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MODE
ONE

HIGH FIDELITY
LOUDSPEAKER KIT



Recommended
retail price

£9-39

including V.A.T.

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send S.A.E.
for fully
descriptive
leaflet.

Consisting of a Fane Model 803 ultra-low resonance 8" speaker unit with PVC cone surround, and a Fane Model 303 high frequency pressure tweeter together with a printed circuit cross-over assembly with ferrite cored coils.

SPECIFICATION OF UNITS

	Model 803	Model 303
Overall Diameter	8"	3"
Natural resonance	30Hz	—
Main resonance	*35Hz	1200Hz
Magnet Pole Diameter	1"	3/8"
Magnet Flux Density	13,000 gauss	10,000 gauss
Frequency response	30Hz-8kHz	10kHz-17kHz
Impedance	8-15 ohms	8-15 ohms
Power Handling	*15 watts	*15 watts

Very easy to assemble, this boxed kit comes with acoustic foam damping material, panels, screws, wire, wiring diagrams and instructions to provide a remarkable loudspeaker assembly—a pair is ideal for stereo.

CABINETS for the 'Mode One' are available in Teak veneer finish. SIZE 15 1/2" x 10 1/2" x 9".

*When used with above cabinet.

Distributors to the wholesale
and retail trade

LINEAR PRODUCTS LTD.

Electron Works, Armsley, Leeds
LS12 3SA. Tel. 630126

Manufactured by

FANE ACOUSTICS LTD.

Hick Lane, Batley, Yorkshire.
Tel. Batley 6431

TRANSISTORISED F.M. tuner head with A.M. gang, slow motion drive. 88-108Mc, with circuit diagram. £2-30p.

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GARRARD SP25 MK. II less Cartridge. £10-00.

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100K log. ganged L/S-20K log. ganged L/S.

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Please add 93p P. & P. & Ins.

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Rogers R/brook FET4 (Cased)	£33.45
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Rogers R/bourne FET4 (Cased)	£41.25
Sinclair PR060 (Module)	£14.19
Sinclair 2000/3000 Tuner	£26.12
Leak Delta FM (Cased)	£49.44
Leak Delta FM/FM (Cased)	£36.43
Alpha Highgate FT150	£33.32
Metrosound FMS 20	£48.40
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Please add £1 P. & P. & Ins.

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Pioneer SX 626	£119.35
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All prices correct at time of press. E. & O. E. and are subject to alterations.

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Goldring GL75	£25.19
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24 x 3 1/2in	23p	17p	IN4012	12p	IN4013	13p	IN4014	14p	IN4015	15p	IN4016	16p	OC71	12p	OC75	15p	OC83	18p
3 1/2 x 5in	29p	30p	IN4017	17p	IN4018	18p	IN4019	19p	IN4020	20p	IN4021	21p	OC71	12p	OC75	15p	OC83	18p
3 1/2 x 3 1/2in	25p	25p	IN4022	22p	IN4023	23p	IN4024	24p	IN4025	25p	IN4026	26p	OC71	12p	OC75	15p	OC83	18p
2 1/2 x 1in	2 for 12p	12p	IN4027	27p	IN4028	28p	IN4029	29p	IN4030	30p	IN4031	31p	OC71	12p	OC75	15p	OC83	18p
2 1/2 x 3 1/2in	—	11p	IN4032	32p	IN4033	33p	IN4034	34p	IN4035	35p	IN4036	36p	OC71	12p	OC75	15p	OC83	18p
5 x 3 1/2in	—	20p	IN4037	37p	IN4038	38p	IN4039	39p	IN4040	40p	IN4041	41p	OC71	12p	OC75	15p	OC83	18p
Insertion tool	54p	54p	IN4042	42p	IN4043	43p	IN4044	44p	IN4045	45p	IN4046	46p	OC71	12p	OC75	15p	OC83	18p
Track cutter	40p	40p	IN4047	47p	IN4048	48p	IN4049	49p	IN4050	50p	IN4051	51p	OC71	12p	OC75	15p	OC83	18p
Pins, pkt. 25	8p	8p	IN4052	52p	IN4053	53p	IN4054	54p	IN4055	55p	IN4056	56p	OC71	12p	OC75	15p	OC83	18p

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	Rec. Price	Retail Price	Comet Price
AKAI AA5200	87-45	64-95	
AKAI AA5500	109-45	80-95	
AKAI AA5800	164-45	121-95	
ALBA UA 700	41-72	27-95	
ALPHA 212 by Highgate	41-53	25-95	
AMSTRAD IC 2000	50-85	30-95	
AMSTRAD Integra 4000	39-85	23-95	
ARMSTRONG 521	64-90	48-95	
FERROGRAPH F307 Mk. II (cased)	74-80	49-95	
GLIXOR MW3000, 15 watts RMS per channel	54-45	25-95	
GOODWIN RH 25 25	65-95	44-95	
JVC Nivico A 300	63-80	39-95	
JVC Nivico MCA 104Z	93-50	74-95	
MCA 105E	143-55	119-95	
MCA V5E/VN550 Quadraphonic	97-90	81-95	
MCA V9E/VN880 Quadraphonic	162-80	136-95	
KELETRON KSA 700 Mk. II	31-10	20-95	
KELETRON KSA 1500 Mk. II	45-10	27-95	
LEAK Delta 30 (cased)	76-89	51-95	
LEAK DELTA 70 (cased)	94-49	63-95	
METROSOUND ST20	43-45	26-95	
METROSOUND ST60	77-00	50-95	
PHILIPS RH521	119-90	98-95	
PIONEER SA500A	51-81	35-95	
SA600A	105-03	65-95	
SA800	139-21	99-95	
SA1000	171-40	107-95	
QL600A Quadraphonic			
Convertor	130-85	93-95	
OD 210 Quadraphonic decoder	47-14	32-95	
QA 800A Quadraphonic	Sp. Price	159-95	
QC800A Pre-amp.	Sp. Price	114-95	
QM800A Pow. amp.	Sp. Price	135-95	
Reverberation 202w	60-45	43-50	
RANK ROTEL 210	38-39	28-50	
RANK ROTEL 310	57-20	39-95	
RANK ROTEL 610	86-35	56-95	
RANK ROTEL RA 810	116-05	83-50	
RANK ROTEL RA 1210	141-90	101-95	
ROGERS Ravensbourne	77-00	50-95	
Ravensbourne (cased)	82-50	64-95	
SINCLAIR 2000	38-50	27-75	
3000	49-50	34-95	
PROJECT 605	32-95	23-75	
SOLARVOX 20, 10 watts RMS per channel	43-95	26-95	
SOLARVOX 30, 15 watts RMS per channel	51-65	35-95	
SOLARVOX MA801 2 x 8 watts RMS plus MATRIX 4 channel	56-52	42-95	
TANDBERG TA300	76-89	59-95	
TANDBERG TA300M	87-45	72-50	
WHARFEDALE Linton amplifier	71-50	50-95	

All take both ceramic and magnetic cartridges.

TUNER/AMPLIFIERS

AKAI AA8030	130-54	96-95
AKAI AA8080	178-07	131-95
AKAI AS8100S Quadraphonic	243-85	181-95
AKAI A8500	233-98	166-95
AKAI 6300	121-21	77-75
ARENA 2600	105-29	55-95
AUTOMATIC RADIO CHX 9912 AM/FM: MPX stereo tuner/amplifier with built-in stereo cassette recorder	107-25	48-95
GOODMANS Module 80, 35w. RMS	87-55	66-95
Module 80 Compact	158-16	119-95
Module 90	112-04	85-95
Module 110 FM/MW/LW/SW/100w. RMS	130-86	99-95
GOODMANS Module 110, Compact	230-65	175-95
JVC Nivico AM100 Quadraphonic	150-16	124-95
JVC Nivico VR 5500/5501 AM/FM VR 5521 AM/FM and SEA	164-75	135-95
4VR 5474 Quadraphonic	219-77	179-95
KYOTO 1000 AM/FM Tuner/Amplifier with built-in Stereo Cassette Recorder. Complete with two speakers and two microphones	79-90	57-95
LEAK Delta 75	163-83	123-95
PHILIPS RH 720	202-41	154-95
PIONEER SX525	134-86	92-95
SX626	184-72	126-95
SX727	222-39	152-95
SX828	285-21	196-95
QX 4000 Quadraphonic	216-81	159-95
QX 8000 Quadraphonic	269-76	190-95
ROTEL RX 150A	65-58	47-95
ROTEL RX 200A	84-10	61-95
ROTEL RX 400A	101-01	74-95
ROTEL RX 800A	140-01	103-95
ROTEL RX 800A Quadraphonic	178-97	131-95
ROTEL RX 154A Quadraphonic	121-58	89-95
SOLARVOX TAM 1105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	37-06	29-75
TANDBERG TR200 MPX	99-79	83-95

TUNERS/AMPLIFIERS—continued

	Rec. Price	Retail Price	Comet Price
TANDBERG TR1000 FM MPX (teak)	146-86	124-95	
TANDBERG TR1010 AM/FM MPX	159-09	133-95	
TELETON CR55	116-63	64-95	
WHARFEDALE LINTON WE40 AM/FM MPX	107-65	81-95	
All the above take magnetic cartridges except Kyoto 1000 which takes ceramic only. All include MPX Stereo Decoder.			
TURNABLES			
CONNOISSEUR BD1 Kit	12-65	10-50	
CONNOISSEUR BD2 Chassis	31-02	24-95	
CONNOISSEUR BD2 P/C/SAU2	31-16	32-95	
GARRARD SP25 Mk. III	15-25	9-25	
GARRARD 40B	12-85	9-50	
GARRARD SL65B	18-78	12-95	
GARRARD SL95B	46-40	30-60	
GARRARD 401	40-43	27-50	
GARRARD SL75B	30-73	26-25	
GARRARD AP75	26-82	18-95	
GARRARD Zero 100A	51-57	37-25	
GARRARD Zero 100S	47-44	34-25	
GOLDRING G101P/C	28-05	19-50	
GOLDRING GL72 Chassis	29-70	20-25	
GOLDRING GL72P	38-61	26-50	
GOLDRING GL75	39-60	26-50	
GOLDRING GL75P	48-84	33-50	
GOLDRING GL85P/Cover	82-50	55-50	
LEAK Delta	65-07	49-95	
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	65-88	52-95	
McDONALD MP60	13-96	9-25	
McDONALD TD15AB	17-71	12-25	
McDONALD HT70	19-49	13-50	
PHILIPS GA212 Electronic	64-95	50-95	
PIONEER PL12D with base and cover	47-19	32-50	
PIONEER PL61 with base and cover	170-53	114-95	
THORENS TD125 Mk. II	109-04	82-95	
THORENS TD125AB	109-04	77-95	
THORENS TD 125AB Mk. II with TP 16 arm	116-05	95-50	
THORENS TD 160/c including base and cover	65-04	53-50	
WHARFEDALE Linton	35-11	25-95	

The following Turntables are complete with base, plinth, plastic cover and cartridge. Fully wired and ready for use. All at special prices.

GARRARD SP25 Mk. III with Goldring G800	Special Price	17-50
McDONALD MP60 with Goldring G800	Special Price	17-25
McDONALD MP60 with SHURE M 44/7	Special Price	18-25
McDONALD HT70 with Goldring G800	Special Price	24-25
GARRARD AP75 with Goldring G800	Special Price	25-95
GARRARD AP76 with Shure M55E	Special Price	28-95
GARRARD AP76 with Shure M75EJ	Special Price	31-25
GARRARD AP75 with Sonotone 9TAHC	Special Price	12-10
GOLDRING GL75 with G800	Special Price	36-95
GOODMANS TD100 with G800E	71-09	48-95

SPEAKERS

AKAI SW 155	70-95	50-95
AMSTRAD ACOUSTA 1500 (pair)	44-00	25-95
AMSTRAD ACOUSTA 2500 (pair)	55-00	32-95
AMSTRAD 138 (pair) Teak	28-60	15-50
B and W Model 70	175-45	125-95
B and W DM1	65-59	48-95
B and W DM4	46-75	35-95
B and W D5 (pair)	55-99	41-95
CELESTION COUNTY (pair)	46-13	34-50
Ditton 120 (pair)	52-80	37-95
Ditton 15	35-20	25-50
Ditton 25	71-50	51-50
Ditton 44	59-40	42-95
Ditton 66	108-90	78-75
FERROGRAPH S1 inc. stand	104-50	75-95
GOODMANS Minister (pair)	46-33	34-95
Havant (pair)	53-77	38-50
Magister	72-19	46-75
Double Maxim (pair)	63-45	45-95
Mezzo 3	39-27	26-95
Magnum K2	50-82	34-95
Goodwood	60-50	41-95
Dimension 8	79-68	54-95
DIN 20 NT KH (pair)	22-95	16-50
KELETRON K54 (pair)	22-66	14-50
K54 (pair)	28-16	17-95
K53 (pair)	36-30	23-50
KS10 (pair)	46-86	30-50
KS15 (pair)	69-85	44-95
KS20 (pair)	78-76	50-95

SPEAKERS

	Rec. Price	Retail Price	Comet Price
LEAK 150 (pair)	2	6	2
LEAK 250 (pair)	46-82	35-95	
LEAK 600	60-85	46-50	
LEAK 600	54-45	38-50	
METROSOUND HFS 103 (pair)	27-50	19-95	
202	23-65	16-95	
Duplex 15	35-20	28-95	
Duplex C553	61-60	42-95	
PIONEER CS53	51-39	34-95	
SINCLAIR Q16	8-47	6-20	
TANDBERG Tan 7	27-78	22-25	
Tan 11 (pair)	37-66	29-95	
TL 12 Teak (pair)	52-25	42-95	
TL 25 Teak (pair)	67-32	55-50	
TL 50 Teak	74-80	58-75	
TELETON 8000 (pair)	19-87	11-50	
THORPE GRENVILLE TG100 (pair)	31-85	19-50	
TG200 (pair)	46-15	28-50	
TG300 (pair)	61-55	34-50	
WHARFEDALE Denton Mark II (pair)	39-32	27-50	
Linton Mark II (pair)	45-66	34-50	
Triton III (pair)	60-85	42-50	
Milton Mark II	38-50	26-95	
Dovedale 3 Mark II	52-25	35-95	
Rosedale	75-90	52-95	
Unit 3 speaker kit (pair)	23-40	18-50	
Unit 4 speaker kit (pair)	41-80	29-25	
Unit 5 speaker kit (pair)	60-50	42-50	

PICK UP ARMS AND HEADS

AUDIO Technica AT 1005 Mk. II	17-85	12-95
AUDIO Technica L2 IIfts	2-46	1-90
CONNOISSEUR SAU2	13-86	11-25
GOLDRING Lenco 75	13-20	8-95
GOLDRING Lenco L50	14-30	8-25
GOLDRING PH6 Head Shell for 69/75	2-81	1-80
GOLDRING PH7 Head Shell for 85	3-47	2-40
GOLDRING PH8 Head Shell for 101	0-92	0-70
SME 3009 ser 11 Improved	34-65	25-95
SME 3009-S2 ser 11 Improved	37-95	28-95
SME S2 Head Shell	2-77	1-90

CHASSIS SPEAKERS

GOODMANS Twin-axiom 8	8-58	6-25
Twin Axium 10	9-47	6-90
Axium 401	19-45	13-95
Axium 8P	5-17	3-75
Axium 10P	5-62	4-10
Axium 12P	14-30	10-40
Axium 15P	23-10	16-50
Axium 18P	39-27	27-95
Axium 100 40 watts din.	13-20	9-50
ARU 172	4-95	3-60
Axent 100	7-59	5-40
Midas 650	14-85	9-50
Aurora	4-10	2-95
Crossover network XO/950	8-55	5-95
WHARFEDALE 8 in. Bronze/RS/DD	4-44	3-20
Super 8/RS/DD	7-95	5-75
Super 10/RS/DD	13-11	9-45

CARTRIDGES

ADC 10E Mk. IV	Sp. Price	15-95
AMSTRAD 900C	5-02	3-15
AMSTRAD 900D	7-63	4-75
AMSTRAD 900 EX	11-23	7-75
AUDIO TECHNICA AT 66	6-17	3-30
*CONNOISSEUR SCU1	5-78	4-75
GOLDRING G850	5-78	2-95
GOLDRING G800	Sp. Price	3-75
GOLDRING G800 Super E	Sp. Price	12-50
GOLDRING G820	11-00	7-50
GOLDRING G820E	16-50	11-40
GOLDRING G820 Super E	22-00	15-20
EMPIRE 1000E/X	58-87	37-95
EMPIRE 999E/X	42-05	26-95
EMPIRE 999TE/X	24-73	16-25
EMPIRE 999SE/X	19-98	12-95
EMPIRE 999E/X	15-48	10-30
EMPIRE 909E/X	12-10	7-95
EMPIRE 105E/X	8-41	6-20
SHURE M3D	8-31	3-60
SHURE M44-G	7-91	4-60
SHURE M44-7	7-52	4-20
SHURE M-44C	7-52	4-60
SHURE M44E	8-18	4-60
SHURE M55E	9-24	5-30
SHURE M75E	14-07	9-95
SHURE M75-6 (S)	8-18	4-95
SHURE M75-B	12-95	7-10
SHURE M75EJ	14-66	8-25
SHURE M75EJ	18-10	10-10
SHURE M75E/95G	Sp. Price	12-15
SHURE M91ED	19-10	9-95
SHURE M91E	31-51	24-95
*SONOTONE 9TAHC Diam/Saph	3-58	1-30
Stoned cartridges above are ceramic—all others are magnetic.		

OVER 1000 ITEMS ALWAYS IN STOCK

All items brand new and fully Guaranteed and backed by after-sales service

— latest models in manufacturers' sealed cartons



COMET for after-Sales Service THROUGHOUT THE U.K.

Service Departments at Hull, Birmingham, Bridlington, Dagenham, Doncaster, Edinburgh, Eastleigh, Goole, Hackbridge, Hayes, Jarrow, Leeds, Leicester, Nottingham, Renfrew, Rochdale, Rochester, Sheffield, Teesside, Wigan.

	Rec. Retail Price	Comet Price
BASES AND COVERS		
CONNOISSEUR Plinth BD1	£ p	£ p
CONNOISSEUR Cover	3-38	4-20
CONNOISSEUR P.U. Mount Board	0-88	0-70
GARRARD WB1 Base	3-56	2-70
GARRARD WB4 Base	5-28	3-90
GARRARD SPC1 Cover	3-47	2-60
GARRARD SPC4 Cover	4-13	3-00
Special Offer of Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500		
	Sp. Price	2-50
Special offer of base and cover to fit McDONALD MP60 and 610		
	Sp. Price	3-50
GOLDRING Plinth 75	9-24	6-40
GOLDRING Plinth 72	8-91	6-20
GOLDRING Covers for 72P	4-46	3-10
Cover for 75P De Luxe	4-95	3-40
Cover for 85P	6-60	4-60
THORENS TX 25 (for TD125AB)	8-25	6-40
THORENS TX11 Cover	4-18	3-40
SME Plinth System 2000 with motor-board		
	43-58	34-95
MOTORBOARDS only	0-51	4-00
SME P1 Spacer	0-92	0-70

	Rec. Retail Price	Comet Price
TUNERS		
AKAI A1550 AM/FM/MPX/FET	84-10	61-95
AKAI AT580 AM/FM/MPX/MOS FET	131-09	96-95
AMSTRAD Multiplex 3000 FM	37-90	26-95
*DULCI FM Decoder	10-45	7-75
*DULCI FM T	23-16	14-90
JVC Nivico MCT VSE/VT500 AM/FM	80-96	62-95
JVC Nivico MCT V7E AM/FM	115-25	94-95
LEAK Delta FM	74-43	52-95
LEAK Delta AM/FM	82-78	62-95
METROSOUND TMS 20	61-70	36-95
PHILIPS RH 890	45-66	33-50
PHILIPS RH 821	103-06	78-80
PIONEER TX500A AM/FM	72-47	48-95
PIONEER TX600 AM/FM	100-35	68-95
RANK ROTEL 320	55-91	39-95
RANK ROTEL 620	87-86	62-95
ROGERS Ravensbourne In Teak Case	61-05	44-95
SINCLAIR 2000	42-44	28-95
3000	42-44	28-95
Project 60 Tuner (stereo)	23-57	16-95
All above Tuners are complete with MPX Stereo Decoder except where stated.		

	Rec. Retail Price	Comet Price
HEADPHONES		
AKAI ASE22	13-09	7-95
AKG K180	30-80	18-70
AKG K60	16-50	9-90
AKG 100	8-80	5-50
AMSTRAD HPSSA	8-25	4-30
HPSA with volume control	13-75	7-40
HPS 7A bass and treble controls	15-35	10-90
KOSS HV1	22-00	17-60
KOSS ESP-9 Electrostatic	75-90	58-25
KOSS ESP-6 Electrostatic	49-50	38-50
KOSS K2 plus 2 Quadrafone	49-50	39-95
KOSS PRO-5 LC	33-00	26-80
KOSS PRO-4	30-80	23-20
KOSS KO-727B	18-15	13-75
KOSS 747	22-00	16-50
KOSS K-711	11-00	8-50
KOSS K6	13-75	10-50
KOSS K6/LC (with volume control)	15-40	11-60
KOSS K6/LC Quadrafone	22-00	18-75
PIONEER SE 50	24-09	16-50
PIONEER SE 30A	13-86	9-25
PIONEER SE 20A	8-67	5-50
PIONEER SEL 20	11-58	7-50
PIONEER SEL 40	19-17	12-50
SOUND MD306	7-15	3-10
WHARFEDALE DD	13-75	10-75
WHARFEDALE Isodynamic	21-95	16-50

	Rec. Retail Price	Comet Price
BLANK TAPES		
SCOTCH DYNARANGE CASSETTES		
C90	0-77	0-40
C90	1-08	0-55
C120	1-63	0-80
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1-20	0-75
C90	1-54	1-00
SCOTCH CASSETTE HEAD CLEANER		
	0-61	0-40
SCOTCH Low Noise 8-TRACK BLANK CARTRIDGES		
40 mins.	1-65	0-99
80 mins.	1-98	1-20
MAGCANT 8-track 90 mins.		
	Sp. Price	0-75
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
5" L.P. 900	2-02	1-25
5 1/2" L.P. 1200	2-37	1-45
7" L.P. 1800	3-18	1-99
SCOTCH HI-FI DYNARANGE DOUBLE PLAY		
5" D.P. 1200	2-50	1-55
5 1/2" D.P. 1800	3-41	2-15
7" D.P. 2400	4-37	2-75
Tapes, cassettes and 8T cartridges, 1-9 items 5p per order. Packs of ten post free.		

	Rec. Retail Price	Comet Price
HI-FI STEREO SYSTEMS—COMPLETE		
BUSH A1005	86-25	48-95
BUSH 1006 with radio	89-06	67-95
DANSETTE 4005	67-73	47-95
DANSETTE 4020	45-50	29-95
DECCA SOUND 613	63-95	48-95
DECCA COMPACT 2 with radio	96-03	75-95
DECCA COMPACT 3 with radio	127-09	99-95
DECCA 403	54-45	42-95
FERGUSON 3450 B with Radio (new Model)	75-40	58-95
FERGUSON 3451 B with Radio (new Model)	101-50	79-95
FERGUSON 3454	39-95	30-95
FIDELITY UA1 Music Master with Radio	94-81	67-95
FIDELITY UA2 Music Master	41-23	28-95
FIDELITY UA3 incl. stereo radio	59-73	43-95
FIDELITY Stereo Nine	Sp. Price	22-95
G.E.C. 2810	74-89	56-95
GROSVENOR MPX 6000 AM/FM/MPX Tuner/Amplifier, magnetic Input, built-in 8-track cartridge player with speakers	65-75	38-95
HMV 2451	115-70	89-95
HMV 2452	62-57	48-95
HMV 2455	165-90	129-95
I.T.T. 1025 KB with 662 speakers and I.T.T. 2250 KB with 659 speakers and radio	136-83	105-95
PHILIPS 808	99-53	72-95
PHILIPS 825	46-92	34-95
PHILIPS 826	71-09	49-95
PHILIPS 835 with radio	65-88	46-50
PHILIPS 836 with radio	90-95	65-95
ULTRA 6027	54-55	42-95
ULTRA 6028	56-85	43-95
ULTRA 6450 B (new model) with radio	75-40	58-95
ULTRA 6451	75-40	58-95
ULTRA 6455	59-20	29-95
ULTRA 6454	36-80	28-95
TAPE RECORDERS		
AKAI 1721L	93-87	66-95
AKAI 4000 DS	93-50	68-95
AKAI X201D	168-30	123-95
AKAI X1810	215-18	159-95
AKAI GX211D	215-18	159-95
AKAI GX190D	224-57	166-95
AKAI GX370D	328-95	244-95

	Rec. Retail Price	Comet Price
TAPE RECORDERS—continued		
AKAI CR80D 8-track stereo tape deck	£ p	£ p
AKAI CR30 8-track stereo recorder	117-02	66-95
AKAI CR80DS Quadraphonic	149-88	109-95
AKAI CR80T 8-track stereo recorder and tuner amplifier	140-78	84-95
AKAI CR81T 8-track cartridge stereo recorder and tuner amplifier	145-65	107-95
AKAI CR81	102-89	75-95
AKAI CR81D	84-10	61-95
FERGUSON 3258 4-track	66-85	47-00
FERROGRAPH 702/704 Dolby	267-30	226-95
FERROGRAPH 702H Dolby	278-30	235-95
FERROGRAPH 722/724 Dolby	305-80	258-95
FERROGRAPH 722H Dolby	316-80	268-95
FERROGRAPH 724	220-00	167-95
FERROGRAPH 727/724	68-50	194-95
FIDELITY Braemar 4-track	32-64	18-50
GROSVENOR RP 9008-track record, play-back deck	51-15	36-95
GRUNDIG TK 121 (twin-track)	54-27	38-95
GRUNDIG TK 141 (4-track)	58-60	43-95
GRUNDIG TK 147 (4-track auto)	92-87	72-95
GRUNDIG TK 148 (4-track auto 2 speed)	69-89	53-95
GRUNDIG TK 246 4-track stereo deck	126-78	94-95
GRUNDIG TK 3200 Hi-Fi (Battery)	135-15	99-95
MARCONI 4248 4-track, 2 speed	49-66	35-95
PHILIPS 4307 4-track	47-40	33-95
PHILIPS 4308 De Luxe 4-track	52-32	38-95
PHILIPS 4416 4-track stereo recorder	137-46	99-95
PHILIPS 4418 4-track stereo	189-99	137-95
TANDBERG 3341X 4-track stereo deck	122-11	102-95
TANDBERG 6041X 4-track stereo	187-62	153-95
TANDBERG 9021X 2-track stereo deck	216-20	182-95
TANDBERG 9041X 4-track stereo deck	216-20	182-95
THORPE GRENVILLE TD145 8-track player deck	20-28	13-50

	Rec. Retail Price	Comet Price
TAPE RECORDERS (CASSETTE)		
AKAI CS35D tape deck	75-13	52-95
AKAI CS35 Stereo Incl. Speakers	105-71	77-95
AKAI GXC 40D tape deck	89-74	65-95
AKAI GXC 40	105-71	75-95
AKAI GXC 40T recorder, tuner/amplifier	157-40	116-95
AKAI GXC 45D tape deck	112-28	83-95
AKAI GXC 46 Dolby tape recorder	143-30	106-95
AKAI GXC 46D Dolby tape deck	131-09	95-95
AKAI GXC 65D Dolby auto-reverse deck	145-18	107-95
BUSH TP 66 Battery/Mains	26-70	20-95
FERGUSON 3253 (mains)	41-15	26-95
FERGUSON 3256 (mains)	36-61	23-95
FERGUSON 3257	53-45	39-95
FERGUSON 3257/7 speakers for above	15-20	11-50
GEC CR200 AM/FM Cassette/Radio, Battery/Mains with slide controls	Sp. Price	34-95
GRUNDIG C210 Battery/Mains	46-00	33-95
HARVARD Elite Cassette/AM/FM Radio (battery/mains)	Sp. Price	22-95
JVC Nivico 9420 LS with AM/FM radio, battery/mains	57-84	39-95
JVC Nivico 1710 Radio/Cassette, AM/FM	Sp. Price	37-95
PHILIPS 2202/2203	22-59	16-95
PHILIPS 2204 battery/mains	28-25	21-95
PHILIPS 2405 Stereo with 2H401L/S	67-78	51-95
PHILIPS 3392	20-24	14-95
PYE 9116 Stereo	65-80	47-95
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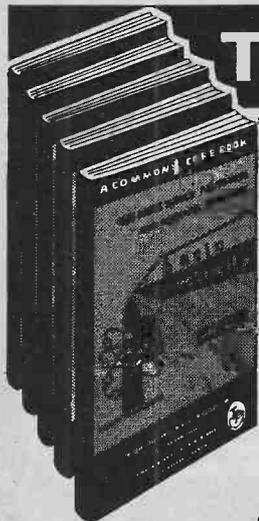
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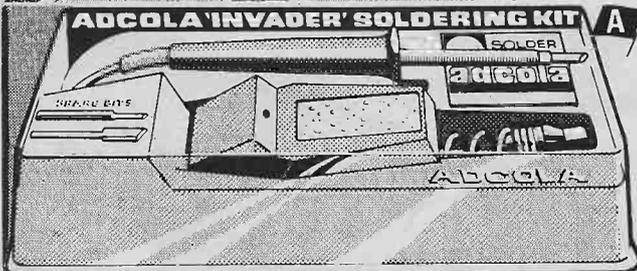
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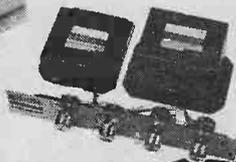


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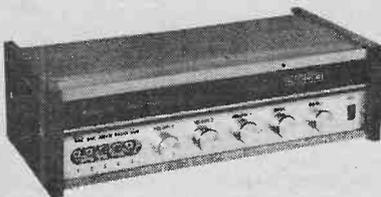
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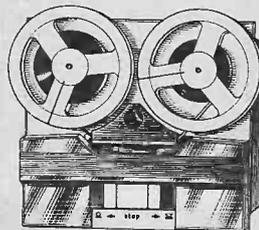
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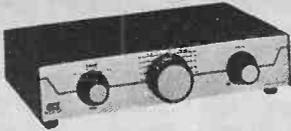
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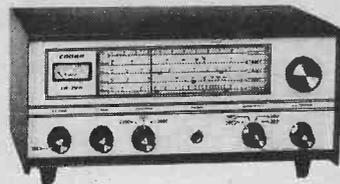


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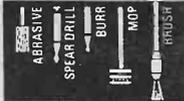
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THIS IS THE FIRST PAGE OF THE GREAT BI-PAK SECTION

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Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
AC107	22	AD161	36	BC145	49	BD133	71	BF182	44	MAT120	21	2G308	38	2N2148	62
AC113	22	AD162	36	BC147	11	BD135	44	BF183	44	MAT121	22	2G309	38	2N2160	66
AC118	25	AD161 &		BC148	11	BD136	44	BF184	27	MPF102	46	2G339	22	2N2192	38
AC117K	22	AD162 (MP)		BC149	13	BD137	49	BF185	33	MPF104	40	2G339A	17	2N2193	38
AC125	13			BC150	20	BD138	55	BF188	44	MPC105	40	2G344	20	2N2194	38
AC126	18	ADT140	60	BC151	22	BD139	60	BF194	13	OC19	38	2G345	17	2N2217	24
AC127	18	AF114	26	BC152	18	BD140	66	BF195	13	OC20	69	2G371	17	2N2218	22
AC128	18	AF115	26	BC153	31	BD155	88	BF196	15	OC22	48	2G371B	13	2N2219	22
AC128	18	AF116	26	BC154	33	BD175	88	BF197	15	OC23	48	2G373	18	2N2220	24
AC132	15	AF117	26	BC157	20	BD176	88	BF200	49	OC24	61	2G374	18	2N2221	22
AC134	15	AF118	35	BC158	13	BD177	71	BF202	104	OC25	42	2G377	33	2N2222	22
AC137	15	AF124	33	BC159	13	BD178	71	BF207	49	OC26	27	2G378	17	2N2223	18
AC141	15	AF125	27	BC160	49	BD179	77	BF258	68	OC28	55	2G381	17	2N2269	15
AC141K	18	AF126	31	BC161	55	BD180	77	BF259	93	OC29	55	2G382	17	2N2369A	15
AC142	15	AF127	31	BC167	13	BD185	71	BF262	60	OC35	46	2G401	38	2N2411	26
AC142K	18	AF139	33	BC168	13	BD186	71	BF263	60	OC36	55	2G414	33	2N2412	26
AC151	16	AF178	33	BC169	13	BD187	77	BF270	38	OC41	22	2G417	27	2N2416	51
AC154	22	AF179	55	BC170	13	BD188	77	BF271	33	OC42	26	2N388	38	2N2711	23
AC155	22	AF180	55	BC171	15	BD189	82	BF272	38	OC44	16	2N388A	60	2N2712	23
AC156	22	AF181	49	BC172	15	BD190	82	BF273	38	OC45	14	2N404	23	2N2714	23
AC157	26	AF186	49	BC173	15	BD195	93	BF274	38	OC70	11	2N404A	18	2N2703	11
AC165	22	AF239	40	BC174	15	BD196	93	BFW10	66	OC71	11	2N524	46	2N2904A	23
AC166	22	AL102	71	BC175	24	BD197	99	BFX29	30	OC72	15	2N527	54	2N2905	22
AC167	22	AL103	71	BC177	21	BD198	99	BFX54	24	OC74	15	2N598	46	2N2906A	23
AC168	26	AS226	27	BC178	21	BD199	99	BFX86	33	OC75	16	2N599	49	2N2907	12
AC169	15	AS227	33	BC179	21	BD200	1-04	BFX86	24	OC76	17	2N696	14	2N2908A	20
AC176	22	AS228	28	BC180	26	BD205	88	BFX87	26	OC77	27	2N697	14	2N2907	10
AC177	26	AS229	27	BC181	26	BD206	88	BFX88	24	OC81	16	2N698	26	2N2907A	24
AC178	31	AS250	27	BC182	11	BD207	1-04	BFY50	22	OC81D	16	2N699	38	2N2923	15
AC179	31	AS251	27	BC182L	11	BD208	1-04	BFY51	22	OC82	16	2N706	9	2N2924	15
AC180	18	AS252	27	BC183	11	BDY20	1-10	BFY52	16	OC83	22	2N708	13	2N2925	15
AC180K	22	AS254	27	BC183L	11	BF115	49	BFY53	18	OC83	22	2N708	13	2N2926(A)	14
AC181	18	AS255	27	BC184	13	BF117	49	BFX25	98	OC84	22	2N711	33	2N2926(Y)	12
AC181K	22	AS256	27	BC184L	13	BF118	77	BXS19	16	OC89	22	2N717	38	2N2926(B)	11
AC187	24	AS267	27	BC186	31	BF119	77	BXS20	16	OC140	22	2N718	26	2N2926(R)	11
AC187K	22	AS268	27	BC187	31	BF121	49	BSY25	16	OC169	27	2N718A	55	2N2926(B)	11
AC188	24	AS271	44	BC207	12	BF123	65	BSY26	16	OC170	27	2N726	31	2N3010	77
AC188K	22	BC107	10	BC208	12	BF128	49	BSY27	16	OC171	27	2N727	31	2N3011	66
AC171	27	BC108	10	BC209	13	BF127	55	BSY28	16	OC200	27	2N743	22	2N4068	13
AC178	22	BC109	11	BC212L	12	BF152	60	BSY29	16	OC201	31	2N744	22		
AC191	22	BC113	11	BC213L	12	BF153	49	BSY38	20	OC202	31	2N914	15	AA119	9
AC192	22	BC114	18	BC214L	15	BF154	49	BSY39	20	OC203	27	2N918	33	AA120	9
AC193	22	BC115	16	BC225	27	BF155	77	BSY40	31	OC204	27	2N929	23	AA129	9
AC194	22	BC116	16	BC228	38	BF156	53	BSY41	31	OC205	38	2N930	23	AA130	10
AC195	22	BC117	16	BCY30	28	BF157	60	BSY42	14	OC209	44	2N1132	24	AA190	11
AC196	22	BC118	11	BCY31	28	BF158	60	BSY95A	14	OC271	47	2N1132	24	BA100	11
AC197	22	BC119	33	BCY32	33	BF159	66	Bu105	2-20	ORF12	47	2N1302	15	BA116	23
AC198	31	BC120	38	BCY33	24	BF160	44	CI11E	5-50	ORP60	44	2N1303	15	BA126	24
AC199	31	BC125	13	BCY34	27	BF162	44	C400	33	ORP61	44	2N1304	18	BA148	15
AC200	31	BC126	30	BCY70	15	BF163	44	C407	37	P346A	22	2N1305	18	BA164	13
AC201	31	BC127	13	BCY71	20	BF164	44	C424	22	P397	46	2N1306	23	BA165	15
AC202	31	BC134	30	BCY72	15	BF165	44	C425	55	ST140	14	2N1307	23	BA166	14
AC203	31	BC135	13	BCZ10	22	BF167	24	C426	38	ST141	18	2N1308	25	BY100	16
AC204	18	BC136	16	BCZ11	27	BF173	24	C428	22	T843	33	2N1309	25	BY101	13
AC205	18	BC137	16	BCX12	27	BF176	38	C441	33	U746	30	2N1613	22	BY105	18
AC206	18	BC138	44	BD121	66	BF177	38	C442	33	2G301	21	2N1711	22	BY114	13
AC207	18	BC140	33	BD122	71	BF178	33	C444	38	2G302	21	2N1859	35	BY126	15
AD142	53	BC141	33	BD124	66	BF179	33	C450	24	2G303	21	2N1890	49	BY127	16
AD143	42	BC142	33	BD131	55	BF180	33	MAT100	21	2G304	28	2N1893	40	BY128	16
AD149	55	BC143	33	BD132	66	BF181	33	MAT101	22	2G306	44	2N2147	79	BY130	17

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AA129	9	BYX38/30	46	OA81	7
AA190	10	BYZ10	38	OA85	10
AA213	11	BYZ11	38	OA90	8
BA100	11	BYZ12	33	OA91	6
BA116	23	BYZ13	27	OA95	6
BA126	24	BYZ16	44	OA200	7
BA148	15	BYZ17	38	OA202	7
BA164	13	BYZ18	38	SD10	5
BA165	15	BYZ19	31	SD19	5
BA166	14	CG52	31	IN34	7
BY100	16	(OA91 Eq.)	5	IN34A	7
BY101	13	CG61	11	IN914	6
BY105	18	(OA70-OA79)		IN916	6
BY114	13	Eq.	6	IN414B	6
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100	0-28	0-37	0-52	0-62	0-65	0-64	0-70
200	0-39	0-41	0-54	0-54	0-63	0-67	0-83
400	0-48	0-52	0-62	0-62	0-74	0-83	1-03
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200	0-06	0-10	0-07	0-16	0-22	0-27
400	0-07	0-15	0-08	0-23	0-30	0-41
600	0-08	0-18	0-11	0-26	0-38	0-50
800	0-11	0-19	0-12	0-28	0-41	0-61
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2N3055

115 WATT SIL POWER NPN 55p EACH

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U 13	30 PNP-NPN Sil. Transistors OC200 & 2S 104	0-55
U 14	150 Mixed Silicon and Germanium Diodes	0-55
U 15	25 NPN Sil. Planar Trans. TO-5 like B8Y61, 2N697	0-55
U 16	10 3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0-55
U 17	30 Germanium PNP AF Transistors TO-5 like ACV 17-22	0-55
U 18	8 6 Amp Silicon Rectifiers BY213 Type up to 600 PIV	0-55
U 19	25 Silicon NPN Transistors like BC108	0-55
U 20	12 1-5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0-55
U 21	30 AF. Germanium Alloy Transistors 2G300 Series & OC71	0-55
U 22	30 PNP like MHz Series PNP Transistors	0-55
U 23	20 Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0-55
U 25	25 300 MHz NPN Silicon Transistors 2N708, B8Y27	0-55
U 26	30 Fast Switching Silicon Diodes like IN914 Micro-Min.	0-55
U 27	12 NPN Germanium AF Transistors TO-1 like AC127	0-55
U 29	10 1 Amp SCR's TO-5 can, up to 600 PIV CR81/26-600	1-10
U 30	15 Plastic Silicon Planar Trans. NPN 2N2926	0-55
U 31	20 Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0-55
U 32	25 Zener Diodes 400mW DO-7 case 3-18 volts mixed	0-55
U 33	15 Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0-55
U 34	30 Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0-55
U 35	25 Silicon Planar Transistors PNP TO-18 2N2906	0-55
U 36	25 Silicon Planar NPN Transistors TO-6 B8Y60/61/62	0-55
U 37	30 Silicon Alloy Transistors SO-2 PNP OC200, 28322	0-55
U 38	20 Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0-55
U 39	30 RF. Germ. PNP Transistors 2N1303/5 TO-5	0-55
U 40	10 Dual Transistors 8 lead TO-5 2N2060	0-55
U 41	25 RF Germanium Transistors TO-1, OC45, NKT72	0-55
U 42	10 VHF Germanium PNP Transistors TO-1 NKT667, AP117	0-55
U 43	25 Sil. Trans. Plastic TO-18 AF. BC113/114	0-55
U 44	20 Sil. Trans. Plastic TO-5 BC115/116	0-55
U 45	7 3A SCR. TO66 up to 600PIV	1-10

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BP x25 and P21. BRAND NEW. Full data available. Fully guaranteed. Qty. 1-24 25-99 100 up Price each 49p 44p 89p

F.E.T.'S

2N3819	81p	2N5458	85p
2N3820	85p	2N5459	44p
2N3821	89p	BFW10	68p
2N3823	81p	MPF105	41p

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A LARGE RANGE OF TECHNICAL AND DATA BOOKS ARE NOW AVAILABLE EX. STOCK. SEND FOR FREE LIST.

QUALITY TESTED SEMICONDUCTORS

Pak No.	Description	Price
Q1	20 Red spot transistors PNP	0-85
Q2	16 White spot R.F. transistors PNP	0-85
Q3	4 OC 77 type transistors	0-85
Q4	6 Matched transistors OC44/45/81/81D	0-85
Q5	4 OC 75 transistors	0-85
Q6	6 OC 72 transistors	0-85
Q7	4 AC 128 transistors PNP high gain.	0-85
Q8	4 AC 128 transistors PNP	0-85
Q9	7 OC 117 type transistors	0-85
Q10	4 AC 127/128 Complementary pairs PNP/NPN	0-85
Q12	3 AF 116 type transistors	0-85
Q13	3 AF 117 type transistors	0-85
Q14	3 OC 171 H.F. type transistors	0-85
Q15	7 2N2926 Sil. Epoxy transistors mixed colours	0-85
Q16	2 GBT890 low noise Germanium transistors	0-85
Q17	5 NPN 2 x ST.141 & 3 x ST.140	0-85
Q18	4 MADDT 8 2 x MAT 100 & 2 x MAT 120	0-85
Q19	3 MADDT 8 2 x MAT 101 & 1 x MAT 121	0-85
Q20	4 OC 44 Germanium transistors A.F.	0-85
Q21	4 AC 127 NPN Germanium transistors	0-85
Q22	20 NKT transistors A.F. R.F. coded.	0-85
Q23	10 OA 202 Silicon diodes sub-min.	0-85
Q24	8 OA 31 diodes	0-85
Q25	15 IN914 Silicon diodes 75 PIV 75mA	0-85
Q26	8 OA95 Germanium diodes sub-min. IN89	0-85
Q27	2 10A PIV Silicon rectifiers IS425R.	0-85
Q28	2 Silicon power rectifiers BYZ 13	0-85
Q29	4 Silicon transistors 2 x 2N696, 1 x 2N697, 1 x 2N698	0-85
Q30	7 Silicon switch transistors 2N706 NPN	0-55
Q31	6 Silicon switch transistors 2N708 NPN	0-55
Q32	3 PNP Silicon transistors 2 x 2N1131, 1 x 2N1132	0-85
Q33	3 Silicon NPN transistors 2N1711	0-85
Q34	7 Silicon NPN transistors 2N2369, 600MHz (code P397)	0-55
Q35	3 Silicon PNP TO-5. 2 x 2N2904 & 1 x 2N2905	0-85
Q36	7 2N3846 TO-18 plastic 300 MHz NPN	0-55
Q37	3 2N3053 NPN Silicon transistors	0-85
Q38	7 NPN transistors 4 x 2N3703, 3 x 2N3702	0-55

ELECTRONIC SLIDE-RULE

The MK Slide Rule, designed to simplify Electronic calculations, features the following scales: Conversion of Frequency and Wavelength. Calculation of L, C and f of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Area Functions. Natural Logs and e Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 2 cm x 4cm. Complete with case and instructions. Price each: £3-68

INTEGRATED CIRCUIT PAKS

Manufacturers 'Fall Outs' which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C.'s and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UI00	-12 x 7400	0-55	UI06	-5 x 7448	0-55	UI08	-5 x 7486	0-55
UI01	-12 x 7401	0-55	UI07	-5 x 7447	0-55	UI09	-5 x 7489	0-55
UI02	-12 x 7402	0-55	UI08	-5 x 7448	0-55	UI09	-5 x 7491	0-55
UI03	-12 x 7403	0-55	UI09	-12 x 7450	0-55	UI02	-5 x 7492	0-55
UI04	-12 x 7404	0-55	UI05	-12 x 7451	0-55	UI03	-5 x 7493	0-55
UI05	-12 x 7405	0-55	UI06	-12 x 7452	0-55	UI04	-5 x 7494	0-55
UI06	-8 x 7406	0-55	UI07	-12 x 7453	0-55	UI05	-5 x 7495	0-55
UI07	-8 x 7407	0-55	UI08	-12 x 7454	0-55	UI06	-5 x 7496	0-55
UI08	-12 x 7410	0-55	UI09	-12 x 7455	0-55	UI07	-5 x 7497	0-55
UI09	-8 x 7413	0-55	UI10	-12 x 7456	0-55	UI08	-5 x 7498	0-55
UI10	-12 x 7420	0-55	UI11	-8 x 7470	0-55	UI09	-5 x 7499	0-55
UI11	-12 x 7430	0-55	UI12	-8 x 7472	0-55	UI10	-5 x 7499	0-55
UI12	-8 x 7406	0-55	UI13					

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	1	25	100+		25	100+		25	100+
SN7400	0-17	0-16	0-13	SN7450	0-17	0-16	0-13	SN74141	0-74
SN7401	0-17	0-16	0-13	SN7451	0-17	0-16	0-13	SN74145	£1-65
SN7402	0-17	0-16	0-13	SN7453	0-17	0-16	0-13	SN74150	£2-30
SN7403	0-17	0-16	0-13	SN7454	0-17	0-16	0-13	SN74151	£1-10
SN7404	0-17	0-16	0-13	SN7460	0-17	0-16	0-13	SN74153	£1-32
SN7405	0-17	0-16	0-13	SN7470	0-32	0-29	0-27	SN74154	£1-98
SN7406	0-39	0-34	0-31	SN7472	0-32	0-29	0-27	SN74155	£1-54
SN7407	0-39	0-34	0-31	SN7473	0-41	0-39	0-35	SN74158	£1-64
SN7408	0-20	0-19	0-18	SN7474	0-41	0-39	0-35	SN74167	£2-09
SN7409	0-20	0-19	0-18	SN7475	0-50	0-48	0-46	SN74160	£1-98
SN7410	0-17	0-16	0-13	SN7476	0-44	0-43	0-42	SN74161	£1-98
SN7411	0-28	0-27	0-26	SN7480	0-74	0-71	0-64	SN74162	£2-40
SN7412	0-39	0-34	0-31	SN7481	£1-32	£1-27	£1-21	SN74163	£2-40
SN7413	0-32	0-29	0-27	SN7482	0-86	0-85	0-84	SN74164	£2-43
SN7416	0-45	0-44	0-44	SN7483	£1-21	£1-16	£1-05	SN74165	£2-43
SN7417	0-45	0-44	0-42	SN7484	£1-10	£1-05	0-99	SN74166	£3-35
SN7420	0-17	0-16	0-13	SN7485	£3-98	£3-85	£3-74	SN74174	£2-53
SN7422	0-55	0-53	0-50	SN7486	0-35	0-34	0-33	SN74175	£1-76
SN7423	0-55	0-53	0-50	SN7489	£6-05	£5-78	£5-50	SN74176	£2-75
SN7425	0-55	0-53	0-50	SN7490	0-74	0-71	0-64	SN74177	£2-76
SN7426	0-50	0-48	0-44	SN7491	£1-10	£1-05	0-99	SN74180	£2-20
SN7427	0-50	0-46	0-44	SN7492	0-74	0-71	0-64	SN74181	£2-05
SN7428	0-77	0-72	0-66	SN7493	0-74	0-71	0-64	SN74182	£2-31
SN7430	0-17	0-16	0-13	SN7494	0-85	0-82	0-75	SN74184	£2-85
SN7432	0-50	0-46	0-44	SN7496	0-85	0-82	0-75	SN74190	£2-15
SN7433	0-88	0-83	0-77	SN7496	0-86	0-83	0-88	SN74191	£2-09
SN7437	0-71	0-68	0-66	SN74100	£1-82	£1-76	£1-71	SN74192	£2-15
SN7438	0-71	0-68	0-66	SN74104	£1-07	£1-04	0-97	SN74193	£2-20
SN7440	0-17	0-16	0-13	SN74105	£1-07	£1-04	0-97	SN74194	£2-97
SN7441	0-74	0-71	0-64	SN74107	0-44	0-42	0-40	SN74195	£2-20
SN7442	0-74	0-71	0-64	SN74110	0-61	0-59	0-55	SN74196	£1-98
SN7443	£1-43	£1-38	£1-32	SN74111	£1-38	£1-27	£1-21	SN74197	£1-98
SN7444	£1-43	£1-38	£1-32	SN74118	£1-10	£1-05	0-99	SN74198	£2-06
SN7445	£1-98	£1-95	£1-93	SN74119	£1-49	£1-35	£1-21	SN74199	£2-05
SN7446	£1-07	£1-04	0-97	SN74121	0-44	0-41	0-38	Terminal Pos Volt Reg. T.O.3	
SN7447	£1-10	£1-07	£1-05	SN74122	£1-54	£1-43	£1-21	Plastic O/P 1.5 Amps. μ A7805	
SN7448	£1-10	£1-07	£1-05	SN74123	£3-08	£2-97	£2-88	5V. & μ A7812 12V. μ A7805	

LINEAR I.C.'s—FULL SPEC.

Type No.	Price	1-24	25-99	100 up
BP 201C—SL201C	69p	58p	49p	
BP701C—SL701C	69p	55p	49p	
BP 702C—SL702C	69p	55p	49p	
BP 703—72702	68p	49p	44p	
BP709—72709	39p	37p	33p	
BP 709P—LA709C	39p	37p	33p	
BP 710—72710	48p	46p	44p	
BP 711— μ A711	49p	47p	44p	
BP 741—72741	55p	50p	45p	
μ A793C	31p	28p	26p	
TAA 263	77p	66p	60p	
TAA 293	1-09p	83p	77p	
TAA 350	£1-87p	£1-74p	£1-65p	

S.G.S. EA1000 £2-89p

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

Type	Price	1	25	100+
BP930	13p	12p	11p	
BP932	14p	13p	12p	
BP933	14p	13p	12p	
BP936	14p	13p	12p	
BP944	14p	13p	12p	
BP945	27p	26p	24p	
BP946	13p	12p	11p	
BP948	27p	26p	24p	
BP951	71p	66p	60p	
BP962	13p	12p	11p	
BP9093	44p	42p	38p	
BP9094	44p	42p	38p	
BP9097	44p	42p	38p	
BP9099	44p	42p	38p	

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

NUMERICAL INDICATOR TUBES



MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
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
PRICE EACH	£1-87	£1-70	£1-09

All indicators 0-9 & Decimal point. All side viewing. Full data for all types available on request.

RTL MICROLOGIC CIRCUITS

	Price each	1-24	25-99	100 up
Epoxy TO-5 case				
uL900 Buffer	38p	36p	29p	
uL914 Dual 2i/p gate	38p	36p	29p	
uL923 J-K flip-flop	55p	51p	49p	

Date and Circuits Booklet for IC's Price 8p.

DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C.'s. TWO RANGES PROFESSIONAL & NEW LOW COST.

PROP. TYPE No.	1-24	25-99	100up
TSO 14 pin type	33p	30p	27p
TSO 16 " "	38p	35p	33p

LOW COST No.

BPS 14	18p	14p	12p
BPS 16	17p	15p	13p

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50W pk 25w (RMS)

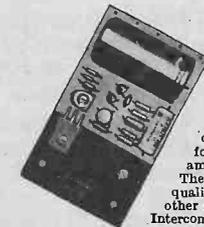
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HI-FI AUDIO AMPLIFIER

THE AL50

- ★ Frequency Response 15Hz to 100,000—1dB. **ONLY £3.58p each**
- ★ Load—3, 4, 8 or 16 ohms.
- ★ Distortion—better than 1% at 1KHz.
- ★ Signal to noise ratio 80dB.
- ★ Supply voltage 10-35 Volts.
- ★ Overall size 63mm x 105mm x 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and ALRO was conceived to fill the need for all your A.F. amplification needs. FULLY BUILT—TESTED—GUARANTEED.

STABILISED POWER MODULE SPM80



AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including—Disc Systems, Public Address, Intercom Units, etc. Handbook available, 10p **PRICE £3-25**

TRANSFORMER BMT80 £2-14½ p. & p. 27½p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages. Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



SPECIFICATION

Frequency Response 20Hz - 20KHz \pm 1dB
better than 0.1%
Inputs : 1. Tape Head 1-25 mV into 50K Ω
2. Radio, Tuner 35 mV into 50K Ω
3. Magnetic P.U. 1.5 mV into 50K Ω

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

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

ONLY £13-14½

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25-30 FREE p. & p.

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SUMMER SEASON

NOT so very many years ago there was much controversy over the invasion by small transistor radios on the beaches of popular British holiday resorts. There is no doubt they can, if not used with discretion, be an intrusion to the enjoyment of other people's relaxation. As a result it is now unlawful to cause a nuisance by allowing radios to be operated in public places.

Since May is generally regarded as the opening of the holiday season we thought that readers will want to look into the possibilities of taking away a small radio or perhaps a cassette player. In this issue, therefore, we have offered a design for a simple TRF receiver for the medium wave band. This is no ordinary MW receiver; it has been designed so that stations beyond the 200 metre mark stand a good chance of being heard.

In spite of certain limitations of the TRF there is no doubt that most people who start building their own radio usually choose this type because of its relative simplicity compared with superhets.

But the problem really is that the TRF is only as good as the aerial-earth system used and the locality in which you wish to listen in. On the other hand, the larger and more expensive superhet can be taken virtually anywhere.

There is a rapidly growing trend to incorporate a cassette recorder in the same case as the radio and this makes sense from a commercial as well as user aspect. So far these are all imported; the U.K. market has grown from about 30,000 in 1970 to almost 400,000 in 1972. Examples of this and other radio and hi-fi equipment recently announced are shown in our special pictorial feature on page 148.

If your holiday turns out to be a wet one, or if you want to save batteries, you can use a small mains power supply unit. It is worth having a regulated supply and in this issue we show you how to make one.

Although the summer months tend to discourage indoor activities, *Practical Wireless* continues to provide some superb designs that you cannot afford to miss. Among these in the coming months will be projects for musicians, amateur radio constructors, f.m. experimenters, audio addicts, pop radio listeners, and equipment testers. As back numbers are not available, we recommend advance orders to avoid disappointment.

Finally, don't forget to have a go in our competition this month; you could win a digital multimeter and a year's supply of new projects, designs, features and promotions in 12 free issues of *Practical Wireless*.

M. A. COLWELL—Editor

The July issue on sale 1st June, will include a tremolo generator for guitars and organs, an experimental f.m. receiver with extended tuning range, a digital i.c. process timer, an article about magnetic amplifiers and a variable frequency oscillator for the 3-band transmitter in this issue. Also watch out for first details of articles specially devised for beginners, plus the extra features and regular news and comment pages.

Further details on page 143.

NEWS...

Mobile rally diary

May 6—The Tulip Time Rally is being held at Sunfleet on the A16 four miles north of Spalding. All information can be obtained from R. Harrison, G3VPR, 38 Park Avenue, Spalding, Lincs.

May 13—South Leicestershire Mobile Rally will be held at Westfield Activity Centre Rosemary Way, Hinckley. Talk-in stations will be manned by G3ZOP/A (Top Band) G8CGW/A on 2m a.m./f.m. and G3WPB/A on 2m s.s.b. Contact for further gen is J. Elliott G8CGW, 92 Hinckley Road, Barwell, Leicester.

May 20—The Radio Amateur Invalid Bedfast Club will be having their rally at the Fairground, Broadlands Estate, Romsey, Hampshire. This will be held in conjunction with the Southampton Group. All information from Mrs. Frances Woolley, G3LWY, Woodclose, Penselwood, Wincanton, Somerset.

May 20—Otley Radio Society are holding their Northern Mobile Rally at Moor Grange School, Ring Road, Leeds. Many stalls and refreshments etc. Contact is D. G. Mott, 17 Newall Carr Road, Otley, Yorkshire.

May 27—The Hull and District Mobile Rally will be at Bishop Burton, near Beverley, Yorkshire. All the information can be obtained from L. D. Colley, G3AGX, 13 Ferry Road, Wawne, Nr. Hull, HU7 5XU.

May 27—The Maidstone Mobile Rally will be held at the YMCA Sports Centre, Melrose Close. Talk-in stations will be GB3YSC on 2, 4, 80 and 160m. Further information from A. S. Walter, G3WXL, 4 Oak Farm Gardens, Headcorn, Kent.

June 10—Elvaston Castle Mobile Rally. This fourth annual event will be held in the grounds of the Castle Country Park, just off the B5010 south-east of Derby. A bring-and-buy sale is one of the main attractions and talk-in stations will be operating on 2m, 4m and Top Band by G3EEO and G3ZBI. Further gen may be obtained from I. Cage, G8GBV, 25 Petersham Drive, Alvaston, Derby, DE2 0JU.

Good old days at Sound '73

IN 1927 the Bedford public address engineer Cecil Clarabut purchased a caravan to tow behind his motor car for his public address work. The van and car travelled to many events in the Bedfordshire area for almost thirty years and according to the records this van and car were last used in June 1958. Since then they have been stored at Mr Clarabut's premises in Bedford and lain idle until Tuesday 6th March this year when the tyres were pumped up, the dust brushed off, a few squirts of oil were given in the appropriate places and it was possible to tow the caravan from Bedford to Harrow for preparation for the Sound 73 Exhibition.

The equipment inside is obviously not as old as the van itself, although the rack dates from the mid 1940's. The 78 record players are probably from the same era, and it is understood that the amplifiers were modernised in 1947 to take the new Reslo VMC microphones. The horn speakers which fitted to the roof rack were manufactured by Goodmans.

Mr Clarabut is selling his premises for re-development and plans to reduce his activities in the audio world. He has therefore kindly donated this caravan and its equipment to the Association of Public Address Engineers' collection and at present the Association's Secretariat is looking for a suitable museum to house this caravan.



Home Radio

The latest issue of this catalogue covers more components than ever. It's a "new look" edition with larger format. If readers would like a copy it is available from Home Radio (Components) Ltd., 240 London Road, Mitcham, Surrey, CR4 3HD. The price is 75p (post paid) or 55p to callers.

Quadraphonic sound

REPORTS are coming in from America and Japan of increasing favour towards discrete four-channel stereo (CD-4), although currently there are in Japan more matrix Sansui QS discs available than any other. JVC-Nivico have opened a record cutting plant in Los Angeles for CD-4 records. The influence of recording companies in America, and presumably in the U.K., together with recommendations for broadcasting, will decide on the ultimate system (or systems) to be generally promoted.

Mr. C. B. Wood, Head of Engineering Information at the BBC, implied in a statement recently that the BBC were likely to take a long time before deciding on their choice of quadraphonic sound, especially when stereo broadcasting, now using p.c.m., has reached a high standard.

Northern Radio Societies Convention

THIS year, the Northern Radio Societies Association Annual Convention will be held at The Forum Halls, Wythenshawe, Manchester, on Sunday, May 6, from 11 a.m. to 6 p.m.

This is a new venue for the convention, on the south side of Manchester, a few minutes from the M56 Motorway and with good access from the centre of Manchester.

The convention will take the same form as in previous years with member societies competing for the G3AYD trophy awarded to the stand giving the best presentation of some aspect of amateur radio.

Talk-in stations will be operating on 2, 4 and 160m and the main station will operate on all h.f. bands using call GB2NRS.

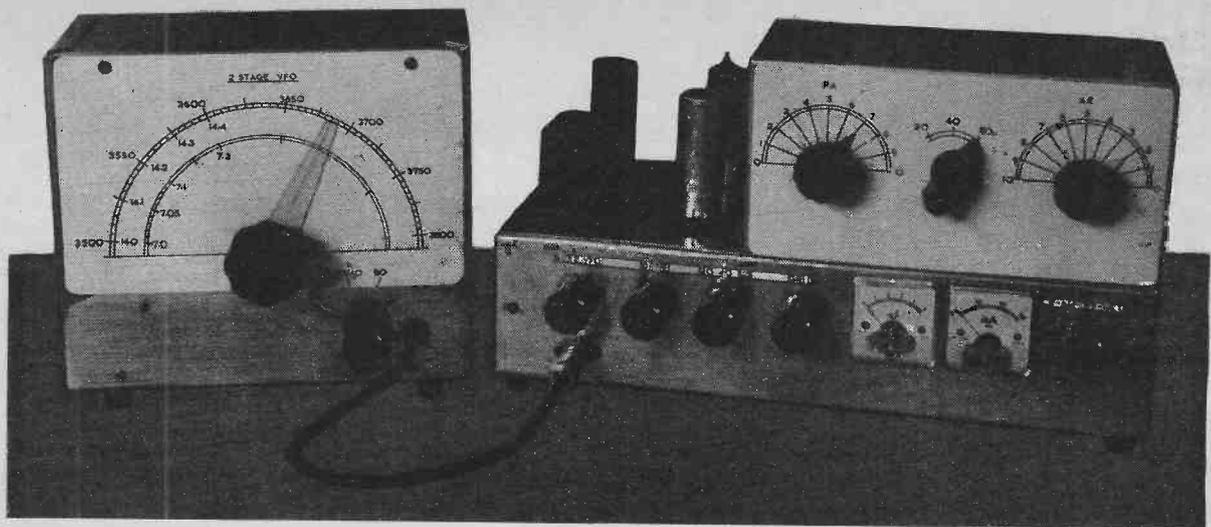
The usual raffle will be organised with tickets on sale during the day.

Further information is obtainable from *Peter Taylor G8BCG*, 2 Columbia Avenue, Gorton, Manchester M18 7LG.

Screwdriver standard

TO provide an authoritative specification for the adequate design of insulated screwdrivers—and for the benefit of purchasers—the British Standards Institution has published BS 2559 *Screwdrivers: Part 3: 1972 Insulated screwdrivers*.

The Standard covers the materials and thickness of the insulation suitable for the tools specified in other parts of BS 2559, and gives a test which utilises a potential of 5kV.



3-BAND TRANSMITTER

PART 1

F. G. RAYER G30GR

THE transmitter described here is of particularly simple construction, being fully enclosed and screened without the use of a cabinet. It covers three bands, 20, 40 and 80 metres and runs about 25 watts input for AM, screen-grid modulated, and about 50 watts CW. Crystal control is used and a single crystal may permit working on two or three bands. There are two crystal holders, with a switch to select them, so a few crystals can give a useful number of working frequencies. Since a variable frequency oscillator is often wanted in addition to crystal control a suitable plug-in VFO is also described. This does not require any changes to be made to the transmitter.

CIRCUIT DESIGN

Fig. 1 is the circuit, a 5763 being used as a crystal oscillator or buffer-multiplier. Switch S1 selects either crystal, or VFO input, and the valve anode circuit L1 can be tuned to the crystal frequency, or to a harmonic.

This type of oscillator works well and gives a good output on harmonic frequencies. For example, 1750-1900kHz crystals may be used for 3.5-3.8MHz, as well as 3.5-3.8MHz crystals. Similarly, those 80m band crystals which fall in the 40m band on their second harmonic, may be used for both 80m and 40m, while 3.5MHz band and 7MHz band crystals may be employed for 14MHz working, as well as on their fundamental frequencies.

L1 is tapped and switched for the required band and tuned by VC1. VR1 allows output of this stage to be adjusted. C3 is in parallel with the RF choke when V1 is used with the VFO.

The power amplifier, a 6146, runs at an input of 50 watts which is easily within the ratings of this valve. Since grid current provides bias and is very important, a 5mA meter is permanently connected in the grid circuit. The second meter indicates PA

anode current. This method is easier in practice than having a single meter, with switch.

The PA tank circuit L3 is designed to match into a 75ohm load, so dipoles and other conventional aerials may be used.

In the modulator V3, a 6BR7, is a high-gain audio amplifier for a crystal microphone and VR2 is a pre-set audio gain control. Using an ECL82, V4a is a further audio stage and V4b the screen-grid modulator. With screen-grid modulation the input to the PA is reduced to about 25 watts, when the transmitter is capable of giving a good signal, well modulated.

A single control switch S4 has four positions, "Net" puts HT on the oscillator (and VFO, if in use) so that the transmitter can be tuned for correct PA grid current and the working frequency located with a receiver. The "Off" position takes HT off all stages. The "AM" position places HT on the PA, and the screen-grid voltage from the modulator. In the "CW" position, the PA SG voltage is raised and taken from the modulated line. The keying is carried out in the cathodes of the 5763 and 6146.

Though a screen-grid modulator does not have the power of a high level anode and screen modulator, the method avoids the need for a large modulation transformer and can work out very satisfactorily.

Power units are separate, which may allow existing supplies to be used. The oscillator and modulator require about 60mA to 80mA at about 250V so a receiver type power pack is satisfactory.

The 500V high voltage supply is used for the PA only. With an AM input of 50mA and CW input of 100mA this will provide inputs of 25 watts and 50 watts. The PA has been run successfully with 400V and even lower voltages but a fairly high voltage here is useful with SG modulation. The PA maximum listed input ratings are 110mA anode current at 750V, but these have not been used in the present transmitter.

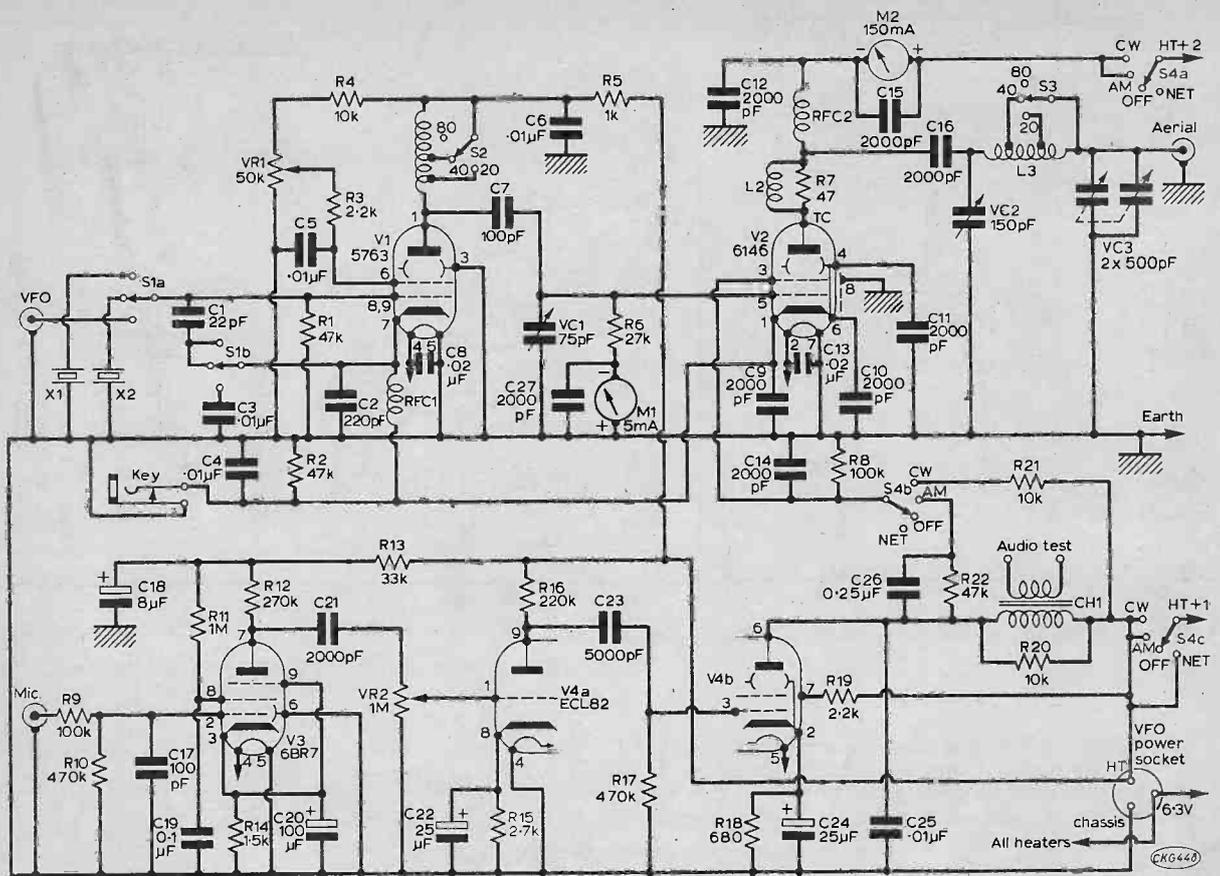
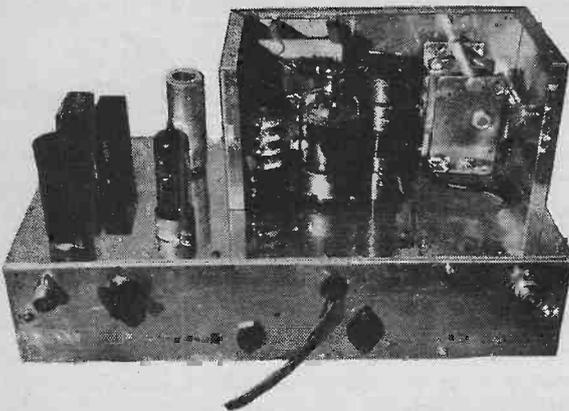


Fig. 1: Complete circuit of the transmitter and modulator.

CHASSIS CONSTRUCTION

The transmitter is built on an enclosed chassis with the PA stage in a closed screening box. This both screens and protects against possible contact with HT circuits the equipment being intended for use in this form, with no other cabinet.

The flanged PA box can be obtained ready-formed. It is 4in. high, 4½in. deep, and 8in. wide, and has flanges at top, back and bottom. It is bolted to the 13 x 6in. chassis as in Fig. 2, which also shows positions of the valveholders. Six holes are punched round V2 for ventilation.



Rear chassis view with part of power amplifier screening removed.

Capacitors VC2 and VC3 are bolted to the front of the box. Their rotor contacts are connected together with stout wire and to a tag held with one of the bolts securing V2 holder.

A tag strip holds C12 and RFC2. A well-insulated lead from C12 runs against the chassis and passes through a hole directly over the 150mA meter negative terminal.

A co-axial lead runs from VC3 through the chassis to the aerial socket.

Fig. 3 shows all wiring, etc., under the chassis. Heater, power and audio circuit leads run against the chassis with adequately insulated wire used for the high voltage circuits.

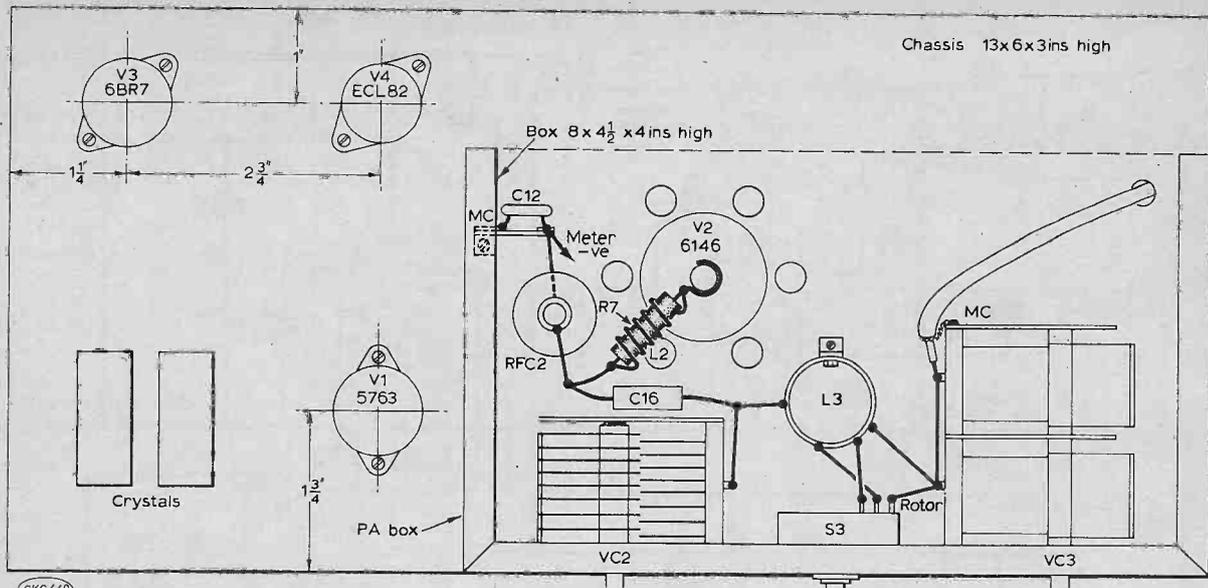
When wiring S1, use one pole to select each crystal holder, and the adjacent VFO input socket. The other pole places C1 from grid to cathode, when the stage is used as a crystal oscillator.

By-pass capacitors in the RF circuits must be connected with very short leads, especially around V2. These are all disc ceramics and since they may be obtained cheaply it may be noted that the actual values used are not too important.

When wiring V3 in particular, keep R9, R10, C17 and grid leads short and against the chassis, and clear of the heater circuit, or hum may be caused.

The chassis listed has flanges at the bottom which allow a flat plate 13 x 6in. or perforated metal of the same size to be attached with self-tapping screws, for screening and protection. A plate should have a number of ventilation holes punched in it.

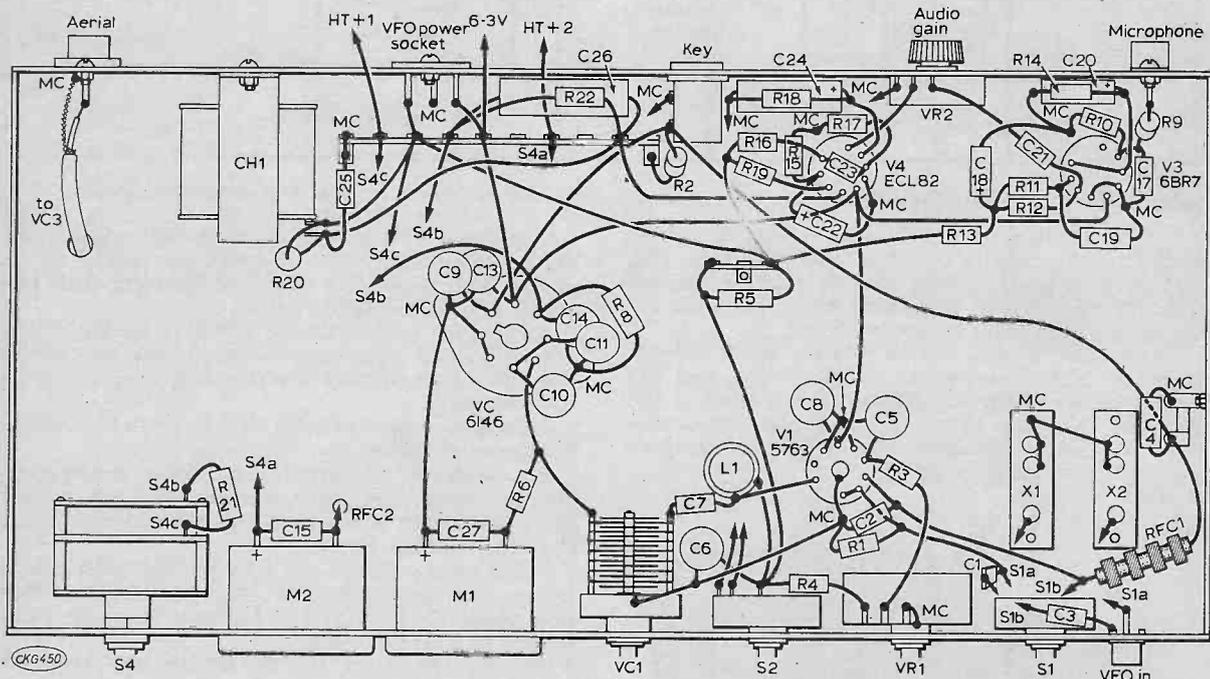
To allow circulation of air, the transmitter is



CKG449

▲ Fig. 2: Component layout on top of the chassis with drilling details.

▼ Fig. 3: Under-chassis wiring information and placement of the smaller components.



CKG450

raised on four rubber feet, attached with bolts to the plate or bottom.

Tag strips are used to support various small components and to anchor the power supply leads, which pass out through a grommet at the back. A 3-way socket is required for the VFO power supply with a 3-pin plug wired to match.

The key jack has closing contacts which complete the cathode circuit to chassis when no plug is inserted. With the key plugged in, it has to be held closed or locked down while tuning up.

Fig. 4 shows connections to the function switch S4. S4a applies HT in the AM and CW positions while S4b switches the screen-grid from R21 to R22. S4c completes the low voltage HT circuit.

INDUCTORS

The parasitic choke L2 is five turns of 18swg wire, spaced to occupy about $\frac{3}{4}$ in. length and about $\frac{3}{8}$ in. inside diameter. All connections here should be stout and short.

★ components list

Resistors

R1 47kΩ ½W	R9 100kΩ ½W	R17 470kΩ ½W
R2 47kΩ 1W	R10 470kΩ ½W	R18 680Ω 1W
R3 2.2kΩ ½W	R11 1MΩ ½W	R19 2.2kΩ ½W
R4 10kΩ 1W	R12 270kΩ ½W	R20 10kΩ 1W
R5 1kΩ 1W	R13 33kΩ ½W	R21 10kΩ 2W
R6 27kΩ 1W	R14 1.5kΩ ½W	R22 47kΩ 1W
R7 47Ω 1W	R15 2.7kΩ ½W	
R8 100kΩ 1W	R16 220kΩ ½W	All 10%

VR1 50kΩ 1W linear potentiometer

VR2 1MΩ log. potentiometer

Capacitors

C1 22pF SM	C15 2000pF 350V D. Cer
C2 220pF SM	C16 2000pF 1kV Mica
C3 0.01μF 350V D. Cer	C17 100pF SM
C4 0.01μF 350V D. Cer	C18 8μF 350V
C5 0.01μF 350V D. Cer	C19 0.1μF 350V
C6 0.01μF 350V D. Cer	C20 100μF 6V
C7 100pF SM	C21 2000pF 350V
C8 0.02μF 350V D. Cer	C22 25μF 6V
C9 2000pF 350V D. Cer	C23 5000pF 350V
C10 2000pF 350V D. Cer	C24 25μF 50V
C11 2000pF 350V D. Cer	C25 0.01μF 1kV Tubular
C12 2000pF 1kV D. Cer	C26 0.25μF 350V Tub.
C13 0.02μF 350V D. Cer	C27 2000pF 350V D. Cer
C14 2000pF 1kV D. Cer	

SM=Silver Mica D. Cer=Disc Ceramic

VC1 75pF variable

VC2 150pF variable 600V

VC3 500+500pF variable

Valves

V1 5763

V3 6BR7

V2 6146

V4 ECL82

Chassis

Universal chassis sides 13 x 3 in. (2)

Universal chassis sides 6 x 3 in. (2)

Flat plates 13 x 6 in. (2)

PA Box. 8 x 4½ x 4 in. (Type P chassis, H. L. Smith)

Perforated metal 9 x 8 in.

Switches

S1 2 pole 3 way

S2 1 pole 3 way

S3 1 pole 3 way

S4 3 pole 4 way (2 wafers)

Miscellaneous

RFC1, 2.5mH 60mA. RFC2, Denco RFC9A 250mA.

M1, 5mA miniature meter. M2, 150mA miniature

meter. Key socket. Co-axial sockets for microphone,

aerial and VFO. CH1, pentode speaker transformer.

Valveholders, B9A (3) with two screens. Valve-

holder, octal (1). Crystal holders (2). Crystals as

required (Senator Crystals, 36 Valleyfield Rd.,

London, SW16). Knobs, rubber feet. VFO power

socket, 3 way).

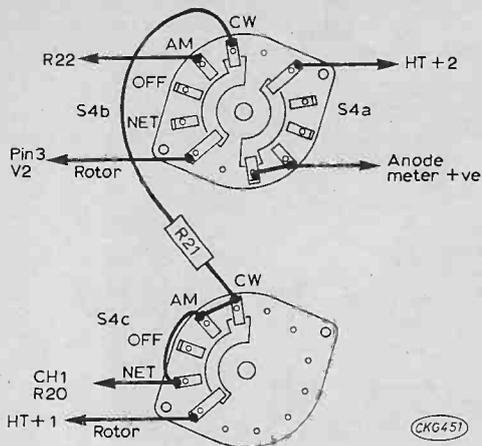


Fig. 4. Wiring of the two wafer switches constituting the function switch S4.

L3 is wound on a 1in. diameter paxolin tube 3¼in. long, as in Fig. 5. The 11½ turn and 13 turn sections are of 20swg wire, wound slightly spaced (20 turns per inch). The 21 turn section is close-wound with 22swg wire, a space of ⅛in. being left between sections.

The switch, coil and taps are so placed that short, direct leads are possible. The spaced windings were made by smearing the tube with adhesive and winding simultaneously with 20swg and 26swg wire, close-wound. The 26swg wire was afterwards unwound. This coil was found to give the same RF output from the transmitter on 14MHz and 7MHz as on 3.5MHz. If other coils are used, there must be sufficient clearance between the winding and metal parts, including the chassis.

After wiring is completed the PA box can be closed with a piece of perforated metal, held with self-tapping screws to the box and chassis.

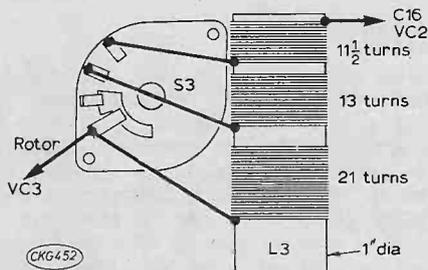


Fig 5: Winding details for the power amplifier coil L3.

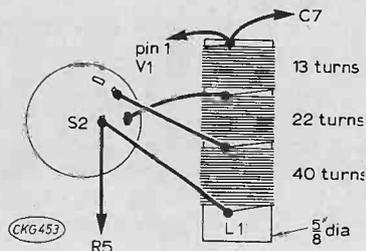
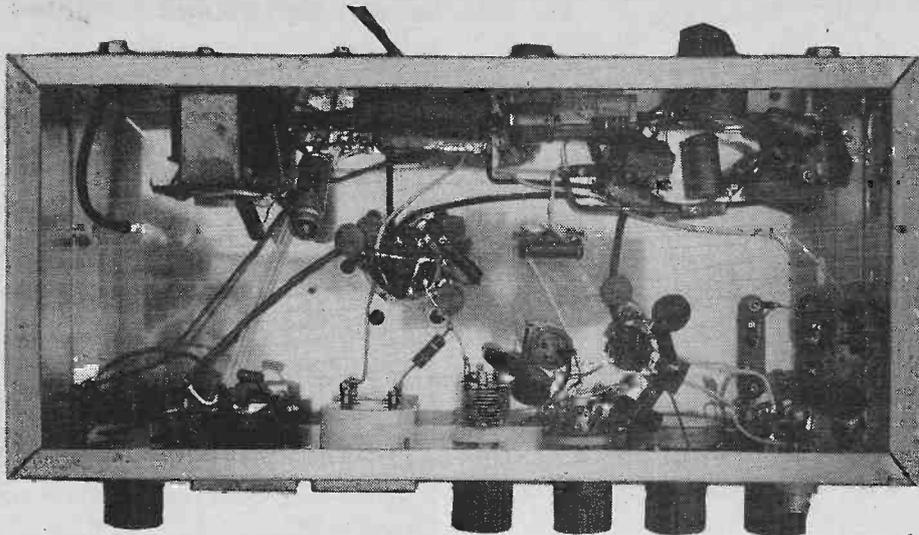


Fig. 6: The driver output coil L1 is wound as shown above.

The driver coil L1 is wound on a ⅝in. diameter paxolin tube 2in. long, as in Fig. 6. The 13 turn and 22 turn sections are of 28swg enamelled wire and the 40 turn section of 32swg enamelled wire. A space of ⅛in. is left between sections, as shown.

With a coil wound in this way it was found impossible to tune to incorrect harmonics with VC1, when doubling. However, when putting any transmitter into use for the first time it is wise to check with an absorption meter, when multiplying from a lower frequency, to be sure the wanted harmonic is obtained.



This view underneath the chassis will help when wiring up from Fig. 3.

AUDIO TEST

As the choke CH1 is the primary of a speaker type transformer, it is worth while testing the audio section with V3 and V4 only in place. Connect a speaker temporarily to the secondary. VR2 is turned up from zero until normal speech in the crystal microphone gives good loudspeaker volume. Feedback of sound from the loudspeaker to the microphone will cause howling.

Audio may also be checked by listening to the signal with a receiver, having the RF and IF gain near zero and the aerial disconnected. Another method is to connect headphones to a crystal diode and few turns of insulated wire, and bring this loop towards L3 when the transmitter is working into an artificial load or the aerial.

PA OPERATION

With V1 and V2 in place, the function switch should never be turned to AM or CW unless some 2mA or so of grid current has been found on "NET." The equipment should not be operated with HT on the screen of V2 and not on the anode (i.e., by having HT2 disconnected).

With a crystal in circuit tune VC1 for maximum grid current. VC1 will be nearly closed for 80m, half closed for 40m and well open for 20m, S2 being in the appropriate position in each case.

Adjust VR1 so that grid current is about 2mA. It will be found that VR1 needs to be nearly at zero when working on the same frequency as that of the crystal, but has to be advanced considerably when L1 is tuned to a multiple of the crystal frequency.

L1 and L3 are always switched to the same band, so that V2 operates straight through at the same frequency since doubling in this stage is not recommended.

For an initial test, plug a 40 watt household lamp into the aerial socket, or clip it across VC3. Close VC2 and VC3 (to avoid doubling). Switch to "NET" and tune for 2mA grid current, as described. Switch to AM and open VC2 so that the anode current dip is found. Open VC3 a little, meanwhile re-tuning

with VC2 for the dip. This increases input and output and the operation is continued until the wanted input is obtained. The lamp should light with increasing brilliance as this is done.

With the switch at CW, input rises considerably and the PA must not be left off tune. The PA can be tuned initially in the AM position, even when CW is required, because the lower screen voltage helps to keep the anode current down.

When using a transmitter with screen-grid modulation the PA must be loaded so that the anode current dip, shown by the anode meter, is quite flat. If not, speech quality, as reported by a station in the usual way, will deteriorate considerably. With an average crystal microphone, VR2 can first be tried about one-third from the zero position. Excess audio will cause over modulation and distortion.

CRYSTALS

Surplus crystals may be used, and it is worth noting that the choice of frequency may determine whether a given crystal can be used in only one band, or two bands. For example, a 3520kHz crystal can be used on 80m, and also on 40m, because it doubles to 7040kHz. But a 3560kHz crystal doubles to 7120kHz which is outside the 40m band.

It will be noticed that all 40m band crystals can be used for both 40m and 20m. On the other hand, crystals of higher frequency than 7.1MHz cannot be used for 40m, but may still be used for 20m where they fall in this band.

The choice of crystals may also depend on the requirement to work CW or AM.

Attempting to use too high a crystal harmonic results in insufficient PA grid current. It was found that 160m crystals were satisfactory for 80m and 40m. Various 80m crystals gave over 5mA on 80 and 40M, and 2mA on 20m, while 40m crystals give nearly 5mA on 40m and 20m. As expected, 160m crystals do not furnish enough drive on 20m.

PART 2, next month, will deal with the design and construction of a matching variable frequency oscillator.

Dear Sir,



VAT

I was rather puzzled by the letter from Alan Secker A.C.A. on Value Added Tax.

Of particular interest was his "nutshell" in paragraph (a) in which he stated that orders received after 31st March 1973 would have to be accompanied by 10% for the VAT over and above list prices. Surely this is not so, as I understood that VAT was to replace purchase tax, and as purchase tax was already on the listed items (until they had been reassessed for VAT) one would, in effect, be paying tax on tax!—**J. I. McCartney** (Littleover, Derby).

[The term "list price" is usually expressed as the retail value of goods excluding tax. For further information on VAT, see the Leader article in April's issue of Practical Wireless]—Editor.

A "go" at the locals

I read with interest the letter in the March issue from Mr. Redhouse (BBC Radio London) replying to correspondence from myself and Mr. J. Manners. There was no reference to either advice to my customers or to the volume of sales . . . As to the rest of the letter, I would like to raise the following points.

Perhaps no-one did quarrel openly with the idea of making the network services available on v.h.f., though why this should be due to "limited resources" baffles me. As the sole authorised broadcasting service in the UK for so many years, the BBC demeans itself and its audience by this excuse. The BBC has also ensured the continuing use of a.m. by making its most popular radio channel available only on m.w., except for a couple of hours at

night and when—perish the thought—it is being relayed by local radio.

Has the BBC really "demolished" its regional structure to make room for commercial broadcasting? According to an IBA leaflet, their stations will have sole use of only 1151kHz. They will share 1546kHz with the BBC. The greatest benefit from the recent wavelength changes would appear to be felt by continental listeners to the BBC's external services.

Radio Stoke, my local radio station, will have been on the air for some 146 hours in the current week (February 3rd-9th). Of this time, it will have relayed 83 hours of Radios 2 and 4. The remaining 63 hours of truly local origin will have contained 10½ hours of repeats. There are no local programmes after 8.30 p.m. at the latest; it has been known for Radio 2 to be relayed from 5.00 p.m. on Sundays. When is a carbon copy not a carbon copy? For the answer to this, tune in tomorrow at 2.00 p.m., go slowly up and down the m.w. band and in between sighing for the erstwhile Radios 390, 270, Caroline, London, etc. *et al* count how many stations are broadcasting "Woman's Hour".—**C. E. Miller** (Uttoxeter).

Knob Twiddlers Unite!



As the new season of mobile rallies approaches, may I suggest to Top Band talk-in station operators that instead of random tuning a specific frequency be announced in advance. Three advantages are apparent.

The first, and by far the most important, is improved road safety. Knob twiddling is very dangerous while driving. The second would be that mobiles not requiring talk-in facilities could arrange nets with friends in advance without fear of causing interference to the talk-in station. Finally, there would be a far better chance of the talk-in station hearing "distress" calls from distant, and not so distant mobiles. **D. Matthews, G3ZZP/M** (London EC2Y 8BR).

'SCOPE COMPETITION RESULT

THE PRACTICAL WIRELESS 'SCOPE COMPETITION WAS A FANTASTIC SUCCESS

Ten prizewinners have each received the portable oscilloscope kit.

These kits, offered as prizes in the "Scope Competition", published in our December 1972 and January 1973 issues, are obviously even more desirable than we had anticipated—we were inundated with entries!

Having considered them all, the judges decided that the best attempt received was that submitted by J. Boraston, of Filton, Bristol, who had listed the features of the prize 'scopes in the following order:

1st-A; 2nd-J; 3rd-L; 4th-K;
5th-E; 6th-C; 7th-B; 8th-D.

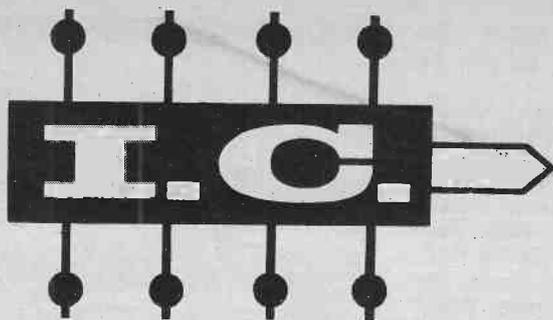
OTHER WINNERS

The nine next best entries according to the judges were sent by:

G. Abrams, Aylesbury;
J. D. Bower, Hull;
M. Brookland, Cuckfield;
P. J. Dick, Edinburgh;
D. M. Haig, Abingdon;
D. Kan, Southsea;
M. E. Randle, Walsall;
J. Summers, Peterhead;
G. A. Towill, Portsmouth.

These ten readers each receive a 3in. portable oscilloscope kit—the K/OS-2 by Heathkit.

NOW TRY YOUR HAND AT THE NEW COMPETITION ON
PAGE 147 OF THIS ISSUE.



OF THE MONTH

L.A.J. IRELAND

Number 38

Toshiba TA7117P Quadraphonic Decoder

ANYONE who has recently returned from the United States may have brought home some of the new quadraphonic records which have begun to catch on in a big way on that side of the Atlantic, and no doubt will shortly become freely available here, so this month's article reviews a new linear i.c. recently released by Toshiba, type TA7117P, which is capable of decoding such records to give four channel stereo sound. It is probably only a matter of time before four channel matrixed sound appears on standard l.p.'s especially now that many of the teething problems, associated particularly with the compatibility of ordinary stereo records and four channel records, have been ironed out.

joint Columbia-Sony venture produced a four channel record which was capable of being played through existing stereo equipment and by means of an adapter placed between the pick-up and main amplifiers true quadraphonic sound could be reproduced. The four channel information is embedded in the groove of the record with the LF (left front) and RF (right front) information cut into the left and right hand 45° grooves. The LB (left back) and RB (right back) information is cut in a clockwise and counterclockwise helix and all the information is transformed into a single complex stylus movement with the various components subsequently separated by the matrix decoder.

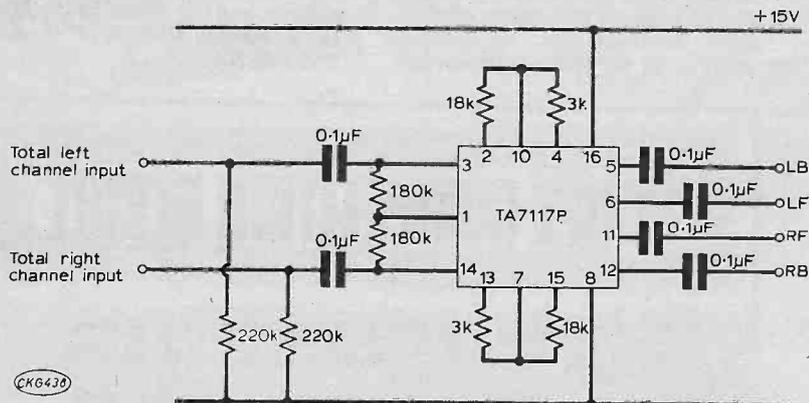


Fig. 1. As can be seen from this diagram few discrete components are needed to provide a complete quadraphonic decoder using the TA7117P. Separate amplifiers and speakers are required for each channel.

Quadraphonics Briefly

Quadraphonic sound is not new; it was first mooted back in the early sixties and in fact a number of experimental four channel tapes were on the market at that time. However, the idea failed to catch on, as the public demand for such tapes was very poor. Before any real impact could be made on the home market, it was necessary for the major recording companies to make an all-out drive to develop and push the sales of quadraphonic records. In 1970 Dynaco, an American firm, introduced a quasi-quadraphonic decoder that would give a type of four channel sound from existing stereo records, and the idea began to catch on. At about the same time a

Practicalities

Few external components are needed with the TA7117P i.c., as is shown in Fig. 1. Channel separation is controlled by the values of the resistor network connected between pins 2 and 4, 13 and 15. The i.c. itself is housed in a 16 lead dual-in-line package.

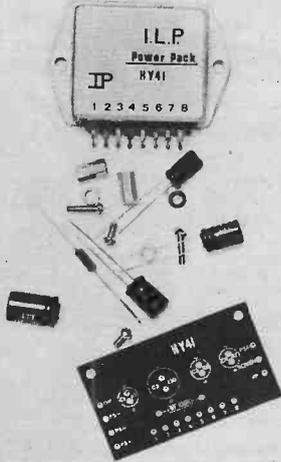
The following are the electrical characteristics of the TA7117P:—Input Impedance 3MΩ, Output Impedance 7kΩ, Current Drain 15mA, Voltage Gain 10dB and Distortion less than 0.1% for an input signal of 100mV.

The unit is available from Erie Electronics Ltd., South Denes, Great Yarmouth.



I.L.P. (Electronics) Ltd

THE HY41



The HY41 supersedes the popular HY40 introduced by I.L.P. last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

OUTPUT POWER: British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.

LOAD IMPEDANCE: 4-16 ohms.

INPUT IMPEDANCE: 30K ohms at 1KHz.

VOLTAGE GAIN: 30db at 1KHz

TOTAL HARMONIC DISTORTION: less than 0.15% (typical 0.05%) at 1KHz.

FREQUENCY RESPONSE: 5Hz-50KHz \pm 1db.

SUPPLY VOLTAGE: \pm 22.5volts D.C.

SUPPLY CURRENT: 0.8 amps maximum.

PRICE: inc. comprehensive manual, P.C. board, five extra components and P. & P.:-
MONO: £4.90 **STEREO:** £9.80

UNIQUE HYBRID PRE-AMPLIFIER

The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from 16-25 Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely integrated system.

INPUTS

Magnetic Pick-up (within \pm 1db RIAA curve)

2mV, 47K Ω

Tape Replay (external components to suit head), 4mV, 47K Ω

Microphone (flat) 10mV, 47K Ω

Ceramic Pick-up (equalized and compensatable) 20-200mV, variable.

Tuner (flat) 250mV, 100K Ω

Auxiliary 1 250mV, 47K Ω

Auxiliary 2 2-20mV, 100K Ω

OUTPUTS

Main Pre-amp output 500mV.

Direct tape output 120mV.

ACTIVE TONE CONTROLS (Bexendall)

Treble \pm 12db.

Bass \pm 12db.

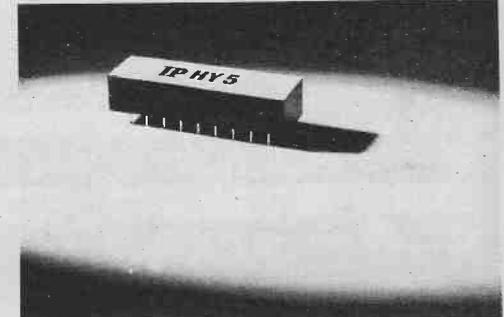
INTERNAL STABILIZATION

Enables the HY5 to share an unregulated supply with the Power Amplifier.

SUPPLY VOLTAGE

16-25 volts

PRICE: MONO: £3.60



SUPPLY CURRENT

6mA approx.

OVERLOAD CAPABILITY

better than 26db on most sensitive input infinite on tuner and auxl.

OUTPUT NOISE VOLTAGE: 0.5mV.

STEREO: £7.20

POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.



Specification

Input: 200-240 Volts.

Output: \pm 22.5 Volts at 2 amps.

Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

PRICE: £4.50 inc. P. & P.

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

Why pay more - look at our Fantastic Bargain Offer!

PENTHOUSE

A COMPLETE AUDIO SYSTEM

An all "White" Hi-Fi Stereo System to blend with modern furnishings. Solid state, fully transistorised tuner/amplifier with Stereo Multiplex Decoder. 4 wavebands Long/Medium/Short/VHF. 8 watts per channel (music power) output. The latest BSR C129 4 speed Mono/Stereo record changer. Two white matching bookshelf speaker units.

OUR PRICE £55.00

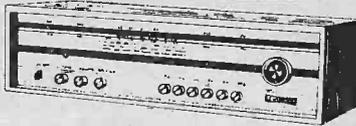


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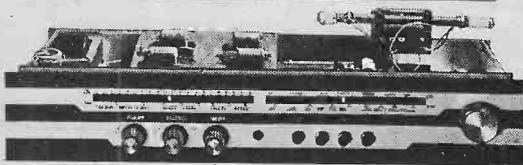
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19" UNTESTED BCC2 SETS. When available £6. Carriage and Ins. £1.65.

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REGULATED POWER

for your Transistor Radio

J. N. WATT

A compact unit that enables a battery driven transistor radio to run from the mains supply. It incorporates a series voltage regulator to give a constant supply voltage even when driving the varying load of a Class B output stage.

THE simple unit described here was constructed by the author for an elderly relative, whose battery radio, although extremely useful for outdoor use in fine weather, did use up batteries at an alarming (and expensive!) rate when left on for long periods of indoor use. For such service, a mains power supply is the obvious answer, but the design of a suitable one is not quite so straightforward as it might at first seem.

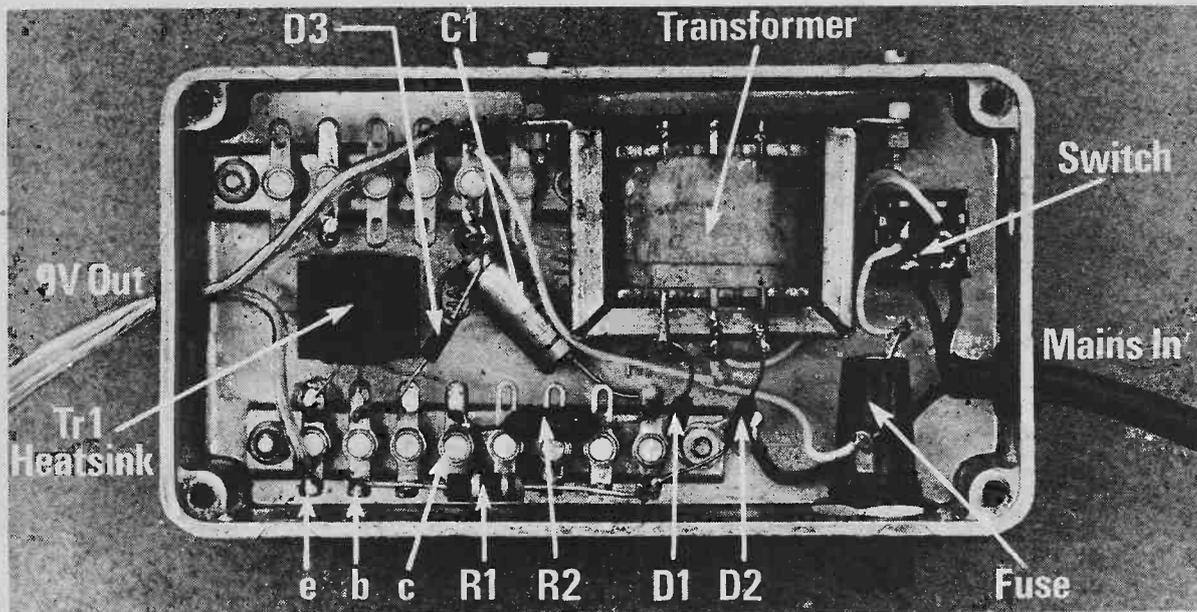
Most battery driven transistor radios employ a Class B output stage; the current requirements of such a stage can vary from a few milliamps when there is no sound output to perhaps 40mA on peaks. Addition of, say, 10mA for the other stages in the radio results in a requirement varying from about 12/15mA to 55mA or so, and the employment of a simple, unregulated supply will lead to large undesirable voltage fluctuations.

To overcome this objection, a series regulator is incorporated, which has that advantage of requiring

a low power zener diode, the power handling being undertaken by the series transistor. The more conventional shunt regulator (conventional at such current levels, that is) would not only call for the use of a larger and more expensive zener diode but, additionally, since the maximum load current would then be diverted to the zener when not required by the load itself, there would be a continuous drain on the transformer of about 60mA—greater than its maximum rating. It is under such conditions of greatly varying load current that series regulators show up best.

Design

Fig. 1 shows the circuit. A 12-0-12V transformer and a conventional twin rectifier produce about 18 volts across C1 when no current is being drawn by the load. The base of Tr1 is held at 5.6V relative to the positive supply rail, by zener diode D3 and hence the negative output is at about 6 volts, since there is about 0.4V across the base-emitter junction of Tr1. With only a few milliamps load current, most of the excess voltage is dropped across Tr1, and R2 has little effect. When the load current rises to about 50mA however, R2 drops more of the excess voltage and this, along with the reduction in voltage across



Every component in the power supply can be clearly identified in this photograph.

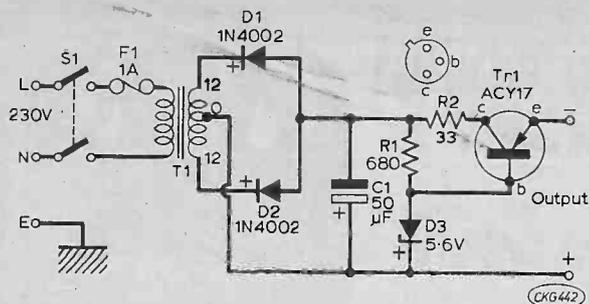


Fig. 1: Circuit diagram of 9V regulated power unit.

C1 due to the higher current causing voltage loss in the transformer windings, means less voltage drop across Tr1. Thus, at times when Tr1 is passing more current it has less voltage across it, so keeping its dissipation low.

The output is not absolutely constant, however, due to the method of feeding the zener diode, D3. The voltage across C1 is, as mentioned previously, 18 volts when no load current is drawn but falls to 11 volts at an output current of 50mA; this means that a variable current flows through D3 and hence its zener voltage is not quite constant, so resulting in a similar change of output voltage. The amount of such change is small, and of no consequence in this application.

Construction

Practical construction of the power supply will depend to a large extent on individual circumstances. In the author's case, there was not room for the power supply to be built inside the radio itself but it was found that the smallest size of Eddystone die-cast box, 4¼ x 2¼ x 1in., was just deep enough to accommodate the transformer mounted on its side, leaving ample room for the remainder of the components, as the photograph shows. Provided that care is taken from a safety point of view, there is no reason why any form of construction found to be convenient should not be employed.

Since the transistor is operating in a closed environment, a small push-on heat sink was fitted to obviate any overheating which might otherwise be caused by lack of ventilation.

The type of connection used to take power to the radio will depend on the original method of connecting the batteries. In the case of the radio mentioned in the first paragraph, four U2s were fitted, so the twin lead from these was cut and a small two way battery plug and socket wired in. A compatible fitting was connected to the leads from the power supply so that either mains or battery operation was possible, by swapping connections. It is essential to observe polarity when wiring up such arrangements.

★ components list

R1 680Ω ½W	Tr1 ACY17
R2 33Ω 3W wirewound	S1 D.P. on-off toggle
C1 50μF 25V	D3 Zener 5.6V 250mW
D1/2 1N4002	T1 12-0-12V 50mA

F1, fuse 1A with holder. Diecast box, type 7134P (Eddystone). Heatsink type TO5. Tag strips.

Later, the running of another radio, with a 9 volt battery, from a second mains supply was required and in this case the battery fitted, a PP3, had a two way connector in place of terminals. Accordingly, the mains power unit was fitted with a mating two way connector identical to that on a PP3, observing polarity of course.

For 9 volt operation the zener diode D3 was changed to one of 8.2V rating; this resulted in an output of about 8.6V which equates with that from a 9 volt battery after a moderate amount of use. The fitting of a 9.1V zener might have given an output voltage that was rather too high for a radio designed to operate efficiently on 9 volts.

TELEVISION

JUNE ISSUE

THE PIL TUBE

One of the most significant developments for some time in colour television is RCA's Precision-in-Line tube which is to be produced in the UK by Thorn (Mazda). This tube has a shadowmask with slits instead of dots, giving increased brightness. The major step forward however is that by using inline guns with a specially designed foroidal scanning yoke the need for dynamic convergence adjustments has been completely eliminated. In fact the coils are attached to the tube and if necessary both must be replaced together. Setting up is almost as simple as with a monochrome set therefore.

TACKLING FIELD FAILURE

Field timebase failure is the most common TV set fault. If changing the valve doesn't do the trick just how do you find where the fault lies? This month we describe practical methods of field timebase testing.

REVERSE AND FORWARD AGC

The application of a.g.c. depends on the characteristics of the devices—valves and transistors—to which it is applied. With transistors there are two opposite techniques of a.g.c.—forward and reverse. The precise mechanisms, not too well known, will be explained this month.

TV RECEIVER SERVICING

One of the first modern UK-produced portable TV chassis was the BRC 1580 chassis: this month Les Lawry-Johns describes the chassis and what goes wrong with it.

TEST REPORT

The next article in this series reports on the Nombrex RC bridge which E. M. Bristol has found to be a useful workshop aid.

PLUS ALL THE REGULAR FEATURES

ON SALE MAY 21

Build yourself a TRANSISTOR RADIO

ROAMER 10 WITH VHF INCLUDING AIRCRAFT

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

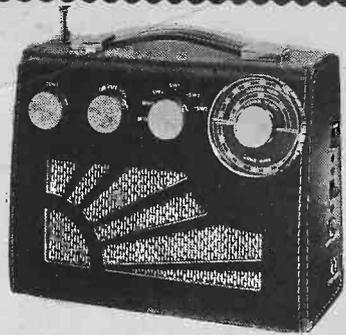
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. 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 80p (FREE with parts).

Total building cost

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P. P. & Ins. 62p

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ROAMER EIGHT Mk I

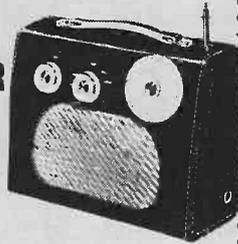
NOW WITH VARIABLE TONE CONTROL



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. 8 transistors plus 3 diodes. Fine tone moving coil 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).

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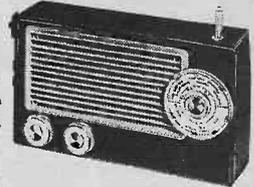


7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, fine tone moving coil 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 25p (FREE with parts).

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ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5½ x 2½in. approx. Easy build plans and parts price list 25p (FREE with parts).

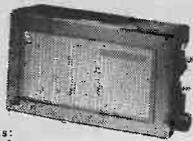


Total building costs **£4-38** P.P. & (Overseas P. & P. £1-05) Ins. 31p

POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended MW band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, super-sensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 6½ x 1½ x 3½in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2-50** P.P. & (Overseas P. & P. 65p) Ins. 24p

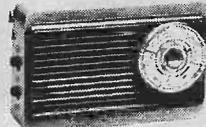


TRANSONA FIVE

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 6½ x 4½ x 1½in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2-75** P.P. & (Overseas P. & P. 65p) Ins. 25p

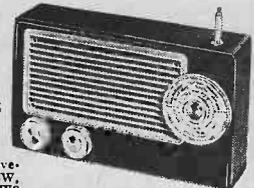


TRANS EIGHT

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 5½ x 2½in. 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).

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PRODUCTION LINES

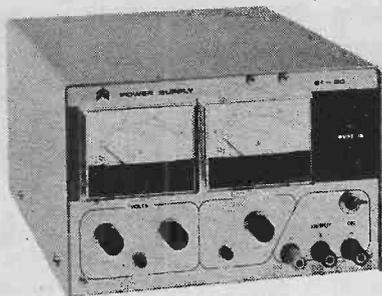
colin riches

BENCH P.S.U.

Model B1-30 is a bench power supply marketed by Elliott Relays. It has separate meters for output voltage and current and a switch on the unit enables interruption of the output so that voltage and current can be set or altered with the load disconnected.

Output voltage is 0-30V. Line stabilisation is better than 0.01% + 1mV for a 10% change in input voltage and load regulation is such that a change from minimum to maximum load will not alter the output voltage by more than 0.05% + 3mV. Output ripple is less than 1mV.

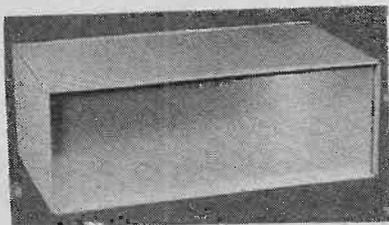
Price of the unit is £35 and further gen can be obtained from *Elliott Relays, 70 Dudden Hill Lane, London, N.W.10.*



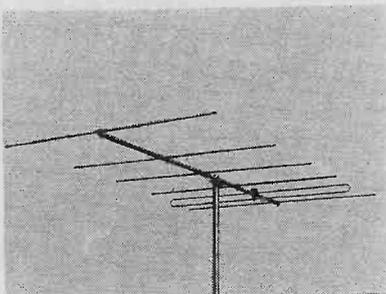
EQUIPMENT HOUSING

These cabinets, distributed by Norman Rose Limited are supplied packed flat in robust cartons.

The design of the cabinets is such that they are ideal for housing test gear, amplifiers, transmitting gear, etc., and they can be assembled in a few minutes without using any tools. The panels simply slot together and "trim strips" lock them in position.



THE "STEREOBEAMS"



J. Beam Aerials Ltd., have launched their new range of "Stereobeam" aerials for both stereo and mono reception. There is a wide choice of models from a dipole to a six-element array.

Each aerial's folded dipole construction incorporates the patented "inverse balun"—a feature providing elimination of pick-up on downlead, reduction of interference and distortion from multi-path reception, reactance compensation to give wide bandwidth and equal performance on all f.m. stations.

The aerial illustrated is the Model SBM6 (8.5dB) priced at £6.95p. Further details on the "Stereobeams" may be obtained from *J. Beam Aerials Ltd., Rothersthorpe Crescent, Northampton.*

Assembly instructions read as follows:

1. Place bottom panel on a working surface and slide the two panels over the upturned end pieces.
2. Place the front and rear panels in position and lock on to the bottom panel with two of the trim strips.
3. Place the top panel in position, the down-turned end pieces engaging in the side panels. Lock to front and rear panels with trim slips.
4. Position self adhesive feet.

All panels are detachable, the top, bottom and side panels being of plastic-coated leather-textured steel.

The cabinet can be dismantled by easing off the trim strips and removing the appropriate panels.

THE VARISPEECH

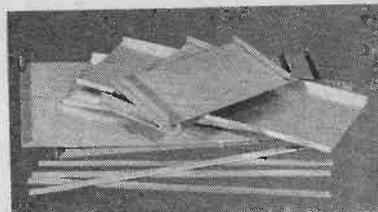
F. W. O. Bauch Ltd. have announced the "Varispeech", a unit which offers precise time control for recordings. It is suitable for language and speech study, timing speeches, conference recordings, transcription, dictation and any use where there is a requirement to accommodate a given script to a given time.

Frequency distortion is introduced on a conventional recorder if recording and playback speeds are altered but the Varispeech offers time compression or expansion without distortion and can, therefore, be used to synchronise a given script to any situation. The operating principle is to convert the voice signal, which is recorded in analogue form on a normal cassette, to a digital equivalent. A special-purpose computer then converts this digital signal to a second digital format with or without time compression/expansion. Re-conversion to analogue form restores the original speech without loss of intelligibility. The record/playback electronics are discrete solid state and the p.s.u. and servo control are 100% integrated TTL and MOS LSI. Further details may be obtained from: *F. W. O. Bauch Ltd., 49 Theobald Street, Boreham Wood, Herts. WD6 4RZ.*



Cabinets come in three sizes: the MC1 (8 x 3 x 9 7/8 in.) costing £3.40; the MC3 (17 x 4 1/2 x 9 7/8 in.) at £4.40 and the MC4 (17 x 6 x 9 7/8 in.)—shown in pictures—costing £4.60.

Norman Rose only distribute to the trade but if you send a s.a.e. to them at *8 St. Chad's Place, Grays Inn Road, London, WC1X 9HJ*, they will let you know the name and address of your nearest stockist.



TAKE 20

JULIAN ANDERSON

No. 49 LIE DETECTOR

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

LIE detectors can be very sophisticated devices, and whilst they are far from infallible, they give a pretty good indication whether someone is telling the truth or not. The principles involved vary but one of them makes use of the fact that when a person is under tension, as they are when they are lying, the perspiration glands start working. Such an effect is easily measurable using a very simple electronic circuit, Fig. 1.

The Circuit

The circuit is primarily one for measuring a change in resistance. A sensor is used which comprises a small piece of Veroboard of a size suitable for holding in the palm of the hand. Alternate strips of this are wired together as shown in the diagram: When the board is held in the hand with the copper side next to the skin, the resistance will appear across the strips and affect the circuit; it is not essential that every part of the board is in contact with the skin.

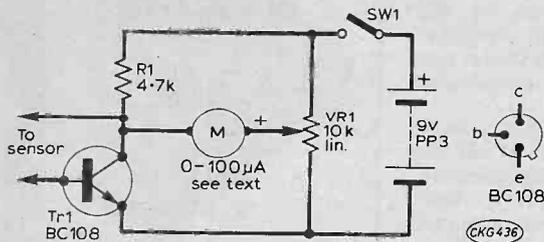


Fig. 1. Simple circuit of the lie detector.

The resistance of the skin is thus transferred to the collector/base circuit of the transistor and it will start to conduct. The transistor is in a bridge circuit. With the sensor held in the hand and with the "subject" not lying, a particular resistance will appear across the transistor and the bridge can be balanced using VR1. By 'balancing the bridge' we mean adjusting VR1 so that the voltages at the collector of the transistor and at the slider of the potentiometer are the same and no current flows through the meter.

In Operation

When the subject is asked a series of innocent questions, the needle of the meter will remain fairly steady; it may wander about a bit but not to any great extent. When the subject is asked a question

which they lie to, the skin will sweat, the resistance between the Veroboard strips will fall, the transistor will pass more current, upsetting the bridge and causing the needle to rise.

Simple though it is, it *does* work, but unless tried reasonably seriously, results may seem a little inconclusive. Asking obvious questions and deliberately lying will not work. "Do you live at No. 4 Green Street?" . . . "No, at No. 5" . . . even if it is a lie will cause little deflection as the subject is not under tension. Just what questions you ask is a matter between you and the person under interrogation. Be careful however, it is easy to cause offence; asking young ladies about their lovelife cannot be recommended and you are likely to become very unpopular if you try this sort of thing. As we have said before, the circuit is *not* infallible and should not be regarded too seriously but, if you select your questions carefully, it makes a good party trick.

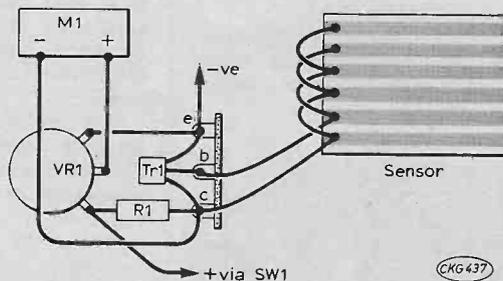


Fig. 2. Author's layout of lie detector using a piece of tagstrip.

Construction

A suggested layout is shown in Fig. 2. The meter used can have a sensitivity of anything between 100 μ A and 1mA; to keep within our budget one of the recording level meters has to be used, which are available from a number of suppliers as well as that mentioned in the components list but the price should be similar.

★ components list

R1	4.7k Ω $\frac{1}{2}$ W, 5%	1p
VR1	10k Ω linear pot	12p
Tr1	BC108	12p
SW1	On-off switch	5p
M1	100 μ A meter, type V150 (Henry's Radio)	70p

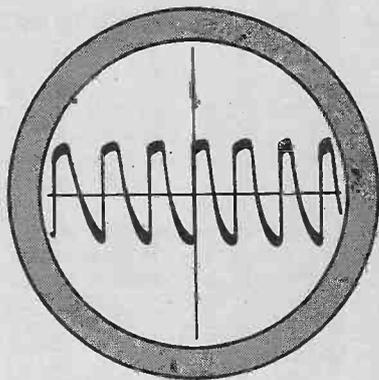
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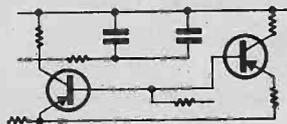
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0B2	.30	6BQ7A	.38	8Q7G	.35	12S7	.23	60L6GT	.45	EAB0C8	.29	EF86	.25	KT44	.98	PL82	.28	UY85	.23	AC166	.22	BCY12	.55	OA72	.17
0Z4	.25	6BR7	.79	6Q7GT	.43	12S7	.23	6EA2	.42	EAC91	.38	EF89	.28	KT66	1.00	PL83	.30	UI0	.45	AC167	.28	BCY33	.22	OA79	.10
1A3	.23	6BR8	.63	6Q7(M)	.43	12S7	.23	60EA3	.40	EAF42	.48	EF92	.28	KT81	2.00	PL84	.28	UI12/14	.38	AC165	.28	BCY34	.25	OA81	.10
1A7GT	.32	6B87	1.25	6R7G	.35	14R7	.48	60C1	.58	EABF801	.60	EF94	.34	PT81	4.00	PL85	.28	UI19	.87	AC166	.28	BCY38	.25	OA86	.09
1B3GT	.35	6B96	.79	6R7M	.55	14S7	.75	60C3	1.70	EBC34	.20	EF95	.34	P88	.44	PL86	.28	UI2	1.78	AC168	.42	BCY39	.28	OA90	.14
1HGT	.33	6BW7	.50	6SA7M	.35	19A05	.24	150B2	.58	EBB1	.10	EF97	.55	KTW61	.63	.60	U22	.39	AC169	.36	BCZ11	.42	OA91	.10	
1L4	.13	6BZ6	.31	6SC7GT	.33	19G6	.50	907	.58	EBC41	.48	EF98	.55	KTW62	.63	PL508	.90	U26	.72	AC170	.31	BCZ12	.42	OA92	.10
1N5GT	.37	6CB6A	.28	6S7G	.33	20D4	1.05	5702	.80	EBC81	.29	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC175	.61	BF158	.32	OA93	.10
1R5	.26	6C4	.28	6S7H	.53	20F2	.65	6763	.50	EBC80	.30	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC177	.61	BF159	.32	OA94	.10
1B4	.22	6C9	.73	6S7J	.35	20L1	.98	7475	.70	EBF63	.38	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC178	.61	BF160	.32	OA95	.10
1U4	.25	6CD6G	1.06	6S7GT	.23	20P1	.50	AC/PEN	.98	EBF69	.28	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC179	.61	BF161	.32	OA96	.10
1U6	.43	6CG8A	.50	6S7GT	.33	20P1	.50	AC/PEN	.98	EBL21	.20	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC179	.61	BF161	.32	OA96	.10
2D21	.35	6CH6	.55	6U4GT	.60	20P4	.89	DD	.98	EC86	.59	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC179	.61	BF161	.32	OA96	.10
2K65	.50	6CL6	.43	6V6G	.17	20P5	1.00	AC/PEN	.38	EC88	.59	EF99	.55	KTW63	.63	PM84	.31	U26	.64	AC179	.61	BF161	.32	OA96	.10
2A4	.25	6CM7	.50	6V6GT	.27	25A6G	.29	AC/THI	.50	EC92	.34	EM81	.37	PCF84	.44	TH233	.98	X65	.50	AF117	.21	BYZ11	.28	OC74	.25
3D6	.19	6CU6	.30	6X4	.20	25L6G	.20	AC/TP	.98	ECC33	1.50	EM83	.75	PCF200	.67	TP220	.98	X66	.50	AF121	.33	BYZ12	.28	OC75	.12
3Q4	.35	6CW4	.63	6X6GT	.25	25Y6G	.43	AL60	.78	ECC35	.95	EM84	.31	PCF801	.28	UABC80	.30	Transistors		AF124	.28	BYZ13	.28	OC76	.17
3Q5GT	.35	6DE7	.50	7B6	.58	25Z4G	.28	ATP4	.40	ECC40	.98	EM85	1.00	PCF802	.37	UAF42	.49	& Diodes		AF125	.19	CG12E	.28	OC77	.30
8S4	.43	6D8A	.50	7B7	.32	25Z5	.40	AZ1	.40	ECC81	.16	EM87	.48	PCF806	.55	UBC41	.45	2M404	.20	AF125	.20	FSY11A	.25	OC78	.17
4CB6	.50	6E16	.55	7H7	.28	25Z6G	.43	AZ11	.46	ECC82	.16	EM87	.48	PCF806	.55	UBC81	.20	2N966	.58	AF139	.72	FSY11A	.25	OC79	.17
5CC8	.50	6E5	.55	7H7	.28	25Z6G	.43	AZ11	.46	ECC83	.21	EY81	.35	PCL82	.29	UBF80	.33	2N1756	.55	AF178	.75	G99	.22	OC81	.12
5T4	.30	6F1	.59	7Y4	.40	30C15	.55	CL33	.90	ECC84	.28	EY83	.54	PCL83	.54	UBF89	.33	2N2147	.94	AF180	.53	GET113	.22	OC81D	.12
5U4G	.30	6F6G	.55	7Z4	.50	30C17	.74	CV63	.53	ECC85	.32	EY84	.50	PCL84	.32	UBL21	.55	2N2297	.25	AF186	.61	GET118	.22	OC82	.12
5V4G	.33	6F13	.33	8BW6	.50	30C18	.89	CY1C	.53	ECC88	.35	EY87/6	.27	PCL805/85	.87	UC92	.35	2N2369	.24	AF239	.42	GET119	.27	OC82D	.12
5Y3GT	.30	6F14	.40	9D7	.78	30F6	.61	CY31	.28	ECC89	.48	EY88	.40	PCL86	.38	UC84	.38	2N2313	.43	BA102	.50	GET578	.42	OC83	.22
5Z4GT	.33	6F18	.45	10C2	.49	30FL1	.58	DAF91	.20	ECC807/100	.00	EZ40	.40	PCL86	.38	UC85	.38	2N2305	.36	BA115	.28	GET587	.42	OC84	.28
5Z4GT	.38	6F23	.65	10DE7	.50	30FL2	.75	DAF96	.33	ECC80	.75	EZ41	.42	PD500	1.44	UCF80	.31	2N3121	2.75	BA116	.28	GET873	.17	OC85	.32
6/30L2	.53	6F24	.68	10F1	.75	30FL12	.67	DC90	.60	ECC82	.25	EZ80	.19	PEN4DD	.98	UCH21	.60	2N3703	2.21	BA129	.14	GET887	.23	OC89	.25
6A8G	.33	6F25	.51	10F9	.45	30FL13	.47	DF91	.14	ECC86	.64	EZ81	.20	PEN45	1.38	UCH42	.57	2N3709	.22	BA130	.11	GET897	.25	OC129	.25
6AC7	.15	6F28	.60	10F18	.35	30FL14	.66	DF96	.34	ECC804	.60	EY01	.75	PEN45	1.38	UCH81	.29	2N3988	.56	BA133	.17	GET898	.25	OC172	.39
6AG5	.25	6F32	.15	10LD11	.53	30L15	.55	DF92	.28	ECC80	.60	EZ32	.39	PEN45DD	.98	UCH82	.80	2N3928	.55	BC107	.14	GET36	.55	OC200	.24
6AH6	.50	6GH8A	.60	10P13	.54	30L17	.65	DE40	.55	ECH21	.63	EZ33	.70	PEN46	2.00	UF41	.60	AA120	.17	BC113	.28	GA5	.31	OC201	.42
6AJ5	.75	6GK5	.50	10P14	1.08	30P4MR	.95	DK92	.43	ECH42	.57	EZ37	.67	PEN463DD	.98	UF42	.60	AA123	.17	BC115	.28	OA10	.47	OC205	.47
6AK5	.25	6GU7	.50	12A6	.63	30P12	.68	DK96	.23	ECH81	.25	HABC80	.44	PEN463DD	.98	UF80	.35	AA139	.20	BC116	.28	OA10	.47	OC205	.47
6AK6	.30	6HG6T	.15	12AC6	.40	30P19	.78	DL92	.43	ECH83	.38	HL23DD	.40	PEN463DD	.98	UF85	.34	AC107	.17	BC118	.28	OA11	.47	ORP12	.58
6AM8A	.50	6J8G	.19	12AD6	.40	30P4	.66	DL96	.35	ECH83	.38	HL41DD	.98	PEN463DD	.98	UF86	.38	AC113	.38	BC118	.28	OA11	.47	ORP12	.58
6AN8	.49	6J9GT	.28	12AEG	.48	30P11	.57	DM70	.30	ECH84	.38	HL42DD	.98	PEN463DD	.98	UF89	.27	AC126	.14	BC108	.14	HE	.17	OC201	.42
6AQ8	.21	6J6	.13	12AT6	.33	30P13	.80	DM71	.60	ECL60	.28	HL43DD	.50	PEN463DD	.98	UL33	.38	UL41	.54	AC127	.19	HE	.17	OC201	.42
6AR5	.30	6J7G	.84	12AU6	.21	30P14	.80	DY87/6	.28	ECL82	.28	HN809	1.40	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6AT6	.18	6J7(M)	.38	12AV6	.28	30P15	.87	DY803	.29	ECL83	.52	HVR2	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6AU6	.19	6JU8A	.50	12BA6	.30	35A3	.48	EB0CC	1.65	ECL84	.54	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6AV6	.28	6K7G	.12	12BE6	.30	35D5	.70	EB0F	1.20	ECL85	.54	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6AW8A	.54	6K8G	.33	12BH7	.27	35L6GT	.42	E83F	1.20	ECL86	.33	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6AX4	.39	6LI	.98	12J7GT	.33	35W4	.23	E86CC	.60	EF22	.63	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6BBG	.13	6L6GT	.50	12K5	.50	35ZACT	.24	E92CC	.40	EF40	.49	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6BA6	.19	6L7	.38	12Q7GT	.34	35ZGT	.30	E180F	.30	EF41	.58	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6BC8	.50	6L18	.44	12Q7GT	.28	50C5	.32	E182CC1	.00	EF42	.33	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6BE6	.20	6L19	1.38	12SCT	.35	50CD6G		E1148	.53	EF73	.75	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42
6BH6	.43	6LD20	.48	12S7	.23	2.17	EA50	.27	EF80	.21	HVR2A	.53	PEN463DD	.98	UL36	.48	UL84	.28	AC128	.22	HE	.17	OC201	.42	

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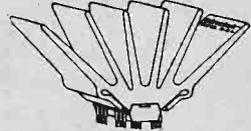
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Special Valves

PART 2 VISUAL OUTPUT VALVES

M.K.TITMAN B. Sc(Eng), C. Eng, MIEE.

THIS section deals with valves which provide visual outputs from electrical signals, using the principles of thermionic devices. It includes such cathode ray tubes as those used for oscilloscopes, television, radar sets, data display and level indicators.

THE BASIC STRUCTURE

The cathode ray tube utilises an electron gun assembly to produce a focused electron beam as shown in Fig. 5. This beam is used to bombard a phosphor-coated screen which fluoresces emitting light at the point of bombardment. Various phosphors can be used to give different characteristics of colour and image retentivity and are consequently specifically chosen for the designed application.

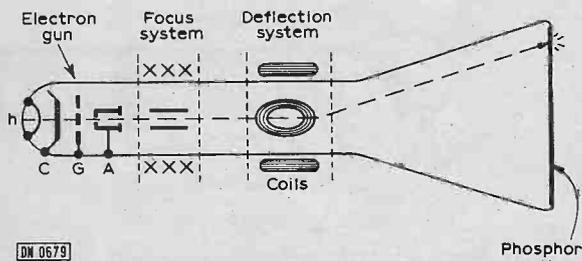


Fig. 5: General arrangement of a CRT using electromagnetic deflection.

The beam direction can be moved by either electrostatic or electromagnetic deflector systems to produce a movable point of light as required. Therefore, by sequential scanning, complex electrical signals can provide visual outputs.

OSCILLOSCOPE TUBES

One of the most important uses of c.r.t.'s is in oscilloscopes where an electrical signal is visually displayed. Since these are essentially test and measuring instruments the tubes used are designed to give linear responses and simplicity of access to the deflection system. For this reason electrostatic deflection plates are used and for safety the anode is earthed which allows the plates to be safely accessible.

The X axis plates are usually internally driven by a ramp generator with switched speeds to give the desired time base. Similarly the Y axis plates are fed via an attenuator/amplifier system from the signal

input, to give a visual display of signal amplitude variations with time.

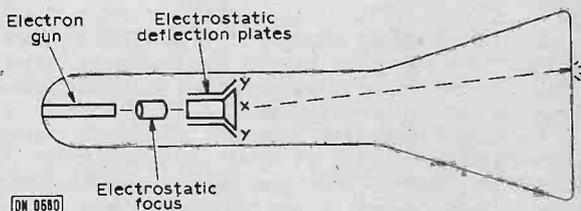


Fig. 6: Oscilloscope CRT with electrostatic deflection by means of the X and Y plates.

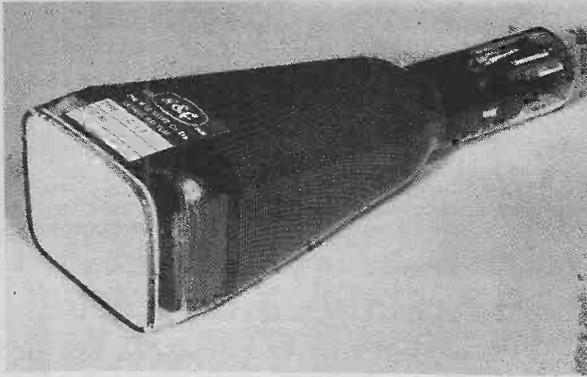
Most modern oscilloscope tubes, such as that shown in Fig. 6 utilise a green phosphor screen but a wide range of colours is available. Such phosphors generally have a short to medium persistence, whereas very long persistence can be achieved using orange phosphors and very short using blue or purple-blue colours. Many tubes use double beam systems in which the beam is split by an electrostatic plate and independently deflected by separate sets of X-Y plates. In addition, other types are available with dual electron gun assemblies and in some, four separate display traces can be achieved in a single tube.

Screen sizes vary from 1in. for monitor tubes to 6in. in diameter. Modern types are also available with rectangular faces. Precision tubes incorporate internal screen graticules to eliminate parallax errors. High brightness types also utilise metallising on the phosphor to increase tube life and reduce burning of the tube face coating.

Final anode voltages are commonly 1 to 3kV for general purpose types but up to 20kV for special purpose, fast response tubes. Typical deflection sensitivities are 10 to 40V/cm for Y plates and 15 to 60V/cm for X plates.

TELEVISION TUBES (MONOCHROME)

These are large screen area c.r.t.'s which use an electromagnetic scan system of four scan coils in two planes. Generally the focusing of the beam is by means of a small ring permanent magnet located on the neck of the tube before the scan coils, but modern tubes often use electrostatic focusing. Most modern television tubes utilise wide angle (110°) deflection and the electrical deflection waveform compensates for the deflection de-focusing. The phosphor used gives an essentially black and white image.



The Marconi-Osram Valve Company's 1400A single gun oscilloscope tube has a flat face with a display area of 10×8 cm. The maximum final anode voltage is 4kV.

Typical operating parameters are: 10kV to 20kV screen potential; 400V to 500V for the anode potential; 0 to 400V focus anode; -50 to -100V grid potential for beam extinction.

Television tubes are generally designated using the Pro-electron code in which the first letter A stands for domestic television picture tube. The next figures indicate the screen diagonal dimension in cms. The final letter is W for monochrome and X for colour tubes. Commonly used tubes are the A59-23W/R and A47-26W/R which are 23in. and 19in. tubes respectively. High performance studio monitor tubes include such types as M21-12W (8½in.) and M36-11W (14in.).

TELEVISION TUBES (COLOUR)

Colour television tubes using the shadow mask screen principle, have three separate electron gun assemblies all contained in a 90° deflection c.r.t. The electron guns use electrostatic focusing and are set 120° apart with their axis tilted with respect to the screen. The individual beams are aimed through holes in the mask at their respective phosphor dots which are of three primary colours—red, green and blue. The alignment of these beams is dependent upon an external purity magnet and the deflection coil assembly. It is critical and requires the use of magnetic shielding around the tube neck, since it is affected by even weak magnetic fields—such as the earth's magnetic field.

The electron beams converge and form a spot which by suitable mixing can give the required colour. Convergence is achieved by physical movement of the permanent magnets in the convergence assembly and centring by passing d.c. through the deflection coils. Dynamic convergence is achieved by the addition of parabolic waveforms to separate secondary windings in the deflection system.

The colour television tubes available are in the range 11in. to 26in. with their designations in the Pro-electron coding as for monochrome tubes. Typical types are A49-11X (19in.) and A63-120X (25in.).

RADAR TUBES

The earliest radar devices used ordinary c.r.t.'s and measured times for the return of a pulse to determine distance. Modern radar sets use special radar

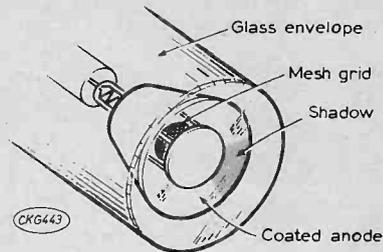
tubes with electromagnetic scan coils which generate a scanning beam from the centre of the tube to the edge. The scan line revolves in synchronism with the rotating aerial and thus an effective picture is built up.

Such tubes are known as Plan Position Indicator tubes (P.P.I.) and are available in a wide range of sizes although typically in the region 8in. to 24in. diameter. The phosphor is specially chosen for its retentivity since the scan rate is usually fairly slow and thus orange displays are common.

The rear port tube is currently being developed to overcome the difficulties attendant upon the use of gratitudes, electronic mapping or frontal projection to superimpose static information on the display. The map, co-ordinate, scale or other information can be slide projected on to the screen through a window on the rear of the tube. This is superimposed on the radar trace to give additional information.

LEVEL INDICATOR TUBES

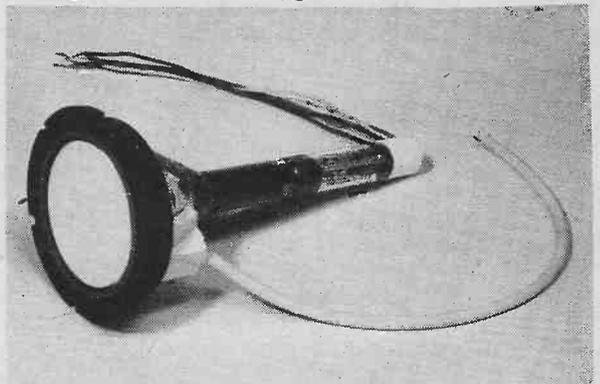
Commonly known as "magic eye" indicators these valves are thermionic devices in which the anode is coated with a fluorescent material. Electrons are beamed past the grid electrode and bombard the anode producing a visible sweep. The basic structure is shown in Fig. 7 and in this case the electron beam bombards the circular anode. With no input the beam width is restricted to form a pencil line but with maximum input a wide band appears, as illustrated.



END VIEW OF MAGIC EYE

Fig. 7: Sketch of the electrode assembly of a typical "magic eye" level indicator.

This form of level indication is widely used for the less critical indication required for general purpose tape recorders and radio tuning indicators. Many different anode shapes are used with side and end viewed anodes. The valves generally fit standard valve holders and operate at normal anode voltages of 100V to 300V, grid - 10V.



The 700J projection CRT is designed for use with high brightness head-up radar displays and requires an anode voltage of 15kV. This tube is also a M-O Valve Co. product.

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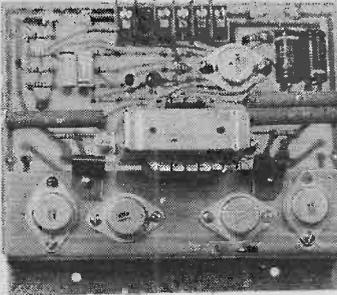
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MVA01 Suitable for disco, mic., tape input. 2 inputs, with Vol. & tone control on each input. Sensitivity 2mV. +25dB @ 12KHz to +20dB @ 40Hz.

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NUMICATORS

Numicators have now superseded dekatrons for the display of numerical information but they can be used only as display devices. A typical side view numicator is shown in Fig. 8. The numerical shaped cathodes are stacked one behind the other and separately connected to the wire outlets. The common mesh anode is connected through a resistor to the positive supply. The cathodes are earthed by means of semiconductor switches and the glow forms in the immediate vicinity of the shortened cathode. Consequently a count display can be obtained by suitable decimal outputs from a decade counter.

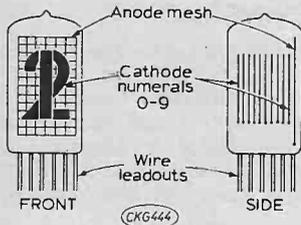


Fig. 8: Illustration of the construction of a numicator tube.

Such digital indicator devices give fairly clear, high intensity, large size numerals and are still widely used in modern digital equipment. Very often the displays incorporate red filters to give a cleaner visual indication and both side and end view configurations are available. In addition to numbers other information displays are available.

CHARGE STORAGE TUBES

These are similar in shape and construction to cathode ray tubes but embody additional electrode structures to store charges. They are used in a wide range of applications such as TV camera valves, scan charge tubes, storage c.r.t.'s and image intensifiers. Generally they are not mass produced and consequently expensive.

Charge storage tubes rely upon a target electrode structure located in an evacuated c.r.t. The target is of insulating material which stores charge on its surface and the flow of this charge is limited by its

surface resistivity which is exceptionally high. The charge itself is generated by photon bombardment in the case of visual to electrical TV camera tubes or alternatively by electron beams which are scanned across the target. This procedure of imprinting a non-conductive target with stored charge is known as writing and the retention as storage.

The mechanism by which the charge is removed is known as reading and is achieved by means of electron beam scanning of the target. The actual output signal is derived from this beam usually by examining the received beam current and generally the effect of this beam is to remove the stored charge to the neutral no charge condition.

TV CAMERA TUBES

The **Image Orthicon** is the ultimate commercial development of the original studio quality camera tube which began in the form of the Emitron tube shown in Fig. 9. Here, photon bombardment produces a charge depending upon the focussed light intensity and this is sequentially read by the scanned electron beam current. The metal plate receives the capacitively induced signal which is then combined with the scan pulse information to give the complete video-signal.

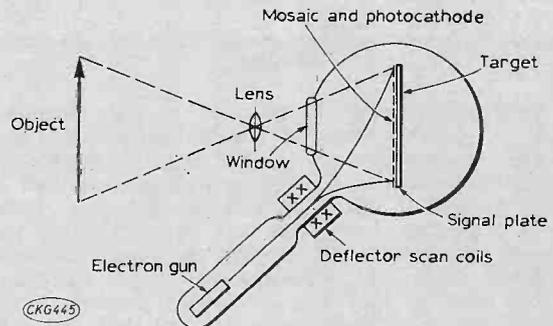
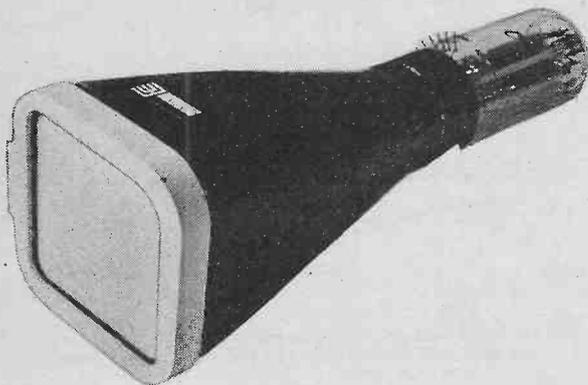


Fig. 9: General layout of the original Emitron TV camera tube.

The image orthicon whose structure is illustrated in Fig. 10 consists of a plain glass high purity optical aperture through which the externally mounted lens focus the object on to a photo-sensitive mosaic screen. The target consists of a very thin glass sheet and fine metal mesh supported in a wire ring. In modern tubes the glass is coated with a metallic oxide such as vanadium or titanium. Electrons are emitted from the photosensitive mosaic and travel to the target to form a charge image corresponding to the light image.

The target is scanned by an electron beam which is slowed down by the field produced by the walls of the tube and the wire mesh. Thus secondary emission electrons are minimised. The beam neutralises the target charge and the remaining electrons are returned to an electron multiplier dynode chain near the electron gun. This gives a very large signal amplification and in consequence this camera tube is very sensitive.

It is widely used in professional studio equipment since the picture is of high quality. Most cameras are equipped with these and the most popular size is 4½ in. diameter. Until recently the major drawback to the use of this tube was its short working



This E716A direct-view storage CRT is manufactured by the English Electric Valve Company has a viewing area of 10 x 10 cm. Because of its good deflection sensitivities it is particularly suitable for compact transistorised equipment. The normal storage time is from less than one second to several minutes but this can be extended to several days!

life, as a result of which it was usually hired and after use returned for target or gun replacement. However improved target materials have contributed to a dramatic increase in operating life.

The Vidicon is now by far the most widely used camera tube largely because of its simplified construction and operation and hence distinct price advantage. A typical vidicon consists of a photoconductive layer deposited on to a conductive signal plate on the inner surface of the glass faceplate. The electron beam scans the target and results in effective connection of the signal plate through the photo-conductive semiconductor layer. In the absence of light this side of the photoconductive surface achieves cathode potential because of the high resistance but the impingement of light reduces the resistance and discharges the surface.

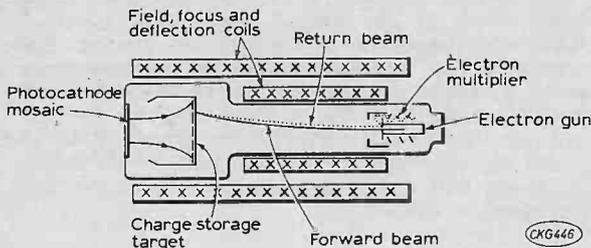


Fig. 10: The image orthicon tube incorporates an electron multiplier assembly.

When the charge is restored by the scanning beam, a current flows in the load resistance connected to the signal plate. This output is dependent upon the rate of discharge as well as time and is thus dependent upon illumination and scan. However, since the charge can only be restored by the beam, there can be a delay on the return of highlighted areas which results in image retention. Until recently this was a serious problem since bright moving objects were blurred, but this has now largely been overcome by the introduction of the Plumbicon tube.

The advent of the Plumbicon has now resulted in the acceptance of this tube for studio work. Because of its relatively small size and considerably simpler operation, it is increasingly used for colour television cameras. Similarly it has always been used for closed circuit television and outside broadcasts.

IMAGE INTENSIFIER AND CONVERTOR TUBES

These are tubes designed to increase the brightness of images by electronic multiplication. They are used in order to obtain acceptable visual images of objects which have poor illumination levels. As such they are incorporated in starlight viewers or infra-red viewers. Another application is the storage and amplification of extremely fast events such as sparks etc. which occur only for times of 10^{-3} to 10^{-6} seconds duration.

Generally multi-storage elements are used, with each stage giving a gain of 30 to 80 and overall gains of 10^6 are possible. A variety of phosphors are used, none of which have a sensitivity corresponding to the human eye. Consequently they do not visually appear as bright normal pictures.

Several types of construction and principles are used, all of which involve photocathodes which emit secondary electrons which travel through a uniform field space. Further gain is achieved either by focussing on secondary emission devices or photocathode and phosphor boundaries or by using fibre optically coupled assemblies.

The tubes operate with supplies in the region of 10 to 45kV and usually involve a slight reduction in image size. The photocathode material is caesium on oxidised silver and typical screen sizes are 0.5in. with a resolution of greater than 10,000 lines per inch.

THERMOVISION CAMERAS

These are essentially radiation detectors in which the infra-red radiation is beamed by means of scanning mirrors on to a detector. Generally the detector is of indium antimonide and this provides the electrical signal. The signal is amplified and transferred together with the mirror scan synchronisation pulses to form a television-like picture on a c.r.t.

A very limited number of these devices are commercially available and needless to say the price is correspondingly high. Generally they are difficult to use since the response is not easily interpreted, however they are very useful for the detection of hot spots at fault positions.

ELECTRON MICROSCOPES

These are very expensive specialist devices used for very large magnification factors of minute objects. In effect they consist of accurate electronic lenses in which the electrons replace light. The potentials used are high ($>60kV$) and the magnification factor achieved by focusing the electromagnetic or electrostatic lenses can be as high as 200,000

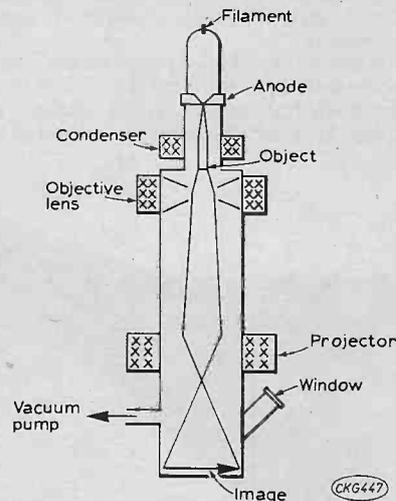


Fig. 11: In the electron microscope electron beams can be focused in the same way as light beams in conventional microscopes.

The construction is diagrammatically illustrated in Fig. 11 and shows the focused electron beam passing through the object. The chamber is evacuated during each operation and the magnified image is recorded on photographic film.

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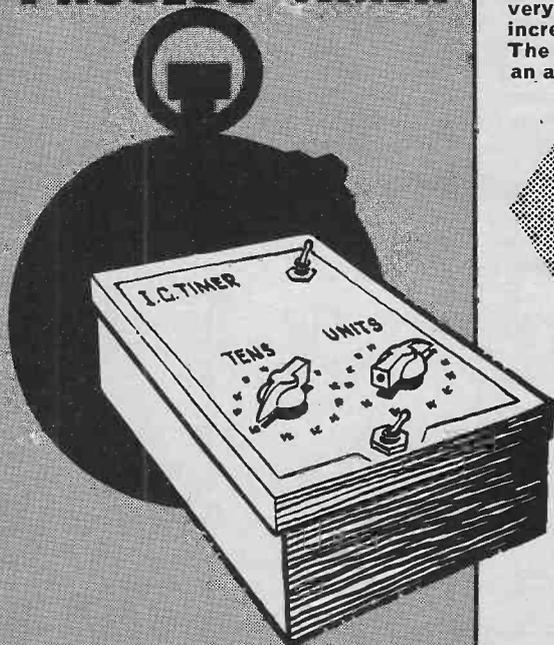


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ORGANS

If you have an electric guitar or organ, you can add character to your playing by using this foot-pedal tremolo generator, leaving your hands free to play the instrument. Two pedals are provided giving (a) variable frequency control of the amplitude modulating oscillator, (b) modulation depth control. This unit is specially designed for ease of operation and is ideally suited for group performers.

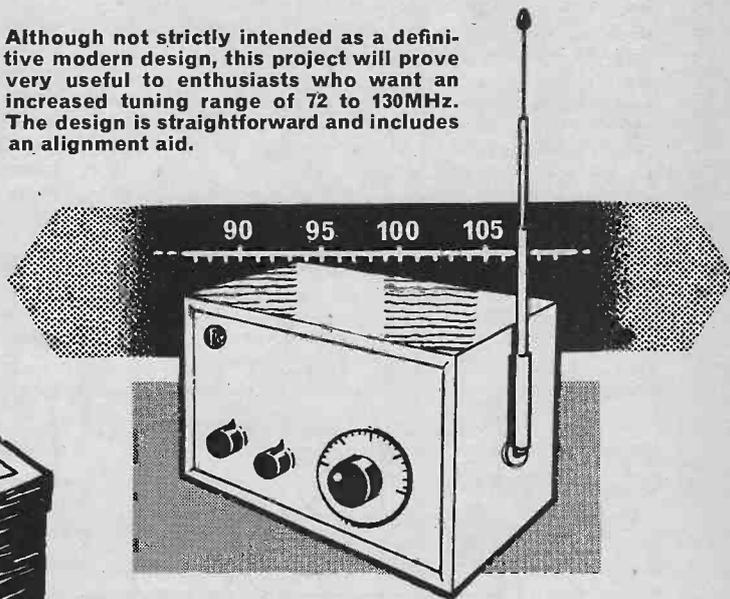
0-99 seconds PROCESS TIMER



For all those operations requiring set timing, such as photographic processing, delayed switching, telephone call unit timing and tape editing, this inexpensive unit uses low cost I.C.s. to provide a very accurate switching timer with two ranges.

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Although not strictly intended as a definitive modern design, this project will prove very useful to enthusiasts who want an increased tuning range of 72 to 130MHz. The design is straightforward and includes an alignment aid.



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STEREO HEADPHONES REMOTE CONTROL UNIT

N. PICKLES

WHILST a great deal of pleasure can be derived from listening to stereo through conventional loudspeakers, it is often more enjoyable and practical, particularly late at night, to use stereo headphones. One of the disadvantages, however, is the usual need to position oneself adjacent to the amplifier for the obvious purpose of using its controls.

It is the opinion of the author that once the conventional bass and treble tone controls have been set to suit one's taste, it is unnecessary to re-adjust them for each record played. This, of course, is assuming that the records being played are all of similar quality. Volume and balance are however

in more frequent need of adjustment and a unit facilitating this from a remote seating position is extremely useful.

The unit to be described contains volume controls for left and right channels and an overall balance control. Also included is a balance meter to monitor the balance of the output of the stereo amplifier and the unit is so designed to allow it to be used as a balance meter without any power supply or headphones connected.

A switch is provided on the unit to select between normal listening and listening via a network which provides some degree of cross-talk between the left and right channels. The idea behind this is that when one listens to stereo from loudspeakers, the sounds received by, say, the left ear constitute a mixture of left and right signals; the same applies for the right ear. It is the balance of these two "views" that forms a stereo image.

However, when one uses stereo headphones the left ear can only hear the signals emanating from the left channel and a corresponding degree of discrimination exists for the right ear. Therefore, strictly speaking, a correct stereo image is not formed aurally. Thus some degree of "crosstalk" between left and right is necessary. This need only be noticeable at mid-frequencies, at round about 1kHz where the ear is most sensitive. The network included performs this function and the effect of this is to shift some of the signals into the centre of the image.

Circuit

The circuit, Fig. 1, shows the network and the components forming the balance meter circuit. The two resistors R1 and R4 provide attenuation for the headphones from the amplifier loudspeaker outlet. With the resistors included the unit can be fed directly from the speaker outlet of the amplifier, but if an amplifier including an attenuated headphones outlet is used then these resistors can be reduced in value or even omitted. Balance and volume adjustment are provided by VR1, VR2/3.

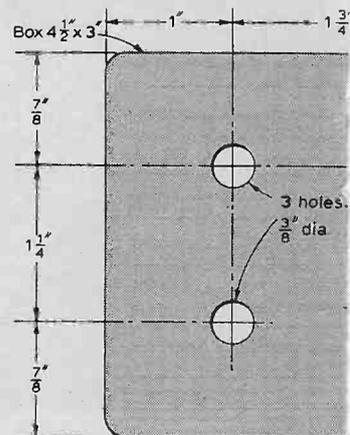
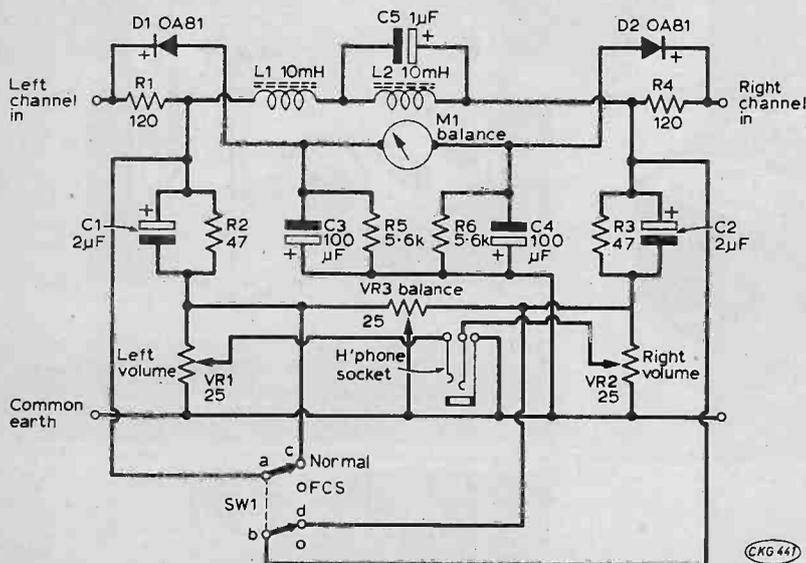


Fig. 1. (left) shows the complete circuit. Fig. 2: (above) gives the positions of the holes. Fig. 3: (right) Details of the veroboard components being mounted on the PCB.

ENG 441

★ components list

Resistors

R1 120Ω	R4 120Ω	VR1 25Ω
R2 47Ω	R5 5.6kΩ	VR2 25Ω
R3 47Ω	R6 5.6kΩ	VR3 25Ω
All ½W 5%		All wirewound pots.

Capacitors

C1 2μF	} All 12VW electrolytics
C2 2μF	
C3 100μF	
C4 100μF	
C5 1μF	

Miscellaneous

M1, stereo balance meter, 100μA (G. W. Smith). L1, L2, 10mH (Repanco CH4). D1, D2, diodes OA81 or OA79. SW1, double pole changeover, slide switch. Plastic box 4½ x 3 x 1¼in, see text. Veroboard 3 x 2in. 0.15in. matrix. Grommet. 3-core cable. Stereo phone plug and socket. Knobs.

Construction

A plastic box, about 4½ x 3 x 1¼in., as used in the prototype, should be obtainable from any good radio parts shop but if difficulty is experienced a plastic soap dish of the type with a clip-on lid can be used. A metal case can be used but then care must be taken to ensure that the underneath of the veroboard is clear of the case bottom.

Drilling details for the box lid are given in Fig. 2. An easy way of cutting the thin plastic is by means of a hot thin knife blade later finishing off the holes with a smooth file after the plastic has hardened. This method is preferred to drilling which can lead to a split box.

The balance meter, two volume controls, slide switch SW1 and the balance control are mounted on the lid and the remainder of the components on a small piece of 0.15in. veroboard approx. 3 x 2in. or eight strips of 15 holes. The board, Fig. 3, is fixed to the box by a single bolt with a spacing nut between the board and the case.

VR1, VR2 and VR3 are flat, miniature, wirewound

In the normal mode the switch SW1 connects the attenuated signals directly to the volume and balance controls. When the signals are switched through the crosstalk circuit (FCS) the signals are channelled through L1, L2, C1, C2, and C5, R2 and R3. Capacitors C1 and C2 shunted by R2 and R3, although not affecting normal sounds, do provide slight attenuation of any mains hum and generally frequencies below 40-50Hz, but with bass notes as encountered in music the effect is largely negligible. Looking at the balance meter circuitry, the arrangement of C3, C4, R5 and R6 is largely a standard circuit, these components providing a path to earth of comparatively low impedance to high frequencies.

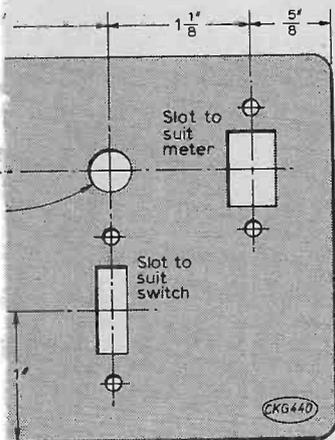
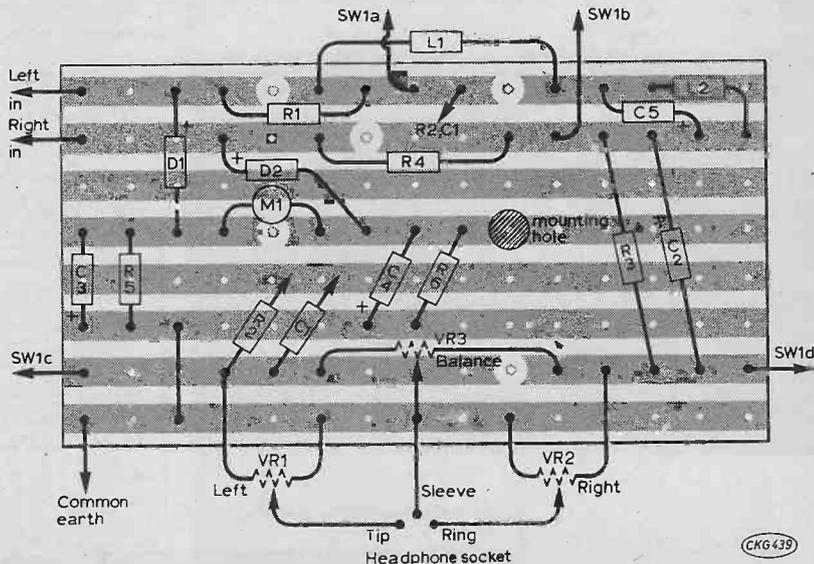
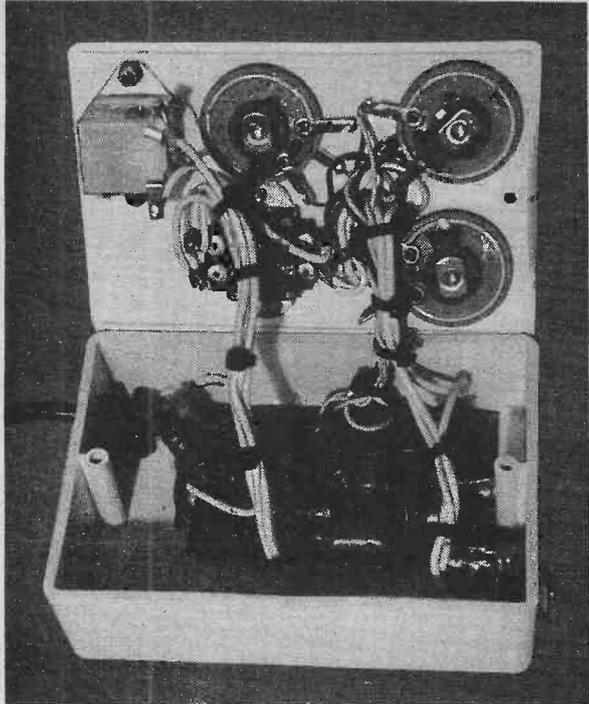


Fig. 2. Drilling details for the box lid. The various holes and slots in the box lid are shown in the positions shown.



CKG439

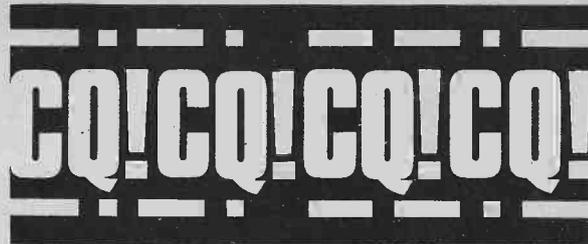


The circuit board is mounted inside the box, the various controls and meter being fitted to the lid.

pots, widely available as "extension speaker volume controls". Standard size pots will require a larger box than that specified here. Single flex is used to wire the panel components to the board, as shown in the photograph. A rubber grommet was used for neatness at the cable entry hole. The cable must be long enough to comfortably reach between the stereo amplifier and the listening point.

More than one set of headphones can be used provided attention is paid to the impedance of the extra sets. Too low impedance will cause a loss of volume which may not be acceptable. If more headphone sockets are fitted they should be wired in parallel.

Component values are by no means critical and there is room for improvement here. Variation of the network values can provide some interesting effects.



APPARATUS REQUIRED

- ..Wanted, kit or built, Heathkit, stereo control unit model USE-1.—E. H. Smith 84 Westgate, Louth, Lincs.
- ..P. S.U. for TX (ADM. Patt No. 100337) made by Rees Mace Marine Ltd.—L. Brown, 46 Massey Road, Gloucester.
- ..Wanted, new or used B12B base.—A. J. Collinge, 87 Iveagh Gardens, Crumblin Road, Dublin 12.
- ..Wanted LP head (red) for Deccalain.—J. F. Glavin, North Lodge, Northlands, Salthill, Chichester, Sussex.
- ..Cossor Radio. Model 522 or 523 with or without cabinet. Working or not. Price please.—A. G. Foster, 44 Warwick Road, Luton, Beds.
- ..Wanted a 13 pole water switch for a tape recorder B.S.R. Challenge. 10 pole one side 3 pole opposite side.—J. Rowsell, 65 Ayresome Park Road, Middlesbrough, Yorks.
- ..Wanted a set of coils to suit a B34 communications receiver, range 150kHz—30MHz.—H.I. Street, 11 Green Farm End, Kineton, Warwicks.
- ..Can anyone supply new or s/h a replacement transformer for a Cossor 1035 Mk III (Parmeko 1KA30219).—M. J. Pickering, 19 The Meadows, Newby, Scarborough.
- ..3 or 4 dust cores for L.F. coils & Crystal phasing capacitor for a Canadian Vancouver radio laboratories model 250.—F. J. Stephenson, 34 Pinfold Lane, Scartho, Grimsby, Lincolnshire.
- ..Wanted coil packs for national HRO-MXS receiver state price and details.—B. Gale, 4 Rosebery Avenue, St. Werburghs, Bristol 2. BS2 9TN
- ..Wanted—Three mullard LA11 or LA2002 pot cores, also Amateur tape recording magazine, January 1962 and November 1962.—Prices to.—R. Cammell, 17 Highfield Avenue, Thundersley, Benfleet, Essex. SS7 1RY.
- ..the address of any retailer who stocks obsolete valves. I needs an EBL31 Mullard.—G. C. Leake, 71 Bants Terrace, Northampton, NN5 6AW.

EXCHANGE:

- ..The "Technique of Building" by E. G. Warland, 367 pages in Mint Condition. Wanted Cossor Scope Manual 1035 MkIII in readable condition. J. Hornes, 91 Salurn Way, Hemel Hempstead, Herts.
- ..P.W. Oct. 1971 for Jan. 1972.—D. Morrell, Maidwell Hall, Northampton.
- ..Osomr Signal Generator. Boxed. Mint Condition. "Take Twenty" complete series 1-30. Plus 30p post. S.A.E. first instance.—W. L. Brunsten, 28 Meadowfoot Road, Wallasey, Wirral, Cheshire.
- ..Collins TCS Transmitter, coverage 160-80-40 metres, large power supply, also very large and heavy, no operating manual, for TW mobile Topband receiver.—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N.12, 8AG.
- ..B40b receiver, above average, aligned last year. Modified for SSB. A real cracker. I want a good multimeter, or would sell.—M. Dickson, 32 Culliford Way, Littlemoor, Weymouth.
- ..5 (five) 4CX250B's: Four new, one used but OK, for Comm. Type RX.—B. K. Arnold, 46 Ellenheim Drive, Bicester, Oxon.
- ..Eddystone S670 "Marine Receiver" for any Transmitting gear or sell.—D. McQuillan, Mildon Cottage, North Road, Keltly, File.

INFORMATION WANTED

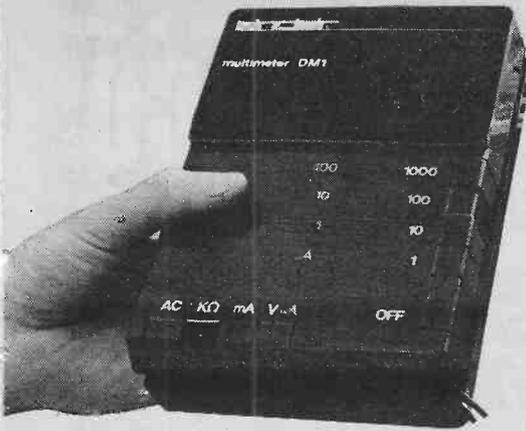
- ..any mods to extend frequency range of R1132A 100/124MHz to include 144MHz.—D. McKenzie, 19, Manse Road, Ardara, Inverness.
- ..lend or give the instruction booklet for the Murphy Radio type A34 (its number is 12656) or as much information as possible concerning valves etc. on this receiver.—S. Thackery, 9 Dale Close, Fritchley, Derbyshire, DE5 2HZ.
- ..wanted any circuit for a transistorised C. R. Oscilloscope or Feb 72 copy of P.W.—P. Decker, 50, Cheshe Road, Leicester.
- ..Ferguson Radio 204BX manual, service sheet or circuit required. Buy or borrow. All replies answered.—A. Nicholls, 8 Findlay Place, Swanage, Dorset.
- ..Info on Indicator unit 266 fitted with CRT VCR97 and used with receiver type 3645.—D. J. Rockliffe, 42, Hollybrow, Selly Oak, Birmingham, 29.
- ..any info or circuit diagram of the Cossor 339A scope.—R. Williams, 34, Gwydir Road, Llandeno, North Wales.
- ..any circuit diagram and component list of metal locators.—J. Martins, Av. Almirante Reis, 238-60E Lisboa, 1, Portugal.
- ..Information wanted circuit details of RCA wavemeter type TE149.—E. Kilner, Spennythorne, Cokes Lane, Chalfont St. Giles, Bucks.
- ..wanted circuit diagram, handbook or manual for TR10 JR-60RX (buy or borrow).—R. Thomas, 13 Northways, Orpington, Kent.
- ..circuits of the following wanted RF units 25, 26 and RX52, also any info on Rx No. 46159 type.—T. Richards, 52 Cookson St, Liverpool, L1 5EU.
- ..details on the Ex-Service Tx.Rx. B44 mark 3 conversion to make tunable from 60-95MHz, will buy or loan manual.—A. C. Norfolk, 24 Hornsby Crescent, Scunthorpe, Lincs.
- ..can you supply me with information or a circuit for the R1155 radio set etc.—A. J. Rudd, Quellerina, 13 Distington Park, Distington, Nr Worlington, Cumberland.
- ..any info on S.T.CR4187 set, manual and/or circuit to buy or copy.—T. Eyre, Battersea Court, University of Surrey, Guildford, Surrey.
- ..circuit or manual and S meter and mains mods. for R209, Rx. J McMillan, Derby Hall University, Nottingham.—J. E. McMillan, 202 Tudor Drive, Kingston, Surrey.
- ..wanted P.W.'s walchart circuit building blocks, also any info. on the Taylor type 20A circuit analyzer.—Mr. Nolan, 274 Kingsdon Square, London, N.1, 7UH.
- ..Info, wanted on ex-government RG42C receiver (1235), also borrow or buy information booklet on Sinclair X10 amplifier.—G. Winterburn, 40 Priesthills Road, Hinckley, Leics.
- ..V.T.V.M. CT54. Mico-Vac. Philips Tape recorder EL3527., B.S.R. tape recorder "Majestic".—J. Moore, 7 Newcastle Road, Liverpool, L15 9HP.
- ..circuitry and makes name of the silicon transistors used throughout in the "Peak Sound" Englefield 840A amplifier 1971.—Mr. W. Wodhams, 13 Wallasey Crescent, Ickenham, Uxbridge, Middlesex.
- ..School-Boy requires loan of Handbook and/or instruction or Manual sheet for Hallcrafters Model S-108 receiver.—G. Knox, 252 Lode Lane, Solihull, Warwks.
- ..Info. on Old 17 set and has anyone modified the R209 II to mains operation, and does this eliminate the "Buzzing" interference on Range II top band 1.8 to 2.0 meg.—K. F. Best, 17 Chepstow Close, Gorse-y-Celloff, Cwmbran, Mon. S. Wales.
- ..info. wanted on where I can obtain a blueprint for a stereo pre-amp, with bass, treble, balance and volume control and its own power supply.—H. W. Verce, 49 Lowestoft Road, Wymering, Portsmouth, Hants.
- ..Info. on servicing and operating information of the Honor Tube Tester.—R. Decamps, P.O. Box 24, 2800 Maline, Belgium.
- ..info. on power supply and the circuit of a Valve Voltmeter, Model CT54 (an ex. Navy kit).—R. Owen, 40 Kingslea Road, Withington, Manchester, M20 9QA.
- ..any info. on "Electra", they make P.A. system loudspeakers.—S. C. Davies, 12 Hamilton Grove, Peel Common, Gosport, Hants.
- ..Wanted; manual or circuit diagram for Pye Reporter Radio telephone.—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N.12 8AG.

Free Competition for PRACTICAL WIRELESS Readers

WIN A DIGITAL MULTIMETER

and a FREE copy of PRACTICAL WIRELESS every month for a year
There are four of these instruments waiting to be won in this easy-to-enter competition organised in co-operation with Sinclair Radionics

HOW TO ENTER:



The Sinclair DM1 Multimeter has been designed to fill a need for constructors who find analogue multimeters in some way limited, while offering a digital readout and higher accuracy, where previous digital multimeters have so far been expensive.

The normal retail price at £49 represents good value and you will find that you will always have a need for such an instrument to measure a.c. or d.c. volts from 1mV to 1,000V; current from 1µA a.c. 1nA d.c. to 1A; d.c. resistance up to 1MΩ. The very high input resistance makes this instrument ideal for almost any circuit using transistors, i.c.s. or valves. A full report appeared in the March 1973 issue only of Practical Wireless.

RULES

There is no entry fee, but each attempt must be fully completed in ink on the proper printed coupon cut from Practical Wireless, and bear the entrant's own full name and address.

Every accepted entry will be examined and the prizes, as described, will be awarded to the four entrants who, in the opinion of an expert panel of judges, have shown the most skill and judgment in listing the eight features in order of importance.

In the event of a tie or ties for any of the prizes, a further eliminating test will be conducted by post between the tying competitors to determine such winners.

Any entry which does not comply with the printed instructions or is received after the closing date will be disqualified, as will any received mutilated or illegible, incomplete, bearing alterations, or with more than one key letter in each space. No responsibility will be accepted for entries lost or delayed in the post or otherwise.

The judges' decision and that of the Editor of Practical Wireless in all other matters affecting the competition, is final and legally binding. No correspondence can be entered into.

The competition is open to all readers in Great Britain, Northern Ireland, and the Channel Isles except employees (and their families) of IPC Magazines, the printers of Practical Wireless, and Sinclair Radionics Ltd.

The winners will be notified, and the result announced in the earliest possible issue of this magazine.

Listed here are eight features of this new multimeter all you have to do is place them in what you consider to be their order of appeal to the average PRACTICAL WIRELESS reader. For example, if you consider that "Probe lead stowing facility" is the most important of them all write 'C' in the box marked 1st on the entry coupon; the letter of your next choice goes into the box marked 2nd, and so on for all eight.

Complete the coupon, all in ink or ball-pen, with your own full name and address, then cut it out and post in a sealed envelope to: PRACTICAL WIRELESS MULTIMETER COMPETITION, 16 GARRICK STREET, LONDON, WC2E 9PR. The closing date is Friday 22nd June 1973.

IMPORTANT

Before sealing, copy out on the outside back of the envelope the eight key letters in exactly the same order as they appear on the completed coupon. Do not enclose any correspondence or matter other than your coupon.

- A** Light, portable and easy to handle
- B** Easy readability from number tubes with decimal point
- C** Probe lead stowing facility
- D** Accuracy of better than 1%
- E** Very high input resistance up to 1,000MΩ
- J** A.C. and D.C. current measuring capability
- K** Price/performance ratio competitive with moving coil multimeter
- L** Voltage measurement from 1mV to 1,000V A.C. or D.C.

FREE ENTRY COUPON

Post to:

**PRACTICAL WIRELESS
MULTIMETER COMPETITION
16 Garrick Street, London
WC2E 9PR**

My order of importance for the eight features is listed on the right. In entering the competition, I agree to the rules as final and legally binding.

NAME
(Mr/Mrs/Miss)
ADDRESS
(Block letters)
.....
.....

1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	

CUT ALONG THIS LINE

DOMESTIC RADIO AND HI-FI EQUIPMENT TO LOOK OUT FOR

SONEX Pictorial Plus

IN spite of some pessimistic mutterings expressed in various quarters on the future of quadraphonic sound, there is no doubt that there is increased confidence in its viability. Several manufacturers, exhibiting at Sonex in the new venue, Excelsior Hotel, London Airport, show that in order to be able to sell four-channel it must be of high quality.

The characteristic "wait-and-see" of the British Trade will not be able to hold out much longer, especially as there are now being made and imported quad recordings based on matrix coding systems SQ and QS. Some manufacturers have wisely chosen to cater for both these systems and the discrete four-channel

system generally known as CD-4 (See News . . . page). Space does not permit an exhaustive treatment of the exhibition, but we have shown here some highlights that are worthy of consideration. Some of the main features are given and prices shown where known. It is stressed that all specifications are quoted and are in no way intended as a basis of transaction under the Trades Descriptions Act. Full details are usually available from manufacturers or agents. E.M.I. Crown and ITT were not at Sonex. The quad SQ system originates from CBS of America; QS from Sansui; discrete CD-4 from Victor Company of Japan. *The Midlands and North have their own special exhibitions.*

CASSETTE RECORDER CC 9201 WITH RADIO CC 9301 (BASF)



Battery/mains portable for chromium dioxide (automatic switch) or ferric oxide tape, wow and flutter less than 0.3%, signal/noise ratio better than 45dB (50dB with Cr02) Amplifier 1.5W (CC9201) and 2.5W (CC9301). Radio in 99301 has a.m./f.m. bands.

CC 9201 is £55; CC 9301 £75.
BASF United Kingdom Ltd.,
Knightsbridge House, 197
Knightsbridge, London, SW7.

FM TUNER 624 (Armstrong)

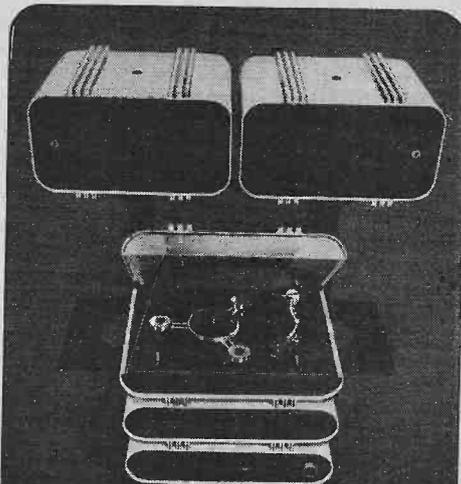
Varicap diode tuning, dual gate fets, ceramic filters, integrated circuit phase lock loop stereo decoder. Six preset stations and variable control. Preset station frequency meter and tuning meter for centre-zero tuning or field strength monitor. Switched afc and local/distant mode. Sensitivity 1mV for 30dB signal/noise. Distortion less than 0.2%. Signal/noise ratio at 100µV 65dB. Price £59.40 inc. VAT.



Armstrong
Audio Ltd.,
Walters Road, London, N7 0RZ.

AM/FM TUNER 623 (Armstrong)

Single scale variable a.m. tuning without band switching; preset stations also available. Continuous coverage 145 to 1,625kHz. Sensitivity on a.m. 250µV ferrite rod or 25µV external aerial. FM section as for 624. Recommended retail price £79.20 including VAT. Also available stereo receiver (illustrated) 626 a.m./f.m. £132 including VAT.



SCIENTELEC MULTIPLE UNIT

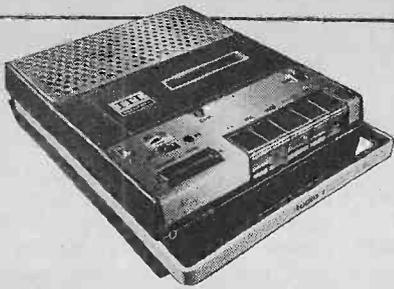
This interlocking system comprises: transcription unit 33 $\frac{1}{2}$ /45 r.p.m. Wow and flutter 0.15%. Rumble: 54dB. Amplifier: 2 x 40W. Bass/treble cut filters. Tuner: input-75/300Ω with 1µV for 24dB sensitivity. Less than 0.5% distortion, amplified a.f.c. and squelch cct. Speakers: 8in. and 3in. (45Hz to 20kHz). 4Ω.—Sinclair (SSB) Ltd., 34A Beddington Lane, Croydon.

PICK-UP ARM LUSTRE GST1 (Acos)

Imported Japanese high quality pick-up arm with counter-balance, bias compensation and preset

adjustable base slide for optimum positioning. This easy to set up arm has an integral lift arm and cue lever, anti-skating adjustment, height adjustment and two headshells for interchange of two cart-ridge types. Price £24.51 plus VAT.
Cosmocord Ltd., Eleanor Cross Road, Waltham Cross, Herts.

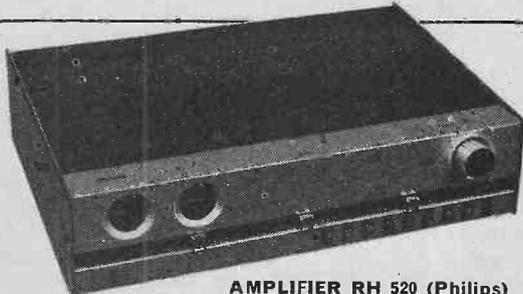




CASSETTE RECORDER STUDIO 60 (ITT)
 Battery/mains portable recorder for chromium dioxide or ferric oxide tape. Fast forward/rewind, start/stop and pause controls. 1W amplifier. Automatic motor cut-out and warning light when tape ends. Recommended retail price £38.95 plus VAT. ITT Consumer Products (UK) Ltd., Maidstone Road, Sidcup, Kent, DA14 5HT.

STEREO AMPLIFIER 1515 & QUAD DECODER SQ1500 (E.M.I.)

The 15+15W amplifier has a quoted distortion of less than 0.2% at full power at 80hms. Conventional controls plus power outlets of full stereo system and outlets for disc and tape mechanisms. Quad decoder for SQ four-channel recordings to CBS specification. Retail prices: Amplifier 1515 £46.50; Decoder SQ1500 £30, both inc. VAT. E.M.I. Pathe Division, E.M.I. Sound & Vision Equipment Ltd., 252 Blyth Road, Hayes, Middlesex.



AMPLIFIER RH 520 (Philips)
 Successor to the 590, this 2 x 15W r.m.s. amplifier conforms to DIN 45500 Standard. It has switchable "Stereo-4" quadrasonic facility, rumble and scratch filters, slider controls, headphone socket, power meters. Recommended retail price £85 including VAT. Philips Electrical Ltd., Century House, Shaftesbury Avenue, London WC2H 8AS.

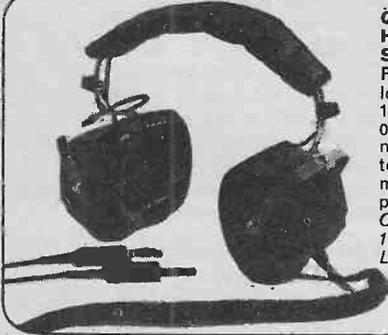
RADIO/HI-FI UNIT RS 252 (Siemens)

Complete system (less speakers) in one cabinet includes PE 3015 transcription turntable with pickup safety lock operated by push-rod near centre spindle; prevents pickup being moved over turntable without a record in position. Shure magnetic cartridge type M75D. 2 x 25W r.m.s. amplifier, radio tuner a.m./f.m. reception, six preset tuners on f.m., slider controls, quadrasonic sound facility. Interconti Electronics Ltd., Albany House, Petty France, London, S.W.1.



QUADRAPHONIC HEADPHONES SH870Q (Crown)

Four-channel phones of low impedance (4 to 16 ohms) for an input of 0.2W maximum per channel. Frequency range 20Hz to 14,000Hz. Recommended retail price £15.95 plus VAT. Crown Radio Co. Ltd., 128 Shoreditch High Street, London, E1 6JE.



POWER AMPLIFIER AP1, AP2 (Right) FM TUNER TF1 (Centre) CONTROL UNIT AC1 (Left)

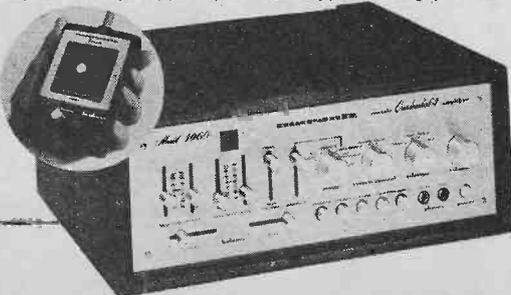
Cylindrical housing power amplifier with up to 50W per channel into 4 or 8 ohms (AP1) or 70W (AP2). Distortion rated at less than 0.02% at 50W. Input sensitivity 500mV for 35W into 8 ohms. FM tuner sensitivity 1.5µV for 30dB quieting. Signal/noise ratio better than 60dB. Distortion better than 0.1% mono, 0.5% stereo. Control Unit has sensitivities of 2.5mV (p/u) 125mV (auxiliary) inputs. Outputs 500mV r.m.s. and 100mV r.m.s. (tape).

Lecson Audio, Nuffield Road, St. Ives, Hunts.



QUADRADIAL-4 AMPLIFIER MODEL 4060 (Marantz)

New equipment designed to provide for synthesised 4-channel sound of matrix-encoded disc or f.m. broadcast programmes. 4 x 15W r.m.s. amplifiers, mode switch for mono on four channels, discrete 4-channel, vari-matrix synthesised 4-channel or enhanced stereo, SQ matrix 4-channel. **QUADRADIAL-4 REMOTE CONTROL (Marantz)** Includes four-channel balance control joystick, master volume, loudness switch. Pysier-Britex (Swift) Ltd., Fircroft Way, Edenbridge, Kent.



4-CHANNEL PLAYER QZ100S (Garrard)

Both this turntable unit and its companion, the QSP25 Mk. 3, are now available with Q prefix to cater for quadrasonic sound. Capable of playing discrete four-channel and two-channel discs or, by using the built-in matrix decoder, they can provide enhanced four-channel output from two-channel recordings. High quality magnetic pickup on the QZ100S has frequency range 20 to 50,000Hz to reproduce CD-4 recording and carrier. Plessey Electronics, Swindon, Wiltshire.



HOTLINES

ON RECENT DEVELOPMENTS

FLAT C.R.T.

THE search for a flat, thin cathode ray tube continues. Many ingenious ideas have been put forward, but many have had to be shelved simply because of cost compared to the c.r.t. This is particularly so in the case of television screens. Could it be that the solutions to date have sought to be too clever? An American company has come up with a solution which is extremely simple, it works, and the cost is not prohibitive.

Basically, the system is based on the principle that if a spot of oil, turpentine, etc is dabbed onto the roughened side of a sheet of frosted glass, the affected spot will become transparent.

Imagine two sheets of glass. The rear one is blackened. The front sheet is frosted, the rough side facing the blacked sheet. Between the two sheets is a reservoir of liquid and the glass is thus transparent or clear all over. All that is necessary is some form of matrix to "address" this "cell". This could be a fine mesh of conductors laid down onto the roughened surface of the front plate—a very fine pattern of lines in the x and y axis—rather like finely ruled graph paper squares.

Action of the device is simple. When power is fed to two electrodes, the point at which they meet will heat and vaporise the liquid, causing a white opaque spot to appear.

The speed at which all this can happen is, in present models, between 1-10mS. Note: this is quite adequate for television applications where the frame speed is about 30 per second. Turn off time is about 10mS.

Various liquids are under investigation. Trichlorethylene, for example, requires 50V at about 2W of power to control each square centimetre of display area. Compared directly to the c.r.t. for TV applications this "picture frame cell" uses more power but at a lower voltage. Because the surface is completely flat, barrel and pin-cushion distortion are eliminated. By utilising low vapour pressure liquids, it should be possible to increase efficiency.

The idea could also be used for a form of storage tube display. The addressing matrix could be used to boil off the liquid in the selected

"trace" areas leaving those areas dry and thus standing out against the transparent surrounding areas. The boiled-off vapour would be returned to a reservoir via suitable ports where it would condense back to a liquid. This liquid in the reservoir could, in turn, be heated and allowed to re-condense over the entire surface of the cell, thus clearing the display ready for the next trace.

Perhaps thin, flat-screen television is nearer than we think, and the Japanese are known to be working on some pretty cute ideas.

I.C. SOUND EFFECT

Electronic organs are popular and circuitry has appeared in many journals. One very nice asset is a Leslie Speaker cabinet which contains a drum which rotates in front of a loudspeaker. This sort of f.m. gives an effect of vibrato and chorus. The more sophisticated home organs have a Leslie Speaker built-in to the organ itself.

A German company has now produced an IC which could replace the entire Leslie System. It has the advantage, besides an obvious tremendous reduction in size, of having no moving parts; no motor noise, nothing to rotate. The IC, designated TCA350, achieves the effect by introducing a delay time. The actual electronics of the system is too complex to deal with here, but the TCA350 contains some 185 field effect transistors and complementary capacitors. Another application could be to use this IC to replace glass delay lines.

MONO CHIP INDUCTORS

Little things please little minds so we're told, but sometimes it's not that cynically simple. Cramming a few thousand semiconductors into a dual in-line package is a common occurrence today, but what of the devices which are very difficult to integrate? Items such as tuned circuits are a problem. However, solutions are on the way, in the form of subminiature inductors or "coils".

Described as monolithic chip inductors, these minute devices are made by stacking U-shaped conductor patterns which have been screened onto a special ferrite tape. The U-shaped patterns are stacked

such that when the individual ends of each U are connected to the U's above and below, a continuous "coil" pattern is achieved. When this has been done, the complete stack is "fired" resulting in a monolithic structure.

It sounds simple; but it isn't. First a special high-permittivity ferrite has to be carefully bonded with a plasticiser to make the tape which is typically about 1.8 thou. (1 thou $\frac{1}{1000}$ inch).

Again when the tiny tapes are stacked, holes must be drilled through the stack to enable the ends of each U-pattern to be connected. The entire coil is only 0.08in³.

Another snag is the d.c. resistance of the "windings". If this is too high, the Q of the coil will be lowered and the tuned circuit would tune far too broadly. The favourite metal, Platinum, was found to give a resultant inductor with far too great a resistivity. Gold and Silver, other immediate candidates, have melting points which are much too low to be of use with many ferrites. One company overcame this by developing a special ferrite material which could be fired at under 900°C.

In their tiny 0.08inch cubes, these miniature marvels, called Magna Chips, have been produced with Q ratings of from 20 to 50 with inductance values in the range 0.1 to 6 μ H. Perhaps transformers are a possible future development, particularly r.f. types. At present, the upper limit appears to be around 50MHz.

GOT A TEMPERATURE?

If you're worried about getting too hot under the collar, you need a Hot Spot temperature recorder/indicator. These devices look like a transistor (there are other mountings) about 0.18inch in diameter. They have a particular temperature rating which you specify on ordering and the present range covers from 100°F to 350°F in 10°F steps. If one of these devices is exposed to its rated temperature it immediately turns from bright silver to black.

Ginsberg

LARGE STOCKS ATTRACTIVE DISCOUNTS DEPENDABLE SERVICE

Everything brand new & to makers specs.

ELECTROVALUE

Electronic Component Specialists

TRANSISTORS BY SIEMENS AND NEWMARKET

2N3055 npn silicon power 60p
AC153K pnp germanium low power 32p
AC176K npn germanium low power 35p
AD181 npn germanium medium power 42p
AD182 pnp germanium medium power 40p
AF189 npn germanium UHF 43p
BC 107 13p; BC108 12p; BC109 13p;
BC187 11p; BC188 9p; BC189 11p } npn
BC177 21p; BC178 18p; BC179 21p } npn
BC257 12p; BC258 11p; BC259 13p } npn
Standard groupings available.
BD185 npn med power 38p
BD186 pnp med power 38p
DIODES
OA90, OA91, OA95 each 6p
OA200 6p; OA202 10p
Other semiconductor
AC128 17p; AF117 35p
BFY51 18p

Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

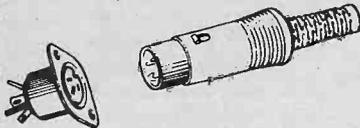
SIEMENS' THYRISTORS

0.8A 400V 85p, 600V 80p
3A 400V 70p, 600V 81.02

ZENER DIODES full range E24 values: 400mW: 2.7V to 36V, 1W each; 1W: 6.8V to 82V, 21p each; 1.5W: 4.7V to 75V, 45p each. Clip to increase 1.5W rating to 3 watts (type 266F) 4p.

DIN PLUGS & SOCKETS

by Hirschmann, 4A rating



2 way LS - socket 10p; plug 12p. 3 way scr. socket 10p; plug 12p. 5 way scr. socket 12p; plug 15p.

TRANSISTOR ACCESSORIES

To3 cover 7p
Heat sinks 1°C/w, type 6W1, undrilled 60p

SWITCHES

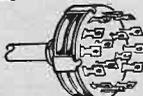
1011C SPST toggle 20p
409 DPDT toggle 25p. (These are chrome plated) 2.5A rating)
7201 Sub-miniature DPDT 250V a.c./2A 48p

ROTARY SWITCHES

Radiospares Miniature Maki-switch (in assembly kit form) Shaft 48p
Wafers, MBB-2P5W, 1P1W 10M-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, 32p

WAVECHANGE SWITCHES

1P12W, 2P6W, 3P4W, 4P3W, each 24p



ELECTROLYTIC CAPACITORS

AXIAL LEAD Prices subject to amendment by the manufacturer.

Rated voltage: 3V	6.3V	10V	18V	25V	40V	63V	100V
Capacity μ F							
0.47						7p	7p
1.0						7p	7p
2.2				7p		7p	7p
4.7			7p	7p		7p	7p
10			7p	7p		7p	7p
22			7p	7p		7p	8p
47	7p		7p	7p		8p	12p
100	7p	7p	7p	7p		8p	15p
220	7p	7p	8p	9p		10p	28p
470	7p	8p	9p	12p		17p	24p
1000	9p	12p	12p	17p		20p	28p
2200	14p	16p	22p	25p		36p	40p
4700	23p	28p	37p	40p			
10,000	37p	40p					

Polycarbonate —5% Tolerance

250V up to 0.1 μ F; 100V/0.1 μ F and above.

0.01: 0.013; 0.015; 0.018; 0.022; 0.027; 0.033; 0.047; 0.056; each 4p.
0.068; 0.082; 0.1; 0.12; 0.15 each 4p.
0.18; 0.22; each 5p
0.27; 0.33; 6p; 0.39 7p; 0.47 8p; 0.56 10p.
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C	1/8W	5%	4.7 Ω -470K Ω	E24	1	0.9	0.75
C	1/4W	10%	4.7 Ω -10M Ω	E12	1	0.9	0.75
C	1/2W	5%	4.7 Ω -10M Ω	E24	1.2	1	0.8
C	1W	10%	4.7 Ω -10M Ω	E12	2.5	2	1.6
MO	1/2W	2%	10 Ω -1M Ω	E24	4	3	2 net
WW	1W	10% \pm 1/20 Ω	0.22 Ω -3.9 Ω	E12	7	7	6
WW	3W	5%	1 Ω -10K Ω	E12	7	7	6
WW	7W	5%	1 Ω -10K Ω	E12	9	9	8

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E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

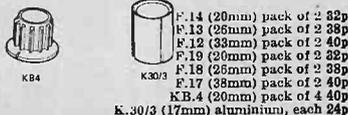
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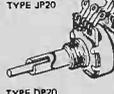
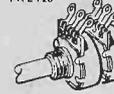
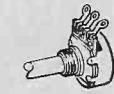
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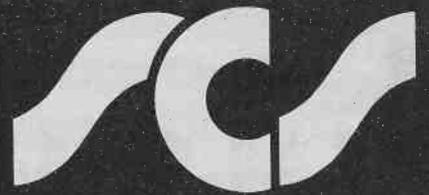
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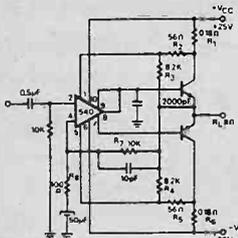
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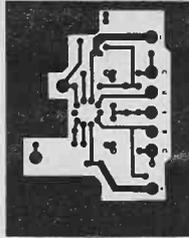
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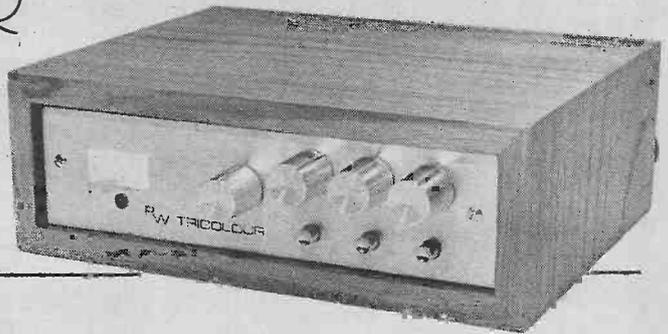


TRICOLOUR

Mood Lighting System

PART THREE

JUREK BUDEK*



THE P.W. *Tricolour* described in parts 1 and 2 dealt with a design which utilised zero voltage control and the printed circuit board, components and metalwork was specifically designed for that purpose.

Part 3 deals with the lamp dimming version of the P.W. *Tricolour* which requires a different printed circuit board, component changes and modified metalwork. To avoid any confusion we will refer to this design as 'Mk II'. The Mk II printed circuit board however has been designed to accommodate either the lamp dimming or zero voltage control designs. Each design has its basic differences and these can be ascertained by reference to the circuitry.

The filter circuit as shown in Fig. 9 part 1 remains identical for each design. The Mk II metalwork is similar in many respects to the original design, but will be reproduced in its entirety for the sake of completeness.

Light Dimming

The light intensity is varied by controlling the input voltage to the lamps. This is achieved by using the same solid state devices, triacs, as in the zero voltage switching design described in parts 1 and 2 in this series of articles (April, May 1973).

Fig. 21 shows some of the voltage waveforms obtained by moving the gate pulses in time with respect to the input voltage and thus controlling the load voltage.



Photograph shows the lamps unit that is used with the P.W. Tricolour

The formulae given below gives the relationship between the output r.m.s. (root mean square) voltage, a function of delay angle ' α '.

$$V.r.m.s. = E.r.m.s. \times \sqrt{2} \sqrt{\frac{1}{2\pi} \left(\pi - \alpha + \frac{\sin 2\alpha}{2} \right)}$$

Where E.r.m.s. = 240V (supply voltage)
Taking the supply voltage as 100, the above formulae can be modified to give the results as a percentage of the supply voltage.

$$V.r.m.s. = 100 \times \sqrt{2} \sqrt{\frac{1}{2\pi} \left(\pi - \alpha + \frac{\sin 2\alpha}{2} \right)} \text{ per cent}$$

Fig. 22, drawn from the above formulae, shows the percentage reduction of the output r.m.s. voltage as a function of delay angle ' α '.

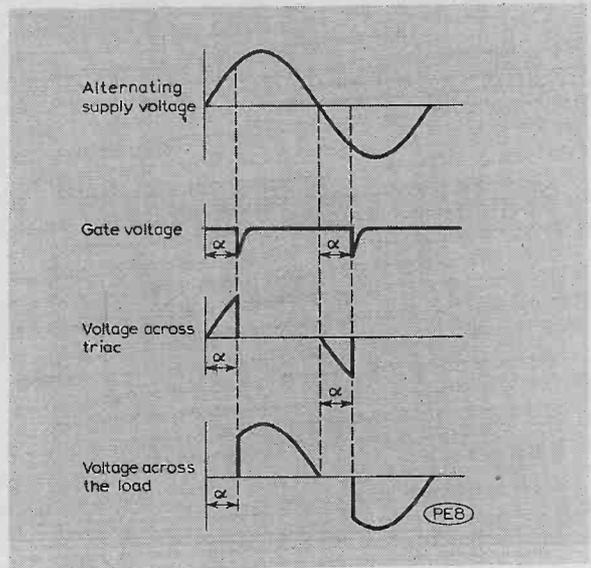


Fig. 21: Some of the triac voltage waveforms obtained by moving the gate pulses in time with respect to the input voltage.

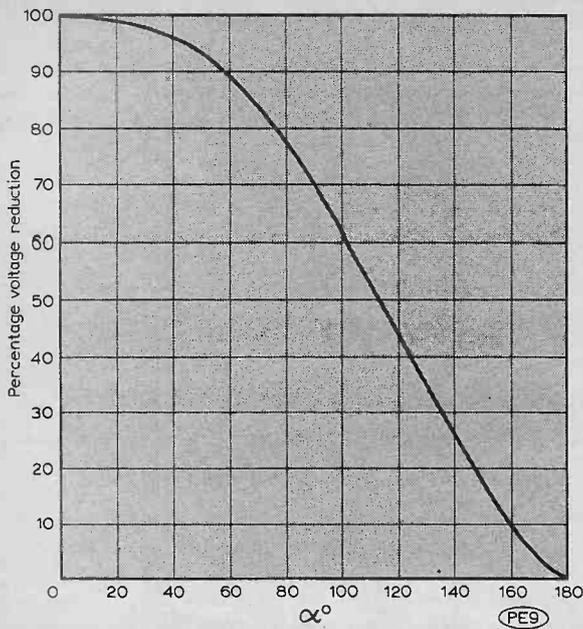


Fig. 22: Graph showing the percentage reduction of the output r.m.s. voltage as a function of the delay angle α

There are various circuits for controlling the gating of a triac and thus the power in the load. One of the simplest ways is to employ an unijunction transistor (u.j.t.).

Unijunction transistor trigger circuits are usually based on the simple relaxation oscillator as shown in Fig. 23.

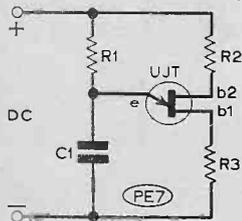


Fig. 23: Circuit shows simple unijunction relaxation oscillator.

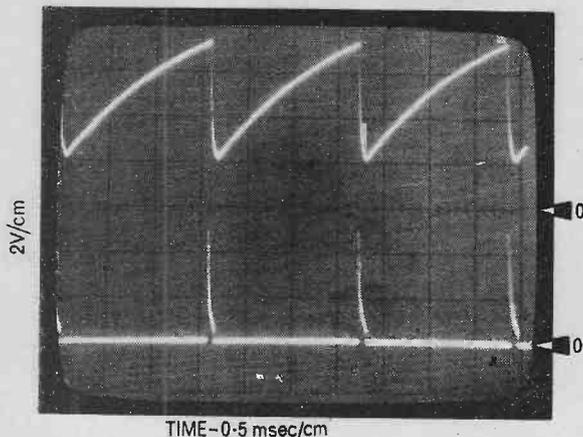


Fig. 24: Voltage waveforms relating to Fig. 23 (see text). Photograph not to scale.

Resistor R1 and capacitor C1 form the timing network. On application of a d.c. voltage capacitor C1 will charge up exponentially at a rate (time constant) determined by resistor R1 and its own value until the peak point voltage of the u.j.t. emitter is reached. At this time the u.j.t. turns on discharging capacitor C1 through the base resistor R3 (i.e. with a time constant $C1 \times R3$ where $R3 \ll R1$). Then the process repeats, resulting in a train of pulses across resistor R3. Fig. 24 illustrates the voltage waveforms across capacitor C1 (upper trace) and the voltage pulses across resistor R3 (lower trace). The values of components for this oscillogram were:

D.C. supply	—	10V
R1	—	15 Ω
R2	—	270 Ω
R3	—	100 Ω
C1	—	0.1 μ F

Synchronisation to the mains is achieved by using the circuit as shown in Fig. 25.

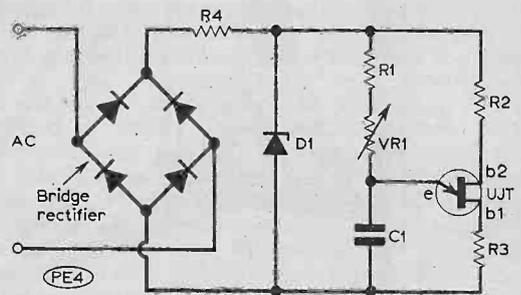


Fig. 25: Mains synchronisation of the unijunction oscillator.

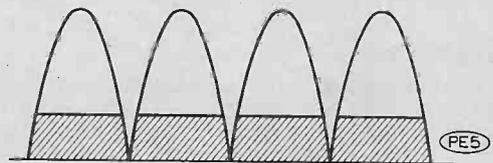


Fig. 26: Waveform related to Fig. 25, see text.

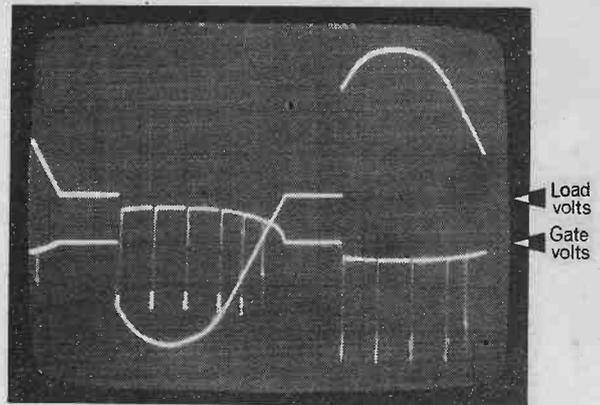
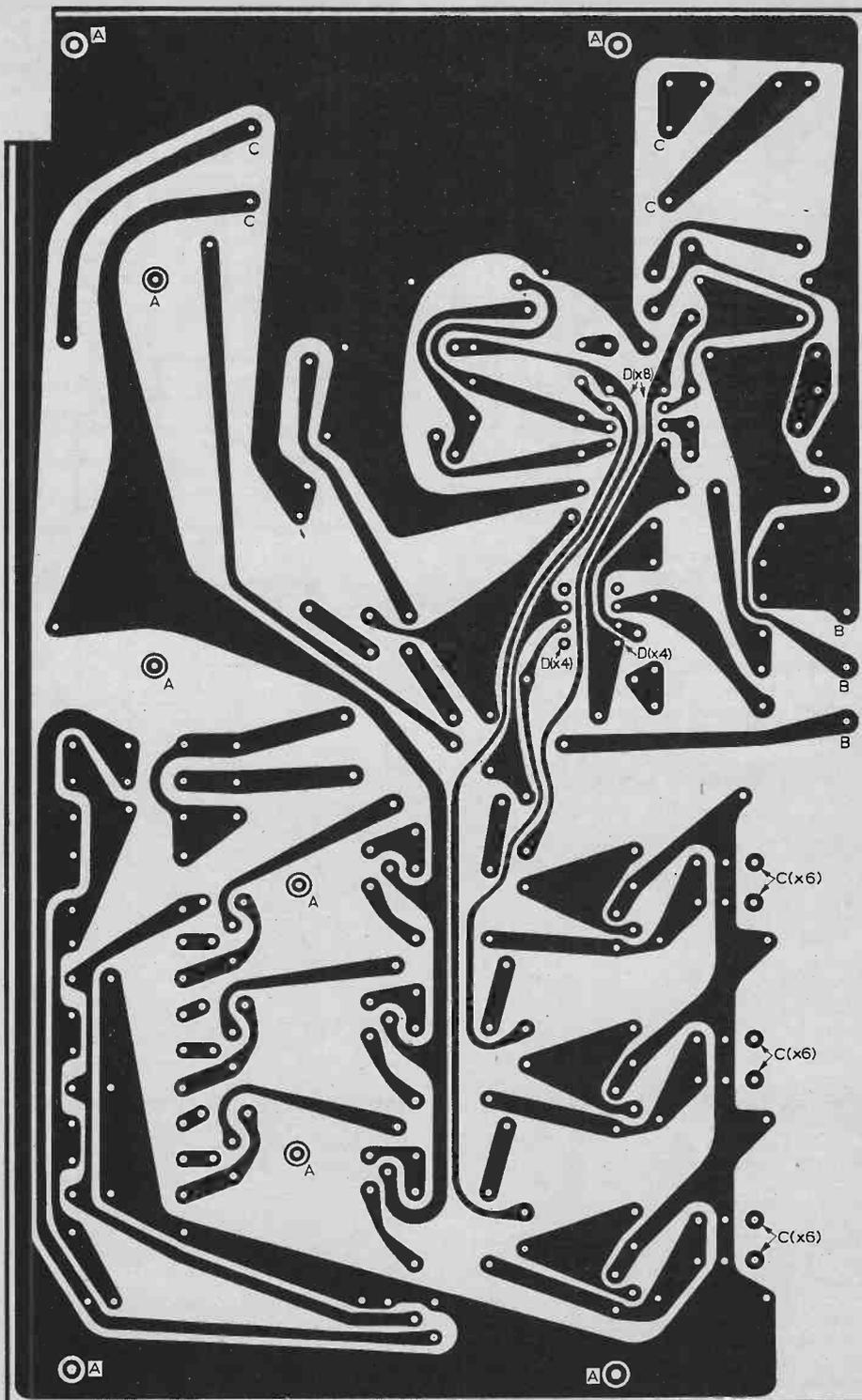


Fig. 27: Triac gate voltage pulses and corresponding voltage waveform across the load.



HOLE DATA
 8 holes 'A' $5/32$ " dia 16 holes 'D' $1/32$ " dia
 3 holes 'B' 1.8mm dia All other holes 1.0mm
 22 holes 'C' 1.3mm dia

Fig. 28: The Mk II printed circuit board for the PW Tricolour. This is shown full size—copper foil side. The respective layouts for zero voltage switching and lamp dimming will be given next month.

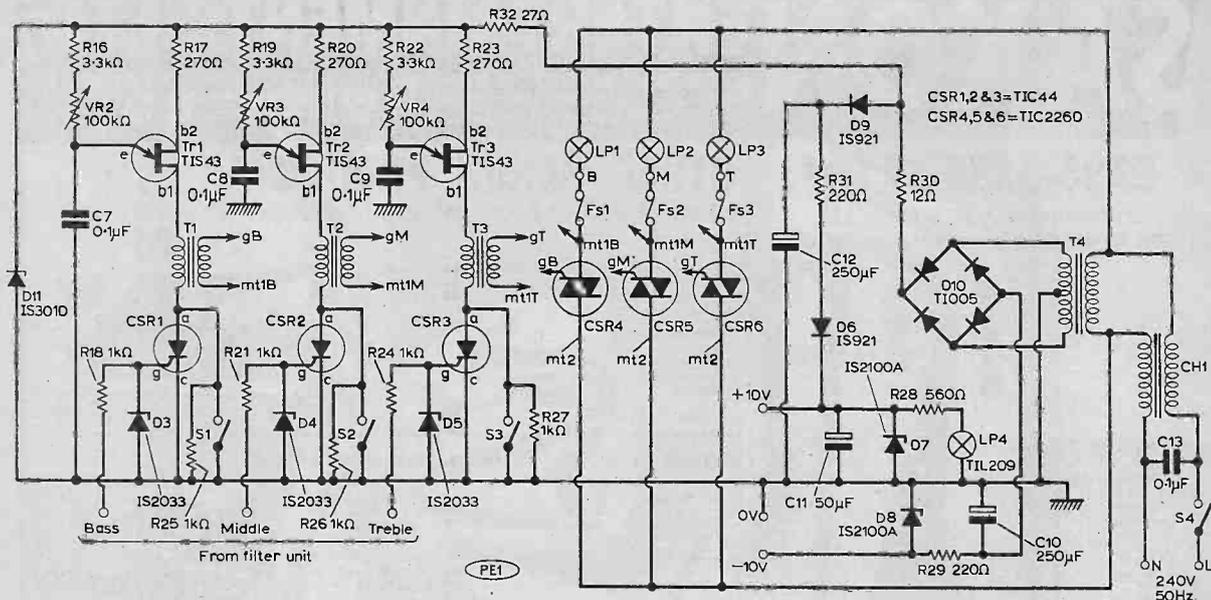


Fig. 29: Circuit showing the P.W. Tricolour lamp dimming control unit. The associated filter unit is exactly as described in Part 1 of this series (April 1973 P.W.)

★ components list

Resistors

R16	3.3k Ω
R17	270 Ω
R18	1k Ω
R19	3.3k Ω
R20	270 Ω
R21	1k Ω
R22	3.3k Ω
R23	270 Ω
R24	1k Ω
R25	1k Ω
R26	1k Ω
R27	1k Ω
R28	560 Ω
R29	220 Ω
R30	12 Ω $\frac{1}{2}$ W
R31	220 Ω
R32	27 Ω

All 10% \pm W unless otherwise specified

Capacitors

C7	0.1 μ F
C8	0.1 μ F
C9	0.1 μ F
C10	250 μ F 25V electrolytic
C11	50 μ F 25V electrolytic
C12	250 μ F 25V electrolytic
C13	0.1 μ F 250V a.c. wkg.

Transformers

T1	Pulse transformer, type PT-ATA ITT Ltd.
T2	
T3	
T4	Miniature mains transformer, 240V primary, 0-12V, 0-12V r.m.s. 6VA type 12V, R. S. Components Ltd.

Semiconductors

Tr1	TIS43
Tr2	TIS43
Tr3	TIS43
D3	IS2033
D4	IS2033
D5	IS2033
D6	IS921
D7	IS2100A
D8	IS2100A
D9	IS921
D10	TI005 Bridge rectifier
D11	IS3010
CSR1	TIC44
CSR2	TIC44
CSR3	TIC44
CSR4	TIC226D
CSR5	TIC226D
CSR6	TIC226D

Texas Instruments Ltd.

Miscellaneous

VR1, VR2, VR3	100k Ω linear potentiometer
FS1, FS2, FS3	5A fuses and panel mounting holders
LP1, LP2, LP3	Colour flood lamps, 240V 100W
LP4	TIL209 indicator lamp, Texas
S1, S2, S3	Push on-push off switches
S4	Single pole mains on-off switch
CH1	Filter choke, Tunewell Transformers type J.B.1
SK1	Lamps socket, Bulgin type P552
PL1	Lamps plug, Bulgin type P551 (fitted to lead from lamps unit)

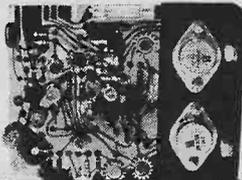
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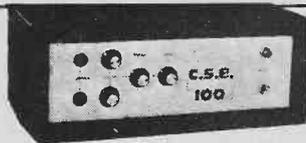
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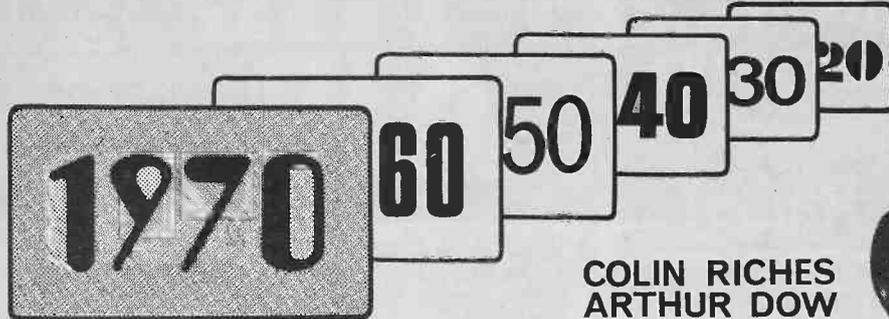
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GOING BACK...



COLIN RICHES
ARTHUR DOW



Mr. Paul Godfrey has sent us some excellent photographs of a vintage wireless. He discovered it at an auction in Great Yarmouth and is wondering if anyone can help him identify the manufacturer and the rough age of the set.

The exterior bears no maker's name but a great many of the components bear the name "Saxon Radio, Blackpool." The wiring is somewhat untidy for the standard of the day and Mr. Godfrey wonders if the wireless may have been made up from a kit.

Three of the valves are made by Tungsram of Hungary and the fourth is a Marconi valve that appears to have been adapted somewhat to fit the holder.

The speaker has been spoilt by a "tatty" coat of paint which has in all probability obscured the name of the manufacturer but he thinks this could be removed to allow it to be re-painted or sprayed properly. So, if anyone can help, you can contact Paul Godfrey at 59 North Quay, Great Yarmouth, Norfolk.

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50 YEARS OF BROADCASTING

THIS excellent gramophone record, produced by the BBC contains no less than 127 separate items combined together to give a masterpiece of sound broadcasting history. The double album covers such milestones as P. P. Eckersley's, "This is Two Emma Toc Writtle calling", with the unmistakable rolling of the 'R's' in Writtle. The opening of Savoy Hill in 1923 is covered and the historic broadcast of the opening of Tutankhamun's tomb by Dr. Howard Carter and the General Strike news announcement of 1926 are all featured. H. G. Wells gives a talk on communications and King George V gives the first ever Christmas Message from Sandringham in 1932.

Side 1 of the record covers 1922-1932, Side 2, 1933 to 1939, side 3, 1940 to 1945 and side 4, 1946 to 1972.

Some of the tracks on side 2 are nostalgic reminders of our favourite programmes—In Town Tonight, Bandwaggon, etc. The death of George V is announced by Sir John Reith (21/1/36). The invasion of Poland and the outbreak of war with Neville Chamberlain's announcement on 3/9/39 are recorded.

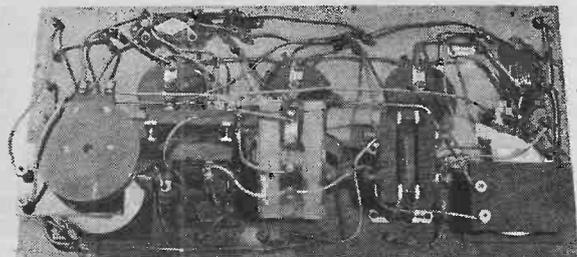
Side 3 starts with Churchill's "Fall of France" speech and voices that were to become so familiar to us all in those years of trouble and strife bring back nostalgic memories. Frank Phillips, Vera Lynn, Alvar Lidell, Tommy Handley, Jack Warner, Freddy Grisewood, John Snagge and Richard Dimpleby all add their voices to the recordings.

Side 4 starts with the 1947 F.A. Cup Final between Charlton and Burnley when the ball burst. There are excerpts from "Take it from Here", 20 Questions, The Goon Show and others. The events of Yuri Gagarin in space and President Kennedy's assassination bring us into the sixties and the final track is the memorial service in Westminster Abbey for Lord Reith (22/7/71) with the lament "Flowers of the Forest" played on bagpipes by Pipe Major Thomas Anderson.

We cannot praise this album too highly. It is a record that should be in the collection of anyone who has gained enjoyment from listening to BBC programmes over the years. We have only been able to mention a few of the fascinating tracks and to do full justice to this memorable record we recommend that you listen to this nostalgic document. Price £3.99 from your local record dealer.



Mr. Godfrey's receiver and horn speaker.



Under-chassis wiring of the above receiver.



BROADCAST BANDS

SHORT WAVE DX by MALCOLM CONNAH

THE first news this month is of an interesting venture by several young readers of this column. They are attempting to form a DX Club for younger listeners.

The name of the club is the **Youth DX-Club International** and the first copy of their magazine arrived on my desk this week. The magazine contains many interesting features including an article on antenna construction and an equipment review. The majority of the articles are aimed at helping the young DXer.

The present membership of the club is composed of 14 and 15 year olds. I have no further information at present but hope to publish more details next month.

DX News

GREECE: The Hellenic National Radio Institute has been heard on the new frequency of 21610 from 1420 to 1500 with a strong signal.

SWEDEN: The new, 500kW, transmitters of Radio Sweden at Karlsburg are now on the air. Due to technical difficulties the output has been reduced, for the time being, to 150kW. It is hoped that these problems will soon be overcome.

URUGUAY: Radio El Espectador, Montevideo is reported to be active again on 11835kHz and has been heard from 1100 to 0300.

The last three items are courtesy of Sweden Calling DXers which, by the way, has just celebrated its 25th. anniversary.

Readers' Logs

The first log comes from the team of **Simon Wormleighton** and **J. P. Fletcher** at Rendcomb College, Cirencester. The equipment used in their station is an HRO receiver with 8 metre folded dipole and an Astrad Altair receiver with an 80 foot long-wire. Stations logged include:

- 5920 R. Kiev, Ukraine in English at 1950.
- 9560 R. Japan with news in English at 1000.
- 9570 R. Australia in English at 0700.
- 9655 R. Damascus, Syria. Nx. in English, 2030.
- 9695 RSA, South Africa, English at 2400.

- 10050 Voice of Vietnam, Hanoi at 1705.
- 11770 BBC, Atlantic Relay in English at 1700.
- 21500 AFRTS, Washington in English at 1500.

Paul Beeson of Bexleyheath caught his father in the act of throwing away a 1947 Murphy type TA92, 6 valve Domestic receiver. Having rescued the set he performed a few minor repairs, added a 100 foot long-wire and obtained the following results:

- 9560 All India Radio in English at 1830.
- 9565 Voice of America, Tangier, at 1730.
- 9580 Warsaw Radio, Poland, news at 2240.
- 9605 R. Bucharest, Rumania at 2020.
- 9645 Armed Forces & Int. Ser., R. Canada, 2055.
- 9690 R. New York World Wide at 2300.
- 9700 IBRA Radio, Lisbon, English at 2015.
- 9830 Voice of Vietnam, Hanoi at 1610.

Richard Witney of Black Notley near Braintree has used his Skywood CX203 and inverted 'L' antenna to hear:

- 5965 Voice of America, Wooferton, at 0545.
- 9760 Voice of Vietnam, Hanoi.
- 11720 RAE, Argentina in English at 2345.
- 15140 Voice of Vietnam, via R. Havana, Cuba, 2115.
- 15435 R. Tanzania in English at 1900.
- 17710 NHK, Japan in English at 0802.

John McFadden of Belfast has just received a Trio 9R59DS receiver and using an indoor loop antenna he heard the following stations during the first five days:

- 9550 R. Lebanon, Beirut in English at 0245.
- 9570 R. Australia with news at 0715.
- 9745 R. Baghdad, Iraq in English at 1930.
- 11650 R. Bangladesh, news in English at 1720.
- 11710 RAE, Argentina in English at 2305.
- 11720 R. Nacional, Brazil in English at 2255.
- 11770 R. Afghanistan in English at 1820.
- 11800 Voice of Turkey in English at 2215.
- 11930 WIBS, Grenada, Sports commentary at 2055.
- 11955 FEBA, Seychelles in English at 1800.

Ian Gordon of Birmingham has a Codar CR70A receiver and uses a central heating radiator as an aerial which must be an unusual feature on the Birmingham skyline. Stations logged included:

- 6125 R. Canada with DX news at 0730.
- 9550 R. Finland in English at 1425.
- 9695 RSA, South Africa at 2110.
- 9710 RAI, Italy, s/on in English at 1935.
- 9745 R. Baghdad, Iraq in English at 2000.
- 9912 All India Radio, Delhi at 2210.
- 17755 HCJB, Quito, Ecuador at 1940.
- 21485 Voice of America, Bethany at 1930.

I hope to answer all those letters which raised specific queries in the near future. Please remember that all queries should be accompanied by a stamped addressed envelope.

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MEDIUM WAVE FROM AFRICA by CHARLES MOLLOY

MEDIUM WAVE stations in North and West Africa are worth listening for after dark at this time of year. From Algeria, Ain Beida is on 533kHz with Arabic programming and Tipaza is on 251kHz on the Long Waves. This station can be found between Kalundborg 245kHz and Lahti, Finland on 255kHz, it has a power of 1500kW and is heard all over Europe with its French programming. From nearby Tunisia the Arabic programme on 962kHz is usually conspicuous by 2200hrs GMT. From 2300hrs onwards when European interference begins to subside, listen for Dakar, Senegal on 764kHz, which often features a programme of African music with announcements in French until it signs-off at 2345hrs. Enugu, Nigeria is a weakish signal on 1320kHz with news in English before it closes down at 2305hrs GMT. Conakry, Guinea is usually a strong signal on 1403kHz with African style music. Bissau, Portuguese Guinea is often strong on 1070kHz with pop music and Portuguese announcements. There are two stations at Funchal on the island of Madeira that can be logged when conditions are good for reception from this area.

VHF/FM FROM EUROPE by SIMON DAVID

IHAVE received an interesting letter (passed on to me by the Editor) from Mr R. B. Callwood who writes from Munich, West Germany. He says that a popular station there is *Austria-3* which transmits from Vienna about 200 miles away to the east.

The most interesting point is that *Austria-3* broadcasts in stereo from 6 a.m. each morning to 4 a.m. the next morning. This makes British stereo services look rather mean by comparison. Mr Callwood moved into a new apartment block that has a Hirschmann communal aerial. Not being satisfied with the aerial's sense of direction he dangled a wire dipole over the balcony of his apartment. More decibels came pouring in but it was still very noisy on stereo signals.

Still not content that the Pioneer SX-626 receiver was running flat out, he made up the f.m. preamplifier from the April issue of P.W. and is now receiving *Austria-3* in stereo loud and clear.

It is not difficult for the BBC to pick up and relay ORTF programmes from France, especially when they "cheat" a little by going to the cliffs at Folkestone.

At least they thought it would be easy to pick up Boulogne 27 miles across the water but ran into trouble with transmission reflections from Wrotham on an adjacent frequency only 30 miles North West. They were obliged to find Lille (100 miles) to avoid trouble. "France Musique" is the usual stereo channel and from Lille comes in on 88.7MHz.

It is an interesting fact that "France Musique" is the "bread and butter" stereo music channel for some listeners in South West England and the Channel Islands. Is that a sign of *joie de vivre*, Vive le Common Market or just plain inadequacy of British stereo broadcasts? The French are now urging the

expansion of British stereo to supplement what they claim to be inadequate service over there.

CSA99 is on 1331kHz with a power of 10kW and can be heard with station identification at 2350hrs followed by news in Portuguese and close-down at 0005hrs. CSB91 with 1kW on 1529kHz is a weaker signal but is on a clear channel after Vatican Radio signs-off at 2200hrs. Try around 2330hrs for a fluttery signal with local or pop music until it goes off the air at midnight.

Back on the mainland Azilal, Morocco can be found on 209kHz on the long waves, in French but with some interference from Kiev, while the Voice of Morocco in Tangiers transmits with 200kW on 1232kHz with Arabic programming until midnight. For the night owl there is Kinshasa in the Republic of Zaire (Congo) which is on the air all night on 692kHz, a frequency which it shares with an East German outlet but it is fairly easy to separate the two with a medium wave loop aerial.

John McFadden (Belfast) has been trying the medium waves with his Ekco transistor portable. Although using only the internal ferrite aerial he heard Radio Blackburn on 854kHz; Radio Merseyside on 1484kHz and Radio Bristol on 1546kHz, all during the daytime. After dark he logged the following broadcasts in English:—BBC World Service on 1295kHz at 1700hrs; AFN Frankfurt on 872kHz at 1730hrs; Radio Berlin International 1511kHz at 1815hrs; Radio Tirana, Albania 1394kHz at 2030hrs; Vatican Radio 1529kHz at 2055hrs; Radio Moscow 1493kHz at 2115hrs; Trans World Radio, Montecarlo 1466kHz at 2230hrs; Warsaw Radio 1502kHz at 2230hrs; Radio Sweden 1178kHz at 2250hrs and Radio Portugal at 2300hrs.

France Musique boasts 70 stereophonic transmitters operating at fixed hours each day; for reception in the south of England the best stations to find will be Boulogne 89.4MHz, Lille 88.7MHz, Caen 95.6MHz, Rennes 89.9MHz, Cherbourg 92.35MHz. These stations radiate sufficiently to receive stereo here although there may be a good deal of noise about. Details are published in *La Semaine Radio Télé* and *Le Figaro* (weekend edition). You should switch off the a.f.c. on your set if you don't want to lock on to the BBC.

My feelings go out to readers in other parts of the country who cannot yet receive stereo at home from the BBC. In particular, Scottish listeners always seem to get the "donkey's tail" in broadcasting and, since I have a yen for my compatriots over the border (I'm no Sassenach!), perhaps we Southerners should toss a metaphorical caber at the policy makers.

The BBC has issued a statement regarding the stereo pilot tone it uses. As a result of confusion over mixed stereo/mono broadcasts the BBC has adopted the following policy:

1. During stereo (or mixed) programmes the pilot tone will be transmitted and is indicated by the stereo lamp if fitted.

2. During wholly monophonic programmes of substantial duration the pilot tone will not be transmitted. This procedure applies to all BBC v.h.f. broadcasts; the Midlands and North Radio-3 transmitters will be so arranged at a later date.

We shall always be pleased to hear of readers' experiences of VHF/FM reception, especially those who listen in to continental stations. Please state stations received, aerial and tuner used.



SHORT WAVES

by DAVID GIBSON, G3JDG

MY remarks in previous episodes regarding four metres (or 70MHz) appear to have struck a few nails on the head. A large number of letters said naughty words (or were they new call signs) and made suggestions which, although both ingenious and original, I found physically impossible.

H. Brown (Eastwood, Essex) suggests that one answer would be to make 70MHz available to the G8 stations. This is a very good idea. All it needs is an effort from the G8s to learn c.w. and get a "full" Amateur Licence—the ball is really back in our court! Is it worth learning c.w. to save 70MHz? If we don't none of us will be using it!

Barry Crowley (Crawley, Sussex) offers useful comment. He reckons that after a 70MHz station has called CQ, the CQ caller tunes up and down the band once and, hearing nothing, closes down or migrates to other bands. Barry says that on one occasion on the mobile channel (70.26MHz) he heard four mobiles, all within working distance, calling CQ one after the other in the space of 15 minutes. Barry's solution is a simple one—patience.

Stations logged by Barry on 70MHz using an AR88D, nuvistor converter and 4 ele. yagi at 40ft include; G2DN, G6HB, G6HD, G3-KSU, NKS/M, OUX, RAE, TR, TIR, VHR, XOG, XSZ/M, XIG, UPS/M, YVR/M, ZHA/M, ZLO/M, ZQX, ZRR, ZYR, G4ARO.

Unwanted signals on 3.5MHz look out. The Northumbria Radio Club is after you. They (like the rest of us) have had enough of the deliberate interference on the 80 metre Amateur Band—and they're doing something about it. How about everyone giving the Northumbria R.C. a little help? Please, have a listen on eighty for intruders and assorted unwanted interference. When you find one, log all the info. you can i.e., a rough d.f. bearing would be very useful, frequency, time in BST (or whatever, but specify) and the type of QRM—carrier only, some LID tapping a microphone, etc. Address for all this info. is **W. Ricalton G4ADD**, 4 South Road, Longhorsley, Morpeth, Northumberland.

A few tasty morsels for the DX fanatics to drool over. Fanning Island should see Amateur activity later this year and a KP6 callsign will (hopefully) be heard from Palmyra Island. Topband DX types will be delighted with the news that both G3RGB and G3SZA worked VK3CZ on 160 metres. Also, GW3YGH had a natter with VK6HD. Well, what do you hear on topband these days?

News has arrived that there is a S.E. Asian DX net on 7.075MHz; listen Tuesday/Friday at 1400hrs. (Go on, have the afternoon off work, your boss will understand).

Mike Prescott (Warrington, Lancs) reckons there's only one station in Bhutan now; A51PN. Watch out in case some expedition turns up, this could double the number of stations! The VE1 prefix for Prince Edward Island is now C11. Apparently, the province years ago.

Contests

Contests in May are: May 5-6, two metre and seventy cms open; 5-6, Bermuda c.w. contest; 5-6, OZ-CCA c.w. contest; 6, 70cm fixed contest; 12-13, Jubilee phone contest; 12-13 Russian c.w. contest; 19-20, Jubilee c.w. contest; 20, S. Manchester DF qualifying round; 27, two metre portable contest; June 2-3, National Field Day.

Logs

L. Tarassenko (Dorchester, Dorset) opens the logs for this month with a little piece entitled "Heard on Eighty Metres". This work was played on a G3JDG receiver (modified) (how dare you Sir?), accompanied by an a.t.u. and a "W3DZZ dipole". Squirts of s.s.b. from; CN8BDO, CT3AR, EA6BJ, EA6BT, FC2WS, HB0AWQ, KP4AN, KV4CI, KZ5JF, M1I, OH0MA, VO1FJ, VP2LI, W1TAT, WA2HSU, W4RQ, W5PWW, ZL3GS, 3A2EE, 4W1AF, 4Z4EF, 6W8DY, 9H5D.

Stephen Glover (Castleford, Yorks, neat handwriting) has a 9R59DS and a poor 30ft. aerial (wonder what a rich aerial is like?) Savoured on 80m s.s.b.; CN8BF, ET3USF, FP8DH, JX3EN, KP4AN, KV4FZ, OD5LX, OD5BA, OY5NS, OY7BA, PZ2OA, VP2SAF, VP7ND, W2PV, YA1OS, ZS2MI, 9H4KN. On 20 metres s.s.b.: CR6AB, KV4CL, OA2WC, OD54D, VK2WC, VK6VW, 4X4BL, 9H4KN, 9V1QQ.

St. Peter-in-the-wood is where **Roger Sarre** lurks. It is located at Guernsey in the Channel Islands. Fellow lurkers include an HRO and a 30ft. end fed. Results of combined lurks; CN8BF, CN8GG, CR7IC, EP2BI, KP4AN, OD5GC, VE1ADV, VEIAM, VO1FN, VP2L1, ZB2CF, ZC4EJ, 4X4BL, 4X4UF, 4Z4DX, 7X0GM, 9H5C all 3.5MHz s.s.b. An h.f. lurk revealed: CN8CG, CT2AK, CR3RY, CR6FW, CR7IZ, EA8GK, EL2DT, EL8G, EP2TC, FP8AA, HC2PY, HI8LC, KP4BAJ, K6RMM, KV4AD, LU8EDN, ST2SA, SV1BS, W4D1W/P/VP7, XT2AC, ZD3D, ZD3X, 4Z4MO, 5B4AC, 5N2AAN, 6W8AL, 9E3USA all s.s.b. on 15 metres.

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

Medium Waves Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

VHF/FM Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

AMATEUR BANDS

Short Wave/VHF

Logs in alphabetical order please by 15th of the month to David Gibson, G3JDG, 12 Cross Way, Harpenden, Hertfordshire.

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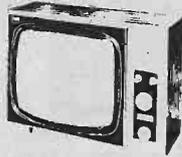
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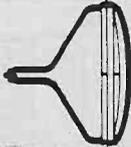
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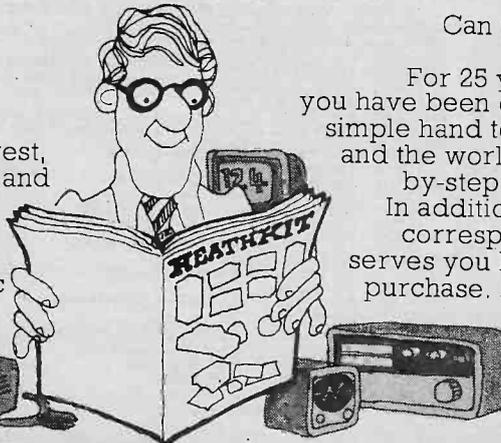
PIC-UP WIRE: super thin flex screened, sheathed, TWIN 7p per yard, 4-core 18p per yard (either up to 6 pds. 7p). Over, charges paid. **MICROPHONES:** CRYSTAL LAMP £1.15. clip/hand, lead 3.5mm jack plug 39p (5p). CM20 Cream Plastic hand 58p (9p); Excellent Dynamic Mike, 30K Ω, only 3 1/2" long, Black/Chrome, Switched, lead with 2.5 and 3.5 mm Jack Plugs, £1.25 (8p). "MIC 45". Curved metal hand grip £1.10 (11p) ALL with leads. **DYNAMIC:** Cardiod Ball. 50K/600 Ω built in volume control, on/off switch, special 200 lead, the best value anywhere at £6.60 (33p): Uni-dir mesh ball 50K/600 Ω jack plug cable, adaptor, £5.29 (22p); Omni-dir. Ball mesh, 50K, cable adaptor, jack plug, £4.29 (33p each). **SPEAKERS:** Very popular 12" ROUND, fitted tweeter, 3, 8 or 15 ohms (state which) £2.08 (33p) or pair for stereo £4.65, charges paid. **SMALL 2 1/2"**, 3 Ω, 8 Ω or 16 Ω (state which) 41p (9p). More speakers in List. **HEADPHONES:** High resistance 2000 Ω adjustable £1.10 (11p). **SPEAKERS:** with lead and min. 2.5mm or 3.5mm (state which) jack plug. **MAGNETIC 11p.** **CRYSTAL** (3.5mm plug only) 28p (up to 6 for 9p any size). **BOLDERING IRON:** Slim, modern, British high speed, 8 1/2", all parts replaceable, highest quality, fully guaranteed £1.20 (11p). **TRANSFORMERS:** Sub-min. 1 1/2" x 1 1/2" 12mm. OUTPUT (3 Ω for OC2, etc.) 18p or DRIVER (up to 12 for 7p). **CONNECTING WIRE:** Packs of 5 coils, each coil 5yds. Assts. cols. **SOLID CORE 16p** (7p). **FLEXIBLE CORE 18p** (9p). **RETRACTABLE FLEXIBLE LEADS (CURLIES):** With phone plug, each end. 6ft 28p, 12ft 48p. With phone plug/phone socket other end 6ft. 29p, 12ft 50p (6p lead any type). **VIBRATORS:** 12v/4 pin non-synch 121HD4, 2 1/2" ex. pins, 33p. SAME but 3 1/2" ex. pins, USA 161p. 12v/7 pin synch. (12387) 2 1/2" ex. pins, 72p (9p any type). **MAINS NEONS:** by leads 11p. **NEON SCREWDRIVER** (pocket tester) 191p (7p either). **MAINS BATTERY ELIMINATOR.** Input 240v-AC. Output 3, 4f, 6, 7 1/2, 9 and 12 volt D.C. by switch selector. On/off switch, pilot lamp, leads, plug to suit most cassette recorders. £4.13 (27p). Highly suitable for all transistor receivers.

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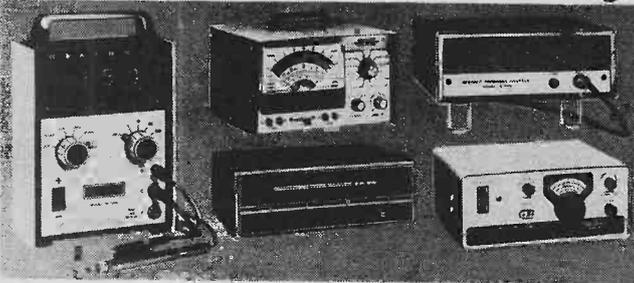
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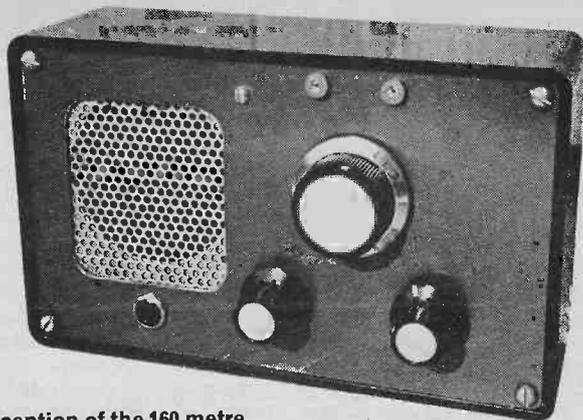
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Simple Medium Wave Receiver

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This receiver gives full medium wave coverage as well as reception of the 160 metre amateur band. Reception of Radio 2 on long waves can be added if required.

THE t.r.f. type of receiver is much easier to construct than a superhet as there are no aerial, oscillator or i.f. circuits to align. By using regeneration, a t.r.f. can have useful sensitivity and selectivity and provide adequate reception of a large number of stations.

The receiver described here covers the usual medium wave band of about 500kHz to 1.6MHz and in addition has a high frequency bandsread range covering 1.5MHz to 2.15MHz. This includes those transmissions at the h.f. end of the MW range and the 1.8MHz to 2.0MHz band, so the receiver will give reception of 160 metre amateurs, as well as shipping and other signals. There is provision for adding an external aerial if wanted and for using headphones.

RECEIVER CIRCUIT

SW1 (see Fig. 1), is a 3-pole 3-way switch, one position giving "Off." L1 is the ferrite rod winding

which is tuned by VC1a and VC1b which are in parallel for MW reception. For the higher frequency range, SW1 disconnects VC1a and C1 is in series with VC1b, resulting in a coverage of about 1.5MHz to 2.15MHz with the full swing of VC1b.

VC1 is a readily available ganged capacitor. It is possible to obtain h.f. bandsread by using a 365pF or similar capacitor in the VC1b position, VC1a being omitted and C1 being 30pF, but this has the disadvantage that most of the frequency coverage is then compressed into a quite small part of the rotation of VC1b, giving cramped tuning at the h.f. end of this band. This arises from the tuning "law" achieved with fixed and variable capacitors in series, and a much more even spread of frequencies across the dial is obtained by having a small value for VC1b.

L2 is the base coupling winding, and L3 is for an external aerial, when used. A to F are pins on the circuit board for leads to other items. Tr1 acts as r.f. amplifier. TC1 is a pre-set adjusted for suitable feedback to L1, and the potentiometer VR1 controls

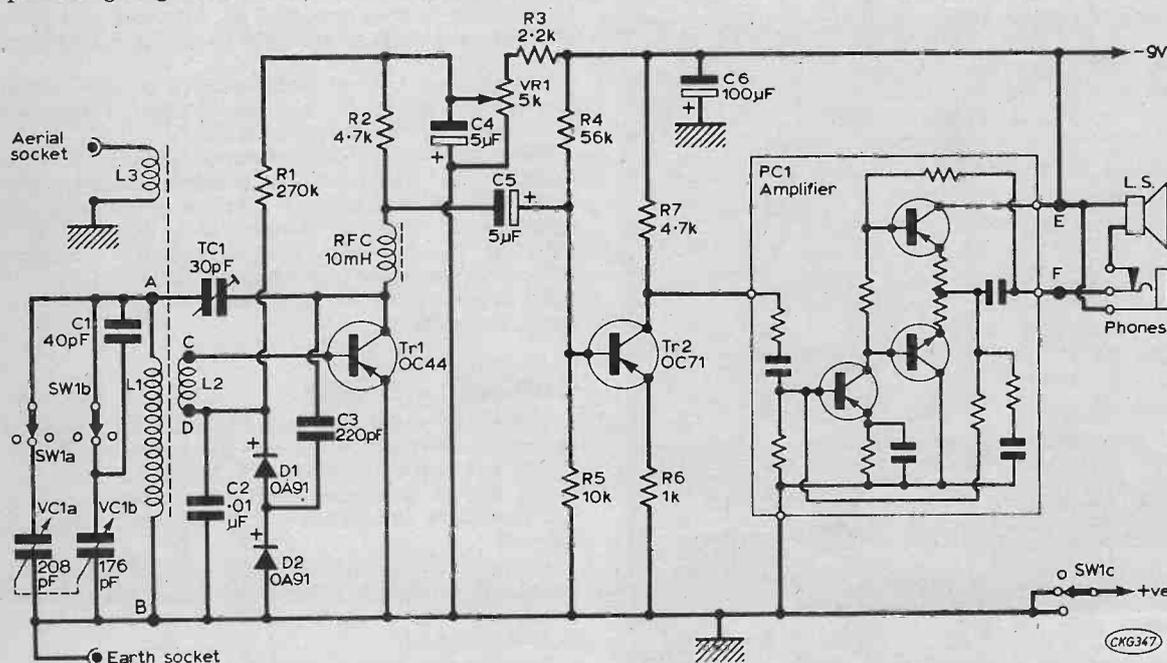


Fig. 1: The circuit of the receiver. Tr1 acts as both an r.f. and a.f. reflexed stage, Tr2 as an audio pre-amplifier and the three transistors in the PC1 package as the audio output stage.

regeneration. Demodulation is by diodes D1 and D2 and audio signals pass through L2 to Tr1, which is a reflexed amplifier with a.f. output developed across R2 and thus reaching the base of Tr2.

Tr2 is followed by the PC1 package. This is a 3-transistor medium gain amplifier of the directly coupled transformerless complementary symmetry type. The NPN-PNP output pair provide about 125mW for a 40Ω or similar speaker. Results are also satisfactory with a 30Ω to 80Ω speaker and the output can instead be taken to phones. Inserting the phone plug disconnects the speaker. The use of this amplifier considerably simplifies construction. It has only four external connections—positive line, negative line, audio input, and output to the speaker.

The whole receiver with speaker is constructed entirely on a panel and perforated board, for easy testing out of its case.

FERRITE AERIAL

Wind a strip of paper 1½in wide on the rod, and secure with a little adhesive, leaving the tube free to slide on the rod. Beginning at the SW1 end, Fig. 2, wind 65 turns of 26s.w.g. enamelled wire side by side for L1, finishing at the chassis end. The ends can be fixed with adhesive or tape. The whole winding should not be painted with adhesive, and turns should not be so tight that the tube and winding cannot be moved on the rod.

A very small space (say ¼in.) is left and L2 is wound in the same direction, beginning with the end to go to pin D. L2 has 6 turns of 34s.w.g. enamelled wire. L3 is similarly wound on a strip of paper about ¾in. long and has 25 turns of 34s.w.g. wire.

The rod is mounted on a strip of paxolin 1¾in. x ¾in. which is secured to the panel by a small bracket. A strip of card or other material passes

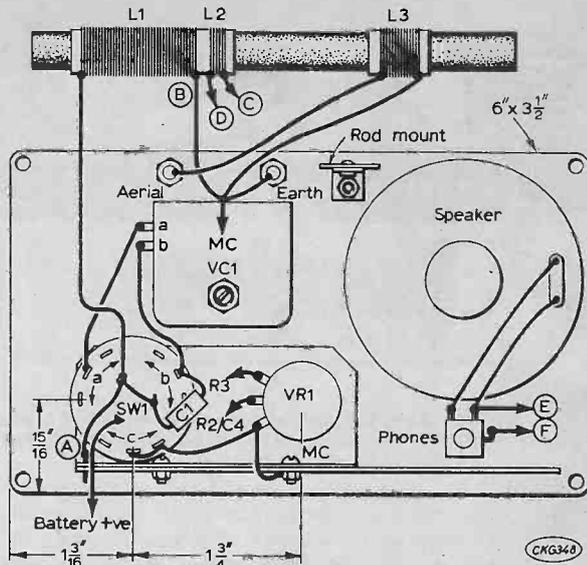


Fig. 2: The component wiring on the reverse of the front panel, together with details of the coil connections.

round the rod and is clamped with a 6BA bolt also through the paxolin.

PANEL

This is 6in. x 3½in. for the case listed, but could be changed to suit a plastic lunch box or other case. Holes are drilled to locate the switch and VR1 as in Fig. 2.

A round hole may be cut to match the speaker cone, and the speaker can be placed behind gauze or other suitable fabric or perforated metal. If a rectangular hole is made, this can be about 2½in. x 1⅞in. Gauze is then cemented on, followed by a piece of stout card with an aperture to match the speaker cone.

The speaker is fixed with adhesive or with screws through fixing lugs if these are present. The phone jack is immediately below, as in Fig. 2.

VC1 requires a ½in. clearance hole, and three holes for 4BA bolts. Drilling positions can be accurately marked by passing a piece of paper over the spindle, and piercing through this, using it as a template. The 4BA bolts must only project the thickness of the capacitor frame behind the panel.

L3 is connected to small sockets for aerial and earth, as in Fig. 2.

CIRCUIT BOARD

A piece of aluminium about 3in. x 1½in. is drilled to match the panel holes for the switch and VR1, Fig. 2, and has a flange which is bolted to the circuit board, Fig. 3. The completed board is thus held by the bushes of the switch and VR1, when wiring is finished.

Figure 3 shows both the top and bottom of the board. A Veropin is inserted at A, for the connection to SW1. Pin B is the earth return for the tuning capacitor and L1.

Pin C is for lead C from L2, and for Tr1 base, Fig. 3. Pin D is the other end of L2.

Pins E and F are connected to the speaker, one

★ components list

Resistors

R1 270kΩ—see text	R5 10kΩ
R2 4.7kΩ.	R6 1kΩ
R3 2.2kΩ	R7 4.7kΩ
R4 56kΩ	All ½w 10%
VR1 small 5kΩ log pot.	

Capacitors

C1 40pF silver mica
C2 0.01μF
C3 220pF
C4 5μF 10V min
C5 5μF 10V min
C6 100μF 12V
VC1 209/176pF, Jackson 00
TC1 30pF miniature trimmer

Miscellaneous

L1/L2/L3 see text. 5 x ½in. ferrite rod.
Tr1 OC44
Tr2 OC71
PC1 Newmarket package amplifier.
2in. or 2½in. speaker, about 30-60Ω
RFC 10mH miniature cored choke.
D1 OA91
D2 OA91
3-pole 3-way small rotary switch.
Veroboard, pins, etc.
6 x 3½ x 2in. case.
Knobs, two small sockets, jack socket (switched).

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Uses differential comparator I.C. with thermistor as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack 88.25.

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For digital instruments, counters, timers, clocks, etc. Hi-vac. XN.3. Price £1.50 each.



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7.0076 copper cores, each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 22p per yard.

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No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	44p	44p							
2 poles	44p	77p	77p						
3 poles	44p	1.04	1.04						
4 poles	44p	1.32	1.32						
5 poles	44p	1.60	1.60						
6 poles	44p	1.87	1.87						
7 poles	77p	77p	77p	77p	1.04	1.32	1.32	2.16	2.16
8 poles	77p	77p	77p	77p	1.04	1.32	1.32	2.43	2.43
9 poles	77p	77p	77p	77p	1.04	1.32	1.32	2.70	2.70
10 poles	77p	77p	77p	77p	1.04	1.32	1.32	2.97	2.97
11 poles	77p	77p	77p	77p	1.04	1.32	1.32	3.24	3.24
12 poles	77p	77p	77p	77p	1.04	1.32	1.32	3.51	3.51

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(A 30 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special mip price. £1.65, p. & ins. 23p.

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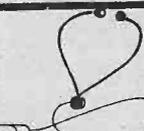
2,400ft of the Best Magnetic Tape money can buy. Some users claim good results with Video and sound. lin., 1/2in. or 1/4in. wide. £1.10 plus 30p. post. Spare spools and cassettes 55p. 1/2 Scotch tape. Brand new. Suits most video recorders. £3.30 for 2,400ft.



MULLARD UNILEX This D.I.Y. Stereo Amplifier is still available complete at £7.70 for the four Mullard Modules, or Modules can be bought separately as follows:—4 watt amplifier module (2 required) Mullard Ref. No. E.P.9000—£1.60 each. Pre amp module Mullard Ref. No. E.P.9001—£1.98 each. Power module—Mullard Ref. E.P.9002—£2.33 each. In addition and made to Mullard Specification we offer: Standard Control Unit with escutcheon—£2.75. Knobs—Set of 5—55p. Unit—£2.54 with Set of Knobs—83p. Mullard Unilex Handbook—29p.

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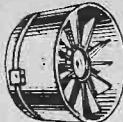
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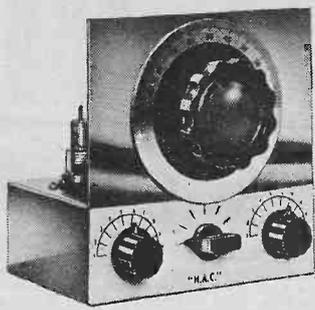


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Fane Pop 15 12" 15 watt 8/15 ohm	£4-40
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Fane Crescendo 12" 8 or 15 ohm	£24-20
Fane 8" d/cone 808T 8 or 15 ohm	£2-64
Fane 8" d/cone, roll surr. 807T 8 or 15 ohm	£3-16
Baker Group 25 3, 8 or 15 ohm	£6-00
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Output V. & Amps.	Ref. No.	Add 10% V.A.T. Price P. & P.					
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80 Volts. All tapped at 0-12-15-20-24-30V							
Output	Ref. No.	Price P.P.	put Ref. No. Price P.P.				
500 mA	MT 112 CT†	1-12	16p	3A	MT 20 AT	2-64	32p
1A	MT 79 AT†	1-55	29p	4A	MT 21 AT	3-10	40p
2A	MT 3 AT	2-23	30p	5A	MT 51 AT	4-81	42p
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500 mA	MT 102 AT†	1-45	24p	3A	MT 105 AT	3-91	41p
1A	MT 103 AT†	2-00	32p	4A	MT 106 AT	5-08	41p
2A	MT 104 AT†	3-10	32p	6A	MT 107 AT	7-47	60p
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1A	MT 126 AT	2-24	32p	3A	MT 125 AT	4-59	41p

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0-20 x 2	300 x 2	MT 214 CT**	£1-21 16p
0-8-9 x 2	500 mA x 2	MT 207 CT**	£1-48 19p
0-15-20 x 2	500 mA x 2	MT 205 AT**	£2-12 29p
0-15-27 x 2	500 mA x 2	MT 203 AT**	£2-45 29p
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20-12-0-12-20	700 mA (d.c.)	MT 221 AT**	£1-11 26p

AT indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. splices; * with interwinding screen; † untapped 240V Primary; ‡ Primary tapped at 210-240V. other Primaries tapped at 200-220-240V.
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General purpose double beam scope for use on 200/250 mains, band width 100 Kc to 4.5 Mc/s depending on gain settings, time markers, int ext sync., etc. Note these are supplied with C.F. probe, mains lead, front cover, circuit, but are less graticule and test leads. Supplied in used condition but tested prior to dispatch.
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Price £1-54 plus 25p post.

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Circular scale type, scaled 0 to 200 linear for approx. 135 deg. could be used up to 180 deg. if required. Ex equip. Tested, American surplus.
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The above prices include V.A.T. charges. Carriage charges apply to U.K. mainland only. Send S.A.E. for list No. 8.

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Phone 0742 444278

circuit running through the jack contacts, Fig. 1, so that the speaker is not in circuit when a plug is inserted. Pin E is also the battery negative line.

Fit the resistors and other items as in Fig. 3, positioning the leads approximately as shown on the underside of the board. In most places the wire ends are long enough to reach the connecting points. Sleeving is put on wires which may touch other wires or joints.

The transistors can have about $\frac{3}{8}$ in. of lead above the board. Lengthy heating of the transistor and diode wires should be avoided when soldering. The diodes and polarised capacitors must be put in as shown.

AF AMPLIFIER

Drill fixing holes to match the holes in the amplifier board. Solder four leads to the four circuit connecting points on the board, and these leads will then come through the Veroboard as in Fig. 3. They are taken to the positive line, pin E (negative line), pin F (speaker) and Tr2 collector and R7. Place extra nuts or washers between the amplifier and Veroboard to act as spacers.

ASSEMBLY

The bushes of the switch and VR1 can now be put through the panel holes, so that the nuts hold the board as in Fig. 2. Leads C and D (L2) and other connections are cut to length, sleeving is put on where necessary, and wiring is completed as shown.

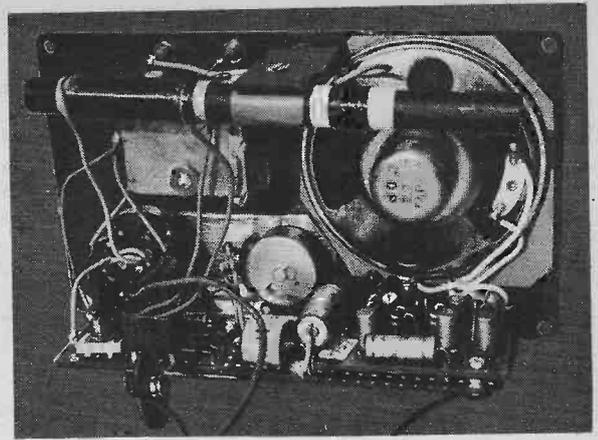
As miniature phone jacks are made in various types, check that connections here are correct. With no plug in, the circuit must run from pins E and F to the speaker. When a plug is inserted, this interrupts the circuit to the speaker and the jack tip is in contact with circuit F so that the phones operate instead. The amplifier ought not to be operated with a load of under 30Ω .

ADJUSTMENTS

If necessary, band coverage can be modified by moving L1/L2 along the rod. Moving it towards the end of the rod increases the frequency reached with VC1 fully open. This frequency limit can be around 1600 to 1500kHz for MW and 2.2MHz to 2.0MHz for the hf. range.

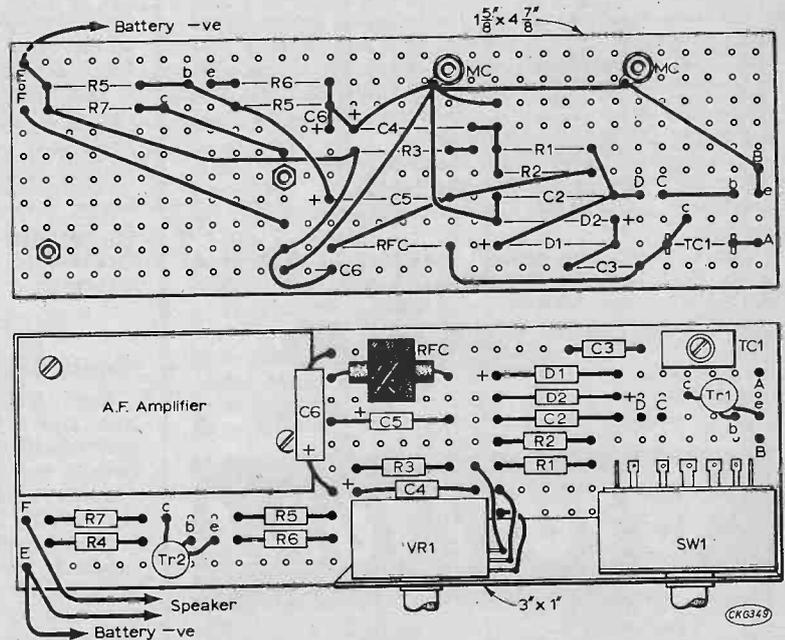
TC1 should only require to be screwed down slightly, so that oscillation can just be secured with VR1 at the l.f. end of the MW band.

VR1 does control volume, but is not a volume control, and merely turning it to maximum is unsatisfactory. Instead, it should be advanced slowly from minimum setting until oscillation just arises when



A rear view of the prototype.

Fig. 3: The component layout on the circuit board; the top section shows the underside wiring.



tuning through a transmission. It is then backed off very slightly. The setting of VR1 is quite critical for maximum possible sensitivity, and varies with frequency. With optimum adjustment, very many signals can be received.

R1 should be satisfactory at $270k\Omega$, but as diodes D1 and D2, and Tr1 will vary, the effect of changing R1 may be tried. A value from about $150k\Omega$ to $330k\Omega$ should be satisfactory, and it may be found that some change improves results.

Headphones become useful when listening for weaker signals in the 1.8MHz to 2MHz range, though more powerful signals can be reasonably audible with the speaker.

Reception of amateur and shipping signals will

be greatly improved by an aerial. Also, adding an earth connection can bring about a very useful improvement in signal strength. Even an indoor wire only a few feet long will increase signal pick-up, especially when an earth is available. An outdoor aerial will naturally give more volume, but a very long aerial will tend to result in strong, local signals breaking through. This can be prevented to some extent by placing a small capacitor in series with the aerial lead to the receiver. In all cases the receiver is kept on the point of oscillation for maximum sensitivity and selectivity. For the reception of a.m. signals, oscillation is just avoided. To receive c.w., regeneration has to be advanced so that oscillation begins.

LONG WAVES

If reception of the BBC on 200kHz is required, the simplest method is to shunt L1 with a silver-mica capacitor which will load it to this frequency. In the original receiver, a value of 2000pF, 1 per cent tolerance, was found suitable, and coverage was then about 195kHz to 205kHz with the full swing of VC1 in use. This method is used in some inexpensive receivers. With so much parallel capacitance, very small changes in the inductance of L1 have a considerable influence on frequency. It is thus necessary to slide L1 on the rod, or to make up the parallel capacitance with a pre-set, such as a 1500pF padder with a 1000pF silver mica capacitor in parallel. The padder is then adjusted for 200kHz with VC1 half open, and the latter then allows a narrow band to be covered for correct tuning.

An improved LC ratio is obtained with a LW winding, but this introduces the need for additional switching for L2, for the full advantage to be obtained.

With the 3-way switch, substituting VR1 by a potentiometer with on/off switch allows the third position to give reception of 1500m. Alternatively, a 4-way switch could be fitted here.

The 208/176pF capacitor is produced both with and without an integral reduction drive. The latter is helpful when tuning; if no drive is used the tuning control knob should be of fairly large diameter. ■



Supplement—May 1973

Tape Tuner

The 2 μ F capacitor between R5 and chassis is C4 (Fig. 1). Pin 6 on T1-3 is in this case marked as pin 5 (Fig. 2).

Baby Alarm

T1 has an unused centre tap on the winding connected to Tr3.
C4+ is connected to R5, Tr4e, C3+.

Light Powered Radio

In the components list, R1 should be 270k Ω , C1—0.01 μ F.

In the text, the mercury cell should be a solar cell and the connections are for transistor AF117. In Fig. 2, Tr1 base should be connected to R1 and C1.

P.W. TRICOLOUR—continued from page 156

The output voltage from the single phase bridge is clipped by a zener diode D1. The shaded part of the sinewave represents the voltage applied to the u.j.t. circuit. The emitter voltage of the u.j.t. drops to zero each time the line voltage crosses zero, so that capacitor C1 is discharged completely to zero every half cycle and charges again at the beginning of a next half cycle at the rate determined by the values of (R1 + VR1) and itself. By varying the resistance of the potentiometer VR1, the charge rate is varied so that the position of the pulses with respect to the supply voltage moves in time.

Fig. 27 shows typical triac gate voltage pulses and the corresponding voltage waveform across the load.

Lamp Dimming Circuit

The circuit shown in Fig. 24 is basically similar to that of Fig. 12 (part 1). Both the power supply of ± 10 V for the filter circuit and the mode of controlling the lamps are as before. In fact the only basic differences are the addition of the zener diode D11 and the replacement of the zero voltage switching system by the unijunction transistor circuit. (Filter choke CH1 and capacitor C13 have been added at the input to the circuit for radio frequency interference suppression.)

The unit is suitable for either mono or stereo record playing in the same manner as described earlier. The flashing of the light can be controlled at various light intensity levels by means of the potentiometers corresponding to Bass, Middle and Treble frequencies. Facilities are also provided for 'by passing' the psychedelic control by closing switches S1, S2 and S3 to allow the lamps to be used as ordinary lamp dimmers.

Radio Interference Suppression

Radio frequency interference problems caused by triac and thyristors phase control can become acute and difficult to suppress to an acceptable level. Many circuits and equipment such as radios, hi-fi amplifiers, etc. are sensitive to these voltage transients and the results are generally unpleasant noises in the speakers and/or causing malfunction of the semiconductor circuits. Each time a triac or thyristor fires in a mainly resistive load, such as lamps, the load current rises in less than a few microseconds from the zero value to its maximum. A frequency analysis of such a step function of current will show an infinite spectrum of energy with the amplitude inversely proportional to frequency. The greatest effect of radio frequency interference is of course, at the peak current, i.e. when the delay angle ' α ' is 90°, and this effect decreases towards '0°' or 180°.

There are two main types of radio frequency interference. One is caused by radiation and the other by conduction through the power leads.

We stated in the April issue that the author had arranged with Henry's Radio Ltd for the supply of all components. We now understand that the printed circuit board and metalwork as shown in the May 1973 issue will not be available from them.

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SN7403	0-20	0-18	0-18	SN7454	0-20	0-18	0-18	SN74153	1-35	2-17	2-20
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SN7408	0-20	0-18	0-18	SN7474	0-40	0-37	0-35	SN74160	2-60	2-40	2-25
SN7409	0-45	0-42	0-35	SN7475	0-45	0-42	0-38	SN74162	3-40	3-25	2-70
SN7410	0-20	0-18	0-18	SN7476	0-45	0-42	0-38	SN74163	3-40	3-25	2-70
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SN7412	0-42	0-40	0-35	SN7481	1-25	1-15	1-10	SN74166	4-00	3-50	3-00
SN7413	0-30	0-27	0-25	SN7482	0-87	0-80	0-70	SN74167	6-25	5-60	5-10
SN7416	0-80	0-77	0-75	SN7483	1-00	0-90	0-85	SN74170	4-10	3-55	3-10
SN7417	0-30	0-27	0-25	SN7484	0-90	0-85	0-80	SN74172	2-00	1-75	1-30
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2N705	0.16	2N3711	0.95	40318	0.50	BC114	0.12	BCZ11	0.60	BFY43	0.62
2N706A	0.12	2N3712	0.95	40318	0.92	BC116	0.15	BD115	0.75	BFY60	0.18
2N708	0.13	2N3713	1.08	40322	0.92	BC116	0.15	BD115	0.78	BFY61	0.18
2N709	0.88	2N3714	1.15	40380	0.46	BC118A	0.18	BD131	0.78	BFY62	0.18
2N711	0.80	2N3715	1.23	40381	0.48	BC118	0.21	BD133	0.82	BFY63	0.18
2N718	0.21	2N3716	1.80	40382	0.88	BC118	0.11	BD124	0.87	BFY66	0.34
2N718A	0.30	2N3717	0.10	40402	0.88	BC119	0.28	BD132	0.80	BFY76	0.22
2N720	0.55	2N3774	3.33	40389	0.46	BC121	0.28	BD132	0.80	BFY76	0.22
2N721	0.55	2N3775	4.19	40394	0.58	BC123	0.29	BD132	0.80	BFY76	0.22
2N724	0.22	2N3776	5.95	40395	0.50	BC125	0.16	BD135	0.48	BFY77	0.24
2N726	0.17	2N3777	4.84	40406	0.44	BC126	0.20	BD135	0.49	BFY76	0.34
2N728	0.30	2N3778	2.25	40407	0.53	BC128	0.20	BD137	0.55	BFY90	0.40
2N729	0.15	2N3779	4.55	40408	0.45	BC134	0.11	BD138	0.63	BFY39	0.20
2N730	0.15	2N3780	4.50	40409	0.52	BC136	0.11	BD139	0.71	BDX19	0.13
2N730A	0.14	2N3781	3.87	40410	0.53	BC136	0.15	BD140	0.83	BDX20	0.14
2N1090	0.23	2N3782	3.27	40411	2.25	BC137	0.16	BDY10	1.88	BDX21	0.20
2N1091	0.24	2N3780	1.76	40414	3.65	BC138	0.60	BDY11	1.50	BDX26	0.34
2N1131	0.20	2N3790	2.20	40435	1.44	BC141	0.89	BDY17	1.50	BDX27	0.34
2N1132	0.20	2N3791	2.20	40435	1.44	BC141	0.89	BDY17	1.50	BDX27	0.34
2N1132A	0.16	2N3792	2.20	40465A	0.44	BC142	0.24	BDY19	1.97	BDX29	0.47
2N1303	0.16	2N3794	0.10	40500	0.69	BC143	0.21	BDY20	0.98	BDX30	0.68
2N1304	0.20	2N3819	0.37	40601	0.87	BC144	0.24	BDY28	0.85	BDX39	0.78
2N1305	0.20	2N3820	0.47	40602	0.46	BC145	0.21	BDY60	0.90	BDX61	0.42
2N1306	0.22	2N3823	0.62	40603	0.58	BC146	0.10	BDY62	0.75	BDX76	0.15
2N1307	0.22	2N3824	0.75	40604	0.58	BC146	0.10	BDY62	0.75	BDX76	0.15
2N1308	0.25	2N3826	0.98	40685	1.10	BC149	0.13	BF115	0.23	BDX77	0.20
2N1309	0.25	2N3854	0.16	40678	0.80	BC153	0.18	BF117	0.48	ABX78	0.25
2N1483	0.90	2N3856A	0.16	AC107	0.95	BC154	0.18	BF119	0.88	BSW70	0.28
2N1507	0.24	2N3855	0.16	AC118	0.16	BC157	0.14	BF121	0.27	BY24	0.20
2N1513	0.20	2N3855A	0.16	AC115	0.16	BC158	0.90	BF123	0.87	BY25	0.15
2N1581	0.35	2N3856	0.18	AC117	0.17	BC159	0.14	BF125	0.85	BY26	0.20
2N1587	0.80	2N3858A	0.18	AC117	0.13	BC180	0.97	BF127	0.87	BY27	0.15
2N1588	0.27	2N3858	0.18	AC126	0.95	BC162B	0.11	BF128	0.20	BY28	0.15
2N1701	1.10	2N3868A	0.16	AC127	0.25	BC163	0.13	BF163	0.29	BY38	0.15
2N1702	2.15	2N3869	0.16	AC128	0.25	BC188C	0.11	BF164	0.15	BY39	0.15
2N1711	0.17	2N3869A	0.16	AC141K	0.80	BC192B	0.13	BF166	0.15	BY38	0.15
2N1893	0.34	2N3890	0.16	AC189	0.25	BC98C	0.13	BF169	0.27	BY53	0.25
2N2102	0.20	2N3896	0.70	AC117	0.14	BC170	0.11	BF160	0.28	BY53	0.25
2N2147	0.70	2N3877	0.85	AC152V	0.17	BC171	0.13	BF161	0.35	BY54	0.30
2N2148	0.80	2N3877A	0.85	AC163	0.23	BC172	0.11	BF163	0.20	BY56	0.79
2N2193	0.40	2N3878	1.28	AC153K	0.25	BC182	0.10	BF166	0.35	BY56	0.15
2N2192A	0.40	2N3879	1.91	AC154	0.20	BC182L	0.12	BF167	0.16	BY57	0.40
2N2193	0.40	2N3900	0.20	AC176	0.18	BC183	0.09	BF173	0.25	BY79	0.40
2N2198A	0.48	2N3900A	0.21	AC178K	0.20	BC183L	0.09	BF177	0.25	BY790	0.45
2N2194	0.47	2N3901	0.23	AC178K	0.20	BC184	0.11	BF178	0.25	BY86A	0.09
2N2194A	0.40	2N3903	0.20	AC188K	0.20	BC184L	0.11	BF179	0.20	BU104	1.42
2N2196	0.37	2N3904	0.17	ACY17	0.25	BC186	0.25	BF180	0.88	BU105	2.25
2N2196A	0.18	2N3905	0.21	ACY18	0.15	BC187	0.25	BF181	0.11	BU111	0.53
2N2216A	0.80	2N3906	0.22	ACY19	0.20	BC204	0.10	BF182	0.30	D40N3	0.82
2N2219	0.37	2N4030	0.42	ACY20	0.10	BC205	0.10	BF183	0.40	GET11	0.45
2N2219A	0.37	2N4037	0.42	ACY21	0.18	BC206	0.11	BF184	0.17	GET113	0.20
2N2220	0.20	2N4058	0.16	ACY22	0.18	BC207	0.11	BF185	0.17	GET114	0.20
2N2221	0.20	2N4059	0.09	ACY28	0.18	BC208	0.09	BF184	0.15	GET115	0.60
2N2221A	0.33	2N3059	0.90	ACY30	0.42	BC209	0.11	BF185	0.15	GET119	0.35
2N2222	0.31	2N4080	0.11	ACY39	0.17	BC212K	0.10	BF197	0.15	GET120	0.25
2N2222A	0.31	2N4081	0.11	ACY40	0.17	BC212L	0.16	BF198	0.15	GET125	0.20
2N2369	0.39	2N4802	0.25	ACY44	0.81	BC214L	0.23	BF199	0.18	GET136	0.20
2N2369A	0.17	2N4303	0.32	AD136V	0.96	BC236	0.16	BF224J	0.14	GET138	0.20
2N2646	0.50	2N4913	0.80	AD140	0.50	BC238	0.09	BF225J	0.10	GET173	0.12
2N2647	1.20	2N4914	0.87	AD140	0.50	BC238	0.09	BF227	0.22	GET180	0.30
2N2711	0.12	2N4916	0.95	AD142	0.50	BC239	0.09	BF227	0.22	GET183	0.20
2N2712	0.12	2N4916	0.20	AD143	0.45	BC251	0.20	BF238	0.22	GET187	0.20
2N2713	0.17	2N4917	0.17	AD149V	0.66	BC252	0.13	BF244	0.18	GET187	0.20
2N2714	0.17	2N4918	0.50	AD149V	1.28	BC263	0.23	BF245	0.33	GET189	0.22
2N2904	0.18	2N4919	0.63	AD150	0.63	BC267	0.09	BF246	0.48	GET189	0.22
2N2904A	0.25	2N4920	0.60	AD161	0.37	BC259	0.17	BF254	0.14	TIP29A	0.48
2N2905	0.26	2N4921	0.50	AD162	0.37	BC259	0.17	BF254	0.14	TIP30A	0.59
2N2906A	0.23	2N4922	0.55	AD163	0.69	BC261	0.20	BF256	0.15	TIP30A	0.59
2N2906	0.18	2N4923	0.60	AD162	0.69	BC262	0.18	BF267	0.41	TIP31A	0.62
2N2906A	0.23	2N4926	0.90	ADZ11	1.00	BC263	0.23	BF268	0.48	TIP32A	0.74
2N2907	0.18	2N4927	1.00	ADZ12	1.75	BC300	0.42	BF269	0.23	TIP33A	1.01
2N2907A	0.25	2N4928	1.00	AF105	0.25	AF106	0.40	BC302	0.27	TIP34A	1.51
2N2923	0.12	2N4929	2.23	AF106	0.25	AF114	0.25	BC303	0.54	TIP35A	2.90
2N2924	0.12	2N4930	2.25	AF114	0.25	BC304	0.43	BF271	0.21	TIP36A	3.70
2N2925	0.10	2N4931	2.70	AF115	0.25	BC307A	0.10	BF272	0.23	TIP41A	0.79
2N2926	0.12	2N6172	0.08	AF116	0.25	BC307A	0.10	BF273	0.23	TIP42A	0.90
Green	0.10	2N6174	0.22	AF117	0.20	BC307A	0.10	BF273	0.23	TIP295S	0.68
Yellow	0.10	2N6175	0.28	AF118	0.50	BC307A	0.10	BF273	0.23	TIP305S	0.80
Orange	0.10	2N6176	0.32	AF118	0.50	BC307A	0.10	BF273	0.23		
2N3053	0.3	2N6195	0.43	AF124	0.24	BC308A	0.09	BF457	0.53		
2N3054	0.46	2N6191	0.96	AF126	0.19	BC308B	0.09	BF459	0.57		
2N3055	0.60	2N6192	1.24	AF127	0.80	BC309A	0.10	BF821	0.10		
2N3090	0.20	2N6193									

SEW PANEL METERS

CLEAR PLASTIC PANEL METERS

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

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

Type SW.100 100 x 80 mm.

50μA	\$3-80
50-0-50μA	\$3-80
100μA	\$3-80
100-0-100μA	\$3-70
500μA	\$3-60
1mA	\$3-40
20V. D.C.	\$3-40
50V. D.C.	\$3-40
300V. D.C.	\$3-40
1 amp. D.C.	\$3-40



5 amp. D.C. \$3-40
300V. A.C. \$3-40
VU Meter \$4-15

Type SD.830 82.5mm x 110mm Fronts

10mA	\$2-50
50mA	\$2-50
100mA	\$2-50
500μA	\$2-50
1 amp.	\$2-50
5 amp.	\$2-50
10 amp.	\$2-50
5V. D.C.	\$2-50
10V. D.C.	\$2-50
20V. D.C.	\$2-50
50V. D.C.	\$2-50
200μA	\$2-30
500μA	\$2-35
1mA	\$2-30
5mA	\$2-50

500mA	\$2-35
500μA	\$2-35
1 amp.	\$2-35
5 amp.	\$2-35
10 amp.	\$2-35
5V. D.C.	\$2-35
10V. D.C.	\$2-35
20V. D.C.	\$2-35
50V. D.C.	\$2-35
300V. D.C.	\$2-35
15V. A.C.	\$2-75
300V. A.C.	\$2-75
VU Meter	\$3-00

Type SD.640 63.5mm x 85mm Fronts

50μA	\$2-80
50-0-50μA	\$2-55
100μA	\$2-55
100-0-100μA	\$2-55
200μA	\$2-55
500μA	\$2-35
1mA	\$2-35
5mA	\$2-35
10mA	\$2-35
50mA	\$2-35
100mA	\$2-35

500mA	\$2-35
500μA	\$2-35
1 amp.	\$2-35
5 amp.	\$2-35
10 amp.	\$2-35
5V. D.C.	\$2-35
20V. D.C.	\$2-35
50V. D.C.	\$2-35
300V. D.C.	\$2-35
15V. A.C.	\$2-40
300V. A.C.	\$2-40
VU Meter	\$2-70

Type SD.460 46mm x 59.5mm Fronts

50μA	\$2-40
50-0-50μA	\$2-35
100μA	\$2-35
100-0-100μA	\$2-35
200μA	\$2-35
500μA	\$2-35
1mA	\$2-35
5mA	\$2-35
10mA	\$2-35
50mA	\$2-35
100mA	\$2-35
500mA	\$2-35

1 amp.	\$2-35
5 amp.	\$2-35
10 amp.	\$2-35
5V. D.C.	\$2-35
10V. D.C.	\$2-35
20V. D.C.	\$2-35
50V. D.C.	\$2-35
300V. D.C.	\$2-35
15V. A.C.	\$2-30
300V. A.C.	\$2-30
VU Meter	\$2-55

***MOVING IRON—**
ALL OTHERS MOVING COIL
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Type MR.85P. 4 1/4in. x 4 1/2in. fronts

50mA	\$3-10
100mA	\$3-10
500μA	\$3-10
1 amp.	\$3-10
5 amp.	\$3-10
15 amp.	\$3-10
30 amp.	\$3-20
20V. D.C.	\$3-10
50V. D.C.	\$3-10
150V. D.C.	\$3-10
300V. D.C.	\$3-10
15V. A.C.	\$3-10
300V. A.C.	\$3-10
8 Meter 1mA	\$3-15
VU Meter	\$3-95
1 amp. A.C.*	\$3-10
5 amp. A.C.*	\$3-10
10 amp. A.C.*	\$3-10
20 amp. A.C.*	\$3-10
30 amp. A.C.*	\$3-10

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

50μA	\$3-40
50-0-50μA	\$2-85
100μA	\$2-85
100-0-100μA	\$2-75
500μA	\$2-65
1mA	\$2-20
5mA	\$2-20
10mA	\$2-20
50mA	\$2-20
100mA	\$2-20
500μA	\$2-20
1 amp.	\$2-20
5 amp.	\$2-20
10 amp.	\$2-20
5V. D.C.	\$2-20
10V. D.C.	\$2-20
20V. D.C.	\$2-20
50V. D.C.	\$2-20
300V. D.C.	\$2-20
15V. A.C.	\$2-80
300V. A.C.	\$2-80
8 Meter 1mA	\$2-80
VU Meter	\$3-50
1 amp. A.C.*	\$2-20
5 amp. A.C.*	\$2-20
10 amp. A.C.*	\$2-20
20 amp. A.C.*	\$2-20
30 amp. A.C.*	\$2-20

Type MR.65P. 3 1/2in. x 3 1/2in. fronts

50μA	\$3-70
50-0-50μA	\$2-90
100μA	\$2-90
100-0-100μA	\$2-80
200μA	\$2-90
500μA	\$2-65
600-0-500μA	\$2-40
1mA	\$2-40
5mA	\$2-40
10mA	\$2-40
50mA	\$2-40
100mA	\$2-40
500μA	\$2-40
1 amp.	\$2-40
5 amp.	\$2-40
10 amp.	\$2-40
20 amp.	\$2-40
30 amp.	\$2-40
50 amp.	\$2-75
5V. D.C.	\$2-40
10V. D.C.	\$2-40
20V. D.C.	\$2-40
50V. D.C.	\$2-40
150V. D.C.	\$2-40
300V. D.C.	\$2-40
15V. A.C.	\$2-55
300V. A.C.	\$2-55
8 Meter 1mA	\$2-55
VU Meter	\$3-70
50mA A.C.*	\$2-40
100mA A.C.*	\$2-40
500mA A.C.*	\$2-40
1 amp. A.C.*	\$2-40
5 amp. A.C.*	\$2-40
10 amp. A.C.*	\$2-40
20 amp. A.C.*	\$2-40
30 amp. A.C.*	\$2-40

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

Type MR.38P. 1 21/32in. square fronts

200mA	\$1-75
300mA	\$1-75
500mA	\$1-75
750mA	\$1-75
1 amp.	\$1-75
2 amp.	\$1-75
5 amp.	\$1-75
10 amp.	\$1-75
3V. D.C.	\$1-75
10V. D.C.	\$1-75
15V. D.C.	\$1-75
20V. D.C.	\$1-75
50V. D.C.	\$1-75
100V. D.C.	\$1-75
150V. D.C.	\$1-75
300V. D.C.	\$1-75
100-0-100μA	\$1-95
200μA	\$1-95
500μA	\$1-95
500-0-500μA	\$1-75
1mA	\$1-75
1-0-1mA	\$1-75
2mA	\$1-75
5mA	\$1-75
10mA	\$1-75
20mA	\$1-75
50mA	\$1-75
100mA	\$1-75
150mA	\$1-75

Type MR.45P. 2in. square fronts

50μA	\$2-50
50-0-50μA	\$2-30
100μA	\$2-30
100-0-100μA	\$2-05
200μA	\$1-95
500μA	\$1-85
500-0-500μA	\$1-85
1mA	\$1-85
5mA	\$1-85
10mA	\$1-85
50mA	\$1-85
100mA	\$1-85
150mA	\$1-85

5 amp.	\$1-85
10V. D.C.	\$1-85
20V. D.C.	\$1-85
50V. D.C.	\$1-85
300V. D.C.	\$1-85
15V. A.C.	\$2-00
300V. A.C.	\$2-00
8 Meter 1mA	\$2-00
VU Meter	\$2-50
1 amp. A.C.*	\$1-85
5 amp. A.C.*	\$1-85
10 amp. A.C.*	\$1-85
20 amp. A.C.*	\$1-85
30 amp. A.C.*	\$1-85



"SEW" EDGWISE METERS

Type PE.70. 3 17/32in. x 1 15/32in. x 2 1/2in. deep

50μA	\$3-40
50-0-50μA	\$2-80
100μA	\$2-80
100-0-100μA	\$2-20
200μA	\$2-20
500μA	\$2-20
1 amp.	\$2-20
5 amp.	\$2-20
10 amp.	\$2-20
20 amp.	\$2-20
30 amp.	\$2-20
50 amp.	\$2-75
5V. D.C.	\$2-40
10V. D.C.	\$2-40
20V. D.C.	\$2-40
50V. D.C.	\$2-40
150V. D.C.	\$2-40
300V. D.C.	\$2-40
15V. A.C.	\$2-55
300V. A.C.	\$2-55
8 Meter 1mA	\$2-55
VU Meter	\$3-70
50mA A.C.*	\$2-40
100mA A.C.*	\$2-40
500mA A.C.*	\$2-40
1 amp. A.C.*	\$2-40
5 amp. A.C.*	\$2-40
10 amp. A.C.*	\$2-40
20 amp. A.C.*	\$2-40
30 amp. A.C.*	\$2-40

"SEW" BAKELITE PANEL METERS

Type MR.65. 3 1/2in. square fronts

1 amp.	\$2-15
5 amp.	\$2-15
15 amp.	\$2-15
30 amp.	\$2-15
50 amp.	\$2-15
5V. D.C.	\$2-15
10V. D.C.	\$2-15
20V. D.C.	\$2-15
50V. D.C.	\$2-15
150V. D.C.	\$2-15
300V. D.C.	\$2-15
50mV. D.C.	\$2-40
100mV. D.C.	\$2-40
30V. A.C.*	\$2-20
50V. A.C.*	\$2-20
150V. A.C.*	\$2-20
300V. A.C.*	\$2-20
500mA A.C.*	\$2-15
1 amp. A.C.*	\$2-15
5 amp. A.C.*	\$2-15
10 amp. A.C.*	\$2-15
20 amp. A.C.*	\$2-15
30 amp. A.C.*	\$2-15
50 amp. A.C.*	\$2-15
VU Meter	\$3-40

Type S-80 80 mm. square fronts

50μA	\$3-50
50-0-50μA	\$2-40
100μA	\$2-40
100-0-100μA	\$2-30
200μA	\$2-30
500μA	\$2-30
1mA	\$2-30
5V. D.C.	\$2-35
10V. D.C.	\$2-35
20V. D.C.	\$2-35
50V. D.C.	\$2-35
300V. D.C.	\$2-35
15V. A.C.	\$2-85
300V. A.C.	\$2-85
8 Meter 1mA	\$2-85
VU Meter	\$3-70
1 amp. A.C.*	\$2-30
5 amp. A.C.*	\$2-30
10 amp. A.C.*	\$2-30
20 amp. A.C.*	\$2-30
30 amp. A.C.*	\$2-30

"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 meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

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

LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5v batteries. Complete with all instructions, etc. \$4.50. P. & P. 20p.

LB3 TRANSISTOR TESTER

Tests 100 and B. PNP / NPN. Operates from 9v battery. Complete with all instructions, etc. \$3.95. P. & P. 20p.

HOMER INTERCOMS

Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.

2 Station \$2.97, 3 Station \$5.25, P. & P. 15p.
4 Station \$8.02, P. & P. 17p.

SEND SAE FOR LIST OF SEMI CONDUCTORS & VALVES

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

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock. Single hole fixing, 3/16 in. dia. shafts. Bulk quantities available.

25 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. 80p. P. & P. 10p.
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. \$1.16 P. & P. 10p.
100 WATT. 15/10/25/50/100/250/500/1000 or 2500 ohms. \$1.65 P. & P. 15p.

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality - Low price - Immediate delivery

B-260 General Purpose Bench Mounting

1 Amp	\$7-00
2-5 Amp	\$8-05
5 Amp	\$11-75
8 Amp	\$15-90
10 Amp	\$22-50
12 Amp	\$23-50
20 Amp	\$49-00
25 Amp	\$58-00
40 Amp	\$82-50

B-260B Panel Mounting

1 Amp	\$7-00
2-5 Amp	\$8-05

Please add postage
ALL MODELS
INPUT 230 V 50/60 CYCLES
OUTPUT VARIABLE 0-260 VOLTS
Special discounts for quantity

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.

80 W	\$2-10	P. & P. 18p
150 W	\$2-70	P. & P. 18p
300 W	\$3-60	P. & P. 23p
500 W	\$4-55	P. & P. 38p
1000 W	\$7-50	P. & P. 38p
1500 W	\$10-20	P. & P. 43p
2250 W	\$17-25	P. & P. 50p
5000 W	\$35-00	P. & P. 41

MCA.220 AUTOMATIC VOLTAGE STABILISER

Input 88 125 VAC or 175 250VAC. Output 120V AC. or 240 VAC. 200 VA rating. \$11.97, carr. 50p.

230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of changeover contacts at 5 amp rating. 50p each. P. & P. 10p (100 lots \$40). Quantities available.

BH.001 HEAD SET AND BOOM MICROPHONE

Moving Coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. \$4.62. P. & P. 15p.

240° Wide Angle IMA Meters

MW 1-6 60mm square \$3.97
MW 1-8 80mm square \$4.97
P. & P. extra

RP214 REGULATED POWER SUPPLY

Solid state. Variable output 0-24V DC up to 1 amp. Dual scale meter to monitor voltage and current

Input 220/240V AC.	\$3-97
Size 185 x 85 x 105mm.	\$3-97

P. & P. 25p.

PS.200 REGULATED P.S.U.

Solid state. Variable output 5-20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V. A.C. Size 7 1/2" x 6 1/2" x 3 1/2". \$19.95. P. & P. 25p.

PS.1000B REGULATED POWER SUPPLY

Solid state. Output 8, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240V AC. Size 4" x 3 1/2" x 6 1/2". \$11.97. P. & P. 25p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS

Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RPH CW; 50p each Post 12p.

MULTIMETERS for EVERY purpose!

TS60 POCKET MULTIMETER
High precision at low cost. Ranges: D.C. 10V, 150V, 1,000V (0.0001 opv). A.C. 15V, 150V, 100V (1,000 opv). D.C. Current 180mA. Resistance 100k ohms. **#1-86. Post 15p.**



MODEL 1092 TESTMETER
5,000 O.P.V. 0/3/15/150/300/1200 V. D.C. 0/6/30/300/600 V. A.C. 0/300μA/300 MA. 0/10K/1 meg Ω. Decibels -10 to +16db. **\$2.75 each +15p P. & P.**



HIOKI MODEL 720X
20,000 O.P.V. Overload protection. 6/25/100/500/1000 V.D.C. 1/15/250/1000 V.A.C. 50μA/250mA. 20K/2 meg ohm. -5 to +62db. **\$4.97. P. & P. 15p.**



HIOKI MODEL 730X
30,000 O.P.V. Overload protection. 6/30/60/300/600/1200 V.D.C. 12/60/120/600/1200 V.A.C. 60μA/30 mA/300 mA. 2K/200K/2 megohm. -10 to +63db. **\$6.50. P. & P. 15p.**



KAMODEN 72.200 MULTITESTER
High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale. Ranges: 0 / .06 / .3 / 3 / 30 / 120 / 600 / 1200V. D.C. 0 / 3 / 12 / 60 / 300 / 1510. A.C. 0 / 6μA / 1.2mA / 120mA / 600mA / 12A. D.C. 0 / 12A. A.C. -20 to +63db. 0 / 2K / 200K / 2 meg / 2 meg ohms. **#18-95. Post 30p**



MODEL TE-200
20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50μA/250 mA. 0/60K/8 meg Ω. -20 to +62db. **\$8-95. P. & P. 15p.**



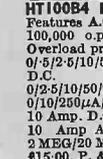
MODEL 500
30,000 O.P.V. with overload protection mirror scale. 0/5/2-5/10/25/100/250/500/1,000V. D.C. 0/2-5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg/60 Meg Ω. **#3-97. Post paid.**



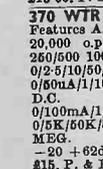
HIOKI MODEL 750X
50,000 o.p.v. 43 ranges 0-0.3 to 1,200V D.C. 0-3 to 1,200V A.C. 0-30μA/300mA. 0-3K/30 meg ohms. -10 to +17db. **\$8-97. Post 20p.**



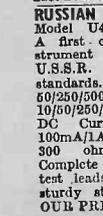
HT100B4 MULTI-METER
Features A.C. current ranges. 100,000 o.p.v. Mirror scale. Overload protection. 0/5/2-5/10/50/250/500/1000 V D.C. 0/2-5/10/50/250/1000 V. A.C. 0/10/250μA/2-5/25/250 MA/10 AMP. D.C. 10 Amp A.C. 0/20K/200K/2 MEG/20 MEG. 20 + 62db. **#15-00. P. & P. 25p.**



370 WTR MULTI-METER
Features A.C. current ranges. 20,000 o.p.v. 0/5/2-5/10/50/250/500/1000 V. D.C. 0/2-5/10/50/250/500/1000V A.C. 0/50μA/1/10/100mA/1/10 Amp D.C. 0/100mA/1/10 Amp AC 0/5K/50K/500K/5 MEG/50 MEG. -20 + 62db. **#15. P. & P. 25p.**



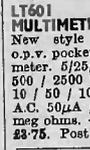
RUSSIAN 22 RANGE MULTIMETER
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2-5/10/50/250/500/1000V D.C. 2-5/10/50/250/500/1000V A.C. DC Current 100mA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. **OUR PRICE \$25-97. P. & P. 25p**



ROUND SCALE TYPE PENCIL TESTER MODEL T.S.68
Completely portable, simple to use pocket sized tester. Ranges: 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. **ONLY \$1-97 P. & P. 13p.**



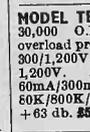
LT501 MULTIMETER
New style 20,000 o.p.v. pocket multi-meter. 6/25/50/250/500 / 2500 V. D.C. 10 / 60 / 100 / 500 / 1000V. A.C. 50μA / 250mA. 6K / 6 meg ohms. -20 to +22 db. **\$3-75. Post 20p.**



MODEL TH-12
20,000 o.p.v. Overload protection. Slide switch selector. 0 / 25 / 2-5 / 10 / 50 / 250 / 1000V. D.C. 0 / 10 / 50 / 250 / 1000V. A.C. 0 / 50μA / 25 / 250V. D.C. 0 / 3K / 30K / 300K / 3 meg -20 to +60db. **\$4-97. Post 15p.**



MODEL TE-300
30,000 O.P.V. Mirror scale, overload protection. 0/5/15/60/300/1,200V. D.C. 0/6/30/120/600/3000. A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/60K/800K/8 meg. ohm -20 to +63 db. **\$5-97. P. & P. 15p.**



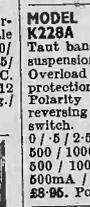
MODEL PL436
20k Ω/Volt D.C. 8k Ω/Volt A.C. Mirror scale. 6/8/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600μA/60/600 mA. 10/100K/1 Meg/10 Meg Ω. -20 to +46db. **\$6-97. P. & P. 15p.**



TMK MODEL TW-50K
46 ranges, mirror scale, 50K/Vol. D.C. 5K/Volt A.C. D.C.: Volts -125, -25, 1, 2.5, 5, 10, 25, 50, 125, 250, 500, 1000V. A.C. Volts: 1-5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2-5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: -20 to +81.5db. **\$8-50. P. & P. 17p.**



MODEL K228A
Tant band suspension. Overload protection. Polarity reversing switch. 30,000 o.p.v. 0 / 5 / 2-5 / 15 / 50 / 250 / 500 / 1000 / 2500V. D.C. 0 / 15 / 50 / 150 / 500 / 1000V. A.C. 0 / 60μA / 5 / 50 / 150 / 500mA / 5A. D.C. 0 / 3K / 300K / 3 meg. **\$8-95. Post 20p.**



HIKOE MODEL 700X
100,000 O.P.V. Overload protection. Mirror scale. 3/6/1-2/1-5/3/6/12/30/60/120/300/600/1200V DC 1-5/3/6/12/30/60/150/300/600/1200 V. A.C. 15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm -20 to +63db. **#13-50. P. & P. 20p.**



MODEL C-7080 EN
Giant 8" mirror scale. 20,000 o.p.v. 0 / 25 / 1 / 2-5 / 10 / 50 / 250 / 1000 / 5000V. D.C. 0 / 2-5 / 10 / 50 / 250 / 1000 / 5000V. A.C. 0/50μA/1/10/100/500mA/10 amp. D.C. 0 / 2K / 200K / 20 meg -20 to +50 db. **#13-95. Post 35p.**

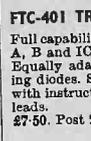


U4312 MULTIMETER
Extremely sturdy instrument for general electrical use. 687 o.p.v. 0/3/1-5/7-5/30/60/150/300/600/900 VDC and 75mV. 0/3/1-5/7-5/30/60/150/300/600/900 VAC. 0/300μA/1-5/6/15/60/150/600mA/1-5/8 AMP. D.C. 0/1-5/6/15/60/150/600mA/1-5/8 AMP. A.C. 0/200 Ω/3K/30K Ω. Accuracy DC 1%, AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **\$9-50 plus P. & P. 25p.**

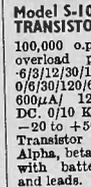


Selected TEST EQUIPMENT

FTC-401 TRANSISTOR TESTER
Full capabilities for measuring A, B and I/O. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. **\$7-50. Post 20p.**



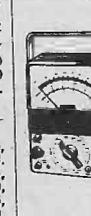
Model S-100TR MULTIMETER/TRANSISTOR TESTER
100,000 o.p.v. mirror scale/overload protection. 0/12/6/3/12/30/120/600 V DC. 0/6/30/120/600 V AC. 0/12/600μA / 12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. -20 to +50db. 0.01-2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. **#13-50. P/P 25p.**



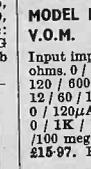
MODEL 449A IN CIRCUIT TRANSISTOR TESTER
Checks true A.C. beta in / out. Checks Icho. Checks diodes in / out. Checks SCR, etc. Beta HI 10 - 500. LO 2 - 50. Icho 0-5000μA. 220/240 V A.C. operation. **#17-50. Post 26p.**



KAMODEN HM. 720B F.E.T. V.O.M.
Input impedance 10 meg ohms. Ranges: 0 / .25 / 1 / 2-5 / 10 / 50 / 250 / 1000V. D.C. 0 / 2-5 / 10 / 50 / 250 / 1000V. A.C. 0 / 25μA / 2-5 / 25 / 250 MA D.C. -20 to +62db. 0 / 5K / 50K / 500K / 5meg / 500meg ohms. **#14-95. Post 30p**



MODEL L-55 FET V.O.M.
Input impedance 10 meg ohms 0 / 3 / 12 / 6 / 30 / 120 / 600V. D.C. 0 / 3 / 12 / 60 / 120 / 600V. A.C. 0 / 120μA / 120mA D.C. 0 / 1K / 100K / 10 meg / 100 meg ohms. **#15-97. Post 15p.**



CI-5 PULSE OSCILLOSCOPE
For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz 1V/RMS. Preset triggered sweep 1-3,000μsec.; free running 20-200,000Hz in nine ranges. Calibrator pps. 220 x 360 x 430mm. 115-230V. AC operation. **\$39-00. Carr. paid.**



TO-3 PORTABLE OSCILLOSCOPE
3in. tube, Y amp. Sensitivity 0.1v p-p/CM. Bandwidth 1-5 cps-15 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0.05v p-p/CM. Bandwidth 1.5cps-500KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 16lb. 220/240V. A.C. Supplied brand new with handbook. **\$47-50. Carr. 50p.**



RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE
5 m/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. x 4in. C.R.T. Calibrated triggered sweep from .2 usec. to 100 mill-sec. per cm. Free running time base 60 c/s-1 m/c/s. Built-in time base calibrator. Supplied complete with all accessories and instruction manual. **\$57. Carr. Paid.**



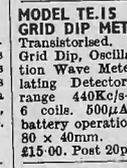
TE-16A TRANSISTORISED SIGNAL GENERATOR
5 ranges 400Hz-30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800KHz modulation. 5 1/2 x 5 1/2 x 3 1/2 in. Complete with instructions and leads. **\$7-97. Post 25p.**



TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω 11.1 meg Ω. G. Ranges ±1% L. 1 μF - 111 μF. HENRYS 6 Ranges 2-2% C.I.O.P. ±11000Pd. 6 Ranges ±2%. TURNS RATIO 1:1/1000-1:1/10. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7 1/4 x 5 x 2 1/2 in. **\$20. P. & P. 25p.**



MODEL TE.15 GRID DIP METER
Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440Kc/s-280Mc/s in 6 coils. 500μA Meter. Battery operation. Size 180 x 80 x 40mm. **#15-00. Post 20p.**



BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR
Sine 18 x 200,000 Hz; Square 18 x 200,000 Hz. Output max. +10 db. (10 K ohms) Operation internal batteries. Attractive 2-tone case 7 1/2 x 5 x 2 in. Price **#17-50. Carr. 17p.**



MODEL MG-100 SINE SQUARE WAVE AUDIO GENERATOR
Range 19-220,000Hz Sine Wave 19-100,000Hz Square Wave. Output Sine or Square wave 10V. P. to P. Size 180 x 90 x 80mm. Operation 220/240V. A.C. **#17-50. Post 37p.**



MODEL AT201 DECADE ATTENUATOR
Frequency range 0-200KHz. Attenuation 0-111db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 x 90 x 65mm. **#12-50. Post 37p.**



TE-65 VALVE VOLTMETER
2-8 ranges. D.C. volts 1.5-1,500V. A.C. volts 1.5-1,500V. Resistance up to 1,000 megohms. 200/240V. A.C. operation. Complete with probe and instructions. **#17-50. P. & P. 30p.** Additional probes available: R.F. \$2-12; H.V. \$2-50.



MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER
Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% AC. Scale length 165mm. 0/300/750μA/1-5/3/7-5/15/30/75/150/300/750mA/1-5/3/7-5/15/30/75/150/300/750V/1-5/3/7-5/15/30/75/150/300/750V DC 0/750mV/1-5/3/7-5/15/30/75/150/300/750V AC. Automatic cut out. Supplied complete with test leads, manual and test certificates. **\$49-00. Post 50p.**



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

KAMODEN HM.350 TRANSISTOR TESTER

High quality instrument to test Reverse Leak current and DC current. Amplification factor of NPN, PNP, transistors, diodes, SCR's etc. 4" x 4 1/2" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. £12-50. Post 30p.



UNR-30 RECEIVER

4 Bands covering 550Kc/s - 30Mc/s. B.F.O. Built-in Speaker 220/240v A.C. Brand new with instructions. £15-75. Carr. 37p.



KAMODEN HMG-500 INSULATION RESISTANCE TESTER

Range 0-1000 Meg-ohms, 500 Volt. Battery operated. Wide range clear meter 4 1/2" x 4". Complete with deluxe carrying case, batteries, instructions. £18-95. Post 30p.



UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550Kc/s-30Mc/s. FET 8 Meter. Variable BFO for 8SB. Built-in Speaker. Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12 1/2" x 4 1/2" x 7". Brand new with instructions. £25. Carr. 37p.



SKYWOOD CX203 COMMUNICATION RECEIVER

Solid state. Coverage on 5 bands 200-420 KHz and .45 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning BFO, AVC, ANL, '8' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 x 266 x 150 mm. Complete with instructions and circuit. £32-50. Carr. 50p.



ARF-300 AF/RF SIGNAL GENERATOR

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine / square 10v. P.P. RF 100 KHz to 200 MHz. Output 1v. maximum. Operation 220/240v. A.C. Complete with instructions and leads. £29-95. Post 50p.



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 fourth 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 2 13/16 in. x 8 3/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. £35-50. Carr. 50p.



LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 160-400Kc/s. 550 Kc/s-30Mc/s. FET front end. 2 inch. filters, product detector, variable B.F.O. noise limiter. 8. Meter, Bandspread, R.F. Gain. 16 1/2" x 9 1/2" x 8 1/2". 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. £50. Carr. 50p.



TRIO 9R59DS COMMUNICATION RECEIVER

4 band covering 550Kc/s. to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. 8SB-CW. ANL. Variable BFO. 8 meter. Sep. bandspread dial. 1F frequency 465 Kc/s. audio output 1.6v. Variable RF and AF gain controls 116/250v. A.C. Size: 7 1/2" x 5" x 10". with instruction manual. £49-50. Carr. Paid.



HA-10 STEREO HEADPHONE AMPLIFIER

All silicon transistor amplifier operates from magnetite, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5Mv/100mV. Output 50mV. £5-97. P. & P. 16p.



1021 STEREO LISTENING STATION

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain slide switch, stereo headphone sockets. 6" x 4" x 2 1/2". £2-25. P. & P. 16p.



MP7 MIXER PREAMPLIFIER

5 microphones inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/2" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono neg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. £8-97. P. & P. 20p.



HI-FI EQUIPMENT

SAVE UP TO 33 1/3% OR MORE

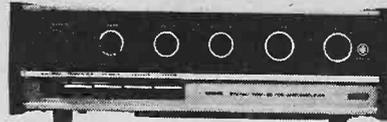
SEND S.A.E. FOR FULL DISCOUNT PRICE LISTS AND PACKAGE OFFERS!



FANTASTIC OFFER!

NIKKO TRM 50 STEREO AMPLIFIER

17 + 17 watts rms stereo amplifier with inputs for Magnetic and Crystal phono, Tuner, Tape, Aux and Tape Monitor. Outputs for two pairs of stereo speakers and Tape. Stereo headphone socket. Full range of controls including loudness control, scratch filter, etc. Size 13" x 9 1/4" x 3 1/2". Unrepeatable offer—limited stocks!



List price £59-50
OUR PRICE

£39-95

Carriage 60p

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20+20 watts rms. Magnetic, ceramic and tape inputs. FM 88-108 MHz. AM 535-1605 kHz. Dual stereo speaker outputs. Headphone socket. (Rec. List Price £117-46)

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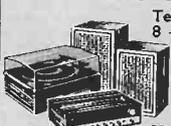
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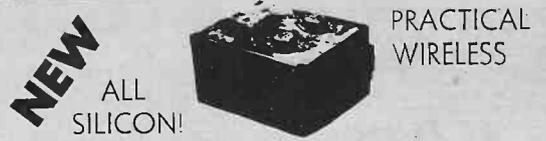
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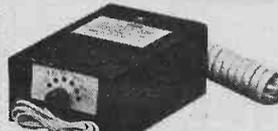
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Vertical or Horizontal
0.1 watt 5p 0.25 watt 7p
100 1KΩ 10KΩ 100KΩ 1MΩ
250 2.5KΩ 25KΩ 250KΩ 2.5MΩ
500 5KΩ 50KΩ 500KΩ 5MΩ

PRICES DO NOT INCLUDE V.A.T.

Capacitors

disc ceramic	low voltage	
0.1µF 18v 5p	0.1µF 30v 5p	
0.22µF 18v 5p	0.22µF 60v 5p	
0.47µF 12v 5p	0.47µF 3v 5p	
1000pf 10p	4700pf 10p	
2200pf 10p	10,000pf 10p	

Ceramic - plate	63V (C333)	
1-8pf	8-2pf	33p 120p
2-2pf	10pf	35p 150p
3-3pf	12pf	47p 180p
3-9pf	15pf	56p 220p
4-7pf	18pf	68p 270p
5-6pf	22pf	82p 330p
6-8pf	27pf	100pf
all 5p. each		

mylar film 100V
1000pf 2p -0.1µF 3p -0.68µF 4p
2000pf 2p -0.2µF 3p -1µF 4p
5000pf 2p -0.4µF 3p -2µF 4p
-0.5µF 3p

polystyrene 160V
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. 3p each

metallised polyester 250V (C280)
-0.1µF 3p -0.68µF 3p -47µF 8p
-0.15µF 3p -1µF 4p -68µF 11p
-0.22µF 3p -1.5µF 4p -1µF 13p
-0.33µF 3p -22µF 5p -1.5µF 20p
-0.47µF 3p -33µF 6 1/2p -2.2µF 24p

metallised polyester - 400V (C281)
-0.1µF 4 1/2p -0.47µF 6p -22µF 10p
-0.15µF 4 1/2p -0.68µF 6p -33µF 14p
-0.22µF 4 1/2p -1µF 7p -47µF 15p
-0.33µF 5 1/2p -1.5µF 8p

silvered mica 1% (>50pf) 500V
2-2pf-820pf 7p 4-7nF-5600pf 13p
1nF-2-2nF 9p 6800pf-0.1µF 22p
2-7nF-3-6nF 16p

mixed dielectric 1000V
1000pf 6p 6800pf 9p -1µF 12p
2200pf 6p 0.1µF 9p -22µF 22p
3300pf 6p -0.22µF 9p -47µF 30p
4700pf 6p -0.47µF 12p

Ceramic
12KV d.c. 8KV d.c. HI-K 750V.
10pf 9p 200pf 9p 1000pf 5p
15pf 9p 220pf 9p 1500pf 5p
22pf 9p 250pf 9p 2000pf 5p
68pf 9p 270pf 9p 3000pf 5p
320pf 9p 300pf 9p 5000pf 5p
1000pf 9p 750V DISC 10,000pf 5p
120pf 9p 470pf 5p feed-through
140pf 9p 1000pf 5p
150pf 9p 5000pf 5p
180pf 9p 10,000pf 5p 1000pf 5p

Mullard B Siemens Electrolytics

CAP µF	VOLTAGE					
	4	6.3	16	25	40	63
1.5	-	-	-	-	-	6p
2.2	-	-	-	-	-	6p
3.3	-	-	-	-	-	6p
4.7	-	-	-	-	-	6p
6.8	-	-	-	-	-	6p
10	-	-	-	-	-	6p
15	-	-	-	-	-	6p
22	-	-	6p	-	-	6p
33	-	-	6p	-	-	6p
47	6p	-	6p	-	-	6p
68	-	-	6p	-	-	6p
100	-	-	6p	-	-	6p
150	-	-	6p	-	-	6p
220	6p	-	6p	10p	12p	18p
330	6p	-	6p	10p	12p	21p
470	-	-	6p	10p	12p	40p
680	-	-	10p	-	12p	18p
1000	10p	-	12p	18p	21p	40p
1500	-	-	12p	18p	21p	40p
2200	-	-	18p	21p	40p	50p
3300	-	-	21p	-	-	-
4700	21p	-	-	60p	75p	80p

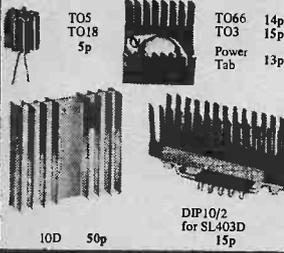
CAP µF	VOLTAGE			
	16	25	40	64
500	-	-	-	30p 40p
1250	-	-	-	50p
1600	-	-	-	75p
2000	-	-	40p	50p
2500	-	-	50p	75p 90p
3200	-	-	50p	75p 90p
4000	-	-	75p	90p
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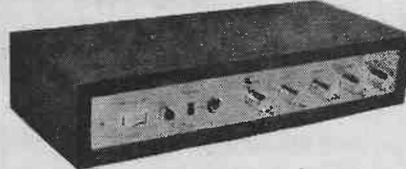


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2 1/2" x 3 1/2"	20p	16p (9)	10p
2 1/2" x 5"	24p	21p (7)	12p
3 1/2" x 3 1/2"	24p	21p (8)	-
3 1/2" x 5"	27p	27p (10)	17p
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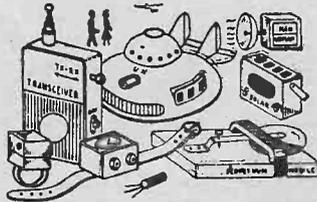
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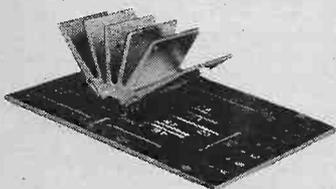


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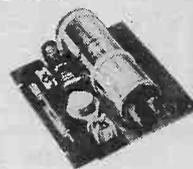
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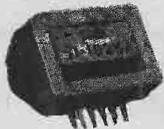
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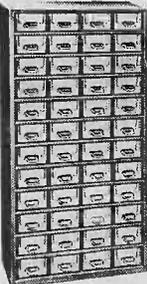
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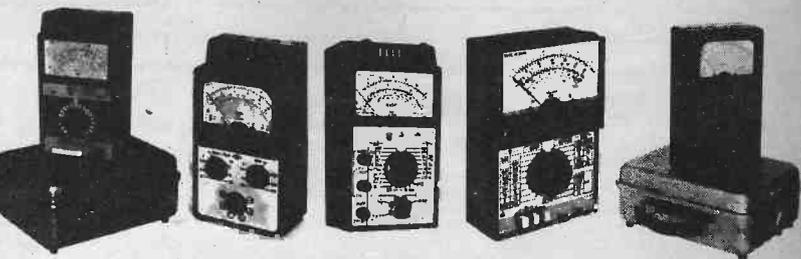
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5Z4G 0.45	6CL6 0.80	6G87 0.45	12E1 3.00	EL84 0.25	PC94 0.40	PY83 0.98	UP11 0.80
6J30L2 0.90	6CL6 0.80	6K7 0.50	12K5 1.00	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6A8A 0.45	6CW4 0.70	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AF4A 0.80	6CY7 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AG5 0.25	6C7 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AG7 0.45	6D3 0.55	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AH6 0.60	6DC6 0.80	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AJ8 0.30	6DK6 0.60	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AK5 0.40	6DQ6B 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AK8 0.60	6DS4 1.25	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AL3 0.45	6E7 0.45	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AL5 0.25	6EH7 0.30	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AM6 0.37	6EJ7 0.35	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6A8E 0.42	6EW6 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AQ6 0.70	6F1 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AR5 0.55	6F5 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AR6 0.65	6FG 0.75	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80
6AS5 0.50	6F11 0.50	6K7 0.50	12K7G 0.50	EL86 0.43	PC94 0.40	PY83 0.98	UP11 0.80

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2N697 0.15	AC132 0.35	BD123 0.80
2N698 0.30	AC153 0.20	BD131 0.75
2N705 0.70	AC154 0.15	BD132 0.80
2N708 0.10	AC157 0.17	BF115 0.20
2N708 0.15	AC189 0.10	BF167 0.18
2N753 0.25	AC174 0.17	BF173 0.20
2N829 0.20	AC187 0.25	BF179 0.30
2N930 0.20	AC188 0.25	BF180 0.30
2N947 0.80	AC177 0.25	BF181 0.30
2N1131 0.25	AC178 0.20	BF184 0.20
2N1132 0.25	AC179 0.25	BF185 0.20
2N1184 1.25	AC170 0.20	BF194 0.14
2N1302 0.17	AC171 0.20	BF195 0.14
2N1303 0.17	AC172 0.10	BF196 0.10
2N1304 0.20	AD140 0.50	BF197 0.12
2N1305 0.20	AD149 0.45	BF200 0.35
2N1306 0.25	AD161 0.35	BFW87 0.25
2N1307 0.25	AD162 0.35	BFW88 0.20
2N1308 0.25	AD171 1.25	BFW89 0.20
2N1309 0.25	AD172 0.25	BFY79 0.20
2N1613 0.17	AF114 0.17	BFX88 0.20
2N1711 0.20	AF115 0.17	BFY17 0.40
2N1756 0.75	AF116 0.17	BFY19 0.25
2N2147 0.75	AF117 0.17	BFY50 0.20
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2N2217 0.25	AF125 0.20	BFY52 0.20
2N2218 0.20	AF127 0.20	BSY26 0.20
2N2219 0.20	AF180 0.35	BSY27 0.15
2N2369A 0.15	AF181 0.35	BSY28 0.17
2N2477 0.45	AF186 0.40	BSY25 0.20
2N2646 0.40	AF239 0.35	BSY95A 0.12
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2N2924 0.18	AS126 0.25	OC23 0.50
2N2926 0.10	AS127 0.30	OC24 0.60
2N3053 0.20	AS128 0.25	OC25 0.35
2N3054 0.50	AS129 0.30	OC26 0.25
2N3055 0.60	AS154 0.25	OC29 0.60
2N3153 0.25	AS155 0.70	OC35 0.50
2N3154 0.25	AS156 0.70	OC36 0.45
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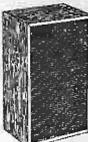
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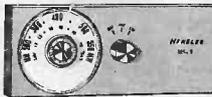
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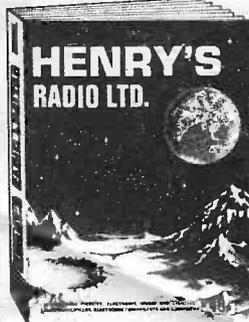
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PRICE: **£1-80** (rec. retail) OR Fitted with triple-coated, iron nickel and Chromium bit 1/8". PRICE: **£1-95** (rec. retail). P&P5p



MODEL MES.KIT

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PRICE: **£1-95** (rec. retail). P&P12p

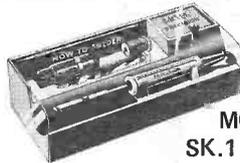
MODEL G

18 watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240, 220 or 110.

PRICE: **£1-83** (rec. retail). P&P5p



All prices mentioned are exclusive of V.A.T.



MODEL SK.1 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE: **£2-75** (rec. retail). P&P12p

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PRACTICAL WIRELESS

VOL. 49 NO. 2

ISSUE 796

JUNE 1973

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

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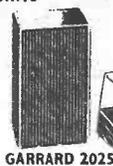
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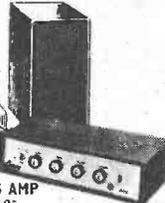


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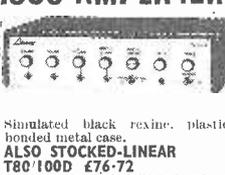
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 - LEEDS** 5-7 County (Mecca) Arcade, Briggate (Closed Wed.). Tel. 28252
 - LIVERPOOL** 73 Dale St. (Closed Wed.). Tel. 236 3573
 - LONDON** 238 Edgware Road, W.2. (Closed Thurs.). Tel. 723 1629
 - MANCHESTER** 60A Oldham Street, (Closed Wed.). Tel. 236 2778
 - MIDDLESBROUGH** 106 Newport Rd. (Closed Wed.). Tel. 47096
 - NEWCASTLE UPON TYNE** Tel. 214659
 - 24 Newgate Shopping Centre (Closed Wed.). Tel. 414658
 - NOTTINGHAM** 19/19A Market Street (Closed Thurs.). Tel. 49068
 - SHEFFIELD** 13 Exchange Street (Castle Market Bldgs.) (Closed Thurs.). Tel. 20716
 - STOCKPORT** 8 Little Underbank. Tel: 480-0777.
 - SUNDERLAND** 5 Market Sq. (Closed Wed.) Tel. 70573