA7M	.35	128J3	.25	90C1	.65	EB94	.10	EL35	1.00	KTW63	.50	PL604/600		UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
0Z4	.35	6BZ6	.21	68C7GT	.33	128K7	.24	180B3	.55	EB97	.10	EL37	.74	MELD6	.75			UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
1A3	.35	6CB6A	.35	68G7GT	.33	128Q7GT		807		EBF80	.30	EL41	.58	N78	3.05			UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
1A7GT	.35	6C4	.35	68H7	.33			5703		EBF85	.35	EL43	.58	N808	.95			UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
1B3GT	.35	6C9	.75	68J7	.35	14H7	.45	5703		EBF89	.35	EL41	.58	N839	.44			UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
1E8GT	.35	6CD4G	1.05	68K7GT	.33	1487	.75	AC2/PEN		EBL21	.60	EL83	.35	P61				UF95	.34	AC127	.17	BCY4A	.33	OC29	.19
1L4	.15	6CG6	.50	68L7GT	.33	19A25	.24			EC86	.50	EL84	.41	PAC80	.32	PM84	.21	UY41	.38	AC126	.35	BF168	.35	OC29	.19
1N5GT	.35	6CH6	.35	6U4GT	.30	19B4G	.30	AC2/PEN		EC88	.50	EL85	.40	PC86	.44	PX4	1.16	UY85	.32	AC126	.35	BF173	.35	OC29	.19
1R5	.35	6CL6	.45	6V6G	.17	19G6	.50	DD	.35	EC92	.34	EL86	.32	PC88	.44	PY33/2	.60	U10	.45	AC128	.35	BF180	.30	OC29	.19
1B4	.35	6CM7	.30	6V6GT	.37	20D4	1.05	AC2/PEN	.35	EL91	.35	EL91	.35	PC95	.55	PY80	.33	UY12/14	.38	AC176	.55	BF181	.40	OC42	.63
1U4	.35	6CU6	.30	6X4	.30	20F2	.65	AC/PEN(7)		ECC33	1.50	EL95	.35	PC97	.36	PY81	.24	UY19	1.75	AC177	.55	BF185	.40	OC44	1.18
1U5	.45	6CW4	.35	6X5GT	.35	20L1	.35			ECC40	.60	EL90	.40	PC90	.39	PY82	.38	UY22	.39	AC177	.55	BF194	.15	OC45	1.10
2D21	.35	6D7E	.50	7A7	.35	30P1	.50	AC/TP		ECC81	.16	EL80	.37	PC84	.57	PY83	.36	UY25	.42	AC178	.55	BF190	.30	OC45	1.11
2GK5	.50	6DT6A	.80	7B6	.35	30P2	.75	AL60	.75	ECC92	.19	EL80	.37	PC85	.54	PY83	.36	UY25	.42	AC179	.55	BF191	.30	OC45	1.11
3A4	.35	6E76	.55	7B7	.35	30P4	.85	ATP4	.18	ECC93	.21	EL81	.37	PC88	.59	PY80	.33	UY26	.78	AC179	.55	BF192	.30	OC45	1.11
3D6	.19	6F1	.50	7E7	.35	30P6	1.00	AZ1	.40	ECC94	.25	EL83	.35	PC90	.42	PY80	.33	UY27	.81	AC179	.55	BF193	.30	OC45	1.11
3Q4	.35	6F6	.65	7E7	.35	30P8	.85	AZ31	.45	ECC95	.25	EL84	.37	PC91	.48	PY81	.24	UY28	.81	AC179	.55	BF194	.30	OC45	1.11
3Q5GT	.35	6F13	.33	7Y4	.40	25L6G	.30	AZ41	.55	ECC96	.45	EL85	1.00	PCF80	.38	PZ30	.48	UY29	.81	AC178	.55	BF195	.30	OC45	1.11
3B4	.35	6F14	.40	7Z4	.50	25Y5	.38	CL33	.90	EC87	.34	EL87	.40	PCF82	.30	QV03/10		UY31	.40	AD140	.36	BY126	.15	OC75	.11
3V4	.35	6F18	.45	9D7	.75	25Y6G	.43	CV65	.55	ECC189	.45	Y61	.35	PCF84	.40			UY32	.40	AD140	.36	BY127	.15	OC76	.15
4CB6	.50	6F23	.65	10C2	.49	25Z4G	.28	CY10	.35	ECC80A	.55	Y61	.35	PCF86	.44	Q895/10	.48	UY31	.40	AD161	.45	BY129	.15	OC77	.15
5C08	.50	6F24	.65	10D7K	.50	25Z5	.40	CY31	.35	ECC807		Y63	.35	PCF80	.67	QV04/7	.63	UY32	.40	AD162	.45	BY131	.15	OC78	.15
5F43	.35	6F25	.61	10F1	.75	25Z6G	.45	DAP1	.50	ECC81	1.70	Y64	.50	PCF81	.55	E10	.75	UY33	.40	AD163	.45	BY132	.15	OC78	.15
5Y3GT	.35	6F26	.60	10F9	.45	30A5	.44	DAP96	.32	ECC82	.37	Y67/8	.37	PCF82	.57	E11	.80	UY34	.40	AD164	.45	BY133	.15	OC78	.15
5Z4G	.35	6F28	.15	10F18	.35	30C15	.55	DF91	.14	ECC83	.25	Y69	.40	PCF80	.55	E16	1.75	UY35	.40	AD165	.45	BY134	.15	OC78	.15
6B0L2	.33	6G8A	.50	10P1D11	.55	30C17	.74	DF96	.14	ECC84	.24	Y71	.38	PCF80	.55	E17	.85	UY36	.40	AD166	.45	BY135	.15	OC78	.15
6A8G	.35	6GK5	.50	10P13	.54	30C18	.55	DE76	.35	ECC84		Y72	.38	PCF82	.59	E19	.85	UY37	.40	AD167	.45	BY136	.15	OC78	.15
6A7	.15	6G7	.50	10P14	1.05	30F6	.61	DE40	.55	E241	.45	Y73	.30	PCF83	.54	E24	.75	UY38	.40	AD168	.45	BY137	.15	OC78	.15
6A65	.35	6H6GT	.15	12A6	.35	30F1L	.55	DE92	.35	ECH21	.65	Y74	.30	PCF84	.54	E28	.90	UY39	.40	AD169	.45	BY138	.15	OC78	.15
6A65	.35	6H6GT	.15	12A6	.35	30F1L	.55	DE92	.35	ECH21	.65	Y74	.30	PCF84	.54	E28	.90	UY39	.40	AD169	.45	BY138	.15	OC78	.15
6A68A	.35	6H6GT	.15	12A6G	.45	30F1L9	.57	DL9	.35	ECH22	.67	Y75	.30	PCF85/86		TH4B	.50	UY40	.40	AD170	.45	BY139	.15	OC78	.15
6A78	.35	6J6	.15	12A6E	.45	30F1L4	.65	DM70	.30	ECH23	.33	Y76	.30	PCF86	.55	FW4/500.75		UY41	.40	AD171	.45	BY140	.15	OC78	.15
6A95	.35	6J7G	.24	12A7E	.38	30L15	.55	DM71	.35	ECH24	.34	Y78	.35	PCF86	.55	FW4/500.75		UY42	.40	AD172	.45	BY141	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
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6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15	OC78	.15
6A75	.15	6J7A	.50	12A7U6	.31	30P4MR	.35	DY87/8	.25	ECL80	.30	Y79	.35	PCF87	.55	GZ30	.33	UY43	.40	AD173	.45	BY142	.15		

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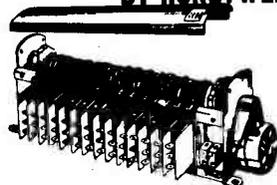


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50	0.23	0.25	0.47	0.50	0.53	1.15
100	0.25	0.33	0.63	0.58	0.63	1.40
200	0.35	0.37	0.57	0.61	0.75	1.80
400	0.43	0.47	0.67	0.75	0.83	1.75
600	0.53	0.57	0.87	0.97	1.25	2.00
800	0.63	0.70	0.90	1.20	1.50	4.00

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100	0.04	0.06	0.05	0.13	0.16	0.22	0.75
200	0.05	0.09	0.08	0.14	0.20	0.24	1.00
400	0.08	0.13	0.07	0.20	0.27	0.37	1.25
600	0.07	0.16	0.10	0.23	0.34	0.45	1.85
800	0.10	0.17	0.13	0.25	0.37	0.55	2.00
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U4	40 Germanium transistors like OC81, AC128	0.50
U5	60 200mA sub-min. Sil. diodes	0.50
U6	30 Silicon planar transistors NPN sim. BSY95A, 2N706	0.50
U7	16 Silicon rectifiers Top-Hat 760mA up to 1,000V	0.50
U8	50 Sil. planar diodes 250mA, OA/200/202	0.50
U9	20 Mixed volts 1 watt Zener's	0.50
U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0.50
U13	25 PNP-NPN sil. transistors OC290 & 28104	0.50
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U15	25 NPN Silicon planar transistors TO-5 sim. 2N697	0.50
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U17	30 Germanium PNP AF transistors TO-5 like ACY 17-42	0.50
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U25	25 300 Mc/s NPN silicon transistors 2N705, BSY27	0.50
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Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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Q15 2 2N2928 sil. epoxy trans.	0.50
Q16 2 2N2900 low noise germ. trans.	0.50
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Q19 3 Mat's 2 3T101 & 1 MAT 121	0.50
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Q26 8 OA95 germ. diodes sub-min. IN69	0.50
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Q28 2 Sil. power recta. BYZ13	0.50
Q29 4 Sil. trans. 2 x 2N696, 1 x 2N697, 1 x 2N698	0.50
Q30 7 Sil. switch trans. 2N706 PNP	0.50
Q31 6 Sil. switch trans. 2N708 NPN	0.50
Q32 3 PNP sil. trans. 2 x 2N1131, 1 x 2N1132	0.50
Q33 3 Sil. NPN trans. 2N1711	0.50
Q34 7 Sil. NPN trans. 2N2369, 500MHZ.	0.50
Q35 3 Sil. PNP TO-5 2 x 2N2904 & 1 x 2N2905	0.50
Q36 7 2N3646 TO-18 plastic 300MHZ NPN	0.50
Q37 3 2N3033 NPN sil. trans.	0.50
Q38 7 PNP trans. 4 x 2N3703, 3 x 2N3702	0.50
Q39 7 NPN trans. 4 x 2N3704, 3 x 2N3705	0.50
Q40 7 NPN amp. 4 x 2N3707, 3 x 2N3709	0.50
Q41 3 Plastic NPN TO-18 2N3904	0.50
Q42 6 NPN trans. 2N5172	0.50
Q43 7 BC107 NPN trans.	0.50
Q44 7 NPN trans. 4 x BC108, 3 x BC109	0.50
Q45 3 BC113 NPN TO-18 trans.	0.50
Q46 3 BC115 NPN TO-5 trans.	0.50
Q47 6 NPN high gain 3 x BC167, 3 x BC168	0.50
Q48 4 BCY70 NPN trans. TO-18	0.50
Q49 4 NPN trans. 2 x BFY51, 2 x BFY52	0.50
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BP01-SN7401	0-15	0-14	0-12
BP02-SN7402	0-15	0-14	0-12
BP03-SN7403	0-15	0-14	0-12
BP04-SN7404	0-15	0-14	0-12
BP05-SN7405	0-15	0-14	0-12
BP07-SN7407	0-18	0-17	0-16
BP08-SN7408	0-18	0-17	0-16
BP09-SN7409	0-18	0-17	0-16
BP10-SN7410	0-15	0-14	0-12
BP13-SN7413	0-28	0-28	0-24
BP16-SN7416	0-48	0-40	0-38
BP17-SN7417	0-48	0-40	0-38
BP20-SN7420	0-15	0-14	0-12
BP30-SN7430	0-15	0-14	0-12
BP40-SN7440	0-15	0-14	0-12
BP41-SN7441	0-87	0-84	0-88
BP42-SN7442	0-87	0-84	0-88
BP43-SN7443	1-85	1-85	1-75
BP44-SN7444	1-85	1-85	1-75
BP45-SN7445	1-85	1-85	1-75
BP46-SN7446	0-87	0-84	0-88
BP47-SN7447	0-87	0-84	0-88
BP48-SN7448	0-87	0-84	0-88
BP50-SN7450	0-15	0-14	0-12
BP51-SN7451	0-15	0-14	0-12
BP53-SN7453	0-15	0-14	0-12
BP54-SN7454	0-15	0-14	0-12

BP60-SN7460	0-15	0-14	0-12
BP70-SN7470	0-28	0-28	0-24
BP72-SN7472	0-28	0-28	0-24
BP73-SN7473	0-37	0-35	0-32
BP74-SN7474	0-37	0-35	0-32
BP76-SN7476	0-47	0-45	0-42
BP78-SN7478	0-43	0-40	0-38
BP80-SN7480	0-87	0-84	0-88
BP81-SN7481	0-87	0-84	0-88
BP82-SN7482	0-87	0-84	0-88
BP83-SN7483	1-10	1-05	0-95

PRICE-MIX. Devices may be mixed to qualify for quantity prices.
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	1-24	25-99	100 up
BP86-SN7486	0-82	0-80	0-78
BP90-SN7490	0-87	0-84	0-88
BP91-SN7491AN	0-87	0-84	0-88
BP92-SN7492	0-87	0-84	0-88
BP93-SN7493	0-87	0-84	0-88
BP94-SN7494	0-77	0-74	0-88
BP95-SN7495	0-77	0-74	0-88
BP96-SN7496	0-77	0-74	0-88
BP100-SN74100	1-75	1-65	1-55
BP104-SN74104	0-87	0-84	0-88
BP105-SN74105	0-87	0-84	0-88
BP107-SN74107	0-40	0-38	0-36
BP110-SN74110	0-55	0-58	0-59
BP111-SN74111	1-25	1-15	1-00
BP113-SN74113	1-00	0-95	0-90
BP119-SN74119	1-35	1-25	1-10
BP121-SN74121	0-87	0-84	0-88
BP131-SN74131	0-87	0-84	0-88
BP145-SN74145	1-50	1-40	1-30
BP150-SN74150	1-80	1-70	1-60
BP151-SN74151	1-00	0-95	0-90
BP153-SN74153	1-20	1-10	0-95
BP154-SN74154	1-80	1-70	1-60
BP155-SN74155	1-40	1-30	1-20
BP156-SN74156	1-40	1-30	1-20
BP160-SN74160	1-80	1-70	1-60
BP161-SN74161	1-80	1-70	1-60
BP164-SN74164	2-00	1-90	1-80
BP165-SN74165	2-00	1-90	1-80
BP181-SN74181	2-75	2-80	2-40
BP182-SN74182	1-87	0-84	0-88
BP190-SN74190	3-50	3-25	3-00
BP191-SN74191	3-50	3-25	3-00
BP192-SN74192	2-10	1-95	1-75
BP193-SN74193	2-10	1-95	1-75
BP195-SN74195	1-10	1-05	0-95
BP196-SN74196	1-80	1-70	1-60
BP197-SN74197	1-80	1-70	1-60
BP198-SN74198	5-50	5-00	4-00
BP199-SN74199	5-50	5-00	4-00

ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C.'s

Type No.	Price		
	1-24	25-99	100 up
BP930	12p	11p	10p
BP932	18p	12p	11p
BP933	18p	12p	11p
BP935	18p	12p	11p
BP936	18p	12p	11p
BP944	18p	12p	11p
BP945	28p	24p	22p
BP948	12p	11p	10p
BP949	28p	24p	22p
BP951	85p	80p	80p
BP962	18p	11p	10p
BP9093	40p	35p	35p
BP9094	40p	35p	35p
BP9097	40p	35p	35p
BP9099	40p	35p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

LINEAR I.C.'s—FULL SPEC.

Type No.	Price		
	1-24	25-99	100 up
BP 201C-SL201C	68p	58p	45p
BP701C-SL701C	68p	50p	45p
BP 702C-SL702C	68p	50p	45p
BP 702-SL702	58p	45p	40p
BP709-SL709	58p	45p	40p
BP 709P- μ A709C	58p	45p	40p
BP 710-SL710	58p	45p	40p
BP 711- μ A711	58p	50p	45p
BP 741-SL741	76p	80p	50p
μ A709C- μ A703C	48p	38p	27p
TAA 263	70p	60p	55p
TAA 293	90p	75p	70p
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S.G.S. EA1000 2-83

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Cathode Current (mA)	2-3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
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DTL & TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C.'s and experimental work.

Pak No.	IC's	Pak No.	IC's
UIC930	= 12 x μ A 930	UIC948	= 8 x μ A 948
UIC932	= 12 x μ A 932	UIC951	= 5 x μ A 951
UIC933	= 12 x μ A 933	UIC961	= 12 x μ A 961
UIC935	= 12 x μ A 935	UIC9093	= 5 x μ A 9093
UIC936	= 12 x μ A 936	UIC9094	= 5 x μ A 9094
UIC944	= 12 x μ A 944	UIC9097	= 5 x μ A 9097
UIC945	= 8 x μ A 945	UIC9099	= 5 x μ A 9099
UIC946	= 12 x μ A 946	UICX9	= 25 Assorted 930 Series

Packs cannot be split but 25 Assorted Pieces (our mix) is available as Pack UICX9
Data booklet available for the BP930 Series, PRICE 13p

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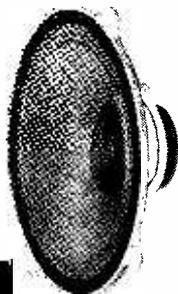
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INDEX TO ADVERTISERS

Amtron	214
Antex Ltd.	207
Baines, R.... ..	275
Baker	275
Baker Reproducers Limited	278
Bell's Television	276
Bently Acoustic Corporation Ltd.	270
Bernard, Gerald	262
B.I.E.T.	256, cov. 3
Bi-Pak Semiconductors	272, 273
Bi-Pre-Pak Limited	209
Boffin Projects	274
British National Radio & Electronic	
School	223, 266
Broadway Electronics	cov. 2
Bull, J. (Electrical) Ltd.	263
C.B.M. Electronic Components Ltd. ...	277
C.T. Electronics Ltd.	277
Carrana, C.	275
Circuit & Supplies	274
Codar Radio Co.	196
Component Factors	276
Comet High Fidelity Discount Ware-	
house	194, 195
Concord Electronics Ltd.	202
D.E.W. Limited	274
Dabar Electronics	260
Discosound	251
Douglas Electronic Industries Ltd. ...	260
Duke & Co. (London) Ltd.	212
E.P.S.	228
Edgware Electronic Centre (Edgware	
Road) Ltd.	271
Electro Spares	70
Electro Value	227
Eley Electronics	206
Elvins Electronics	208
Expo (Drills) Ltd.	278
F.E.T. King	277
Felstead Electronics	266
Field Electrics Limited	262

Galleon Trading	276-277
Gladstone Radio	255
Global Audio Discount Warehouse	212
Government Communication Head-	
quarters	275
H. Electronics	276
HAC Shortwave Products	224
Hadley, C.	278
Harversons Surplus Co. Ltd.	213
Henry's Radio Ltd.	267, cov. 4
Home Radio (Components) Ltd.	255
I.C.S.	206, 274
Jef Electronics	277
Jermyn Industries	202
Johns Radio	cov. 2
Johnsons (Radio) Ltd.	262
KVA Electronics	224
Kensington Supplies	276
Keytronic	276
King, J. M.	274
Knopp, J.	274
Lasky's Radio Ltd.	197
Lewis Radio	228
Lindair (Electrotech) Ltd.	271
Linear Products Ltd.	266
London Computer Operators Training	
Centre	276
Lowe Electronics Ltd.	256
M & B Components (Leeds) Ltd.	279
Marktyme	206
Marshall, A. Son	252
Merlin Supply Co.	196
Mole, M. & Son Ltd.	cov. 2
Morse	275
Multicore Solders Ltd.	271
NIP	274
Omni-Detector Co.	274
Padgetts Radio Store	256
Partridge Electronics	212
Pembridge College of Electronics	196

R.D.I.	274
Radio Component Specialists	259
Radio Exchange Ltd.	193
Radio & T.V. Components (Acton) Ltd.	
... ..	200, 201
Radio Society of Great Britain	198
Readers Radio	198
R.C. Electronics	210, 211
Robin Hood	274
RSC Hi-Fi Centres Ltd.	264, 265
R.S.T.	260
Salop Electronics	274
Scientific & Technical Services	255
Selray Book Co. Ltd.	275
Sinclair Radionics Ltd.	268, 269
Shopperities Ltd.	199
Smith, G. W., & Co. (Radio) Ltd.	203, 204, 205
South Supplies	276
Southern Audio Services	198
Suprlectronics	208
Surplus Electronic Trading	224
Swanley Electronics	224
Taylor Kirby	277
Teleradio Special Products	274
Thacker, A. H.	262
Thornbury Trade Disposals	277
Tidman Mail Order	277
Trampus Electronix	278
Velco Electronics	206
Web Europa	262
West London Direct Supplies	208
Weyrad (Electronics) Ltd.	228
Windsor Elec	278
Wilmslow Audio	208, 260
Wilsic Electronics Ltd.	196
York Electrics	270
Yukan Self Spray	275
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6AM5	0.35	6EH7	0.30	6X5GT	0.40	20C5	0.50
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25Z6GT	0.85	50C6G12.0	0.50	DK92	0.55	ECC85	0.40
30A5	0.50	50EH5	0.60	DK96	0.80	ECC88	0.40
30A3B3	0.40	50EGT0.85	0.55	DK98	0.45	ECC89	0.50
30C1	0.30	85A2	0.50	DM70	0.55	ECC91	0.20
30C15	0.80	90A2	2.40	DM160	0.65	ECC189	0.65
30C17	0.90	90AV	2.50	DY81	0.50	ECC807.125	0.55
30C18	0.80	90C1	0.85	DY86	0.32	ECCF80	0.35
30F11	0.75	90CV	2.40	DY87	0.33	ECCF82	0.35
30F11.9	1.20	813	3.75	DY802	0.35	ECCF86	0.65
30F14.4	0.85	866A	0.75	ES8C	0.85	ECCF80.185	0.65
30L1	0.40	5642	0.70	E180F	1.00	ECH42	0.75
30L15	0.35	5670	0.50	EAB8C00.35	0.85	ECH81	0.30
30L17	0.80	6080	1.60	EAF42	0.55	ECH83	0.45
30P12	0.80	6145	1.60	EBC33	0.60	ECH84	0.45
30P19	0.80	614B	2.50	EBC41	0.55	ECL80	0.45
30P17.1	0.75	6360	1.25	EBC81	0.80	ECL81	0.50
30PL1	0.93	6939	2.25	EBF60	0.40	ECL82	0.35
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35A5	0.75	7986	1.25	EEL86	0.50	EY81	0.40
35B5	0.65	7985	1.25	EEL88	0.55	EY80	0.55
35C5	0.50	9002	0.40	EEL89	0.50	EY81	0.40
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35W4	0.35	AZ31	0.55	EFC93	0.55	EY88	0.43
35Z4G	0.35	CB11	0.80	ECC35	1.00	EY89	0.25
35Z4G	0.35	CB13	1.00	ECC40	0.65	EY83	0.55
35Z5GT	0.60	CY31	0.35	ECC41	0.35	EY85	0.35
25C5	0.50	DAF96	0.45	ECC82	0.30	EY86	0.30
25L6GT	0.50	DF96	0.45	ECC83	0.30	EY89	0.35

EP91	0.33	GZ30	0.40	FF81B	0.85	U201	0.35
EP92	0.35	GZ31	0.35	FF1200	0.65	U281	0.40
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EP183	0.30	HABCS00.45	FL92	0.45	U404	0.60	
EP184	0.35	HK90	0.40	PL83	0.45	U801	0.30
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EK90	0.30	N78	1.50	PL802	0.85		
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EM87	0.70	PC8805	0.80	QQV03-20A		UF42	0.60
EN91	0.38	PC8806	0.70		5.25	UF43	0.60
EY51	0.40	PC8808	0.85	QQV06-40A		UF80	0.35
EY80	0.55	PC82000.70			5.50	UF85	0.40
EY81	0.40	PCL81	0.50		3.00	UF89	0.40
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EY86	0.40	PCL83	0.85	TT92	3.20	UL84	0.40
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EY88	0.43	PCL85	0.40	U26	0.80	UY1N	0.80
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2N705	0.70	AC133	0.20	BF115	0.20
2N708	0.10	AC154	0.10	BF167	0.15
2N708	0.10	AC157	0.20	BF173	0.20
2N733	0.25	AC169	0.10	BF179	0.30
2N929	0.22	AC176	0.25	BF180	0.35
2N930	0.25	AC187	0.30	BF181	0.25
2N947	0.30	AC188	0.30	BF184	0.25
2N1131	0.25	AC137	0.25	BF187	0.20
2N1132	0.25	ACX18	0.20	BF194	0.15
2N1184	0.25	ACX19	0.25	BF195	0.15
2N1301	0.40	ACX20	0.20	BF196	0.20
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2N1305	0.25	AD140	0.50	BFW37	0.25
2N1306	0.25	AD149	0.50	BFW38	0.25
2N1307	0.30	AD161	0.35	BFW89	0.20
2N1308	0.25	AD162	0.35	BFW91	0.20
2N1309	0.30	ADZ11	1.25	BFY88	0.25
2N1613	0.22	ADZ12	1.25	BFY17	0.40
2N1711	0.25	AF114	0.20	BFY19	0.60
2N1756	0.75	AF115	0.25	BFY60	0.25
2N1947	0.25	AF116	0.20	BFY61	0.20
2N2160	0.65	AF117	0.20	BFY62	0.25
2N2217	0.30	AF118	0.45	BSY26	0.20
2N2218	0.30	AF125	0.25	BSY27	0.20
2N2219	0.35	AF137	0.20	BSY28	0.20
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2N3053	0.15	AS Y28	0.25	OC26	0.25
2N3054	0.60	AS Y29	0.30	OC28	0.60
2N3055	0.75	AS Y54	0.25	OC29	0.60
2N3133	0.30	AS Z15	0.70	OC30	0.75
2N3134	0.30	AS Z16	0.70	OC35	0.50
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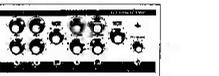
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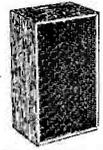
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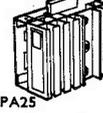


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"BANDSPREAD" PORTABLE TO BUILD



Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bands need for extra selectivity. Also slow motion geared tuning, 600 mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance.
TOTAL COST TO BUILD £7.98, p.p. 32p. (Battery 22p). All parts sold separately—Leaflet No. 2 77" MEDIUM AND LONG WAVE PORTABLE (as previously advertised) £6.98, p.p. 35p from stock—Leaflet No. 1.

SLIDER CONTROLS

Top quality, 60mm stroke singles and ganged. Complete with knobs. 5K, 10K, 25K, 50K, 100K, 500K, 1 meg, Log and Lin. 45p each. 10K, 25K, 50K, 100K, Log and Lin ganged. 75p each. Post 1-5 15p; 6 or more 20p.