PRACTICAL WIRELESS

AUGUST 1971

20p

OTHER PROJECTS:-
DIRECT CONVERSION RECEIVER
L. F. BANDS TRANSMITTER

pw
TREASURE TRACER

ADCOLA Soldering Instruments add to your efficiency

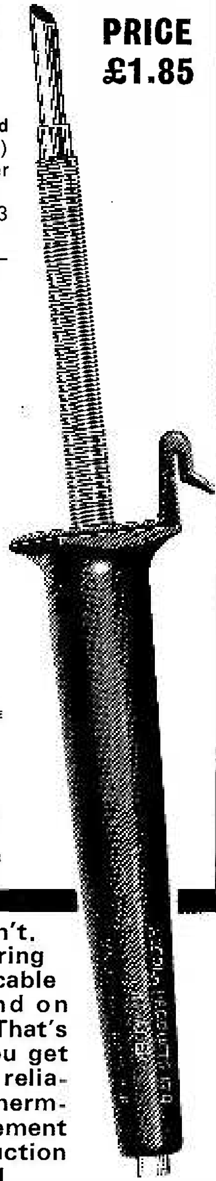
THE NEW 'INVADER'

ADCOLA L.646

for Factory Bench
Line Assembly

PRICE £1.85

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit*.
Standard temp. 360°c at 23 watts.
Special temps. from 250°c—410°c.



***Additional Stock Bits**
(illustrated) available

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B 38 1/8" — 3.2 mm CHISEL FACE
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B 24 3/16" — 4.75 mm SCREWDRIVER FACE
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B 42 LL 3/16" — 4.75 mm CHISEL FACE
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B 44 LL 3/16" — 4.75 mm SCREWDRIVER FACE

Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service . . . reliability . . . from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.

ADCOLA

* *Write for price list and catalogue*

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(INCORPORATING M. & B. RADIO)

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MB2/20A TWO METRE TRANSCEIVER Rx tuneable over 2 metre band. 20 watts RF output AM modulated. Ideal for mobile or fixed station, only requires connection to speaker, aerial and 12v DC supply to become fully operational (fuller details on list). **£50 inc. carr. U.K.**

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can effectively make the 'mono' facility redundant on a stereo amplifier. This solid-state device synthesises two distinctly different signals from a mono source to realistically simulate the stereo effect with music. For amplifiers with a tape-monitor facility, connection to the tape socket will allow operation from any selected mono source. Alternatively the unit may be connected in series with most programme sources. We provide a lead and 6 month guarantee. Send s.a.e. for further details stating amplifier.

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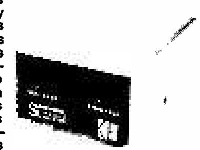
"... the sample we have tried is beautifully made and carefully designed . . ." "Distortion is negligible and the noise-figure is excellent. Input impedance is very high, whilst the output impedance is sufficiently low to improve the noise-figure with some amplifiers." "... there is little doubt that on certain types of material the effect of this simulator is pleasing, never ludicrous and may well be judged worthwhile." **Hi-Fi News & Record Review** (New Products section).



A CUSTOMER SAYS: "I find that the simulator does all that is described in your advertisement. Mono transmissions have a new dimension. 'Reprocessed mono' recordings are as good as some stereo recordings, and mono recordings played in simulated stereo offer more enjoyment in listening. I am thoroughly satisfied with the simulator." **Mr. W. J. C., Douglas, Isle of Man.**

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Norman H. Field Electronics, Vehicle & General House, Hurst Street, BIRMINGHAM.

Recommended retail price **£10** Stocked by good retailers, or obtainable direct. p. & p. 20p.

KAMPEL ELECTRONICS LTD.,
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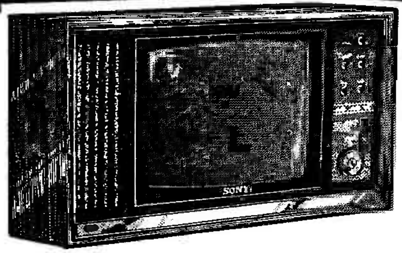
NOW AVAILABLE SONY



KV-132 13" COLOUR TELEVISION

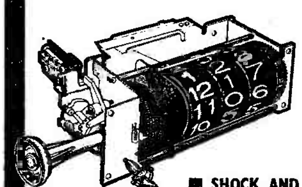
This amazing value 13in. UHF colour TV is now available from Lasky's. Designed with the new TRINITRON tube to give you superb colour reproduction, sharper focusing with reliability and durability. Its light weight enables it to be moved from room to room with ease and like all Sony products it has solid state circuitry for trouble-free operation. Finished in a handsome teak cabinet 20in. x 13in. x 16in. Weight 39lbs. AC Mains. 240 volts.

COMPLETE with free Parabolic aerial valued at £6·00

LASKY'S PRICE ONLY £199

Post free U.K. only

DIGITAL CLOCK SCOOP!



- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION
- 12 HOUR ALARM
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- FORWARD AND BACKWARO TIME ADJUSTMENT
- SILENT OPERATION SYNCHRONOUS MOTOR
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Exclusively from Lasky's in chassis form for you to mount in any housing you choose. The clock measures 4¾W x 1¾H x 3½D (overall from front of drum to back of switch). SPEC.: 210/240V AC, 50Hz operation; switch rating 250V 3A. Complete with instructions.

HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS

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SPECIAL QUOTATIONS FOR QUANTITIES

BSR McDONALD MP60

High precision low-mass counterbalanced pick up arm, heavy balanced turntable, simple to operate controls, viscous cueing device, slide in cartridge carrier, 4 pole motor.

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BSR McDONALD UNITS and PACKAGES

A. Chassis only. **B.** Complete with Lasky's plinth and cover. **C.** Complete with Lasky's plinth, cover and AD76K cartridge. **D.** Comp. wired on BSR plinth with cover. **E.** As D plus AD76K cartridge.

Model	A	B	C	D	E
610	£15·45	£18·75	£22·50	£24·50	£28.50
510	£13·45	£16·95	£20·75	£22·00	£26.00
310	£9·95	£13·45	£17·25	£21·00	£23.50
MP60	£12·50	£15·75	£19·50	£21·50	£25.50

GARRARD SL 55B Four-speed auto changer

LASKY'S PRICE **£10·50** POST 35p

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Garrard SP 25 Mk. III wired £12·00
Garrard SP 25 Mk. III with 9TA cart. .... £13·95
Garrard AP 76............£20·95
Garrard 3000 with 9TA cart. £10·50
Garrard 2025TC with 9TA cart. .... £9·85

GARRARD PACKAGES

POST FOR ALL PACKAGES 50p.

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Garrard AP 76 with Shure M44E cart. and Lasky's plinth and cover £40·00
Garrard SP 25 Mk. III, AD 76K cart. and Lasky's plinth and cover...... £20·00
Garrard SP 25 Mk. III, Micro M 2100/e cart. and Lasky's plinth and cover £25·00

SENCOR CASSETTE RECORDER MODEL-S5002

This compact cassette recorder offers tremendous performance and value. Brief spec.: 5 trans. circ., constant speed capstan drive. P.M. dyn. spk., economical operation on 4 x 1·5v batts. Features: Powerful volume. Built in auto. level control circ. assures perfect recording regardless of vol. control position. Handsome cabinet in stylish woodgrain with black plastic trim. Size: 8¾ x 5¼ x 2¾in. Jack sockets for mic., earpiece. External 6v batt. pack or AC adaptor. Comp. with mic. earpiece, removable carrying strap and batts. and a free C-60 cassette.

LASKY'S PRICE £13·95 POST 25p

SONY TFM 8030L SCOOP!

LIST PRICE £29·75

High performance 11 transistor Battery/Mains portable radio

This top quality solid state receiver is now available from Lasky's at over 27% below the manufacturer's list price making it without doubt **the SCOOP of 1971!** Covers MW, LW and FM (VHF), 11 transistor circuit for high sensitivity and stability. Powerful output to 5in. P.M. Dynamic speaker. AFC for drift free reception. Push button wavechange selectors and tone control. 3 power sources—9v batt. (PP9 or equiv.) household mains or car battery with adaptors. Dial light. External jacks for earphone, tape recording, external power input and car aerial. Padded leatherette cabinet, chrome trim, strong carrying handle. **Tech. spec.:** Freq. range: FM 87–108 MHz, LW 150–285KHz MW 530–1,605KHz. Circuit: 11 transistors, 7 diodes. Directional telescopic aerial for FM, internal ferrite bar for LW/MW 9¼(W) x 8(H) x 3½(D). Comp. with earphone and batt.

LASKY'S PRICE **£21·50**

Optional extras: AC-90E AC adaptor £4·00; DCC-128 stabilised car battery cord £6·00. Post **FREE** if bought with radio.

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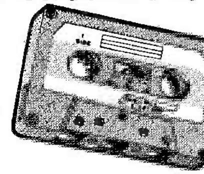
5in.	Double play, 1200ft.	75p
5in.	Long play, 900ft. Acetate	50p
5in.	Standard play 600ft.	40p
5¾in.	Double play, 1800ft. Mylar	£1·13
5¾in.	Long play 1200ft. Acetate	75p
5¾in.	Standard play 900ft. PVC	63p
5¾in.	Long play, 1200ft. Mylar	75p
5¾in.	Triple play, 2400ft.	£1·75
7in.	Standard play, 1200ft. Acetate	63p
7in.	Standard play, 1200ft. Mylar	63p
7in.	Long play, 1800ft. Mylar	98p
7in.	Double play, 2400ft. Mylar	£1·25
7in.	Long play, 1800ft. Acetate	75p
7in.	Triple play, 3600ft. Mylar	£2·50

P. & P. 5p extra per reel. 4 reels and over Post Free. Special quotes for quantities

Lasky's COMPACT CASSETTES

C60 • C90 • C120

Exclusively made for us in USA Great Savings



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C60	37p	5p	£1·65	20p	£5·95	25p
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U.S.A. Cassette head cleaner 53p. Post 5p

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IS4	27
IS5	25
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3A4	35
3Q4	40
3Q5	45
3S4	35
3V4	45
5R4GY	60
5U4G	33
5V4G	42
5Y3GT	32
5Z4G	40
6/30L2	75
6A7	75
6A8G	63
6AK5	30
6AM5	32
6AM6	33
6AQ5	35
6AS7G	80
6AT6	30
6AU6	25
6B4G	£1·00
6B8G	20
6BA6	25
6BE6	30
6BH6	45
6BJ6	45
6BQ7A	40
6BR7	85
6BR8	65
6BS7	£1·30
6BW6	85
6BW7	70
6C4	33
6C5G	30
6C6	25
6CD6G	£1·20
6CH6	55
6CW4	63
6D6	25
6E5	38
6F1	70
6F5G	50
6F6G	30
6F8G	35
6F11	38
6F13	38
6F14	65
6F23	80
6F24	75
6F25	75
6F28	70
6F32	25
6G6	25
6H6	23
6J5M	50
6J5G	20
6J5GT	30
6J6	20
6J7M	45
6J7G	30
6J7GT	45
6K6GT	55
6K7M	35
6K7G	20
6K7GT	35
6K8M	60
6K8G	35
6K8GT	50
6K25	75
6L6G	45
6L18	45
6Q7G	30
6Q7GT	43
6SA7M	40
6SC7M	70
6SG7M	35
6SH7M	35
6SJ7GT	30
6SK7GT	30
6SL7GT	35
6SN7GT	35
6SQ7GT	40
6U4GT	60
6U5G	40
6V6M	60
6V6G	30
6V6GT	38
6X4	30
6X5G	35
6X5GT	35
7B6	70
7B7	45
7C5	£1·13
7C6	75
7D5	55
7H7	35
7R7	70
7S7	£2·25
7Y4	60
9BW6	50
10C2	63
10F1	90
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10F18	45
10LD11	60
10P13	68
11E3	£4·00
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12AU7	30
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12BE6	35
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12E1	£1·35
12J5GT	25
12J7GT	35
12K7GT	35
12K8GT	50
12Q7GT	35
12SA7GT	40
12SG7	35
12SH7	30
12SJ7	30
12SK7	45
12SR7	35
14H7	50
19AQ5	40
20D1	50
20F2	70
20L1	£1·10
20P4	£1·10
20P5	£1·20
25A6	35
25L6GT	45
25Y5	60
25Z4	45
25Z5GT	55
25Z6	65
30C1	33
30C15	80
30C17	85
30C18	75
30F5	85
30FL1	75
30FL12	95
30FL14	75
30L15	85
30L17	85
30P4	£1·12
30P12	80
30P19	80
30PL1	80
30PL13	93
30PL14	90
35A5	75
35L6	50
35W4	30
35Z3	60
35Z4GT	50
35Z5	40
37	40
42	50
50B5	45
50C5	40
50CD6G	£1·65
50L6GT	50
75	50
78	45
80	50
85A2	40
150B2	60
150C4	60
801	50
807	50
813USA	£3·75
866A	75
954	60
1625	40
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5763	70
7193	20
7475	40
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AZ31	55
CBL31	90
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CL33	£1·00
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DCC90	£1·00
DF33	48
DF70	45
DF91	25
DF92	20
DF96	42
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DH77	30
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DK91	35
DK92	50
DK96	42
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DL92	35
DL93	35
DL94	45
DL95	40
DL96	42
DM70	40
DY86	33
DY87	35
E88CC	65
EA50	20
EABC80	35
EAF42	55
EB91	20
EBC33	50
EBC41	55
EBC90	30
EBF80	40
EBF83	45
EBF89	33
EBL1	70
EBL21	60
EBL31	£1·38
EC90	33
ECC81	33
ECC82	30
ECC83	30
ECC84	30
ECC85	25
ECC88	40
ECH21	63
ECH35	60
ECH42	70
ECH81	30
ECH83	43
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EF50	25
EF80	25
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EF86	33
EF89	28
EF91	33
EF92	40
EF98	75
EF183	33
EF184	35
EL32	30
EL33	63
EL34	53
EL41	55
EL42	58
EL84	25
EL95	35
ELL80	£1·00
EM34	90
EM80	40
EM81	63
EM84	38
EY51	40
EY86	40
EZ35	35
EZ40	45
EZ41	48
EZ80	28
EZ81	28
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GZ30	50
GZ32	50
GZ34	60
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N108	£1·50
OA2	38
OC3	38
OZ4	40
PC86	60
PC88	60
PC97	50
PCC84	38
PCC89	53
PCC189	55
PCF80	33
PCF82	35
PCF84	50
PCF86	60
PCF801	50
PCF802	50
PCF805	75
PCF806	70
PCF808	78
PCL82	38
PCL83	58
PCL84	43
PCL85	40
PCL86	45
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PEN46	40
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PL83	45
PL84	40
PL500	80
PL504	80
PL508	90
PL509	£1·45
PL802	83
PX4	£2·00
PX25	£2·00
PY33	63
PY81	30
PY82	30
PY83	38
PY500	£1·00
PY800	50
PY801	50
R2	60
R19	40
S130	£1·75
SP4	50
SP41	45
SP61	55
STV280/80	£10·00
SU25	£1·00
SU2150	75
T41	£1·00
TDD4	50
TH41	£1·75
U10	60
U14	60
U19	£2·50
U25	78
U26	78
U78	30
U191	75
U251	80
U301	63
U403	50
U404	40
U801	£1·18
UABC80	35
UAF42	55
UBC41	50
UBC81	45
UBF80	40
UBF89	38
UCC84	43
UCC85	40
UCF80	55
UCH42	70
UCH81	35
UCL82	38
UCL83	60
UF41	60
UF89	38
UL41	65
UL84	35
UM80	28
UU6	£1·05
UU7	£1·05
UU8	£1·05
UU9	45
UY21	50
UY41	45
UY85	33
VMP4G	85
VP4B	£1·25
VR105/30	38
VR150/30	35
VU111	60
VU120	80
VU508	£2·50
W81M	63
Y63	50

Transistors

Type	Price
1N914	08
1S113	25
1S202	23
2G302	23
2G371	23
2N404	23
2N697	18
2N706	10
2N1132	30
2N1305	25
2N2147	75
2N2160	63
2N2218	30
2N2219	33
2N2369A	20
2N2646	53
2N2904	30
2N2926	13
2N3055	75
2N3702	13
2N3819	35
2N4289	18
AAZ12	30
AC126	25
AC127	25
AC128	25
ACY20	23
ACY39	55
AD140	50
AD149	50
AD161	38
AF115	30
AF117	25
ASY26	25
BC107	13
BC108	13
BC109	13
BC169C	13
BFS98	28
BFY50	23
BFY51	20
BY100	18
BZY88	18
CRS1-40	48
DD003	15
GET102	30
GET882	25
GJ7M	38
KS100A	20
MJE520	88
MJE2955	£1·75
MJE3055	93
NKT212	27
NKT214	15
NKT223	33
NKT251	24
NKT713	25
OA70	10
OA71	10
OA81	10
OA85	13
OA91	08
OA211	38
OAZ200	55
OAZ201	50
OAZ207	48
OAZ210	33
OAZ222	40
OAZ224	38
OAZ241	23
OAZ242	23
OAZ246	23
OC35	50
OC44	18
OC45	15
OC57	60
OC58	60
OC59	65
OC71	15
OC72	25
OC81	25
OC81D	20
OC82	25
OC82D	15
OC84	25
OC170	25
OC171	30
OC200	40
OCP71	98
ORP12	50
ZS170	10
ZS271	18
ZTX107	15
ZTX108	15
ZTX300	13
ZTX304	28
ZTX500	20
ZTX503	20
ZTX531	30

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The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The ivory mounting plate of the DIMMASWITCH matches modern electric fittings. Two models are available, with the bright chrome knob controlling up to 300w or 600w of all lights except flourescents at mains voltages from 200-250v, 50Hz. The DIMMASWITCH has built-in radio:

600—£3.20 Kit from £2.70
300—£2.70 Kit from £2.20

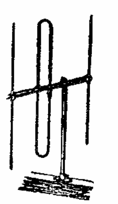
All plus 10p. post and packing.
Please send C.W.C. to:—

DEXTER & COMPANY
2 ULVER HOUSE, 19, KING STREET, CHESTER CH1 2AH Tel: 0244-25883,
As supplied to H.M. Government Departments.

NEW RANGE U.H.F. TV AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors. **Loft Mounting Arrays.** 7 element £2·25. 11 element £2·62½. 14 element £3·00. 18 element £3·50. **Wall mounting with Cranked Arm.** 7 element £3·25. 11 element £3·75. 14 element £4·12½. 18 element £4·50. **Chimney Mounted Arrays complete.** 7 element £4·00. 11 element £4·37½. 14 element £4·75. 18 element £5·25. **Complete assembly instructions with every aerial.** Low Loss co-axial cable 8½p yd. King Teleboosters—Lab gear U.H.F. Boosters from £3·75. Belling Lee 'Concord' all band V.H.F./U.H.F. mains operated pre-amp £7·50. **State clearly channel number required on all orders.** p.p. Aerials 40p. Accessories 15p. C.W.O. or C.O.D.

BBC - ITV- FM AERIALS



B.B.C. (Band 1) Loft £1·25. Wall S/D £1·62½. 'H' array £3·00. ITV (Band 3) 5 element loft array £2·25. 7 element £2·75. Wall mounting 5 element £3·25. Combined BBC/ITV loft 1 + 5 £2·75. 1 + 7 £3·37½. Wall mounting 1 + 5 £3·87½. Chimney mounted 1 + 5 £4·50. Preamps from £3·75. Combined BBC/ITV/BBC 2 aerials 1 + 5 + 9 £4·00. 1 + 5 + 14 £4·50. 1 = 7 = 14 £5·00. Available loft only. FM radio loft S/B 97½p. 'H' £1·92½. 3 element array £2·87½. Standard co-axial cable 5p yd. Coax plugs 8½p. Outlet boxes 30p. Diplexer crossover boxes 87½p p. & p. Aerials 40p; accessories 15p C.W.O. or C.O.D. (Min C.O.D. charge 17½p.) 5p for fully illustrated lists.

Callers welcomed—open all day Saturday.

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£6.75

Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master** and **3 Subs**), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. £0.40.

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No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. Price **£13.95** P. & P. 50.55.

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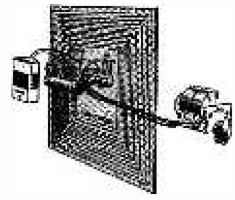
FIND BURIED TREASURE WITH THIS

READY BUILT & TESTED

Treasure Locator Module

Only **£4·95** (99/-)



BRAND NEW FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, wood, dirt, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, WATCHES, JEWELLERY, NUGGETS, METALLIC ORE, HISTORICAL RELICS, BURIED PIPES, KEYS, NAIL-IN-TREES, ETC., ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **PRINTED CIRCUIT SEARCH COIL** *so stable and sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN!** *You could even pay for your holidays with two or three days electronic beachcombing—it's almost like having a licence to print money!* Unclaimed treasure now exceeds the combined wealth of all nations. **ORDER NOW WHILE PRESENT STOCKS LAST—TREMENDOUS DEMAND EXPECTED AT THIS REMARKABLY LOW PRICE. DEMONSTRATIONS DAILY. ORDERS DESPATCHED IN STRICT ROTATION. SEND NOW £4·95 + 30p carr.** (99/- + 6/-) etc. (High quality Danish Stethoscope headphones £2·75 (55/-) extra if required).

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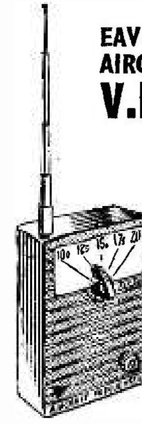
V.H.F. AIRCRAFT BAND CONVERTER

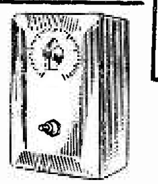


ONLY **£2·37** (47/6)

Many thousands of v.h.f. Aircraft Band Converters now selling in **U.S.A.** *Listen in to* **AIRLINES, PRIVATE PLANES, JETPLANES.** *Eavesdrop on exciting crosstalk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve rippling decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON RINGWAY, PRESTWICK ETC., ETC. CLEAR AS A BELL!** This fantastic fully transistorised instrument *can be built by anyone nine to ninety in under two hours.* (Our design team built four—everyone worked first time). *No knowledge of radio or electronics required.* No soldering necessary. Fully illustrated simply worded instructions take you step-by-step. Uses standard PP3 battery. Size only 4¾" x 3" x 1⅝". All you do is extend rod aerial, place close to any ordinary medium-wave radio- (even tiny portables) **NO CONNECTIONS WHATEVER NEEDED.** Use indoors or outdoors. **THERE WILL BE ENORMOUS DEMAND FOR THIS NEW DESIGN, SEND NOW, ONLY £2·37** (47/6)+23p (4/6) p. & p. for all parts, including case, nuts, screws, wire, etc., etc. (parts available separately).

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING

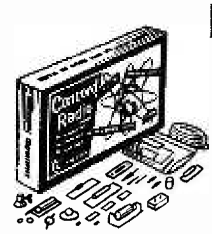
RELAXATRON



only **£2·25** (45/-)

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the **RELAXATRON** is basically a pink noise generator based on avalanche operated transistors. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. *A group of Dentists have experimented on patients with this pink noise*—**NO ANESTHETICS WERE USED!** The noise ostensibly created a most definite reaction on these patients' nervous systems with the results that their pain systems were blocked. **IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX**—then build this fantastic Relaxatron. Once used you will never want to be without it—use this amazing pink noise generator whenever you feel uneasy, can't relax or wish to concentrate. **TAKE IT ANYWHERE**, pocket sized. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life) **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustated plans. No soldering necessary. All parts including case, a pair of crystal phones, Components, Nuts, Screws, Wire, etc. etc. no soldering. **Send only £2·25 + 25p** (45/- + 5/-) p. & p. parts available separately.)

BUILD 5 RADIO AND ELECTRONIC PROJECTS



TOTAL BUILDING PRICE **£1·97** (39/6)

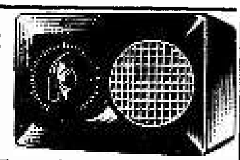
Amazing Radio Construction set! Become a radio expert for **£1·97** (39/6). A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated Step-by-step plans, all Transistors, loudspeaker, personal phone, knobs, screws, etc., all you need. Presentation Box **37p** (7/6) extra as illus. (if required) (extra parts available separately) no soldering necessary. Send only **£1·97** (39/6) + 23p (4/6) p. & p.

GET A GOOD NIGHT'S SLEEP—EVERY NIGHT!

INGENIOUS ELECTRONIC

SLEEP INDUCER

only **£2·75** (55/-)



CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries—extremely economical. Size only 3" x 4⅜" x 1⅝"—take it anywhere. **All parts including case, loudspeaker, components, nuts, wire, screws, etc. etc. THERE WILL BE A GREAT DEMAND FOR THIS UNIQUE NEW DESIGN—SEND NOW £2·75 + 25p** (55/- + 5/-) p. & p. (parts available separately).

FIND BURIED TREASURE!

TREASURE LOCATOR TRANSISTORISED

NOW IT'S HERE AT LAST, after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototypes, our design team have come up with this real winner. This fully portable transistorized metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, LOST COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS ETC. ETC.** Outdoors or indoors. *Extremely sensitive, will signal presence of certain objects buried several feet below ground!* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions—it really is easy as A.B.C. transistorized — no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13¾" x 10" x 2¼". Great demand expected at this remarkably low price—**ORDER WHILE PRESENT STOCKS LAST.** All parts including detector head case, nuts, screws, wire, simple instructions etc. etc. **ONLY £2·37** (47/6) + 27p (5/6) p. & p. (Sectional handle as illustrated 75p (15/- extra). Parts available separately. Made up looks worth £15 !

ONLY **£2·37** (47/6)

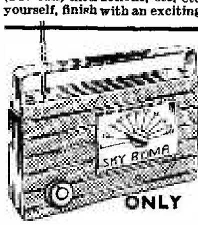
REAL WORKING ELECTRONIC ORGAN

Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds etc. Eight months were spent in creating and testing this superb, revolutionary electronic organ. **Fully transistorized**—no valves. **Proper self-contained loudspeaker.** *Fifteen separate keys span two full octaves*—play the *"Yellow Rose of Texas"*, play *"Silent Night"*, play *"Auld Lang Syne"*, play *lots and lots of similar tunes* on this real working electronic organ. Although it's no theatre organ it's certainly no tiny thing, it measures 13¾ x 10 x 2¼". You have the thrill and excitement of building it together with the pleasure of playing a real, live, throbbing electronic organ. *Take it anywhere—play it anywhere,* **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED—NONE WHATEVER.** No soldering necessary. it really is as simple as a.b.c. to make. **Anyone from nine years upwards can build it easily in one short evening following the fully illustrated, step-by-step, simply worded instructions. BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT at our low, low building price. ONLY £2·75** (55/-) + 23p (4/6) p. & p. for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformer, volume control, wire, nuts, screws, simple (but full) instructions, etc. etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

ONLY **£2·75** (55/-)

SHORTWAVE TRANSISTOR RADIO

Can be built in one evening



ONLY **£2·25** (45/-)

At last! After trying countless circuits searching for easy build, work first-time short waver. Giving advanced world-wide performance, we chose this 'Sky Roma'. Anyone from 9 years up can follow the step-by-step, easy-as-ABC, fully illustrated instructions. (We built ten prototypes and every one worked first time) no soldering necessary. 76 stations logged on rod aerial in 30 mins.—**Russia, Africa, USA, Switzerland, etc. Experience** thrills of world wide news, sport, music, etc. **Eavesdrop on unusual broadcasts.** Uses PP3 battery. Transistorised (no valves!). Size only 3" x 4⅜" x 1⅛". As tremendous demand anticipated price held to only **£2·25** (45/-) + 17p (3/6) p. & p. for all parts incl. Cabinet, screws, instructions etc. (Part available separately).

EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.

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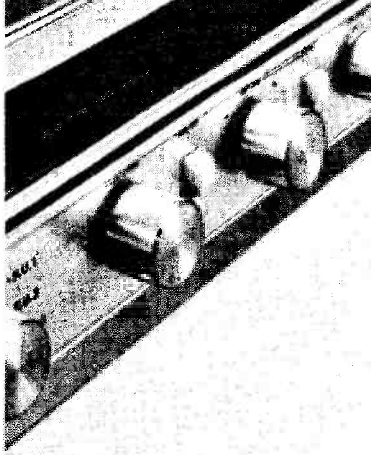
(Nr Bayswater & Queensway Tubes. 1 minute ABC Cinema)
(STAFF WANTED FOR ALL DEPARTMENTS) Callers Welcome 9 a.m.-6 p.m. inc. Saturday

28watts, r.m.s. 40Hz to 40kHz ± 3dB

There are two stereo amplifiers — the RT100 for ceramic cartridges, the RT101 for magnetic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.



Viscount III Audio Suite complete £49

PRICES SYSTEM 1

Viscount III RT101 amplifier	£22.00 + 90p p&p
2 x Duo Type II speakers,	£14.00 + £2 p&p
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23.00 + £1 p&p
Total	£59.00

Available complete for only £52.00 + £2.50 p&p

SPECIFICATION

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. *P.U.1* 150mV into 3 Meg. *P.U.2* 4mV @ 1kHz into 47K. equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power.) Tape out facilities; headphone socket, power out 250 mW per channel. *Tone controls and filter characteristics.* Bass: + 12 dB to − 17 dB @ 60HZ. Bass filter: 6dB per octave cut. Treble control: treble + 12 dB to − 12 dB @ 15 kHz. Treble filter 12 dB per octave. *Signal to noise ratio:* (all controls at max) RT101 — P.U.1. & radio — 65dB. P.U.2 — 58 dB. RT100 same as RT101 but P.U.2. 450 mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* 26dB on all inputs. Size $13\frac{1}{2}'' \times 9'' \times 3\frac{1}{2}''$

SYSTEM 2

As System 1, but with 2 x Duo Type III speakers at pair £32.00 + £3 p&p

Available complete for £69 + £4 p&p

SYSTEM

Viscount III Amplifier RT100	£17.00 + 90p p&p
2 x Duo Type II speakers, pair	£14.00 + £2 p&p
Garrard SP25 Mk. III with CER. diamond cartridge, plinth and cover	£21.00 + £1 p&p
Total	£52.00

Available complete for only £49.00 + £2.50 p&p

SPEAKERS Duo Type II

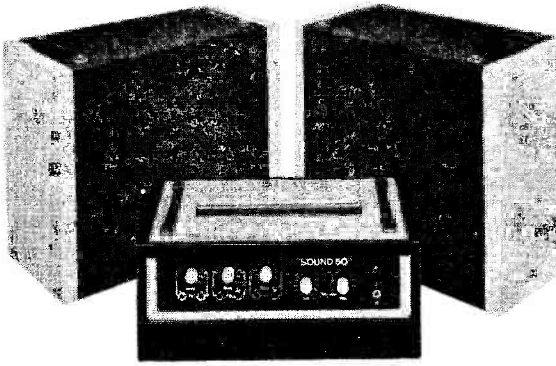
Size $17'' \times 10\frac{3}{4}'' \times 6\frac{3}{4}''$. Drive unit $13'' \times 8''$ with parasitic tweeter. Max. power 10 watts, 3 ohms. Teak veneer cabinet. **£14 pair + £2** p&p. Duo Type III Size $23\frac{1}{2}'' \times 11\frac{1}{2}'' \times 9\frac{1}{2}''$. Drive unit $13\frac{1}{2}'' \times 8\frac{1}{4}''$ with H.F. speaker. Max. power 20 watts at 3 ohms. Frequency range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair** + £3 p&p.

Radio and TV Components (Acton) Ltd. 21c High Street, Acton, London W3 6NG
323 Edgware Road, London, W.2. Mail orders to Acton. Terms C.W.O. *All enquiries S.A.E.*

R+TV

SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

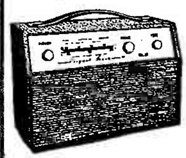
Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency response:** —3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
Speaker Impedance: 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10 KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.
To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
SPEAKERS! Size 20" x 20" x 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £50 Plus £4 P. & P.
Sound 50 amp and 2 speakers

or available separately. Amplifier £28.50 plus £1.50 P. & P.
Speakers £12.50 each plus £1.75 P. & P.

THE ELEGANT SEVEN Mk. III

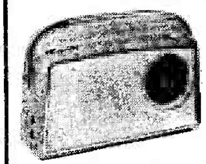
(350mW Output)



7 transistor fully-tunable M.W.—L.W. superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
MAINS POWER PACK KIT: 75p extra.

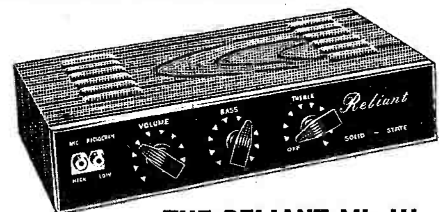
Price £5.25 plus 50p. P. & P.
Circuit 13p FREE WITH PARTS.

THE DORSET (600mW Output)



7-transistor fully tunable M.W.—L.W. superhet portable. Set of parts. The latest modulised and pre-alignment techniques make this simple to build. Sizes: 12 x 8 x 3in.

Price £5.25 plus 50p P. & P.
Circuit 13p FREE WITH PARTS

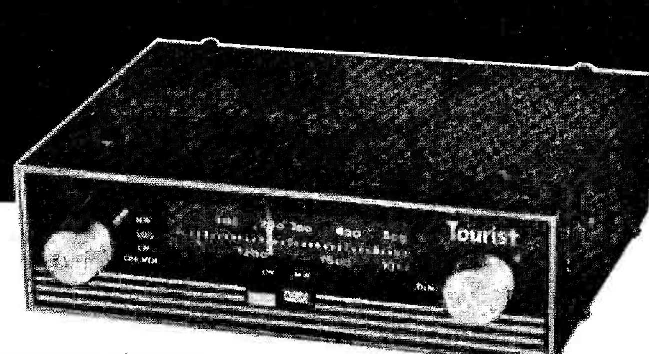


THE RELIANT Mk III
SOLID-STATE GENERAL PURPOSE AMPLIFIER

in simulated teak case **£7.25** plus P. & P. 50p

SPECIFICATIONS
Output 10 watts. Output impedance—3 to 4 ohms.
Inputs 1. -xtal mic 10mV Tone Controls—Treble control range ± 12dB at 10KHz. 2. -gram/radio 250mV. Bass control range ± 13dB at 100Hz.
Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. Signal to Noise Ratio—better than −60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input—220/250V. A.C. Size of chassis—10¾in. x 4¾in. x 2¼in. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Built and tested.

TOURIST
MARK 3
CAR RADIO



ALL TRANSISTOR

Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

See previous page for address

SET OF PARTS
£6.30
plus P. & P. 50p.
Circuit diagram 13p. Free with parts
Speaker, baffle and fixing kit **£1.25** extra plus 25p. p. & p. Postage free when ordered with parts.

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R+TV
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Juliette

COMMUNICATION RECEIVERS from the U.S.A. The leaders in specialist radios UNIQUE in VHF frequencies UNSURPASSED in performance & styling

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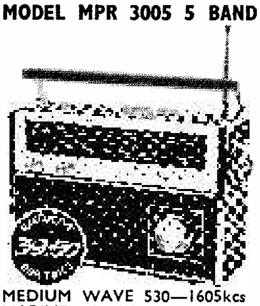
BUT ALSO *Classical Music, Pop and All That Jazz ! ! !* TURN ON TO INSTANT SOUND . . . These are Communications receivers and unique entertainment sources in one neat, transistorised portable package. They keep exciting Aircraft, Shipping, RT mobiles plus Medium Wave, FM National and Local broadcasts at your fingertips. Both are extremely reliable and feature large powerful PM dynamic wide range speakers, switchable AFC to prevent FM drift, tone control, dial lighting, sensitive swivel telescopic VHF and rod aerial, precise slide rule vernier tuning, external aerial and earphone sockets (cuts off speaker for private listening). Earpiece supplied. Operate from standard batteries or mains.

BUY DIRECT AT PRICES 15% BELOW RETAIL VALUES

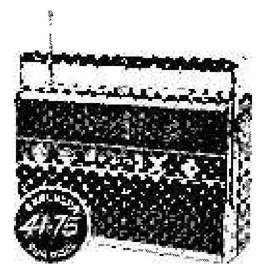
MODEL MPR 3005 5 BAND



MEDIUM WAVE 530—1605kcs
MARINE 1.4—4.6Mcs
FM/VHF 87—108Mcs
AIRCRAFT VHF 108—136Mcs
HIGH VHF/PB 146—176Mcs
Batts. incl. Plus 62½p P/P

Impressive finish in Walnut with deep Chrome die-cast side panels and grained inserts. Trimmed with brushed Aluminium and black speaker grille. Log scale for easy tuning. Size 9¾" x 12" x 4". Wt. 5¾lbs. approx.

MODEL MPR 3016 6 BAND



SAME BANDS & FREQUENCIES AS MODEL MPR 3005 *PLUS* ADDED FEATURE OF SW 5.0—12.0Mcs (with Fine Tuner).
Batts. incl. Plus 62½p P/P

Styled in elegant black case with luxury Chrome trim, soft padded speaker grille, die-cast sides and walnut insert. Size 8¾" x 11" x 3¾". Wt. 5lbs. approx.

EARPIECE SUPPLIED WITH BOTH MODELS

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The latest in contemporary U.S.A. innovation

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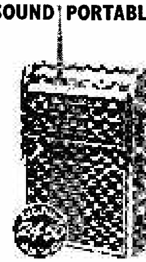

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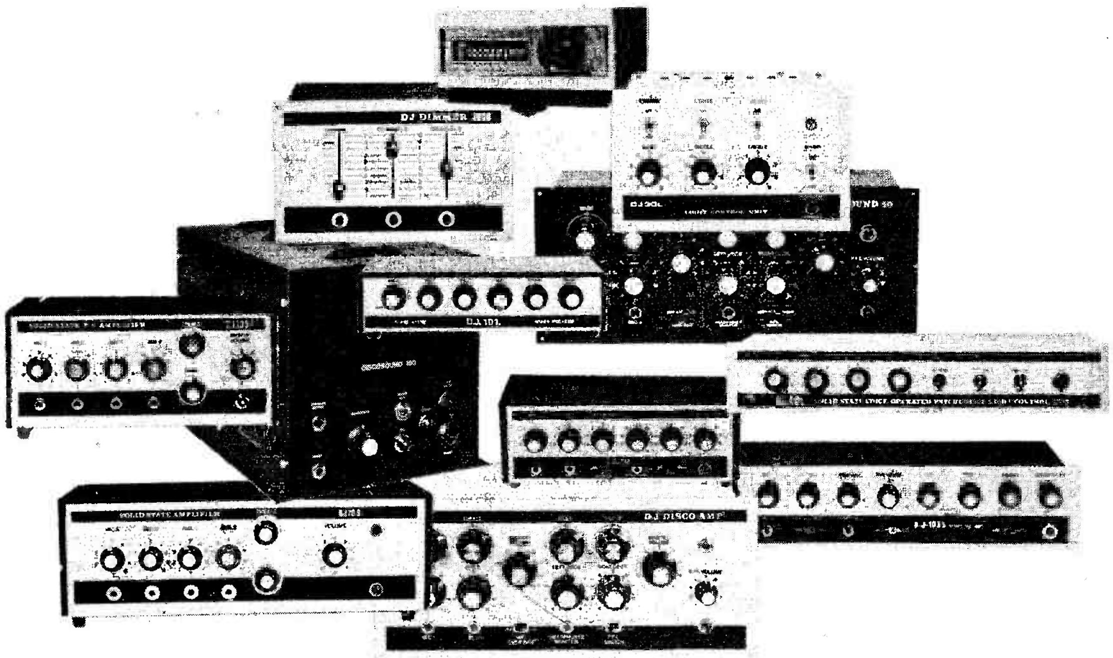

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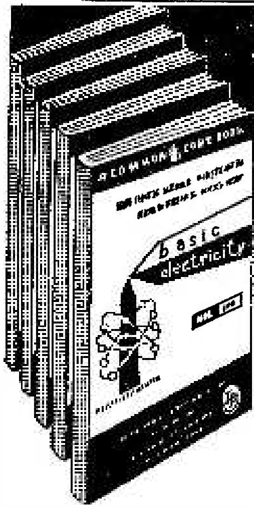

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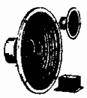

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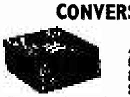

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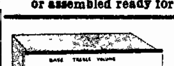

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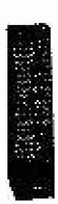

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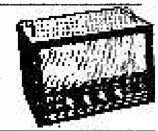

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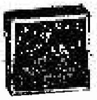
HIGH QUALITY LOUDSPEAKER UNITS

IN TEAK VENEERED CABINETS

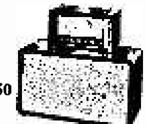


L13 13" × 8" 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. **£5·25** carr. 40p

L12 12" **25 WATT** 10,000 lines 15 ohms. Also supplied Rexine covered **£10·50** carr. 45p

L125 50 WATT Two tone Rexine and vynair finish. Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Or deposit £4 and 9 monthly payments of £3·35 Total £34·15 **£31** Carr. 75p

R.S.C. BASS REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists. gram, radio, tape, Peak Output rating.
Loudspeaker unit optional horizontal or vertical mounting. **£60**
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes". Carr. £1.50
Bass and Treble controls. Send S.A.E. for leaflet.
Credit Terms Deposit £16 and 9 monthly payments of £5.75 (Total £67.75)

FAL PHASE 50 MkII AMPLIFIER 50W

Solid state 4 Separately controlled inputs. Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3-30 ohms. Size 17" × 7" × 7½" 200-250v. A.C. mains. Output 60 watts music rating **Or deposit £6 & 9 monthly payments £3·50. Total £37·50.** **£33·50** Carr. 65p

FAL PHASE 100 AMPLIFIER 100W

Solid State. 4 Separately controlled inputs Plus master volume control. Ind. Bass and Treble Controls. Output for speaker/s 3-30 ohms. Protective circuit to guard against damage from accidental shorts. **I.H.F.M.** Output rating. **Or deposit £12 & 9 monthly payments £6·25. Total £68·25.** **£61·95** Carr. 75p
Send S.A.E. for leaflets.

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. **2 YEARS' GUARANTEE**
High flux ceramic magnets. Heavy cast chassis. All carr. free.

'POP' 100 18" 100 Watt 14,000 gauss 8/15Ω **£22·05** Dep: £6 and 9 monthly payments £2·10 (Total £24·90)

'POP' 60 15" 60 Watt 14,000 gauss 8/15Ω **£12·90** Dep. £3.30 and 9 monthly payments. £1.30 (Total £15).

'POP' 50 12" 50 Watt 13,000 gauss 15Ω **£10·50** Dep £2 and 9 monthly payments £1.15 (Total £12.35) Pair suitable all purposes

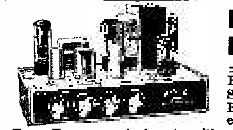
FOR BASS GUITAR, ELECT. ORGAN, ETC.

FANE LOUDSPEAKERS 'POP' 25/2

12in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). **£6·75** Carr. free
or Dep. £1 and 9 mthly payments 75p (Total £7.75).

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



Highly sensitive. Push-Pull high output, Hum level—70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. **For Clubs, Schools, Theatres. Dance Halls Outdoor Functions,** etc. **For Electronic Organ, Guitar, String Bass,** etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-np etc. to be used for mixing purposes, 200-250 v. 50 c/s A.C mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover **£1.75** Or factory built with EL34 output valves and 12 months' guarantee for **£19.75** **£15·75** Carr. 65p
TERMS: Deposit £4 and 9 monthly payments of **£2·10** (Total **£22·90**). Send S.A.E. for leaflet.

RSC TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary

Primaries 200-250v. 50c/s. Screened
MIDGET CLAMPED TYPE 2¾ × 2⅝ × 2¼in.

250v., 60mA, 6.3v. 2a	90p
250-0-250v., 60mA 6.3v 2a	95p
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a.	£1.25
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£1.99
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£1.99
300-0-300v. 130mA, 6.3v. 4a., c.t., 6.3v. 1a. For Mullard 510 Amplifier	£2.40
350-0-350v. 100mA, 6.3v. 4a., 0.5-6.3v. 3a.	£1.99
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	£2.40
425-0-425v. 200mA, 6.3v. 4a., c.t., 5v. 3a.	£4.49
425-0-425v. 200mA, 6.3v. 4a., 6.3v. 3a., 5v. 3a	£4.69
450-0-450v. 250mA, 6.3v. 4a., c.t., 5v. 3a.	£4.99
TOP SHROUDED DROP-THRO' TYPE	
250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a.	£1.20
250-0-250v. 100mA. 6.3v. 3.5a.	£1.40
250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a.	£1.45
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	£1.50
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£1.99
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£1.99
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier	£2.35
350-0-350v. 100mA, 6.3v 4a., 0-5-6.3v. 3a.	£1.99
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	£2.35

FILAMENT or TRANSISTOR POWER PACK Types 6.3v. 1.5a. **45p**; 6.3v. 2a. **49p**; 6.3v. 3a. **69p**; 6.3v. 6a. **£1.15**; 12v. 1a. **50p**; 12v. 3a. or 24v. 1.5a **£1.20**; 0.9-18v. 1½a. **99p**; 0-12-25-42v. 2a. **£1.60**

CHARGER TRANSFORMERS 0-9-15v. 1½a. **95p**; 2½a. **99p**; 3a. **£1.10**; 5a. **£1.30**; 6a. **£1.49**; 8a. **£1.85**

AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v., 50-80 watts **99p**; 150 watts, **£1.70** 250 watts **£2.49**; 500 watts **£5.25.**

OUTPUT TRANSFORMERS

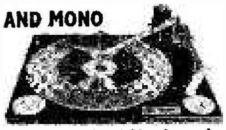
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	45p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	75p
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω	£1.25
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	£1.20
Push-Pull Ultra Linear for Mullard 510, etc.	£1.99
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£1.80
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£2.99

SMOOTHING CHOKES 150mA, 7-10H. 250 Ω **65p**; 100mA, 10H, 200 Ω **55p**; 80mA, 10H, 350 Ω **45p**; 60mA, 10H, 400 Ω **25p**.

SELENIUM RECTIFIERS F. W. (Bridged) All 6/12v. D.C. output. Max. A.C. input 18v. 1a. **25p.** 2a. **35p.** 3a. **50p.** 4a. **65p.** 6a. **80p.**

PHILIPS STEREO AND MONO AUTOCHANGER

£9.75 Post 25p

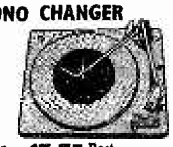


Precision hi-fi quality at bargain price. Silver and grey deck enamelled finish. 10¼in. dia. turntable. 4 speeds, 16, 33⅓ 45 and 78 rpm. Plays 7, 10, 12in. discs which can be mixed. Fitted renowned Philips plug-in pick-up with stylus LP Stereo/EP and 78. Sensitivity 100mV. Frequency response 30cps–16Kc/s. Lightweight stylus pressure 3–6 grammes. Board size required 14 × 12¼ in. Above 4in. Below 2¼in.

PHILLIPS PORTABLE PLAYER CABINET

Size 18 × 15¼ × 7¾in. Cut for above deck. Amplifier space 14 × 5 × 3¼in. Satin aluminium front grille. Really smart appearance. Black/White or Green/Grey. Chrome fittings. **£4** Post 25p

BSR C.109 SUPERSLIM
STEREO AND MONO CHANGER



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¾ × 11¼in. Above motor board 3¾in. below motor board 2½in. with STEREO and MONO XTAL **£7.75** Post 25p.

GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk II £15 Model 3500 Stereo and Mono Autochanger £14. Post 25p.

RECORD PLAYER PORTABLE CABINET **£3.75** Space for amplifier and autochanger. Post 25p.

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made with 2-stage triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer, knobs, loudspeaker valves ECL82, EZ80. Response 50–12,000 cps. Sensitivity 200mV. Post 25p. **£4**

RSC 2 WATT AMPLIFIER with loudspeaker and valves UCL82 and UY85 Post 25p **£3**

R.C.S. TEAKWOOD BASE. Ready cut out for mounting (State player make and model) **£2.75**

R.C.S. PLASTIC COVERS FOR ABOVE BASE. Durable tinted plastic, attractive appearance. **£2.75**

EMI PICK-UP ARM with mono xtal and stylus £1·25.

EMI JUNIOR 4 SPEED RECORD PLAYER Mains operated motor, turntable and pick up **£3** Post 25p.

HI-FI PICK-UP CARTRIDGES. Diamond Stereo/Mono. 9TA £2·90; GP94 £2·75; GP93 £2·25; Mono GP91 £1·50; GC8 £1·25; GP67 95p. ACOS L.P. only 50p. All standard fixing complete with stylus.

WEYRAD P50—TRANSISTOR COILS

RA2W Ferrite Aerial..	65p	Spare Cores	3p
Osc. P50/1AC........	30p	Driver Trans. LFDT4 .	50p
I.F. P50/2CC 470 kc/s.	33p	Printed Circuit, PCA1 .	50p
3rd I.F. P50/3CC......	33p	J.B. Tuning Gang.....	65p
P51/1 or P51/2	33p	Weyrad Booklet	10p
P50/3V	33p	OPTI	55p

Mullard Ferrite Rod 8 × ⅜in. 20p, 6 × ¼in. 25p.

VOLUME CONTROLS Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p

80ohm Coax 4p. yd. BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2. FRINGE LOW LOSS Ideal 625 and colour. **10p yd.**

WIRE-WOUND 3-WATT POTS. Small type with small knob. Values 10 Ω to 30 K., Carbon 30 K to 2 meg. **25p**

WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 10 OHMS to 100 K. **40p**

VEROBOARD 0·15 MATRIX
2½ × 5in. 19p. 2½ × 3¾in. 16p. 3¾ × 3¾in. 19p. 3¾ × 5in. 26p.
EDGE CONNECTORS 16 way 25p; 24 way 33p.
PINS 36 per packet 17p. FACE CUTTERS 33p.
S.R.B.P. Board 0·15 MATRIX 2½in. wide 3p per 1in.. 3¾in. wide 4p per 1 in.; 5in. side 5p per 1in. (up to 17in.). S.R.B.P. undrilled 1/16in. Board 10 × 8in. 15p.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides. 6 × 4in. 45p; 8 × 6in. 50p; 10 × 7in. 70p; 14 × 9in. 90p; 16 × 6in. 90p; 12 × 3in. 50p.

ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 8p; 8 × 6in. 15p; 10 × 7in. 17p; 12 × 8in. 23p; 14 × 9in. 27p; 12 × 12in. 32p.

1½ inch DIAMETER WAVE-CHANGE SWITCHES 25p. 2 p. 2-way, or 2 p. 6-way or 3 p. 4-way 25p each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 25p.
1 inch DIAMETER Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way. 6 p. 2-way, 1 wafer 60p, 2 wafer 90p. Extra wafers up to six 30p each.
TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 23p.

ALL PURPOSE HEADPHONES

H.R. HEADPHONES 200 ohms Super Sensitive ..	£1·75
LOW RESISTANCE HEADPHONES 3-5 ohms ..	£2·00
DE LUXE STEREO HEADPHONES 8 ohms ..	£3·25

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E. **£2.35** Post 15p

GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

for Mike, Tape, P.U., Guitar, etc. Battery 9–12v or H.T. line 200–300v D.C. operation. Size 1¾" x 1½" x ½". Response 25 c.p.s. to 25 Kc/s. 26db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. **90p** Post 10p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V ..	14p	100/25V ..	10p	16+16/500V ..	55p
4/350V ..	14p	250/25V ..	14p	50+50/350V ..	35p
8/450V ..	14p	500/25V ..	20p	60+100/350V ..	58p
16/450V	15p	8+8/450V	18p	32+32/250V ..	18p
32/450V	20p	8+16/450V	20p	32+32/450V ..	33p
25/25V	10p	16+16/450V	25p	32+32+32/350V	43p
50/50V ..	10p	32+32/350V	25p	100+50+50/350V	48p

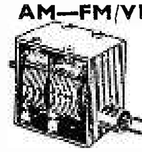
SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 35p.
CERAMIC 1pF to 0·01 mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p. 1,000V-0·001, 0·0022, 0·0047, 0·01, 0·02, 8p; 0·047, 0·1, 14p.
SILVER MICA. Close tolerance 1% 2·2–500pF 8p; 500–2·200 pF 10p; 2,700–5,600pF 20p; 6,800pF–0·01, mfd 30p; each.
TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365+365 with 25+25pF, 50p 500pF slow motion, standard 45p; small 3-gang 500pF £1·10. SHORT WAVE. Single 25pF 55p
CHROME TELESCOPIC AERIAL, swivel base, 23in. 20p.
TUNING. Solid dielectric. 100pF. 500pF, 35p each.
TRIMMERS. Compression 30, 50, 70pF, 5p; 100pF, 150pF, 8p; 250pF, 18p; 600pF, 750pF 10p; 1000 pF 10p.
RECTIFIERS CONTACT COOLED ½ wave 60mA 38p; 85mA 48p. SILICON BYZ13 30p; BY100 30p; BY127 30p.
EX-GOVERNMENT RECTIFIERS 250v, 200mA, 30p.
NEON PANEL INDICATORS 250V AC/DC Red or Amber 30p.
RESISTORS. ¼ w., ½ w., 20% 1p; 2 w. 5p.
HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p.
Ditto 5% Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt 10 ohms to 100K, 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key

⅜in. 33p	⅞in. 38p	1⅛in. 38p	1⅜in. £1·20	2 3/32 in. £2·21
½in. 33p	1in. 38p	1¼in. £1·08	1½in. £1·45	2½in. £2·86
⅝in. 34p	1 1/16in. 38p	1⅛in. £1·08	2in. £1·99	1in. sq. £1·83

AM—FM/VHF TUNING GANG



Super quality small size 1½ × 1½ × 1¾in., plus spindle 1½ × ¼in. 365 + 365 pF with 25 + 25 pF. British made. Geared slow motion drive 6:1. Plastic dust cover. 6BA tapped front vxing. Cast aluminium frame **50p** Post Free

MAINS TRANSFORMERS

ALL POST 25p each

250-0-250 50 mA. 6·3 v. 2 amps, centre tapped ..	£1·10
250-0-250 80 mA. 6·3 v. 4 amp.	£1·40
250-0-250 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£2·00
350-0-350 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£2·00
300-0-300 v. 120 mA., 6·3 v. 4 a. C.T.; 6.3 v. 2 a...	£2·50
MINIATURE 200 v. 20mA., 6·3 v. 1 a. 2½ × 2½ × 2in.	75p
MIDGET 220 v. 45 mA., 6·3 v. 2 a. 2¾ × 2½ × 2in.	90p
P.E. AURORA TRANS. 12 + 12v., 500mA	£1·50
MINI-MAINS 20v, 100mA. 1⅝ × 1⅝ × 1⅜in......	50p
HEATER TRANS. 6·3v. 3 a.	60p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6·3 v. 1½ amp...	80p

GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2·00
1 amp.. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60, £2·00
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3·00
AUTO TRANSFORMERS 115v. to 230v. or 230v. to 115v. Input/Output, 150w. £2·00; 500w. £5; 1000w. £12.
CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp., £1·20; 2 amp £1·50; 4 amp. £1·90.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12 v. outputs, 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p.
All transformers Postage 25p extra.

E.M I. 13½ × 8in. LOUDSPEAKERS

With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45–60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2.25** Post 15p

Also with twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. As illustrated) **£4** Post 15p

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 25p **£5**

10W MINI-MODULE £3.25 LOUDSPEAKER KIT

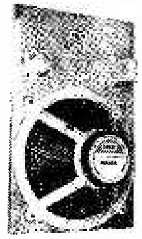
Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8¼ in. Separate Bass. Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16½ × 10½ × 6in. Modern Design, dark grey Tygan covered baffle **£5** Post 25p

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in. MAJOR £9



30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms. Post Free

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11.50**

BAKER "BIG—SOUND" SPEAKERS

'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front
For 12in. round Loudspeaker .... £9. Post 25p
For 13 × 8in. Loudspeaker .... £5. Post 25p
For 10 × 6in. round Loudspeaker ...... £4. Post 25p
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.

THIS ELAC CONE TWEETER IS OF THE VERY LATEST DESIGN AND GIVES A HIGHER STANDARD OF PERFORMANCE THAN MORE EXPENSIVE UNITS.

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1.90** Post 10p

TWO-WAY XOVER NETWORK 3000 c/s.

With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5¼in. × 4in. with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm imp. **£1.90** Post 10p

GOODMANS HEAVY DUTY 10in. WOOFER 10w. Large ceramic magnet. 30–12,000 cps. Ideal P.A., Columns, Hi Fi. Enclosures etc. **£4**

Horn Tweeters 2-16kc/s, 10W 8 ohm or 15 ohm £1·50. De Luxe Horn Tweeters 2-18 Kc/s, 15W, 8 ohm £3. TWO-WAY 3000cps CROSSOVERS 3 or 8 or 15 ohm 95p. SPECIAL OFFER! 80 ohm, 2¾in. dia.; 35 ohm. 3in. 25 ohm, 3in. dia.; 6 × 4in.; 8 × 5in. 15 ohm 3¼in. dia; 7 × 4in.; 8 × 5in. 3 ohm, 2½in, 3in, 5in. 5 × 3in. 7 × 4in. **£1** EACH TYPE

LOUDSPEAKERS P.M. 3 OHMS. 6½in. £1.10; 8 × 5in. £1·25; 8 × 2½in. 90p; 3in. £1.75; 10 × 6in. £1.90.
5in. WOOFER 8 watts max. 20-10,000 cps. 8 or 15 ohm. £1·80.
ELAC 8 in. De Luxe Ceramic 3 ohm or 15 ohm £2·50.
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. dia. 4 watt; 10in. dia. 5 watt; 12in. dia. 6 watt 3 or 8 or 15 ohm models £1.95 each. Post 15p.
OUTPUT TRANS. EL34 etc. 25p; MIKE TRANS. 50:1 25p.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
GOODMAN'S OUTPUT TRANSFORMER 5 watt push-pull for valves EL84 etc., 3, 8 and 15 ohms 85p. Post 20p.

100 WATT ALL PURPOSE POWER AMPLIFIER

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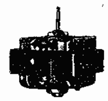

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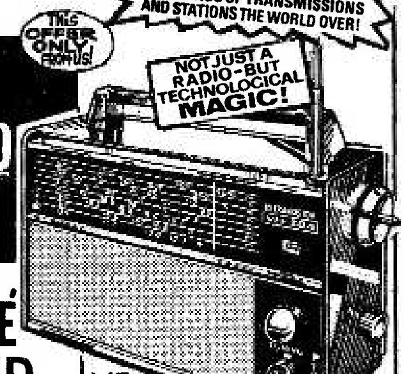

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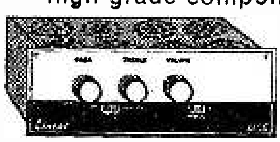

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Suitable for speakers 3-15 ohms.

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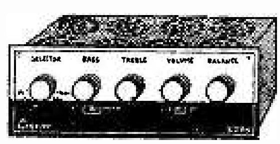

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2N4288	17½p
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NKT210	30p
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NKT244	17½p
NKT245	20p
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NKT262	30p
NKT264	20p
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NKT452	62½p
NKT453	47½p
NKT603F	32½p
NKT613F	32½p
NKT674F	30p
NKT677F	30p
NKT713	25p
NKT781	30p
NKT10419	30p
NKT10439	37½p
NKT10519	32½p
NKT20329	47½p
NKT20339	37½p
NKT80111	77½p
NKT80112	97½p
NKT80113	£1.12
NKT80211	92½p
NKT80212	92½p
NKT80213	92½p
NKT80214	92½p
NKT80215	92½p
NKT80216	92½p
OC20	75p
OC22	50p
OC23	60p
OC24	60p
OC25	50p
OC26	27½p
OC28	62½p
OC29	62½p
OC35	50p
OC36	62½p
OC41	22½p
OC42	25p
OC44	20p
OC45	12½p
OC46	15p
OC70	15p
OC71	12½p
OC72	12½p
OC74	32½p
OC75	22½p
OC76	22½p
OC77	30p
OC81	20p
OC81D	22½p
OC83	25p
OC84	25p
OC139	32½p
OC140	32½p
OC170	30p
OC171	30p
OC200	40p
OC201	60p
OC202	75p
OC203	42½p
OC204	42½p
OC205	90p
OC207	75p
OCP71	42½p
ORP12	62½p
ORP61	50p
P346A	22½p
TIS34	62½p
TIS43	40p
TIS44	12½p
TIS45	12½p
TIS46	12½p
TIS47	12½p
TIS48	12½p
TIS49	12½p
TIS50	17½p
TIS51	12½p
TIS52	12½p
TIS53	22½p
TIS60	22½p
TIS61	25p
TIS62	27½p
TIP29A	50p
TIP30A	60p
TIP31A	62½p
TIP32A	75p
TIP33A	£1·02½p
TIP34A	£2·05

Post & Packing 12½p per order. Europe 25p. Commonwealth (Air) 65p (MIN.)
Matching charge (audio transistors only) 12½p extra per pair.
Prices subject to alteration without prior notice.

TTL. LOGIC I.C. NEW PRICES

	1–24	25–99	100–499
SN7400 ..	25p	20p	18p
SN7401 ..	25p	20p	18p
SN7402 ..	25p	20p	18p
SN7403 ..	25p	20p	18p
SN7404 ..	25p	20p	18p
SN7405 ..	25p	20p	18p
SN7406 ..	80p	75p	70p
SN7407 ..	25p	20p	18p
SN7408 ..	25p	20p	18p
SN7409 ..	25p	20p	18p
SN7410 ..	25p	20p	18p
SN7411 ..	25p	20p	18p
SN7413 ..	50p	45p	40p
SN74118..	£1	90p	80p
SN7420 ..	25p	20p	18p
SN7430 ..	25p	20p	18p
SN7440 ..	25p	20p	18p
SN7441AN	£1·00	90p	80p
SN7442 ..	£1·00	90p	80p
SN7445 ..	£2·50	£2·30	£2·10
SN7446 ..	£1·25	£1·10	£1·00
SN7447 ..	£1·10	£1·00	90p
SN7448 ..	£1·00	90p	80p
SN7450 ..	25p	20p	18p
SN7451 ..	25p	20p	18p
SN7453 ..	25p	20p	18p
SN7454 ..	25p	20p	18p
SN7460 ..	25p	20p	18p

	1–24	25–99	100–499
SN7470 ..	45p	40p	35p
SN7472 ..	40p	35p	30p
SN7473 ..	45p	40p	35p
SN7474 ..	45p	40p	35p
SN7475 ..	£1·00	90p	80p
SN7476 ..	45p	40p	35p
SN7482 ..	£1·30	£1·20	£1·10
SN7483 ..	£1·00	90p	80p
SN7486 ..	50p	45p	40p
SN7490 ..	£1·00	90p	80p
SN7491 ..	£1·50	£1·40	£1·30
SN7493 ..	£1·00	90p	80p
SN7494 ..	£1·50	£1·40	£1·30
SN7495 ..	£1·00	90p	80p
SN7496 ..	£1·00	90p	80p
SN74107	45p	40p	35p
SN74121..	90p	85p	80p
SN74151..	£1·10	£1·00	90p
SN74153	£1·90	£1·70	£1·50
SN74154	£2·20	£1·45	£1·80
SN74160/ T157D1	£1·80	£1·70	£1·60
SN74161	£2·60	£2·50	£2·40
SN74164	£2·20	£1·95	£1·80
SN74165	£2·25	£1·95	£1·80
SN74192	£2·25	£1·95	£1·80
SN74193	£2·25	£1·95	£1·80

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	10p	12½p	15p	16p	17½p	19p	20p	—
3A	15p	—	—	22½p	—	30p	—	—
6A	—	—	25p	30p	32½p	35p	—	—
10A	—	52½p	57½p	65p	77½p	86½p	97½p	£1·25
17A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½
35A	—	80p	90p	£1·00	£1·25	£1·50	£2·50	—

1 amp and 3 amp are plastic encapsulation.

DIODES & RECTIFIERS

IN34A	10p	AA119	10p	BAX16	12½p	BYZ13	25p
IN914	07½p	AA129	10p	BAY18	17½p	FST3/4	22½p
IN916	07½p	AAZ13	10p	BAY31	07½p	OA5	17½p
IN4007	22½p	AAZ15	12½p	BAY38	25p	OA10	22½p
IS44	10p	AAZ17	12½p	BY100	17½p	OA9	10p
IS113	15p	BA100	15p	BY103	22½p	OA47	07½p
IS120	15p	BA102	22½p	BY122	47½p	OA70	07½p
IS121	17½p	BA110	32½p	BY124	15p	OA73	10p
IS130	12½p	BA115	07½p	BY126	15p	OA79	09p
IS131	12½p	BA141	32½p	BY127	17½p	OA81	07½p
IS132	15p	BA142	32½p	BY164	57½p	OA85	07½p
IS920	07½p	BA144	12½p	BYX10	22½p	OA90	07½p
IS922	07½p	BA145	20p	BYZ10	35p	OA91	07½p
IS923	07½p	BA154	12½p	BYZ11	32½p	OA95	07½p
IS940	07½p	BAX13	12½p	BYZ12	30p	OA200	10p
						OA202	10p

TRIACS

SC35D	£1·12½	SC51D	£1·95
SC36D	£1·00	40430	97½p
SC40D	£1·50	40486	95p
SC41D	£1·20	40528	72½p
SC45D	£1·62½	40430	£1·30
SC46D	£1·42½	40432	£1·87½
SC50D	£2·05	40512	£1·45

BRIDGE RECTIFIERS

A.	PIV		A.	PIV	
1	100	47½p	4	50	60p
1.4	140	52½p	4	100	70p
2	50	55p	4	400	95p
2	200	70p	5	50	62½p
2	400	80p	6	200	87½p
			4	400	£1·12½

THYRISTORS

PIV	50	100	200	300	400
1A	25p	27½p	37½p	40p	47½p
4A	47½p	55p	57½p	—	77½p
5A	—	55p	65p	—	90p
7A	—	55p	65p	—	97½p

TIC47 0.6 amp. 200 PIV 55p.
Also 12 amp. 100 PIV 75p
2N3525 at £1.12½p

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½ × 3¾in	17½p	20p
2½ × 5in	21p	24p
3¾ × 3¾in	21p	24p
3¾ × 5in	27½p	27½p
5 × 17in (Plain)	85p	—

Vero Pins (Bag of 50) 25p
(Bag of 100) 40p
Vero Cutter 45p
Pin Insertion Tools (·1 and ·15 matrix) at 55p.

HEAT SINKS

4·8 × 4 × 1in Finned for Two TO-3 Trans., 47½p. 4·8 × 2 × 1in Finned, for One TO-3 Trans., 32½p. For SO-1, 2½p. For TO-5, 5p Finned. For TO-18, 5p Finned. For TO-18, 1/– Finned.

RESISTORS

Carbon Film

⅛ watt 5%, 1p. — ⅛W, 1W & 2W E24 Series.
¼ watt 5%, 1½p.
½ watt 5%, 2p.
1 watt 10%, 2½p. — ¼W & ½W E12 Series.
2 watt 10%, 6p.

CAPACITORS

A large and comprehensive range available: Electrolytic, Polyester, Ceramic, Polystyrene, Silver Mica, Tantalum, Trimmers, Tuners.

Examples:
2,000mF 25V, 42½p
2,500mF 50V, 67½p
3,000mF 25V, 52½p
5,000mF 50V, 97½p
Most Mullard Electrolytics in stock

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only). 7½p
5 watts 5% (up to 8·2kΩ only), 10p
10 watt 5% (up to 25kΩ only), 12½p

POTENTIOMETERS

Carbon:
Log. and Lin., less switch, 16p.
Log. and Lin., with switch, 25p.
Wire-wound Pots (3W), 40p.
Twin Ganged Stereo Pots, Log. and Lin., 40p.

PRESETS (CARBON)

0·1 Watt 6p
0·2 Watt 6p
0·3 Watt 7½p
VERTICAL OR HORIZONTAL

THERMISTORS

R53 (STC) £1·27½ — VA3705 87½p
K151 (1k) 12½p
Mullard Thermistors also in stock. Please enquire.

Tel. 01-452 0161/2/3 — Telex 21492

A. MARSHALL & SON

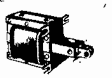
28 CRICKLEWOOD BROADWAY, LONDON, N.W.2

Send 5p for new Comprehensive Semiconductor and I.C. list (24 pages).

CALLERS WELCOME
HRS. 9–5.30 MON.-FRI.
9–5.0 SAT.
9–1.0 THURS.

HEARING AID AMPLIFIERS
(Ex behind ear deaf aids) 3 transistors on tiny P.C. board with volume control—whole thing only about half as big as Oxo cube. **£1·75** or with sub-miniature microphone and L.S. attached **£3·50.**

MAINS OPERATED SOLENOIDS



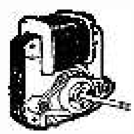
Model 772—small but powerful ⅝" pull—approx size 1½" x 1¼" x 1¼" **60p.** **Model 400/1** ⅜" pull Size 2¾" x 2" x 1¾" **75p.**
Model TT10 1½" pull Size 3" x 2½" x 2½"—**£1·80** plus 20p post and insurance.

BEST QUALITY BRITISH MADE ELECTRICAL PLUGS AT APPROX. HALF PRICE
15 amp 3 pin **10p** each or ten for **90p**, 5 amp 3 pin **8p** each or ten for **70p**, 5 amp 2 pin **5p** each or ten for **45p.**

DRILL CONTROLLER
NEW IKW MODEL

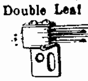
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50** plus 13p post and insurance. Made up model also available, **£2·25** plus 13p post & p.

MAINS MOTOR



Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **50p.** Postage 15p for first one then 5p for each one ordered.

NEED A SPECIAL SWITCH?



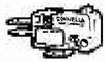
Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic push-rod suitable for operating, **5p** each, **45p** doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **18p** each, **£1·80** dozen, your assortment

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. **50p** post free.

MICRO SWITCH

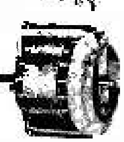


5 amp. changeover contacts, **9p** each, **£1** doz. 15 amp. on/off **10p** each, 15 amp changeover **15p** each, 10 for **£1·35.**

MAINS OPERATED CONTACTOR

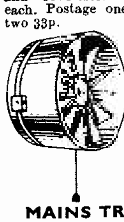
220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2½ x 2 x 2in. **£1 each.**

PAPST MOTORS



Est. 1/40th h.p. Made for 110–120 volt working, but two of these work ideally together off our standard 240 volt mains. A really beautiful motor, extremely quiet running and reversible. **£1·50** each. Postage one 23p, two 33p.

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, **£2** plus 36p post and ins.

MAINS TRANSISTOR POWER PACK
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **83p**, plus 18p postage.

24V BUZZER.
Made by G.E.C. in brown heavy bakelite case, these work off AC mains through step down transformer. Price **40p** each.

9 PIN PLUG AND SOCKET.
Suitable for connecting multicore flexer to equipment. Socket size approx. ⅞" diameter. Plug size 9/10" diameter with flex entry. **25p** pair.

OUT OF SEASON BARGAIN
TANGENTIAL HEATERS

Once again we are able to make a special bargain offer of these very popular heating units. Tangential heaters although brought out a few years ago are still the latest and best type as nothing has yet been made which could be called an improvement on them. The Tangential unit is still the only one used in good quality heaters made by Hoover, G.E.C. and all the famous names. The unit comprises quiet running AC induction mtor with special bearings, the tangential impeller and a 2 section heater element which allows switching **half** and full heat in the case of the 2 k.w. and one third—two thirds and fr" heat in the case of the 3 k.w. These heaters are also fitted with a **safety cutout** to cut the heaters should the impeller stop or the air flow be impeded. They are free standing and need only the simplest of cases, even a wooden cabinet is suitable or the plinth of the kitchen cabinet. Lots of customers missed our special Summer offer of these heaters last year so order early. 200/240 2 k.w. model **£2·50.** 200/240 3 k.w. model **£3·50.** Control switch heaters only **25p** or two-heat, cold-blow and off **35p.** Postage and insurance 33p on heaters.

STANDARD WAFER SWITCHES
Standard size 1½ wafer—silver-plated 5-amp contact, standard ¼" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

AMPLIFIER MAINS TRANSFORMER
50v 1½ amp. Upright mounting with fixing brackets and metal shrouds to contain magnetic field, 50 c/s primary, tapped 110v, 117v, 210v, 230v and 250v. 2 secondaries, one 50v 1½ amp. other 6v 1 amp for pilot light, etc. **£1·95,** postage 30p.

THIS MONTH'S SNIP
BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3¾" x 6¼" x 2" with leads and prods. Price **£1·75** plus 20p postage.

COMPUTER TAPE

2,400 ft. of the best magnetic tape money can buy. Almost unbreakable and on a metal computer spool. Users have claimed successful results with video as well as sound recordings 1" wide **£1**, ¾" **88p**, ½" **75p**, P. & P. 33p extra. Spare spools **50p** each. Cassette to hold spool **50p** each. No extra postage if ordered with tape, otherwise 30p extra.

CAPACITOR DISCHARGE IGNITION SYSTEM
Well proved that it helps starting and increases petrol economy. Also increases acceleration but saves contact wear. For details see Practical Wireless June. Gives optional capacitor or standard ignition at the flick of a switch. Price **£4·95**

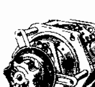
MICROSONIC KEYCHAIN RADIO

7 transistor Keychain Radio in very pretty case, size 2¾ x 2¼ x 1¼in.—complete with soft leather zipped bag. 7 transistor, ferrite rod. Loudspeaker.
In transit from the East these sets suffered corrosion as the batteries were left in them but when this corrosion is cleared away they should work—offered without guarantee except that they are new. Price only **£1·25** less batteries plus **13p.** post 6 for **£7** post free. Pair of rechargeable batteries and charger **85p.**

MAINS RELAY BARGAIN
Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V. A.C. Good British Make. Unused. Size approx. 1½" x 1".

Open construction		
Single pole	**25p** each	**10 for £2·25**
Double pole	**32p** each	**10 for £2·90**
Treble pole	**40p** each	**10 for £3·60**

4 AMP VARIAC CONTROLLERS

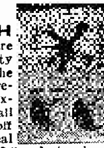


With this you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. Ex equipment but little used—as good as new offered at approx. half price. **£5** plus 75p. post and ins.

OVEN THERMOMETER WITH ALARM

Basically this is a thermometer which is calibrated between 500 and 900 deg. C using a sensor on a flexible lead. The second feature, however, is an alarm which can be set anywhere within the temperature range. When the temperature is reached a buzzer sounds. Presumably the buzzer could be replaced by a relay or contactor to work another device. Limited quantity only of these units, price **£3·50,** includes thermometer —scale—sensor and buzzer.

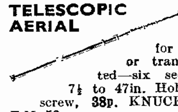
ELECTRIC CLOCK WITH 25 AMP SWITCH



Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **£2**, less than the value of the clock alone—post and insurance 14p.

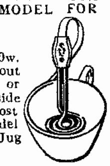
P.W.
TREASURE TRACER
As described in this issue.
Send today for price list of parts.

TELESCOPIC AERIAL



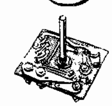
for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw, **38p.** KNUCKLED MODEL FOR F.M. **50p.**

QUICK CUPPA



Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1·25,** post and insurance 14p. 12v. car model also available same price. Jug heater **£1·50** plus p. & p. 14p.

THYRISTOR LIGHT DIMMERS



Will dim incandescent lighting up to 600 watts from full brilliance to out. Assembled and wired ready to install **£3.**

12 VOLT 1½ AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mf/d/ smoothing. Price **£1·50** + p. & p. 20p.

REED SWITCHES
Glass **encased,** switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature. 1in. long × approximately ⅛in. diameter. Will make and break up to ½A up to 300 volts. Price **13p** each. **£1·20** dozen.
Standard. 2in long × 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **10p** each. **90p** per dozen.
Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ⅛in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price **30p** each. **£3** per dozen.
Small ceramic magnets to operate these reed switches **9p** each. **90p** per dozen.

PUSH BUTTON CHANGE OVER SWITCHES

This is a Honeywell micro switch mounted on a metal frame with spring loaded plunger to operate. Panel fixing by single ⅜" hole. Single Changeover switch **25p** each or ten for **£2·25**, 2 changeover switch operated by single plunger **35p** each or ten for **£3·15**, 3 changeover switches **45p** each or ten for **£4·05.**

METER BOX
Designed to take 3½" flush mounting meter. This has a 2¾" diameter hole with 3 meter fixing holes. Overall size of box 4" x 4" x 2½" deep, hinged to a metal base 2½" x 4½" x ⅝" deep. Price **50p.**

PILOT BULBS
6-8 Volts 15 amp tubular MES British made good quality. 1 dozen in a box. 25p per box.

5 AMP CONNECTOR STRIPS
This is the normal type of connector strip. 12 connectors with grub screws mounted in a line and moulded in polythene. **15p** each **£1·50** perdozen.

A New Service to Readers. A bulletin bringing news of new lines, special snips and "too few to advertise" lines will be posted to subscribers during first week of each month. The bulletin will be called "Advance Advert News" and the Subscription is **60p** per year. Subscribers will also receive our completed 1971 catalogue when this is published.

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

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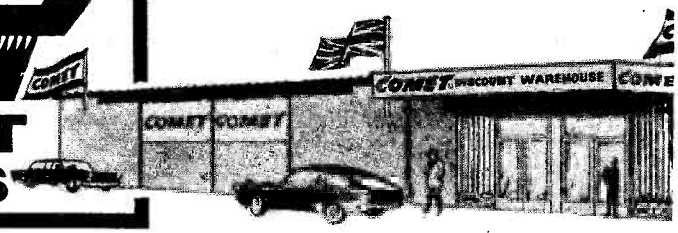
COMET
HI-FI DISCOUNT WAREHOUSES

DRIVE-IN CAR PARK



STEREO AMPLIFIERS

	Rec. Retail Price	Comet Price
ALBA UA 700	34·50	26·00
ARMSTRONG 521	56·00	42·50
*DULCI 207	26·00	17·50
DULCI 207M	32·00	21·95
FERROGRAPH F307	62·00	44·00
GOODMANS Maxamp	54·00	38·00
LEAK Stereo 30 Plus	56·50	43·00
LEAK Stereo 30 Plus, in teak case	62·50	47·95
LEAK Stereo 70	69·00	52·00
LEAK Stereo 70, in teak case	75·00	56·95
*LINEAR LT 66	21·00	17·00
METROSOUND ST20	36·00	24·95
METROSOUND ST20E	39·50	29·50
PHILIPS RH 591	79·00	61·50
PHILIPS RH 590	52·00	39·50
PHILIPS RH 580	29·00	23·00
PIONEER SA500	62·10	41·95
PIONEER SA700	98·00	68·95
PIONEER SA900	134·10	95·95
PIONEER Reverberation	45·50	31·95
ROGERS Ravensbourne	59·50	45·95
ROGERS Ravensbourne (cased)	64·00	49·50
ROGERS Ravensbrook Mk. II	47·50	36·50
ROGERS Ravensbrook (cased) Mk. II	52·50	41·50
SINCLAIR 2000	35·00	27·00
SINCLAIR PROJECT 60/2 X Z30/PZ5	23·90	16·50
SINCLAIR PROJECT 60/2 X Z50/PZ8/trans.	34·86	23·25
SINCLAIR AFU	5·95	4·95
SINCLAIR Neoteric	61·95	46·00
SINCLAIR 3000	45·00	34·95
TELETON SAQ 206 (new release)	29·00	18·50
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs	185·00	139·00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

TUNERS

	Rec. Retail Price	Comet Price
*ARMSTRONG 523 AM/FM	53·76	42·00
*ARMSTRONG 524 FM	41·89	33·00
ARMSTRONG M8 Decoder	9·50	8·00
*DULCI FMT.7 FM	26·00	22·00
DULCI FMT.7S Stereo	35·00	29·25
GOODMANS Stereomax	82·52	49·95
LEAK Stereofetic Chassis	66·50	52·00
LEAK Stereofetic in teak case	72·50	59·00
PHILIPS RH 690	47·00	38·00
PHILIPS RH 691	89·00	75·50
PIONEER TX500 AM/FM	77·94	63·50
PIONEER TX900 AM/FM	153·69	123·00
ROGERS Ravensbourne chassis	61·89	47·95
ROGERS Ravensbrook	45·01	38·00
ROGERS Ravensbrook (cased)	51·26	41·00
TELETON GT 101	45·50	31·95
TELETON 201X FM	36·00	27·50

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

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
AKAI AA 8500	229·00	181·00
AKAI 6600	142·53	112·00
ARENA R500	82·00	67·00
ARENA 2400	90·30	72·00
ARENA 2700	105·00	85·00
ARENA T9000	303·45	258·00
ARMSTRONG M8 Decoder	9·50	8·00
ARMSTRONG 525	91·89	74·50
ARMSTRONG 526	104·71	84·50
GOODMANS Module 80, 35w. R.M.S.	95·00	72·00
MIDLAND 19/542	49·56	37·50
PHILIPS RH 790	139·00	112·00
PIONEER SX770 AM/FM	160·43	126·00
PIONEER SX990 AM/FM	194·74	150·00
PIONEER 440	111·10	89·00
TANDBERG 1171 comp. with decoder	110·00	94·00
*TELETON F2000	51·50	30·50
TELETON 7 AT 20	105·00	77·95
TELETON 10AT1 150w. RMS	160·00	103·00
TELETON TFS50	82·50	59·00
TELETON TFS 50LA MW/LW/VHF	87·50	63·50
*TELETON R.8000 with Speakers	63·25	37·50
TELETON CR55	120·00	87·00
TELETON GA101	37·50	28·50
WHARFEDALE 100.1	149·00	119·00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

All the above Tuners and Tuner/Amplifiers include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

COMET for after-sales service
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Pictured, Service Dept. at Clough Rd., Hull also at Leeds, Stockton, Goole, Wakefield, Doncaster, and Bridlington

PICKUP ARMS

	Rec. Retail Price	Comet Price
GOLDRING Lenco L75	12·33	10·50
GOLDRING Lenco L69	9·29	7·00
SME 3009 with S2 Shell	34·47	27·00
SME 3012 with S2 Shell	36·71	30·50

CARTRIDGES

	Rec. Retail Price	Comet Price
GOLDRING 800	13·00	6·95
GOLDRING 800E	18·86	10·95
GOLDRING 800 Super E	26·01	19·50
*GOLDRING CS90 Stereo	5·20	4·25
*GOLDRING CS91/E	7·81	6·25
GOLDRING G850	6·50	5·25
EMPIRE 100ZE/X	63·00	52·50
EMPIRE 999VE/X	44·50	36·00
EMPIRE 999TE/X	27·60	22·50
EMPIRE 999SE/X	21·00	17·50
EMPIRE 999E/X	16·50	13·00
EMPIRE 999/X	11·50	9·25
EMPIRE 909E/X	12·85	10·25
EMPIRE 909/X	9·00	7·50
EMPIRE 90EE/X	9·75	8·00
ORBIT Magnetic NM 22	Special Price	2·90
PICKERING V15 AC2	8·40	7·00
ORTOFON SL15E	29·65	23·75
ORTOFON 2X15K Transformer	7·00	5·25
SHURE M3DM	7·41	4·95
SHURE M31E	12·05	8·95
SHURE M32E	11·10	8·25
SHURE M32-3	10·20	8·00
SHURE M44-5	11·10	7·95
SHURE M44-7	10·20	8·00
SHURE M-44C	10·20	8·00
SHURE M44E	12·05	8·25
SHURE M55E	12·95	9·50
SHURE M75G	17·60	14·00
SHURE M75-6	16·70	13·00
SHURE M75EJ	19·45	16·00
SHURE M75E-95G	23·15	18·00
SHURE M75E	21·30	14·50
SHURE V15-11	40·76	28·95
SHURE V15-11-7	38·90	29·00

Starred cartridges above are ceramic. All others are magnetic.

TURNTABLES

GARRARD AP76 turntable, fully wired complete with Goldring G.800 Cartridge base and cover. Special Price 30·95
GARRARD SP25, Mk III fully wired with Goldring G800 Magnetic Cartridge. Complete with base, plinth and cover— Special Price 21·98
GARRARD 2025 fully wired with Sonotone 9TAHC Cartridge complete with base and cover Special Price 15·50
GOLDRING 705/P turntable, fully wired complete with Goldring G850 cartridge, base and cover 25·00 15·95

	Rec. Retail Price	Comet Price
DUAL 1219 transcription	60·40	50·00
DUAL 1209 transcription	42·62	35·00
GARRARD SP25 Mk III	16·45	11·90
GARRARD SL65 B	21·25	15·90
GARRARD SL75 B	39·20	26·50
GARRARD SL95 B	50·01	35·50
GARRARD 401	38·07	29·50
GARRARD SL72 B	33·11	27·90
GARRARD 3500, with GKS Cartridge	17·23	12·90
Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Special Price	4·00
GARRARD 40B	13·84	10·97
GARRARD AP 76	28·88	21·50
GOLDRING GL69 Mk. II	26·63	21·25
GOLDRING GL69 P Mk. II	35·14	28·50
GOLDRING GL75	36·41	31·50
GOLDRING GL75 P	46·94	38·50
GOLDRING Covers for 69P and 75P	4·21	3·50
GOLDRING C99—plinth and cover for G99	11·45	9·90
GOLDRING G99	26·00	22·90
GOODMANS 3025	37·74	26·90
McDONALD MP 60	15·75	11·75
McDONALD 610	20·00	15·75
Base and Cover for McDONALD MP 60 and 610	Special Price	4·50
PHILIPS 228	20·00	17·00
PHILIPS GA 146	31·50	25·00
PHILIPS 202 Electronic	69·00	54·00
PIONEER PL 12A with base & cover	49·93	37·95
THORENS TX 25 cover	8·85	7·00
THORENS TD125	79·04	61·95
THORENS TD125AB	120·20	98·00
THORENS TD150A Mk. II	46·16	35·95
THORENS TD150AB Mk. II	49·96	42·95
THORENS TX11 Cover	4·43	3·95

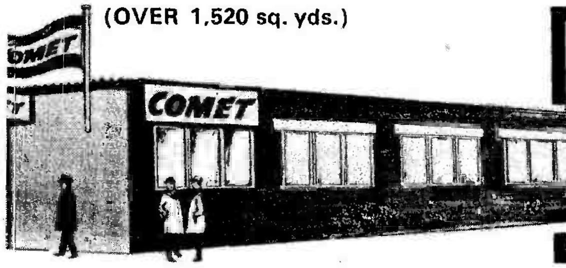
SPEAKERS

	Rec. Retail Price	Comet Price
B & W Model 70	159·50	121·95
B & W DM3	63·00	49·95
B & W DM1	32·00	25·50
CELESTION Ditton 120	24·00	18·00
CELESTION Ditton 15	32·00	25·50
CELESTION Ditton 25	65·00	50·95
GOODMANS Minister	25·00	20·50
GOODMANS Magister	62·50	47·95
GOODMANS Maxim	20·39	16·50
GOODMANS Mezzo 3	34·00	25·95
GOODMANS Magnum K2	44·00	33·00
KEF Cresta	22·17	18·00
KELETRON KN 500 4 speaker system (pair)	23·00	16·95
KELETRON KN 700 4 speaker system (pair)	27·50	19·95
KELETRON KN 1000 4 speaker system	19·25	13·95
KELETRON KN 1500 4 speaker system	24·75	18·95
KELETRON KN 2000 4 speaker system	28·75	20·95
LEAK 200	24·95	18·90
LEAK 300	32·50	23·95
LEAK 600	49·50	36·90
LOWTHER Acousta (with PM6)	45·50	38·50
LOWTHER Acousta (with PM7)	53·00	46·00
LOWTHER Ideal Baffle	35·50	30·00
METROSOUND HFS 103 (pair)	25·00	17·95
METROSOUND 202	21·50	15·95
METROSOUND HFS 20 (pair)	39·00	25·95
METROSOUND HFS 10 (pair)	27·44	22·95
PHILIPS RH481	11·00	8·95
PHILIPS RH482	18·00	14·95
SINCLAIR Q16	8·98	6·95
STE-MA 275 3 speaker system	23·10	15·95
WHARFEDALE Speakers		
Airedale	69·50	54·95
Denton	19·95	15·50
Super Linton	24·95	20·50
Melton	32·50	24·95
Dovedale 3	42·50	31·95
Rosedale	65·00	50·95
Triton (pair)	59·90	45·95
Unit 3 Speaker Kit	13·00	10·50
Unit 4 Speaker Kit	18·00	13·95
Unit 5 Speaker Kit	26·00	19·95

CHASSIS SPEAKERS

	Rec. Retail Price	Comet Price
GOODMANS Axiette 8	8·10	6·50
GOODMANS Twinaxiette 8	9·17	7·50
GOODMANS Axiom 10	9·16	7·75
GOODMANS Axiom 80	28·31	23·75
GOODMANS Axiom 201	14·45	10·95
GOODMANS Axiom 301	20·70	15·75
GOODMANS Axiom 401	17·86	14·95
GOODMANS Audiom 8P	5·55	4·25

(OVER 1,520 sq. yds.)



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GOODMANS Audiom 10P	6·05	3·58
GOODMANS Audiom 51	13·05	9·75
GOODMANS Audiom 61	18·95	14·00
GOODMANS 12P	12·37	10·00
GOODMANS 15P	20·00	16·97
GOODMANS Audiom 18P	34·00	26·97
GOODMANS Twin Axiom 10	10·23	8·25
GOODMANS ARU 172	4·50	3·50
GOODMANS Trebax 100	8·60	6·00
GOODMANS Trebax 5K/20XL	9·70	7·50
GOODMANS Midax	12·95	9·00
GOODMANS Attenuator	3·55	2·50
GOODMANS Crossover Networks XO/950/5000	9·75	7·25
GOODMANS Crossover Networks XO/950	7·40	5·75
GOODMANS Crossover Networks XO/5000	2·65	2·00
WHARFEDALE 8 in. Bronze/RS/DD	5·00	4·00
WHARFEDALE Super 8/RS/DD	8·50	7·00
WHARFEDALE Super 10/RS/DD	14·00	11·50
WHARFEDALE WMT 1 Matching Transformer	0·84	0·75
HI-FI STEREO SYSTEMS (complete)		
ARENA MR15	145·00	115·95
ALBA UA552	47·50	35·95
ALBA UA662	62·97	47·95
DECCA Sound 603	72·50	58·95
DECCA Sound 604	72·50	60·95
DECCA Sound 1203	97·50	78·95
DECCALIAN 5, complete with stand.	65·50	52·95
EKCO SRG 609	88·50	69·95
EKCO ZU5	165·00	135·00
FERGUSON 3422	87·85	69·95
FERGUSON 3423	118·25	94·95
FERGUSON 3424	123·15	99·95
FERGUSON 3425	145·10	111·95
FIDELITY Music Master UA2	46·00	34·95
FIDELITY Music Master UA1	98·00	82·95
GOODMANS 3000 Suite	140·45	92·95
H.M.V. 2416	129·70	103·00
H.M.V. 204/5/6	202·85	165·00
K.B. KA1250, complete with two 653 speakers	72·00	59·95
K.B. KA1250, complete with two 651 speakers	83·00	65·95
LEAK 30/GOLDRING/WHARFEDALE	182·65	142·95
LEAK 70/THORENS/WHARFEDALE	226·87	175·00
MARCONI Unit 4	77·45	66·95
MARCONI Unit 3	86·00	69·95
METROSOUND Stereo 1010	82·30	65·95
PHILIPS 580/481/105	71·00	55·95
PHILIPS GF823	51·50	41·95
PHILIPS GF824	69·50	56·95
PHILIPS GF833	67·50	55·95
PHILIPS GF834	88·00	73·95
PHILIPS 882 (less L/S)	99·00	78·50
PHILIPS GF417	99·50	82·95
TELETON 2S60F, with Stereo Radio	75·00	55·95
TOSHIBA SP8507	248·00	175·00
ULTRA 6405	79·95	66·95
TAPE RECORDERS AND TAPE DECKS		
AKAI M10L	245·05	185·95
AKAI X200D	190·00	155·95
AKAI X5000 W/L	177·98	135·95
AKAI X330	342·57	265·95
AKAI X-330D	312·56	243·95
AKAI X-360	380·08	279·95
AKAI X-360 D-deck	318·92	243·00
AKAI 1800SD	199·42	165·95
AKAI 1710L	89·85	65·95
AKAI 1720L	97·21	77·50
AKAI CR80 8-track stereo recorder	115·03	99·95
AKAI CR80D 8-track stereo tape deck	95·00	79·95

	Rec. Retail Price	Comet Price
AKAI 4000 4-track Stereo	124·90	97·95
AKAI 4000 D 4-track Stereo deck	89·95	69·50
BUSH TP 60 Cassette Tape Recorder	29·40	24·95
BUSH TP 70 Cassette Battery/Mains Tape Recorder	29·95	23·95
BUSH Discassette DC70	21·95	16·95
FERGUSON 3252 4-track	104·30	83·95
FERGUSON 3245 Twin track	38·00	29·95
FERGUSON 3246 4-track	44·10	34·95
FERGUSON 3247 4-track	49·65	39·95
FERGUSON 3248 4-track	55·65	43·95
FERROGRAPH 722	266·41	219·00
FERROGRAPH 724	266·41	219·00
FERROGRAPH 702 2 track tape deck	228·71	193·00
FERROGRAPH 704/W 4 track tape deck	228·71	193·00
GRUNDIG C200L deluxe Cassette	39·90	29·95
GRUNDIG TK 141 (4-track)	61·85	49·95
GRUNDIG TK 121 (Twin-track)	56·85	43·95
GRUNDIG TK 146 (4-track Auto)	68·14	53·95
GRUNDIG TK 149 4-track	57·63	47·95
MIDLAND TC 144 cassette	18·00	13·95
PHILIPS 2202 Cassette Tape Rec.	29·90	22·95
PHILIPS 2204 cassette battery/mains	33·50	25·95
PHILIPS 2205 Cassette Tape Rec.	43·15	34·95
PHILIPS 3302 Cassette	23·90	18·95
PHILIPS 4307	49·50	38·95
PHILIPS 4404 2-track stereo recorder	95·00	73·95
PHILIPS 4407 4-track stereo recorder	110·00	89·95
PHILIPS 4303	43·00	34·95
PHILIPS 4302 Twin Track Auto	39·00	32·00
PHILIPS 4500 4-Track Stereo Tape Deck	126·00	98·95
PHILIPS 4408 4-Track Stereo	139·00	109·00
PHILIPS 4308 4-Track	60·50	45·50
PHILIPS Cassette Stereo Tape Deck	54·00	45·95
PYE Cassette Recorder/Radio (Batt./Mains)	45·50	36·95
TANDBERG 1841 4-track Stereo Tape Deck	69·75	59·95
TANDBERG 3021X twin track stereo	109·90	93·00
TANDBERG 3041X 4-track stereo	109·90	93·00
TANDBERG 4021X twin track stereo	180·00	150·00
TANDBERG 4041X 4-track stereo	180·00	150·00
TANDBERG 6021X twin track stereo	195·00	165·00
TANDBERG 6041X 4-track stereo	195·00	165·00
TELETON 511 Batt./mains cassette	20·50	17·50
TELETON FXB 510 D 4-track Stereo	67·50	52·00
TELETON TRC 130 cassette. with VHF/AM radio. Battery/mains twin motors	41·75	31·90
TELETON TC110 cassette, battery/mains	27·75	20·00
TOSHIBA GT 840 S	110·00	67·95
TOSHIBA GT 601v Twin Track	45·15	29·95
TOSHIBA 850 SA	94·00	59·95
WHARFEDALE Dolby DC9 Cassette Stereo Tape Deck	115·00	97·00
BASES AND COVERS		
GARRARD WB1 Base	3·86	3·25
GARRARD WB4 Base	5·69	4·75
GARRARD SPC 1 Cover	3·74	3·00
GARRARD SPC 4 Cover	4·44	3·75
Special offer of Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Special Price	4·00
GOLDRING Plinth 75	8·52	7·00
GOLDRING Plinth 69	8·52	7·00
GOLDRING Covers for 69P and 75P	4·21	3·50
THORENS TX25 (for TD125AB)	8·22	6·50
THORENS TX11 Cover	4·11	3·75
Base and Cover for TD 125	15·18	12·50
SME Plinth System 2000	39·20	31·25
MOTORBOARDS only	4·95	3·00

COMPLETE HI-FI SYSTEMS

Completely wired, mounted and ready for use.

	Rec. Retail Price	Comet Price
GOODMANS AUDIO SUITE, Goodmans Maxamp stereo amplifier, Goodmans stereomax AM/FM Tuner with decoder. Pair of Goodmans Magnum K2 speakers, Garrard AP76 turntable in base, complete with cover and Goldring G800 Cartridge. Beautifully finished in walnut	257·13	169·95
GOLDRING 705P turntable complete with G850 Cartridge, Midland Tuner/Amp., pair of Metrosound 103 Speakers	99·56	69·95
GOODMANS Module 80 Tuner/Amplifier, Goodmans 3025 Turntable with Goldring G800 Cartridge with 2 Goodmans Minister Speakers	182·74	139·00
METROSOUND 448 8-track stereo play-back unit complete with 2 HFS 10 Speakers	83·56	70·95
GOLDRING 705P turntable complete with G850 Cartridge, Teleton 206 Amplifier, pair of Keletron KN500 Speakers	77·00	49·95
TELETON Stereo 8 track tape Audio system complete with speakers	54·75	48·00
GARRARD SP 25, Mk. III mounted in base, plinth and cover with GOLDRING G800 Cartridge. Teleton 206 Stereo Amplifier 12 watts RMS, and 2 KELETRON KN500 Speakers, each speaker is a 4 speaker system	88·33	58·95
PIONEER PL 12 turntable, Goodmans Maxamp, Shure M55E Cartridge, 2 Keletron KN 700 speakers (each speaker cabinet contains 4 speakers)	144.38	105·00
GARRARD AP76 turntable complete with Goldring G800 Cartridge, base and cover, Rogers Ravensbrook Amplifier in teak case and 2 Goodmans Minister Speakers	142·51	108·50
LEAK 30/THORENS/WHARFEDALE	182·65	142·95
GOLDRING GL 75P mounted in teak base with hinged perspex cover complete with GOLDRING G800E Cartridge. Leak Stereo 30 Plus Amplifier in Teak case. 2 GOODMANS Mezzo 3 Speakers	200·50	154·20
THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Stereo 70 Amplifier in Teak case. 2 Wharfedale Dovedale 3 Speakers	226·87	175·00
THORENS TD 125AB Electronic Turntable complete with cover. SHURE V15-11 Cartridge, GOODMANS Maxamp, GOODMANS Stereomax AM/FM Tuner. 2 GOODMANS Magister Speakers	422·48	309·00

Complete Price List FREE on request!

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(Dept. P.W.) 68A Armley Rd. (Artist St.), Leeds LS12 2EE Tel. 32055 (5 lines)

(Dept P.W.) Teesway, Portrack Lane, North Teesside Industrial Estate, Teesside, TS18 2RH Tel. 66132/65215

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Using the world famous gimbal pivot system. Complete but less pick up head. **£2·50** P. & P. 20p

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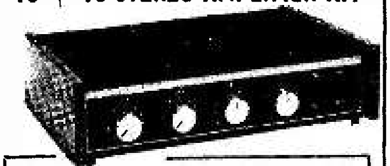
Beautifully made in heavy Mu-metal cylindrical case for minimum hum pick-up. Size 1½" high×1½" dia. Ratio 150 : 1 approx. Especially suitable for matching dynamic or ribbon mikes or pick up from low to high impedance or vice versa. **75p each Post Free**

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS
For TO3, complete with mica's & bushes. Size 2¾"×3" approx. **25p** pair P. & P. 5p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD FOR EASY CONSTRUCTION

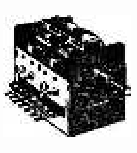
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12–15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12"w. x 8"d. x 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

PRICES

AMPLIFIER KIT	**£10·50**	P. & P. 15p
POWER PACK KIT	**£3·00**	P. & P. 30p
CABINET	**£3·00**	P. & P. 30p

(Post Free if all units purchased at same time)
Full after sales service
Also available ready built and tested **£20·50**. Post Free.
***Note:** The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.*

SPECIAL PURCHASE OF MANUFACTURERS SURPLUS!
All Transistor F.M. tuner head with twin A.M. Gang incorporated. Beautifully engineered with precision geared reduction drive. FM RF Transistor, oscillator/Mixer and first I.F. stage (10.7 Mc/s output) with optional AFC connection. Built on printed circuit panel and fully screened. Extremely stable over range 88–108Mc/s. Brand new and pre-aligned. Size 2¼"h x 1¾"w x 2½"d. For 6v D.C. at 2.8mA. A.M. Gang fitted with trimmers which can be connected to standard A.M. aerial and oscillator circuits if required. LIMITED NUMBER. Only **£2.25** post free. Connection details supplied.



HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × $\frac{1}{16}$in. FIVE for **50p**. P. & P. 13p.

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 6 section Lacquered Brass. Extends from 6in. to 22½in. approx. Maximum diameter ½in. **25p** each. P. & P. 5p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long x 3½in. wide x 3in. deep. Price **£1·75** P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500mA. **70p**. P. & P. 13p. Pri. 200/240v. Sec. 12–0–12 at 1 amp. **88p**. P. & P. 13p. Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£1·38**. P. & P. 30p. **Tapped Primary** 200–220–240v. Sec. 21.5v. at 500mA. **63p**. P. & P. 13p.

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Beautifully made teak finish enclosure with most attractive Tygan-Uynair front. Size 16½" high x 10½" wide x 5¼" deep. Fitter with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.

OUR PRICE £8.40 Carr. 65p
Cabinet Available Separately £4·50 Carr 60p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter **£6·50** Carr. 65p

LOUDSPEAKER BARGAINS
3" 4 ohm **50p**, P. & P. 8p. 5in. 3 ohm **80p**, P. & P. 15p. 7 × 4in. 3 ohm **£1·05**, P. & P. 20p, 10 × 6in. 3 or 15 ohm **£1·90**, P. & P. 30p, E.M.I. 8 × 5in. 3 ohm with high flux magnet **£1·62**. P. &. P. 20p E.M.I. 13¼×8in. 3 ohm with high flux ceramic magnet **£2·10** (15 ohm **£2·25**), P. & P. 30p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·20**, P. & P. 30p. E.M.I. 13" × 8" twin cone (parastatic tweeter) 8 ohm £2.25 P & P 30p.

BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production b y well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£5·50**. Guitar models: 25w. **£6·50**, 35w. **£8·50**. P. & P. 38p

E.M.I. 3½in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 or 15 ohms **93p** each. P. & P. 13p.

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35 ohm SPEAKERS 3in. only **63p** P. & P. 13p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price **75p** yd. length. P. & P. 15p (min 1 yd.) S.A.E. for samples.

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Adjustable headband with comfortable flexifoam ear-muffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15.000Hz. Matching impedance 8–16 ohms. PRICE **£2·95**. P. & P. 15p.

SINGLE HEADPHONE. With aluminium headband. Approx. 200 ohm, **25p**. P. & P. 8p

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, **93p**, P. & P. 8p

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **£1·05**, P. & P. 8p

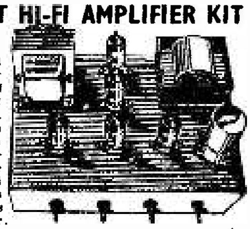
GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9–18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" x 1¼" x ¾". Brand new complete with instructions. Price **88p**. P. & P. 13p.

BRAND NEW E.M.I. LIGHTWEIGHT PICK-UP ARM WITH ARM REST. Fitted mono t/o stylus and cartridge for LP/78. ONLY **£1**, P. & P. 13p.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£3·75** P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **£4·88** P. & P. 50p.

DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14¼ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **£3·98**. P. & P. 50p.

10/14 WATT HI-FI AMPLIFIER KIT



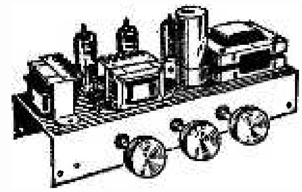
A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 13p (Free with parts). All parts sold separately. ONLY **£7·97** P. & P. 55p. Also available ready built and tested complete with std. input sockets, **£9·97**. P. & P. 55p.

BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched pair) **75p**; V15/10p **50p**; OC71 **25p**; OC76 **30p**; AF117 **18p**; 2G339 (NPN) **15p**.
Set of Mullard 6 transistors OC44, 2—OC45, AC128D matched pair AC128 **£1·25**; ORP12 Cadmium Sulphide Cells **53p**. All post free.

SPECIAL PURCHASE! SPEAKER CABINET FROM FAMOUS MAKER!

Beautifully made all wooden construction cabinet with medium walnut finish front, gold anodised expanded aluminium grille and dark sides. Approx. size overall 11½" high x 5" deep x 13½" wide at base. Easily removable baffle cut out for 8" speaker. Fibre board back. Could accommodate amplifier or radio together with speaker. An expensively made cabinet at a give away price.
LIMITED NUMBER ONLY **£1·38** Post Free.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mv for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. PRICE **£8·92** P.&P. 45p

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97** Carr. 50p. With stereo cartridge **£7·97** Carr. 50p.
SUITABLE PLINTH UNIT FOR ABOVE with rigid plastic cover. **£5·75** complete P. & P. 50p.
LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000, AT60 etc. S.A.E. for latest Prices!
PLINTH UNITS cut out for Garrard Models, 1025, 2025, 2000, 3000, 3500 etc. With rigid transparent plastic cover. Special design enables above models to be used with cover in position. Also suitable for housing AT60 and SP25. OUR PRICE **£5.75** complete. P. & P. 50p.

LATEST ACOS GP91/18C mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50** P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2·50** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3.** P. & P. 10p.
LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. **£1·63** P. & P. 10p.
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·50** P. & P. 10p.

3-VALVE AUDIO AMPLIFIER HA34 MK II.

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·75**. P. & P. 35p.

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

HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
FEW ONLY.
BARGAIN PRICE **£2.75** P. & P. 35p

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. 1971 edition including many 1000's of British, U.S.A., European and Japanese transistors.
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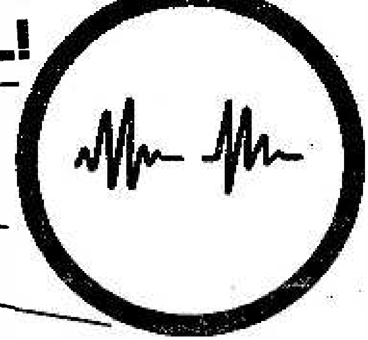

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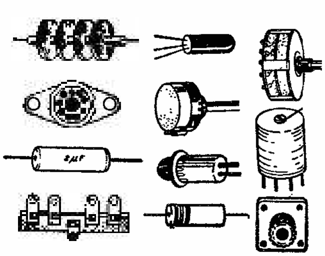

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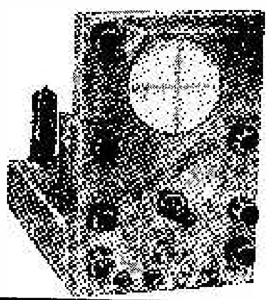

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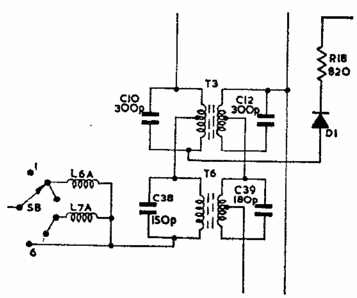

4 ▶ **CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS AND SEE HOW THEY WORK . . . INCLUDING . . .**

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- SERVICING PROCEDURES

This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of Electronic equipment, Radio and TV receivers, etc.

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PRACTICAL WIRELESS

VOL 47 NO 4
Issue 774

AUGUST 1971

Exhibitions R.I.P.?

THERE are probably more exhibitions today than ever before, but those embracing areas of interest to readers of P.W. appear to have suffered the ravages of economics, indecision and wrong priorities.

The pre-war "Radiolympias" were intended for trade and public alike and even the last one in 1939 had lots of interest for the home constructor. Most hobbyists who could get to Olympia, went there. Post-war radio shows carried on the tradition, although with less and less for the amateur enthusiast—the trend was changing.

In the last decade, the unity of the radio industry began to deteriorate as first one, then another, major company broke away from the main exhibition (then at Earls Court) to hold their own private shows. In 1964 there were over ten "splinter" shows in London at exhibition-time and this mass exodus killed the public radio and TV show in this country. The costs of mounting stands in the exhibition halls available, plus the attitude of brushing off the public (the ultimate customers) were contributory factors.

Now, after some years of August trade-only exhibitions scattered all over London, manufacturers this year abandoned the traditional "showtime" period and held their shows during May. An attempt to get the industry together again under one roof failed. Next year, shows will again be held in the Spring. After that one needs a crystal ball. But still there seems to be no hope of anything for the public to see!

On another front, the various audio exhibitions overlap to some extent and are the subject of both praise and criticism. The Audio Fair gave up hotel rooms for the open spaces of Olympia and brought in photographic and then musical instrument interests. There has been talk of radio and TV exhibits. However, even if audio exhibitions do not please everyone, at least the public can get in!

Discounting the more specialised and professional orientated exhibitions, this leaves one more erstwhile important calendar date for the radio amateur—the RSGB Exhibition. We have seen this develop (or disintegrate?) from its unpretentious but delightfully social atmosphere of the Hotel Royal days, through various stages at Seymour Hall and Royal Horticultural Hall. It tried to change its angle, gave itself a pompous (and, we feel, misleading) name, lost its character and died. For this year there is to be no RSGB Exhibition.

A sad story for exhibition-minded radio enthusiasts. The problems will only be solved when we have more modern (and economic) exhibition halls for the larger shows and organisers, societies and manufacturers who are old-fashioned enough to think first of the public, then give them what they want.

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

SEPTEMBER ISSUE WILL BE PUBLISHED ON AUGUST 6th

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

12V Iron from Antex

Antex have introduced the 'MES 12' soldering iron for operation from any 12 volt supply such as a car battery or accumulator.

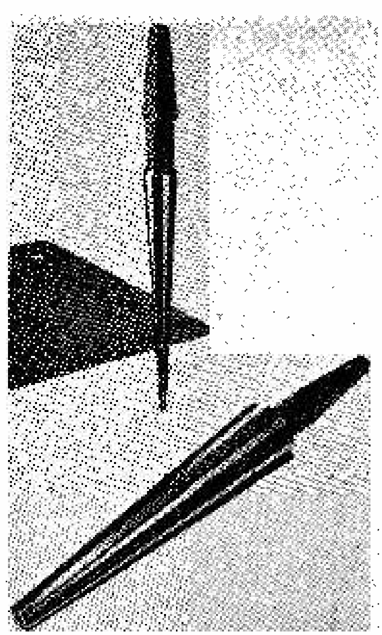
Two large crocodile clips provide direct connection to the battery terminals and 15 feet of 2 core lead gives ample scope for normal operation.

This iron is absolutely ideal for use in conditions where a mains supply is not available. It is supplied in a durable plastic wallet which will 'house' the iron when not in use. Recommended U.K. price is £1·95. *Antex Limited, Mayflower House, Plymouth, Devon.*

Fudging irons

West Hyde Developments are asking: How often do you fudge a hole? They maintain that their taper reamers are the finest fudging irons available. These West Hyde reamers, due to their many flutes and cutting edges, will open a hole from $\frac{1}{8}$in to $\frac{7}{16}$in in a few seconds and the hole will be rounder than when drilled. On the many occasions when equipment cannot be put up on a drilling machine due to size and damaging the finish a West Hyde reamer in an ordinary hand brace will solve the problems without vibration and with little effort.

Two sizes are available, $\frac{1}{8}$in. to $\frac{1}{2}$in (3mm to 12mm) and $\frac{3}{8}$in to 1in (9mm to 25mm). Prices are: small size £2·75+10p postage and packing. Large size £3·40+15p postage and packing.



The I.B.C. 1972

One of the leading events in the world broadcasting calendar, the International Broadcasting Convention, will next be held in London from 4-8 September 1972. This will be the fourth IBC.

The Convention, which will be held at Grosvenor House, Park Lane, will comprise technical sessions and a comprehensive exhibition of the latest television and sound broadcasting equipment, both highlighting the future technological options available to broadcasting administrations.

IBC is sponsored by the Electronic Engineering Association, the Institution of Electrical Engineers, the Institute of Electrical and Electronics Engineers, the Institution of Electronic and Radio Engineers, the Royal Television Society and the Society of Motion Picture and Television Engineers.

All enquiries to *The Secretariat, International Broadcasting Convention, IEE, Savoy Place, London WC2R 0BL, England.*

Cut price stereo

Audio Supplies Limited have a supply of "The Great Musicians" stereo LPs and for £1·15p (p.p. free) they are offering three records. Each 10in. stereo LP is incorporated in an illustrated 12-page record book which gives an insight into the life of the composer and explains how his life influenced his work.

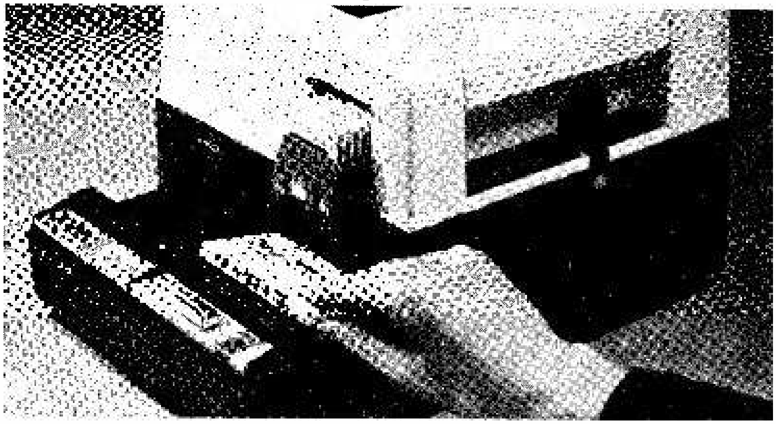
These LPs originally retailed for 13s. 11d. each and there are 55 titles from which to choose by 20 of the world's greatest composers. *Audio Supplies Limited, (Dept. P.W.) 50 Stamford Hill, London, N.16. Telephone 01-806 3611.*

Mobile rally diary

July 11	Worcester, Upton on Severn.
Aug 8	Woburn Abbey.
Aug 15	Derby.
Aug 22	Swindon, Wroughton Aerodrome.
Aug 29	Stratford-on-Avon.

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

Zeiss Ikon P500 projector



Basically, the P 500 consists of the Perkeo S 150 projector mounted on top of a Philips cassette tape recorder and loudspeaker to form a single unit. The projector can be used by itself in the normal manner and so can the tape recorder. Individual slides can be inserted in the gate without using the magazine—the importance of this feature will be appreciated by anyone who has done much slide-sorting. The forward and reverse movements of the magazine have also been retained and can be worked either manually (in which case you use a remote control cable instead of the push-buttons that are operated on the standard S 150) or else by means of the tape. To make the magazine move on to the next slide you put a short impulse on the tape; to make it move backwards to the slide shown previously you instead use a long impulse.

The Philips tape recorder is connected to the projector electrically. An extra record/playback head has been fitted to add the high-frequency impulse to the tape which changes the slides; the recorder itself is housed in a drawer which pulls out of the back of the unit. Space is provided to store spare cassettes, the microphone and various cables and accessories.

There are also, in addition to the mains inlet, four sockets. One allows you to connect an external speaker, useful when operating in a large hall. Another a combined input/outlet socket, lets you record from a source such as a microphone, radio, tape recorder, record player or mixer or alternatively to boost the output via an amplifier. A third allows the remote control for the projector to be fitted and the last one is for the cable that lets you put the slide change impulses on the tape.

The recommended price of the P 500 will vary according to the lens fitted, but with the Vario-Talon f3·5 70-120mm it is £222.18.6d £222·92½), including £66.18.6d (£66·92½) P.T. The price includes the microphone and the impulse device.

IC's on the wall

Mr. J. Evans of the Mullard Press Dept., informs us that a large coloured chart produced by the Mullard Educational Service outlines the manufacturing process of integrated circuits. It measures nearly 30×22in. and has diagrams showing cut-away views of a silicon chip at different manufacturing stages as resistors, capacitors, diodes and transistors are formed by various diffusion techniques. Captions alongside the diagrams detail what is done to the chip.

The chart is suitable for use in schools, colleges, universities and other training establishments where electronics is taught. Price 25p post free (send cash with order), it can be obtained from the *Mullard Educational Service, Mullard Limited, Mullard House, Torrington Place, London WC1E 7HD.*

Radio Brighton

From the start of programmes on Saturday, May 29, BBC Radio Brighton transmitted on 95·8MHz instead of 88·1MHz and the effective radiated power increased from 75 to 500W.

Lexor's board

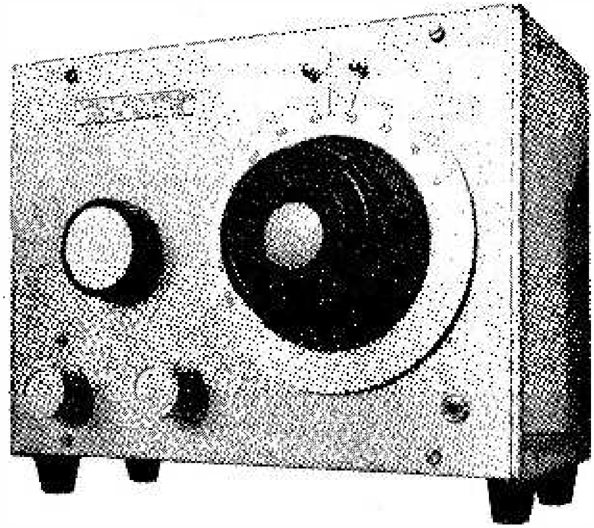
Lexor Dis-Boards Limited now announce their brand new 'Mini-Board'. Having pioneered the multi-socket power board business more than ten years ago, Lexor are aware that 75% of users' needs can be met by only one model. This has now been specially designed and set up for quantity production and sells for only £3·95.

Four high-grade 13A ivory sockets are mounted in a slim blue leather-finish case and fed via 5ft. of cable from a ready-fitted 13A ivory fused plug. There is the characteristic red safety warning lamp, and the units can be used portable and free-standing or easily fixed permanently to walls, benches, etc. Simple cable extensions of 15ft. or 25ft. are available for the situations where the flex will not reach.

Illustrated brochures carrying full details, prices and sales terms are available from *Lexor Dis-Boards Limited 25/31Allesley Old Road, Coventry.*

DIRECT CONVERSION RECEIVER for 80 metre SSB/CW

R. F. GRAHAM



AS anyone who has become interested in the reception of single-sideband and c.w. (Morse) signals knows, the usual type of receiver for a.m. (amplitude modulation) reception is not able to resolve these transmission. When a beat frequency oscillator is present in the receiver, s.s.b. and c.w. can be received and modern communications receivers have a b.f.o. Older communications receivers having a b.f.o. allow reception of s.s.b. but with some difficulty unless the operator is experienced.

REQUIREMENTS

To clarify requirements for s.s.b./c.w. reception, Fig. 1A shows the stages of a typical superhet. (1) is the r.f. amplifier, which amplifies signals at the received frequency. (2) is the mixer, with oscillator (3), which may be separate, or combined in a single frequency-changer. Output from this section is at a fixed intermediate frequency, and passes through the i.f. amplifier (4) to the a.m. and product detector circuits (5). With domestic type receivers, this stage is an a.m. detector only where a.m. signals are demodulated, and passed through the audio amplifier (6) to the speaker (7).

Where the receiver is intended also for s.s.b./c.w. reception, (5) incorporates a product detector and a beat frequency oscillator (8) is also provided.

When s.s.b. signals are received, the b.f.o. supplies an unmodulated r.f. input, which replaces the "carrier", suppressed in s.s.b. transmission. This local carrier and the s.s.b. from the i.f. amplifier (4) are combined in such a way as to give an audio output, which passes to the audio amplifier and speaker.

For c.w. reception, the output of the b.f.o. (8) heterodynes with the c.w. coming through the i.f. amplifier (4) to give an audio tone, is amplified and fed to the speaker (7).

Fig. 1B is a direct conversion receiver and its much greater simplicity is obvious. (1) is the r.f. amplifier, tuned to the required signal in the usual way and fed to a product detector (2) which also receives input from the variable frequency oscillator (3) which covers the band upon which reception is wanted the circuit being so designed that an audio output is obtained directly from the product detector (2), which is amplified by stage (4) and routed to the speaker.

When receiving s.s.b. only those s.s.b. frequencies which combine with the v.f.o. frequency to give an audio output are heard. Thus the selectivity of the receiver does not depend upon the r.f. amplifier or product detector signal frequency circuits but upon the selectivity of the audio stages.

Thus apparent selectivity is achieved because unwanted signals are combined with the v.f.o. in stage (2) to give outputs which are not in the audio range of stage (4). To receive c.w. the v.f.o. is tuned to one side of the c.w. carrier to give an audio output from the product detector. This particular circuit is not really suitable for the reception of a.m. signals which require the local carrier to be phase-locked to the a.m. carrier.

The receiver described here will be found to give a very lively performance. As it is assumed that anyone just becoming interested in the reception of amateur s.s.b. and c.w. may not have much in the way of calibration or test equipment, the v.f.o. is designed to use three 1 per cent tolerance capacitors and a coil with adjustable core, so that it is only necessary to set the core to give 80m band coverage. The radio frequency circuits are peaked for best reception.

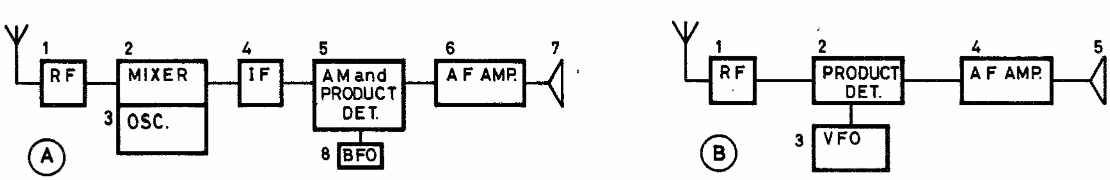
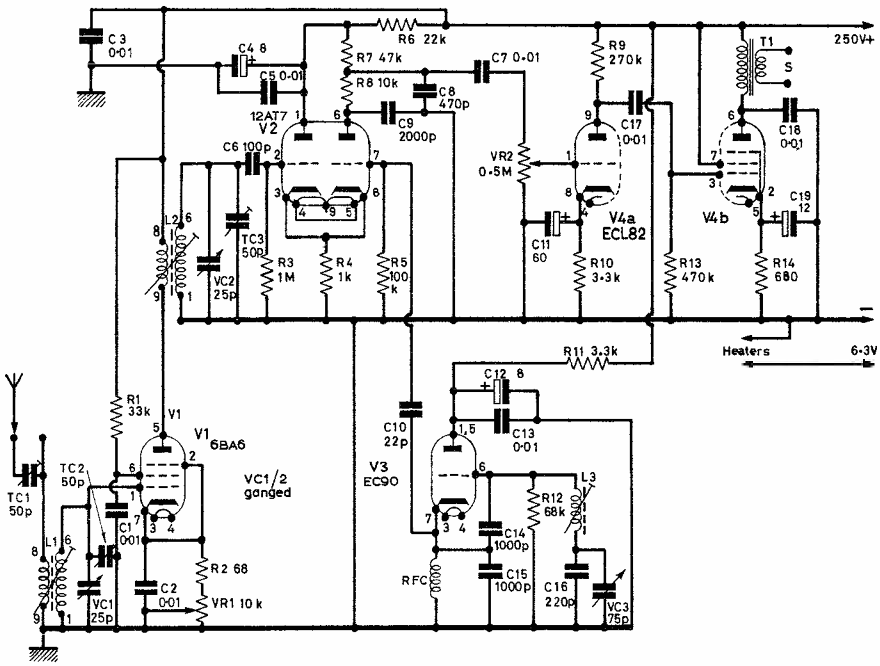
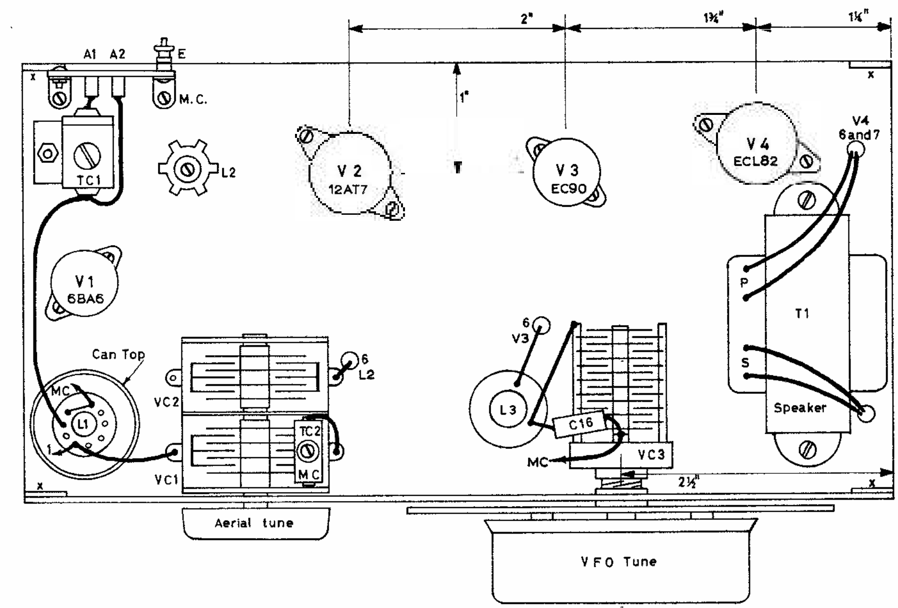


Fig. 1A shows the arrangement of the standard superhet while Fig. 1B illustrates the reduced number of stages required for a direct conversion receiver.



◀ *Fig. 2. The complete circuit of the Direct Conversion Receiver. The main tuning dial (shown in the heading photograph) drives the v.f.o. tuning capacitor VC3.*

▼ *Fig. 3. Layout of the major components on top of the chassis with important dimensions shown.*



CIRCUIT

Fig. 2 is the complete circuit. V1 (6BA6) is the r.f. amplifier, with gain control VR1. L1 and L2 are tuned by VC1/2, which is a small ganged capacitor for the r.f. tuning control.

V2 (12AT7) is the product detector, the wanted signal is present at one control grid and injection from the v.f.o. at the other grid. Audio output from the second anode passes to the 2-stage audio amplifier, VR2 being the volume control.

V3 (EC90) is the v.f.o. covering 3·5-3·8MHz, with a little to spare. VC3 is operated through a ball-drive and although tuning is quite critical it is eased by the narrow band covered by VC3. Coverage is determined by L3 and the three capacitors C14, C15 and C16, so it is only necessary to adjust the core of L3. Because of the large value of these capacitors changes in capacitance around V3 have little effect on its frequency.

C5 and C13 are r.f. by-pass capacitors with C4 and C12 in parallel with them to avoid hum from the h.t. supply and reduce audio feedback effects. The receiver is intended for use with a supply of about 220-250V at 40-50mA with the heaters drawing 1·53A at 6·3V.

CONSTRUCTION

The chassis, Fig. 3, is an 8×4in. "universal chassis" flanged member. This allows a complete case to be assembled by using two further 8×4in. members, top and bottom, with two 6×4in. members for the sides. The panel is 8×6in. and the surface of the chassis is 2in. above the bottom edge of the panel. Cut away the four corners "X" so that the 6×4in. sides fit round the chassis, allowing the box to be screwed together.

Flanges on the members listed are ready punched, and can be secured together with 4BA bolts and nuts while the receiver panel is secured to the top, bottom and side flanges with self-tapping screws. The case back should be of perforated metal, or have rows of ventilation holes.

VC1/2 is bolted to the panel, TC2 being soldered to a tag and VC1 as shown. The aerial coil L1 must be screened with the aluminium can supplied. The can lid is secured to the chassis by the fixing bush of L1. Leads for TC1 and VC1 pass out near the chassis. The lead from pin 6 passes through the chassis to tag 1 of V1. The normal adjusting screw of L1 cannot be reached because of VR1. So the core is removed, a shallow saw-cut is made across the end and it is replaced. Drill a hole in the screening can for this purpose and cut off about one-third of the screwed portion of the can, so that when it is tightly fitted it does not cut into the leads to TC1 and VC1.

TC1 is mounted on a strip of insulating material. A1 and A2 are optional aerial connections.

VC3 is fitted so that its spindle projects $\frac{9}{16}$in. The ball drive is lined up so that it rotates freely and its lug is held with a long bolt with extra nuts. The lead MC from VC3 in Fig. 3 runs to a tag bolted to the chassis near L3.

The primary (P) connections of T1 run through to pins 6 and 7 of V4. Secondary leads (S) go to a small panel jack, for speaker or headphones.

Inductors. With the "Range 3" coils listed, Blue for L1 and Yellow for L2, adjustment of the cores and TC2 and TC3 gives easy coverage of 80m and VC1/2 need not be exactly 25pF.

L3 is 30 turns of 26 s.w.g. enamelled wire, close-wound on a $\frac{1}{2}$in. diameter former with adjustable core. The winding is put near that end of the former furthest from the metal chassis and turns secured with Bostik 1.

Wiring. Wiring and components are shown in Fig. 4. The heater, grid and anode leads are run close to the chassis. Trimmer TC3 has one tag bolted to the chassis, so that it can be adjusted from the rear.

All connections should be reasonably short and direct, and run as shown. VFO wiring, especially to L3, C16 and VC3, is of stout wire, kept as short as possible.

Tag strips are used to support various small components. A 3-cored cable or coloured single flex twisted together, is employed for h.t. positive, 6·3V, and common return connections—red may be used

★ components list

Resistors :

R1	33kΩ 1W	R8	10kΩ
R2	68Ω	R9	270kΩ
R3	1MΩ	R10	3·3 kΩ
R4	1kΩ	R11	3·3kΩ 1W
R5	100kΩ	R12	68kΩ
R6	22kΩ	R13	470kΩ
R7	47kΩ	R14	680Ω

All ½W 10% except as indicated.
VR1 10kΩ potentiometer, wire wound.
VR2 500kΩ potentiometer, log.

Capacitors :

C1	0·01μF 350V disc	C11	60μF 6V
C2	0·01μF 350V disc	C12	8μF 350V
C3	0·01μF 350V disc	C13	0·01μF 350V disc
C4	8μF 350V	C14	1000pF 1% SM
C5	0·01μF 350V disc	C15	1000pF 1% SM
C6	100pF SM	C16	220pF 1% SM
C7	0·01μF 350V	C17	0·01μF 350V
C8	470pF	C18	0·01μF 350V
C9	2000pF	C19	12μF 50V
C10	22pF SM		

VC1 2 x 25pF gang. (Jackson Type 02).
VC3 75pF variable. (Jackson Type C804).
TC1, 2, 3 50pF pre-set trimmers.

Valves :

V1	6BA6 (EF93)	V3	EC90
V2	12AT7	V4	ECL82

Chassis and Case :
2 off 6 x 4in. sides, Type CU41B
2 off 8 x 4in. sides, Type CU56A
1 off 8 x 6in. plate, Type CU178
4 off Case feet, Type Z146
(all from Home Radio)

Miscellaneous :
L1 Denco 'Blue' Range 3 (valve type).
L2 Denco 'Yellow' Range 3 (valve type).
L3, see text.
Ball drive, (Jackson 4489/C) RFC, 2·5mH.
2 off B7G skirted valveholders and screens.
2 off B9A skirted valveholders and 1 screen.
Knobs, tag-strips, output jack socket.
T1, output transformer about 60:1 to carry 40mA.

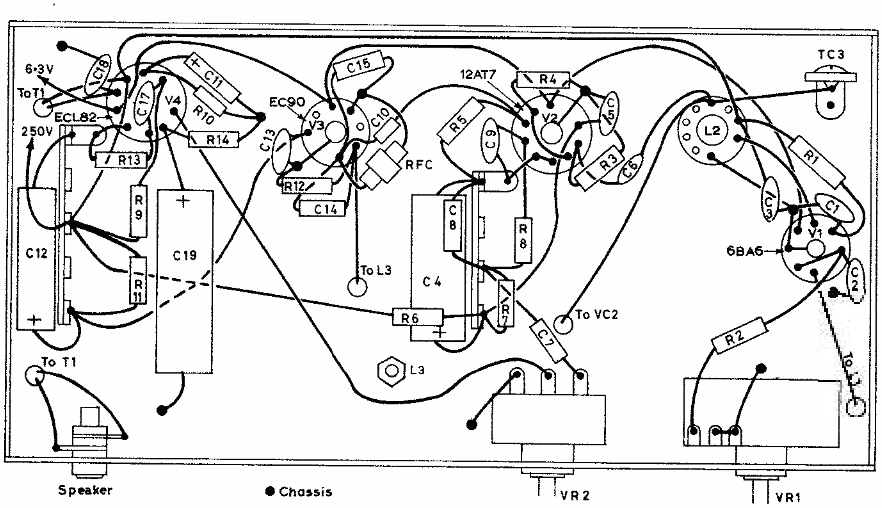


Fig. 4. Wiring guide for components underneath the chassis. Wiring around the v.f.o. valve V3 should be kept as short as possible to improve stability.

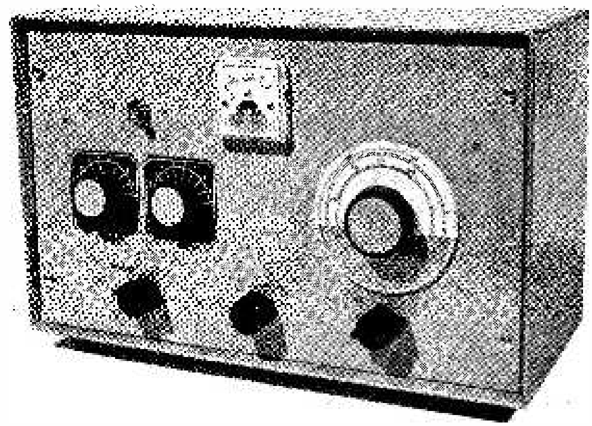
continued on page 314

QRP TRANSMITTER for the LF BANDS

F. G. RAYER G3OGR

IT is apparent that there is a good deal of interest in small transmitters for the low frequency bands. There are several reasons for this. Such equipment can be constructed at small cost, with easily obtained components, and only a modest power pack is needed to reach the maximum allowed power input of 10 watts in the case of the 160m band. Many newly licensed amateurs start with such equipment, and when using this power on the low frequency bands the chances of interference to TV are minimal.

The transmitter described here is primarily for 160m working, but will be found to be a very practical piece of equipment on 80m also, coverage of this second band being easily arranged. In addition, an end-fed aerial is often used for 160m, which will also generally perform well on 80m. The 80m band also offers greatly improved range over 160m and contacts during daylight, so it is well worth having.



CIRCUIT

In Fig. 1, V1 (6C4) is the variable frequency oscillator, followed by V2 (6AM6) which is a buffer/doubler. V3 (6BW6) is the power amplifier, and runs at about 10 watts input, anode current being shown by the meter. This is a straightforward arrangement which gives good results with a minimum of difficulty.

VC1 tunes the v.f.o. from 1·75-2·0MHz and, for the 160m band, the 1·8-2·0MHz sector is used, transmitter output being on the same frequency as the v.f.o. For 80m, the v.f.o. is tuned over the range 1·75-1·9MHz, and V2 acts as doubler, so that the output frequency is from 3·5-3·8MHz. V6 provides a regulated supply for the v.f.o.

L2 and L3 are broadly resonant coils for 160m and 80m. When first testing the equipment, grid current in the p.a. stage can be checked by clipping a test-meter across R8. L4 is the pi-network tank coil, tapped for 80m.

The audio section has V4 (12AX7) as a high gain amplifier, followed by V5 (6BW6) which choke modulates V3. This arrangement has been found to give good modulation and quality when using a crystal microphone and it requires relatively few components.

With any set of transmitting/receiving equipment the problem arises of providing "Transmit" and "Receive" change-over facilities. A relay is often used to switch the aerial from receiver to transmitter, to switch on the transmitter and to mute the receiver or speaker.

No external items of this kind are necessary with this transmitter, as the required switching is incorporated. This gives complete change-over from "Receive" to "Transmit" with single switch control.

The switch has four poles, section S1 switching the aerial to the tank coil L4 at T (Transmit), but transferring the aerial to the receiver at R (Receive). Section S2 short-circuits the aerial feed to the receiver during transmission, to minimise r.f. leaking through to the receiver. S3 is in series with one speaker lead, and so silences the speaker during transmission.

The transmitter power circuit is controlled by S4, which applies h.t. to all stages on transmit. S5 is a separate two-way switch, which allows h.t. to be put on V1 and V2 only. This allows the v.f.o. to be tuned to any wanted frequency, and be "netted" with the receiver, either to answer a CQ, or to begin transmission on a selected channel.

The aerial, or matching device, if used, is plugged into the aerial co-axial socket. A co-axial lead of convenient length is made up, and plugged into the "Rx" outlet of the transmitter. This lead runs to the aerial and earth terminals of the receiver. Communications type receivers normally have a separate speaker, one lead of which is cut, and extended if necessary, so that plugs can be inserted into the "Mute" transmitter sockets.

The two switches on the transmitter then give complete control, for tuning the v.f.o. netting on a signal, and changing from reception to transmission.

CONSTRUCTION

VFO

By using a ready-made inductor and accurate capacitor values, experiments to obtain suitable band coverage are avoided. It is only necessary to adjust the core of L1, and trimmer TC1, to set the band so that VC1 tunes 1·75-2·0MHz, with a little to spare at each end of the dial.

The v.f.o. is assembled in a box 3×2×2in. which screens it completely and also helps isolate components from sources of heat. This box is readily made from "universal chassis" strips. One strip is 7×2in., with flanges which are cut 2in. from each end, so that the strip can be bent into an open U-form 2in. high and 3in. wide, with flanges all round. An accurate bend is most easily obtained by holding the strip on a block of wood.

The second strip is 3×4in. and also has flanges. It is cut through centrally to obtain two pieces 3×2in. One of these is bolted to the front of the box as in Fig. 2 and carries VC1. After wiring is complete and the box is fixed to the chassis the second 3×2in. flanged piece is secured with self-tapping screws to close the back.

The v.f.o. is completely wired as in Fig. 2 before it is mounted. Trimmer TC1 is fixed just clear of the box top with a bracket or by bolts with spacers. A small hole is drilled in the box to permit adjustment of TC1. All connections are direct and rigid and points MC are joined with wire and also to tags bolted to the chassis.

The tag-strip in Fig. 2 is secured inside the box and supports the r.f. choke, C2, and C3. Coloured leads identify the wires which pass through the chassis—brown for h.t. (150V), blue for 6·3V, and yellow for the lead from C5.

The box is fixed to the chassis by bolts through the flanges which turn inwards (omitted in Fig. 2, for clarity) and through the front and back plates. It is placed so that the ball drive can be arranged as in Fig. 3.

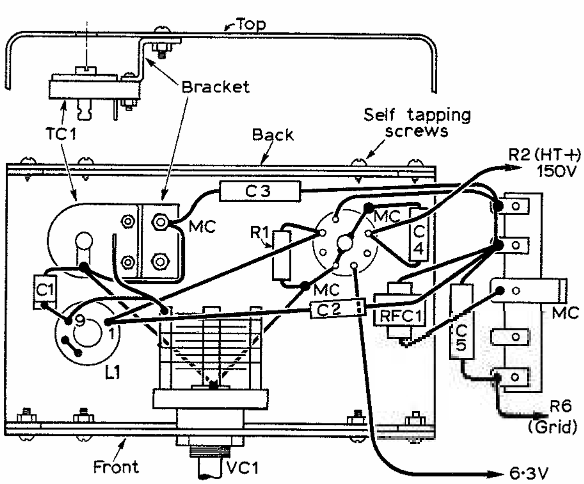


Fig. 2: Constructional details of the VFO assembly.

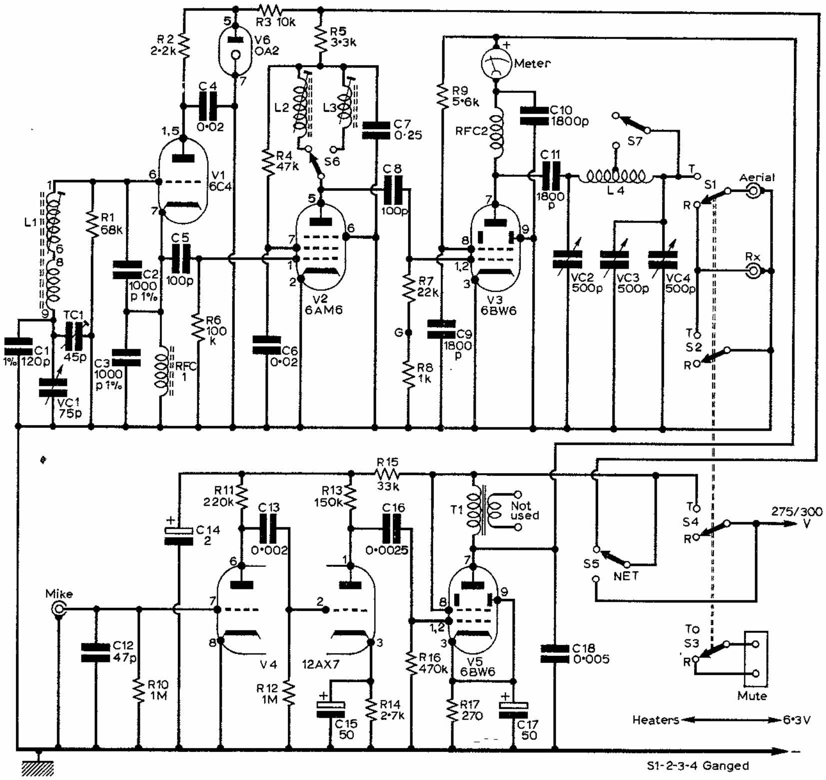


Fig. 1: Complete circuit of the QRP transmitter.

Top of Chassis

Fig. 3 shows the position of the major components. Capacitor VC2 is of a type fixed to the chassis with small feet. Capacitor VC3/4 has three holes in the front plate and is bolted to a small bracket to bring the spindle level with that of VC2. These spindles pass through ½in. clearance holes.

Panel and chassis are fixed together by the switches and panel brackets. The lower edge of the panel must project about ½in. beyond the chassis, to clear the mounting flange of the case.

Buffer Stage

Components are placed around V2 as in Fig. 4, with grid and anode circuits separated and heater leads close against the chassis. The MC connection to the central spigot of the valveholder passes across the holder, as shown.

The coupling winding provided on L2 and L3 is not required, and must be completely removed. The outer end of the larger winding of L3 is then unsoldered from its pin and 28 turns removed. The end of the wire is cleaned and re-soldered to the pin.

PA Stage

Grid circuit components are under the chassis, and are placed around V3 approximately as in Fig. 4. A hole is drilled in the chassis adjacent to the anode, pin 7, a lead passing directly through to the r.f.c. Anode circuit items are above the chassis.

C10 is anchored to a tag strip (Fig. 3) which also supports r.f.c.2, the top of the choke being held by C11. The 1800pF 1kV disc ceramic capacitors used in these positions are easily obtainable, but 2000pF

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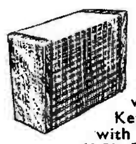

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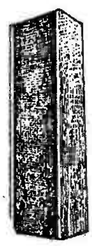

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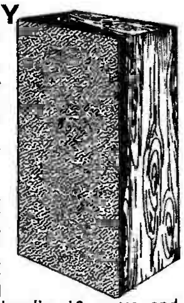

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EF184	35p
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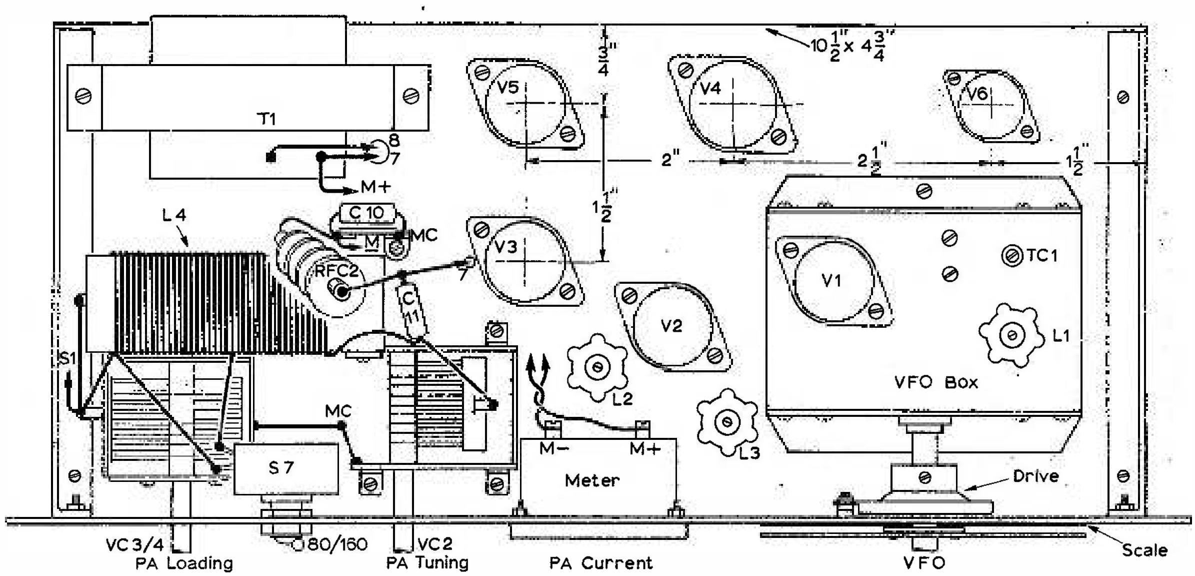


Fig. 3: Plan view of chassis showing disposition of major components.

mica capacitors of 750V rating could be used instead.

The p.a. coil has 63 turns of 22 s.w.g. enamelled wire, close-wound on a 1in. diameter paxolin tube about 2¾in long. During winding, a loop is made at 33 turns for the switch S7 connection. This leaves 30 turns in circuit from VC2 to the switch.

The coil is mounted by bolting a 1in. long strip of paxolin to it and attaching this to the frame of VC2 with a second bolt. The coil is well clear of metal parts and the cabinet top.

Audio Section

Grid leads and components should be against the chassis especially connections to pin 7 of V4 otherwise there is some danger of instability or picking up of hum or r.f.

No gain control was included because it was found that speaking normally with a hand-held crystal microphone gave just about the required audio level. Gain can be reduced by removing C15 or by substituting a 1 megohm potentiometer for R12 connecting the slider to pin 2 of V4. It should be mounted on the back runner near V4 or be connected with screened leads.

The modulation choke T1 is the primary of a mains pentode type speaker matching transformer and should be able to carry 70-80mA, and of low d.c. resistance, to avoid excessive voltage drop.

A test of the a.f. section can be made by connecting a speaker to the secondary of the transformer. The speaker must be well clear of the microphone, to avoid audio feedback. Speech should be reproduced at ample volume with good quality. Causes of distortion could be low emission valves, wrong resistor values, or slight leakage in C13 or C16 upsetting the bias of the following stage.

Fig. 4: The wiring underneath the chassis.

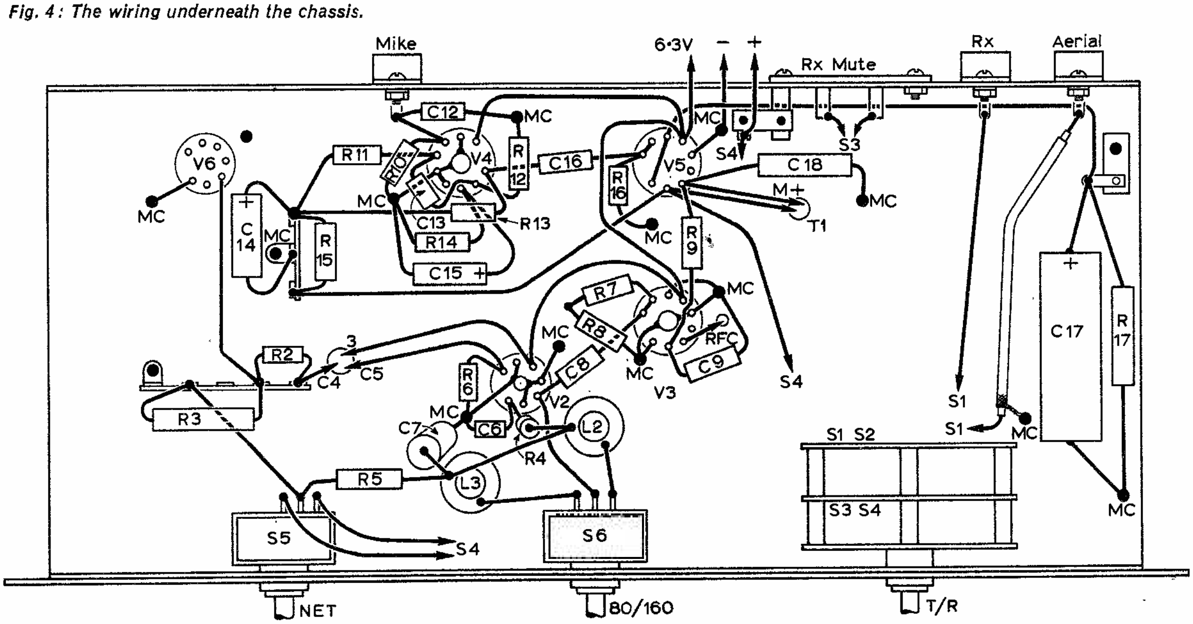
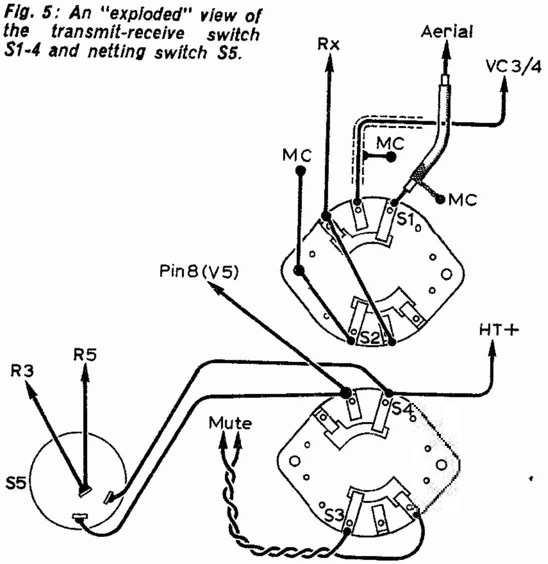


Fig. 5: An "exploded" view of the transmit-receive switch S1-4 and netting switch S5.



Switching

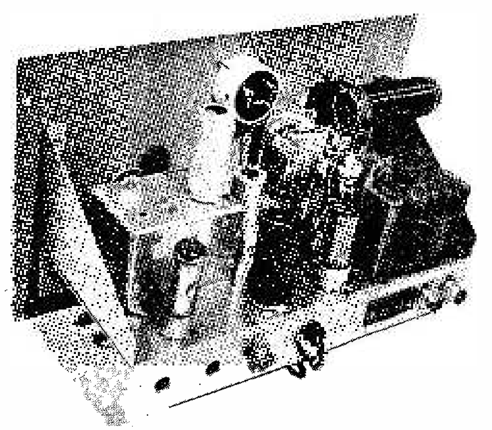
Fig. 5 shows switch connections. A co-axial lead is used for the aerial, taken to chassis at the socket, and at VC3/4. S5 is switched to the "Tune" position only when adjusting the v.f.o. frequency, and so S4 normally switches on all transmitter h.t. circuits.

VFO Dial

A pointer, cursor or disc of transparent material such as perspex can be mounted on the flange of the ball drive by two short 8BA screws. A disc with a line marked on it was used. A piece of thin card of larger diameter than needed was temporarily fixed to the panel, and calibration marks made around the edge of the disc. The card was removed, markings transferred to scales of suitable diameter, and the card cut down to size and cemented in place, finally checking that the calibration was still correct.

CW

V3 can be keyed by disconnecting pin 3 from the chassis, connecting a 5000pF capacitor directly from this tag to chassis and wiring a lead from pin 3 to a jack, normally closed to complete the circuit.



This places the key between cathode and chassis when the plug is in. It is also necessary to take T1 out of circuit, which can be done by fitting a two-way switch to the back runner, so that on c.w. h.t. reaches the r.f. section only. The lamp load mentioned later for a.m. tests is not suitable on c.w. Connect a 470 ohm resistor in series with a 5000pF capacitor across the key jack.

VFO CALIBRATION

Calibration is most easily done with a 100kHz crystal marker used in conjunction with a communications type receiver. First adjust the core of L1, and trimmer TC1, for suitable coverage. As TC1 is increased in value, the range of frequencies covered by VC1 will be reduced. TC1 and L1 also allow the band edges to be adjusted. It is best to arrange that almost the whole swing of VC1 is needed to tune from 1·75-2·0MHz, but to avoid the extreme positions.

★ components list

Resistors:

R1	68kΩ	R10	1MΩ
R2	2·2kΩ	R11	220kΩ
R3	10kΩ 3W	R12	1MΩ
R4	47kΩ	R13	150kΩ
R5	3·3kΩ 1W	R14	2·7kΩ
R6	100kΩ	R15	33kΩ 1W
R7	22kΩ	R16	470kΩ
R8	1kΩ	R17	270Ω 2W
R9	5·6kΩ 2W		

All ½W 10% unless indicated otherwise.

Capacitors:

C1	120pF SM 1%	C10	1800pF 1kV
C2	1000pF SM 1%	C11	1800pF 1kV
C3	1000pF SM 1%	C12	47pF SM
C4	0·02μF 350V	C13	0·002μF 350V
C5	100pF SM	C14	2μF 350V
C6	0·02μF 350V	C15	50μF 6V
C7	0·25μF 350V	C16	0·0025μF 350V
C8	100pF SM	C17	50μF 50V
C9	1800pF 1kV	C18	0·005μF 1kV

TC1 45pF trimmer, ceramic.
VC1 75pF miniature, air.
VC2 500pF variable, air.
VC3–4 500+500pF ganged variable, air.

Valves:

V1	6C4 (EC90)	V4	12AX7 (ECC83)
V2	6AM6 (EF91)	V5	6BW6
V3	6BW6	V6	OA2

Inductors:

L1 "Yellow", Range 3 (Denco)
L3 "Red", Range 2 (Denco)
L2 "Blue", Range 2 (Denco)
L4 See text
RFC1 2·5mH miniature iron-cored choke
RFC2 2·5mH 60mA sectionalised choke

Miscellaneous:

Valveholders, B7G with skirt (3) B9A with skirt (3). B7G screens (2) B9A screens (1). Co-axial sockets (3). Switches, 4 pole 2 way rotary (1) 1 pole 2 way rotary (1) on/off toggle (1). Miniature meter, 50mA f.s.d. T1, see text. Flanged ball drive. Knobs etc. Cabinet No. BX5 with chassis 10½ x 4¾ x 1½ in. (Home Radio). VFO box made from flanged chassis strips CU136 and CU144 (Home Radio).

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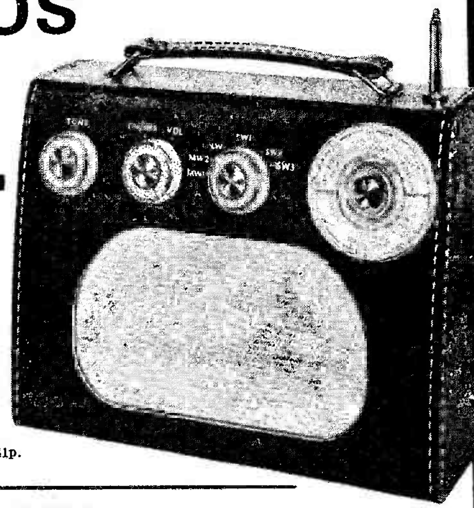

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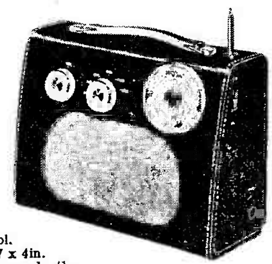

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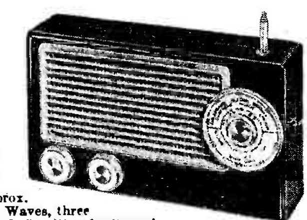

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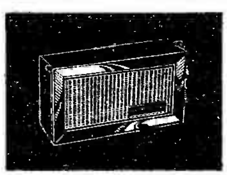

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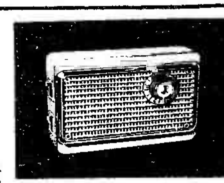

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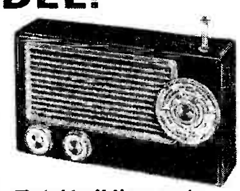

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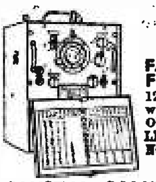

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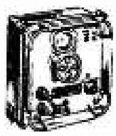

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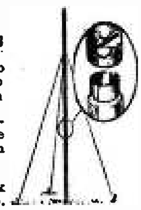

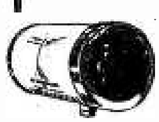

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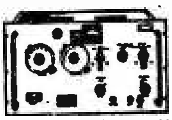

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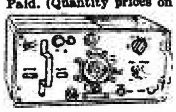

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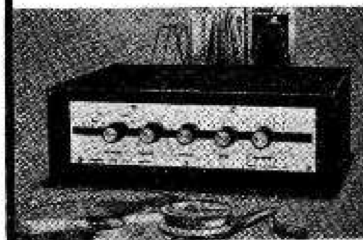

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With S5 at the "Tune" position and a lead from the receiver lying near the transmitter, tune the receiver to 3·5MHz using the crystal marker, tune VC1 to zero beat, and mark the scale for 3·5MHz repeating for 3·6, 3·7 and 3·8MHz. Also mark 3·6 as 1·8, 3·7 as 1·85, and 3·8 as 1·9MHz. Continue with the 3·9 and 4·0MHz marker pips, but marking the v.f.o. for 1·95 and 2·0MHz only. If the extreme settings of VC1 have been avoided the 10kHz points can be filled in linearly between the 100kHz points.

A 10mA or multi-range meter is connected from "G" Fig. 1 to chassis, the latter being positive. The v.f.o. is set to 1·9MHz, S6 to 160m, and the core of L2 is adjusted for maximum grid current, which should be around 3mA. Then adjust the v.f.o. to about 3·7 MHz, switch to 80m adjusting L3 core for maximum grid current which will be around 2mA.

TESTING

It is simplest and best to test the whole equipment by feeding the transmitter output into an artificial aerial load. This can be a 15 watt or 25 watt 240V or similar household lamp. Clip it across VC3/4 and chassis, or fit a holder, lead and co-axial plug so that it may always be employed for tests.

P.A. tuning procedure is that generally employed with a pi-network. Check that S7 is closed for 80m, or open for 160m, to match the position of S6. Fully close VC3/4 and also VC2 (to prevent the possibility of doubling in the p.a.). Switch to "Transmit" and open VC2 to obtain a dip in anode current, as shown by the panel meter. Current will be low but loading is increased by opening VC3/4, meanwhile adjusting VC2 for minimum current. As this is done, the minimum current rises, and the 15 watt lamp should light with fair brilliance when the input reaches about 10W.

The d.c. input to V3 anode is anode volts×anode current, thus 33mA at 300V will be 9·9 watts. A supply voltage of less than 275V is not recommended.

If the transmitter is loaded into the lamp, and a receiver is tuned to the signal, speech should sound clear and well modulated. The receiver should have its aerial disconnected and r.f. gain turned well back, or overloading may cause distortion.

POWER SUPPLY

Fig. 6 is the circuit of a suitable power supply. The mains transformer actually used was a Parmeko P.2931, 250/0/250V 150mA, with SE-05 rectifiers D1 and D2, and Parmeko P.3141 120mA choke. This provided 280V with a load of 120mA. BY100 rectifiers would also be suitable. The voltage obtained when using semi-conductor rectifiers is somewhat higher than with a valve rectifier. Many transformers have winding for valve rectifiers so a 5U4G is a suitable rectifier for a 5V 3A winding, or an EZ81 for a 6·3V 1A winding.

AERIALS

The simplest possible aerial is an end-fed wire. Some lengths will offer such a load impedance that the transmitter can be worked directly into the aerial, on one or both bands. Other lengths present load impedances which are outside those which can be matched by the transmitter, and then proper tuning or loading will be impossible. One of the

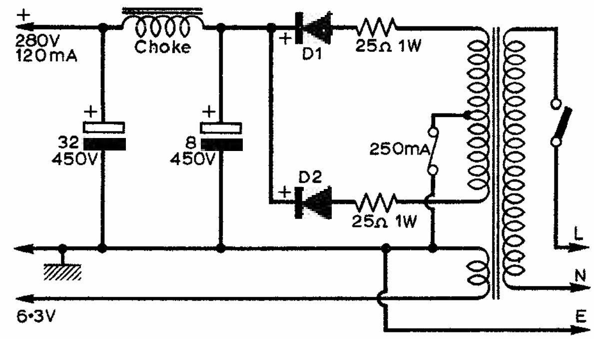


Fig. 6: Suggested power supply for the QRP transmitter.

matching circuits in Fig. 7 can then be used.

Fig. 7(a) is the simplest. L1 may be similar to the tank coil, or be a surplus tapped inductor, or may consist of a number of turns, found by trial and error, on a former 1in. to 3in. in diameter.

Fig. 7(b) is similar but has a capacitor VC1 added, of about 250pF, which allows more accurate adjustment and has fewer tappings on L2.

Fig. 7(c) is series tuning often used for quarter-wave aerials on l.f. bands. VC2 can be 500pF and again L3 resembles the tank coil. The tapping makes L3 into an auto-transformer and may be set about 10 turns from earth for 160m, or 4 or 5 turns from earth for 80m. For the latter band only L3 may have fewer turns.

Fig. 7(d) is parallel tuning suitable for a half-wave aerial on 80m. L4 is about 30 turns on a 1in. diameter former, with a 250pF capacitor for VC3 and L5 is about 4 turns of insulated wire over the earthed end of L4.

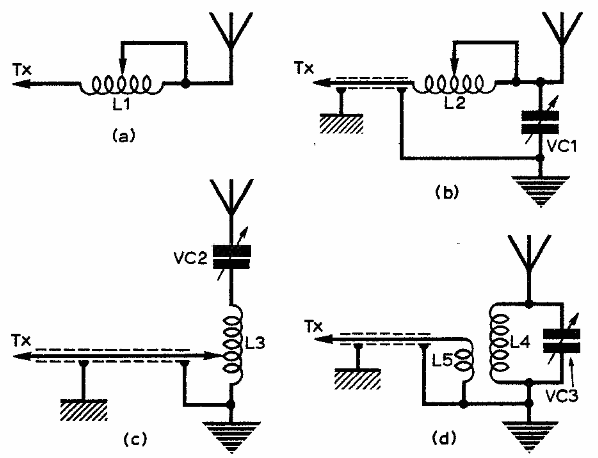


Fig. 7: Four circuits enabling almost any aerial to be matched to the transmitter.

A typical aerial of 126ft in length would be about a quarter-wave on 160m, and a half-wave on 80m, so Fig. 7(c) would be required for 160m, and Fig. 7(d) for 80m working. However, it is generally easier to make up a tuner with one of the circuits in Fig. 7 or a similar circuit and to experiment with tappings until the transmitter can be satisfactorily loaded by the aerial. Even very short wires (under 10ft.) may be used with these circuits but range is much reduced. ■

I.C. OF THE MONTH

L.A.J. IRELAND

Number 22 — G.E. PA264-265 Voltage Regulators

MANY constructors will have come across the difficulty of having to operate 6 volt portable transistorised equipment from a 12 volt car battery. In such equipment current drain will usually be dependent upon the audio output so as to conserve the life of the battery and as a result the conventional voltage dropper resistor will not suffice. An alternative approach is to use some form of voltage regulator and lately the G.E. Company have released a monolithic i.c. capable of fulfilling just this function. With a 5 watt power dissipation capability, the i.c. eliminates the need of both a high power pass transistor and its associated drive components and with a half dozen or so discrete components needed to complete the unit, it makes an ideal compact in-line device.

Background

Readers familiar with the present series of articles will remember the precision voltage regulator type LM100 reviewed in the June 1970 issue of P.W. This was a rather sophisticated low-power i.c. in which a built-in reference voltage was compared to a fraction of the output voltage to achieve accurate stabilisation. One of its big draw-backs however was the need for an external power transistor if an output current in excess of 12mA were to be drawn and towards the end of the article attention was drawn to the G.E. unit, type PA264, which would overcome these difficulties but which at the time was only in the development stage of production.

Operation

Basically the PA264 functions as follows. By referring to Fig. 1 it can be seen that Tr1 and Tr2 form a differential comparator whose inputs are controlled by an external zener and a sample of the output voltage. Tr2 in turn directly controls the Darlington pair Tr4 and Tr5. Any tendency in the output voltage to decrease will be counteracted by a drop in voltage at the base of Tr2 which in turn will tend to increase the current through Tr4 and Tr5. The reverse situation occurs if the output voltage tends to increase and so the unit is self-compensating.

The output voltage may be varied in two ways, by potting down the reference voltage applied at pin 14 or by varying the feedback voltage at pin 13. However there are practical limitations to these methods in that the voltages set at pins 14 and 13 should be kept within the limits 1·5-3·5 volts for optimum performance. Values of components specified in Fig. 1 are for a 6 volt output but it should be remembered that any output above 3 volts may be obtained with suitable choice of components. The maximum voltage rating of the PA264 is 25V and of the PA265 37V and this in fact is the only difference in their electrical characteristics.

Packaging

The units are housed in a rather unusual epoxy package with eight staggered leads in addition to

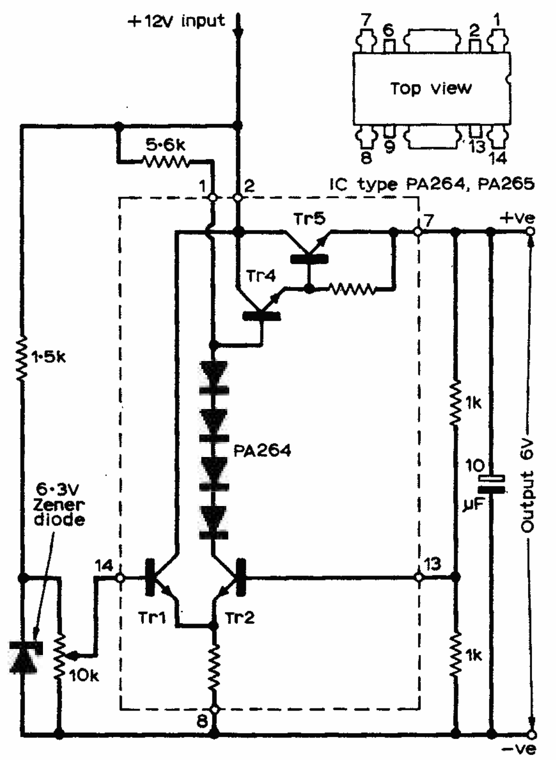


Fig. 1. Circuit of the PA264 with additional components required to provide 6v from 12v supply.

continued on page 322

VHF INTERFERENCE PROBLEMS

VIVIAN CAPEL

THE opening of local radio stations on the v.h.f. band and the continual plugging by the BBC of the better quality obtainable with frequency-modulation is increasing the public interest in this area of broadcast reception.

Unfortunately, the claims that reception is interference-free is far from true, and as a result users and engineers may face some tricky problems. While interference from foreign stations, the bane of medium-wave listening, is absent, there are other forms to take its place.

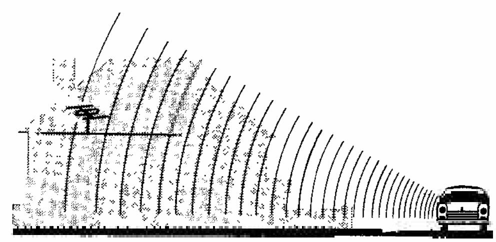
For those living on or near main roads, car ignition interference is probably the most troublesome. This is especially so if the road is on a hill, when not only is the interference generated by a car in low gear much worse, but it also takes longer to pass.

All new vehicles are now suppressed, and have been for the last few years, indeed it has been noticeable that ignition interference has been thinning out, as the older vehicles become fewer in comparison with the new ones. However, there are still sufficient passing on any main road in a given time to cause a number of serious interruptions to any particular programme.

While the irate listener may feel like taking drastic action against the offenders, the solution in this case cannot be applied to the source, and in any case would be illegal! Usually, part of the trouble lies with the aerial. The majority of chimney stacks are already so festooned with Band I and III television aerials plus probably u.h.f. as well, that there just isn't room for a Band II radio aerial. Often, in areas not too remote from the transmitter, quite good signal strength can be obtained with the internal aerial wire running around the back of the cabinet, or at least with one along the picture rail. So the idea of having anything more elaborate seems pointless and money-wasting.

However, although the signal may be strong enough to give reasonable fade-free reception, it is when a splash of interference comes along that the inadequacy becomes all too apparent. The signal-to-noise ratio is just not good enough.

If the chimney looks as though it just will not stand any more, the answer may be in the loft. A good loft aerial is much less expensive than an outdoor one as it does not have to be weather-proof, or need chimney lashings. It will give a much stronger signal, and being elevated well above the road will be out of the worse area of ignition interference. The directional properties of the aerial will also help as any radiation from directions other than the transmitter will be reduced. If the transmitter direction is away from the road, mount the aerial on that side of the loft as this will put the bulk of the house between the aerial and the road, and so afford a degree of shielding. This really should reduce ignition interference to the level of background noise, if not entirely eliminate it.



Loft aerial positioned on side of house furthest from the main road. House affords measure of screening from ignition interference.

The other form of interference can be more troublesome to deal with. There seems in most of our major cities a proliferation of private radio-telephone installations as used by police, ambulance, taxis and other services. These operate on a number of frequency bands, three of them in the v.h.f. range, 70-85MHz., 103-140MHz. and 168-175MHz. There is also one in the u.h.f. region. The broadcast v.h.f. frequencies of Radio 1, 2, 3, and the local stations lie within the range 88-96MHz. or right in between the two lowest radio-telephone bands, and so are vulnerable to interference from them.

Spurious Signals

To see how this interference can occur, we will review the ways by which spurious signals can be received with a superheterodyne receiver. First, there is breakthrough of signals at the *i.f. frequency*, which in the case of most f.m. receivers is 10·7MHz. The local oscillator has no effect on these, so they would be heard irrespective of the setting of the tuning dial, and in fact, this factor serves to identify them. There are no authorised transmissions at this frequency, so this class of interference should not be encountered unless it was due to a short-wave transmitter operating illegally.

Another form of interference is the well-known *image* or *second-channel* type. There are two frequencies that will produce a response in a superheterodyne receiver, one is the sum of the local oscillator frequency and the i.f., and the other is the difference between them. If, as is common practice, the oscillator is running higher than the programme signal, it is operating on the difference, and another signal which is the sum will produce interference.

We can use an example to illustrate: If the wanted signal is at 90MHz, the oscillator is running at $90+10\cdot7=100\cdot7$MHz. An unwanted signal will produce the i.f. frequency at the output of the mixer if it is higher than the oscillator by the frequency of the i.f., or $100\cdot7+10\cdot7=111\cdot4$MHz. As can be seen, this is within the middle band used by radio-telephone services. Second-channel interference then, arises from signals twice the frequency of the i.f. away from the wanted signal; higher if the oscillator is running high, and lower if it is low. For normal v.h.f. sets the interfering signal would be 21·4MHz higher than the broadcast frequency.

Similar, is the *i.f. harmonic interference*. This is the sum of the local oscillator and half the i.f., and also their difference. Such a signal will produce an output at the mixer anode of half the i.f. frequency, and it is the second harmonic of this which will be passed by the i.f. circuits.

Using our above example, the local oscillator frequency is again 100·7MHz, and the interfering frequencies will be $100\cdot7+5\cdot35=106\cdot05$MHz and $100\cdot7-5\cdot35=95\cdot35$MHz. In relation to our wanted signal of 90MHz, the frequencies are plus half and $1^1{}_2$ times the i.f. Harmonics are not usually as strong as the fundamental, so interference from this cause is not so likely to give trouble unless the unwanted signal is very strong.

A further type is the *beat interference*. This occurs from a signal that is spaced from the wanted signal, either above or below, by the i.f. frequency, and is caused by the two signals beating together to form a resultant at the i.f. frequency. Actually, the interfering signal performs the same function as the local oscillator, only of course it carries its own modulation which is passed on through the i.f. stages and detector along with that of the wanted signal. If the interfering signal is strong enough, the set would continue to work with the local oscillator stopped, and this fact could be used to help identify this form of interference. Thus for a wanted signal of 90MHz, beat interference would be caused by signals at 79·3MHz and 100·7MHz.

Finally there is the interference caused by *oscillator harmonics*. All oscillators produce harmonics, and the second-harmonic of 100·7 which you remember is our local oscillator frequency for receiving a signal at 90MHz, is 201·4. Signals spaced above and below this by the i.f., i.e. $201\cdot4-10\cdot7=190\cdot7$, and $201\cdot4+10\cdot7=212\cdot1$MHz, would therefore be passed into the i.f. circuits.

These frequencies are in the commercial television band and above the highest radio-telephone range. The third-harmonic of the oscillator would bring it even higher. Frequencies so remote from the wanted ones should be greatly attenuated by the tuning in the r.f. circuits and the tuned aerial, so should not present any problems. If though it is found that commercial t.v. signals are breaking through, this is the probable cause.

Summing up then, interfering signals can be spaced from the wanted one by twice (second channel); $1^1{}_2$ times (i.f. harmonic); once (beat interference); and half (i.f. harmonic) times the i.f. frequency, on the high side; and one (beat interference) times on the low side. So there are at least five possible frequencies that will interfere with each and every broadcast station. As there are four BBC programmes in most areas, this gives us some 20 possible interfering frequencies. The situation is aggravated by the fact that f.m. receivers are not sharply tuned as are a.m. sets. It is of course necessary to maintain a wide pass-band because of the nature of the f.m. signal. Broadcast deviations are up to 75kHz either side of the carrier frequency, so receiver circuits must extend well beyond these limits.

This means that interfering frequencies do not have to be spot on the values calculated, and if only near them, interference can result. With the previously noted increase in radio-telephone users, it can be seen that the possibility of interference with broadcast programmes is high, and is steadily increasing.

Radio-telephones

The question is, what can be done? Mobile units are not so much a nuisance, as they operate at low power, and usually cause interference only when they are fairly close to the receiver. The chance of a mobile operating at a frequency which could cause interference, coming sufficiently close to a working f.m. receiver tuned to a vulnerable frequency, is not very great, and the odd occasion when it may occur could hardly constitute a major nuisance.

It is the base stations that are the real menace. These are operating more or less continually, and are relatively high powered. Should one of these be within a few miles and operating on a critical frequency, then constant jamming will result.

The first step is to try to identify the offender. This is not too difficult as a number of his messages are being unwillingly intercepted. The class of business can be quickly deduced, and a local knowledge of the businesses of that type large enough to operate radio telephones, will help to narrow things down. One clue is whether the interference is present in the evenings or at week-ends. If it is, then a business that offers service outside normal hours will be the obvious culprit.

After eventually identifying the source, one can try swinging the aerial away from the direction of the transmitter while not losing too much of the broadcast signal. A local road map will help to obtain the precise directions involved. Do not swing too far away from the BBC station though, as the received signal may then be reflected and suffer phase-distortion, which is similar to ghosting on a television picture.

The next step is to find out the exact frequency of the transmitter. Once the owner has been identified, this should present no problem; if the reason for requiring the information is explained, he will no doubt be willing to co-operate. He may not know the frequency, perhaps being non-technical, but this should be shown on the transmitting licence or other paperwork connected with the system. The relation-ship between the frequency and that of the broadcast signal with which it is interfering can then be seen and the type of interference identified.

If it has not proved possible to discover the source of the interfering transmission, it may be possible to deduce the type of interference from the clues given above, and so arrive at the possible frequency. For example, stopping the local oscillator (without shorting-out the input signal) will determine whether the interference is due to a beat-signal. If this is found to be the case, the frequency will be spaced either above or below the wanted signal by an amount equal to the i.f. So if receiving a station on 90MHz, the interference will be either 79·3 or 100·7MHz. As the latter does not fall within the band used for radio telephones, then it is fairly certain that 79·3MHz or thereabouts is the offending frequency.

Co-axial Stubs

Having discovered the interfering frequency, the next thing is to suppress it (electrically of course). One method of doing this which is often recommended is the parallel stub of co-axial cable. Co-ax exhibits the properties of inductance and capacitance and so will form a resonant tuned circuit. With a velocity factor of unity, the length of the stub should be a quarter of the wavelength of the signal it is desired to eliminate. It should then be connected in parallel with the aerial-feeder near to the aerial socket on the receiver, the free end being left open-circuited.

In theory then, it is a straightforward matter to calculate the length and connect up. Not so in practice. First of all, the velocity factor of the co-ax is not unity, but varies from one sample to another. Typical values are 0·67 for the solid dielectric type, and 0·85 for the semi-air spaced variety. This must be multiplied by the quarter-wavelength to arrive at the actual length, so an exact calculation with any sample of co-ax is not easy.

There is a further complication; much depends on the characteristics of the aerial input circuit, whether it is inductive of capacitive. At a frequency higher than resonance, a tuned cricuit appears capacitive, whereas at a lower frequency it is inductive, the two balance out only at the resonant frequency. The receiver aerial circuits will be tuned to the wanted frequency, so at an interfering frequency, the circuit will appear either inductive or capacitive depending on whether the frequency is higher or lower than the wanted one, and the degree of inductance or capacitance will depend on the spacing of the frequencies and the Q of the circuit.

It can be seen then, that cutting a stub to the exact size is very much a matter of chance. The recommended method of tuning the stub is to cut it longer than the estimated length and cut off sections about ½ inch at a time until the minimum level of interfering signal is attained. To do this as with most tuning procedures, it is necessary to go through the resonant point to ensure that the peak (or trough in this case) has been reached, and then tune back. Obviously it is not possible to stick back on the last few sections that have been chopped off, so the thing to do is carefully note how much has been removed since the signals started to increase, and then measure up a new stub made from the same type of co-ax.

Severe interference was being experienced on the author's own set-up which consisted of a separate f.m. tuner feeding the hi-fi system. The trouble was with the reception of Radio 3 from the Wenvoe transmitter which uses the frequency of 96·8MHz. Programmes were completely blotted out when the interference occurred, not only during the day but up to late at night and also at weekends. It was impossible to enjoy a concert, and tests with other f.m. receivers in the neighbourhood confirmed that they too likewise suffered. Their owners either put up with it, switched to a.m., or just didn't listen to Radio 3.

It was obvious from the messages received that the source was a television repair shop controlling its service vans. The fact that a number of vans were apparently in communication indicated a business of some size, and also the evening and weekend operation narrowed down the field among the local firms. A few phone calls to the short-list of suspects revealed that it was the local Rediffusion workshop. The chief engineer was co-operative and apologetic, offering to check the frequency of the transmitter and that it was duly suppressing its harmonics, but of course the frequency was assigned by the Post Office Telecommunications Department, and there was nothing he could do about that.

He was able to state the frequency which was 85·725MHz. It then became obvious that this was a case of beat interference, as the frequency is 10·7MHz away from 96·425MHz, which is just 0·375MHz off the Radio 3 centre frequency. It was an obvious boob by the Post Office in assigning so critical a frequency to a powerful base station. Admittedly, frequencies are scarce and the demand is great, but troublesome frequencies such as these could easily be assigned to mobiles.

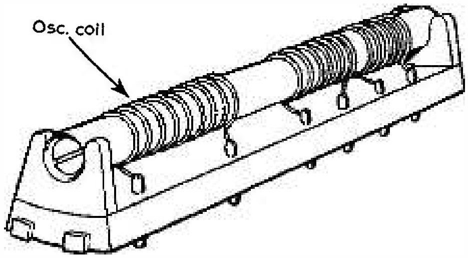
An interference form was obtained from the Post Office, and all the details as to source of interference, frequency and type were included and duly sent off. However, nothing more was ever heard, and as the interference continued it appears that nothing was done by way of re-allocating the frequency.

Series Wavetrap

It was therefore decided to tackle the problem without G.P.O. assistance. First of all, stubs were tried, but the difficulties previously described foiled success with these. Unfortunately, the Rediffusion base was in exactly the same direction from the aerial as the Wenvoe transmitter, so no rejection could be obtained by swinging the aerial. Nonetheless it was tried, and although the f.m. signal dropped, the interference decreased more so, so some improvement in signal interference ratio was obtained.

Finally the possibility of a series resonant wavetrap in the aerial feeder was considered. A coil resonating with its self-capacity and tuned with a brass slug was needed to enable a quick and convenient adjustment frequency adjustment to be made. The problem was, how to make one with any degree of accuracy that would not need lengthy experiments with the intermittent signal source similar to a stub.

Looking around the workshop for some ready-made component which might fill the bill, attention turned to some old coil biscuits from scrapped television tuners. A channel 2 oscillator biscuit was found among them. The BBC station on channel 2 operates at 48·25MHz (sound). The sound i.f. for the set concerned, and which is now common for most modern t.v. receivers, is 38·15MHz. This means that the frequency of the oscillator coil was 86·4MHz. As the Rediffusion frequency was 85·725MHz., this was near enough to be within the tuning range of the coil.



Appearance of typical coil biscuit. Oscillator coil is usually the largest and contains a tuning slug.

Accordingly it was connected in series with the aerial feeder, and the interference was completely eliminated, without the need even to tune the coil.

Most t.v. workshops have old tuners knocking around, so a call at the local radio dealers could well produce a coil suitable for the purpose, should similar interference be experienced. The chart shows the frequencies of the main BBC band I television channels, and assuming a 38·15MHz sound i.f., the actual tuning range of an oscillator-coil biscuit. It will be noted that channels 3 and 4 coils will tune to frequencies within the v.h.f. radio band, so will be no use as wavetraps for radiotelephone frequencies as these are all outside this band. Channel 5 is just at the start of the medium radiotelephone band, and could easily tune to some of its lower frequencies.

TELEVISION CHANNEL	SOUND FREQUENCY	OSCILLATOR COIL FREQUENCY
1	41·5MHz	79·65MHz
2	48·25MHz	86·40MHz
3	53·25MHz	91·40MHz
4	58·25MHz	96·4MHz
5	63·25MHz	101·4MHz

Remember, too, that the range of the coil can be extended by the fitting of a different type of tuning slug. A brass slug will decrease the inductance, hence increase the frequency, while an iron-dust slug will increase inductance and decrease the frequency. If the range is still outside the interfering frequency, a couple of turns taken off the coil will push it higher, or a small capacitor of a few pF. will bring it lower, if wired in parallel. The biscuit may have two or three coils on the same former, the oscillator is the one nearest the open end and which has the tuning slug. The other coils are coupling coils and should be ignored. ■

Direct Conversion Receiver *continued from page 300*

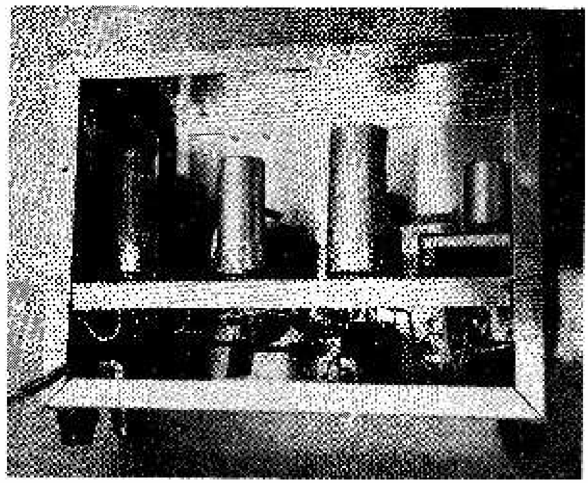
for h.t. positive, black for chassis and some other colour for the 6·3V heater supply.

ALIGNMENT

Set TC2 and TC3 about half closed and tune in any signal, with VC3 nearly open, and adjust TC2 and VC1/2 for best volume. Find a signal with VC3 nearly fully closed and peak VC1/2 for best results, then rotate the core of L1 for maximum volume.

If necessary, the core of L3 is rotated to obtain suitable band coverage with VC3. The coverage of VC3 can be checked by placing the aerial lead of a calibrated receiver near L3 and listening for the carrier produced by V3.

At all times the r.f. gain control VC1/2 is adjusted as needed for best reception even though VR1 may have to be turned back with strong signals. The cores of L1 and L2 are adjusted around 3·5MHz and the trimmers TC2 and TC3 are set near 3·8MHz. TC2 may also need re-adjustment after changing the aerial. These circuits are merely peaked up for best volume and are not too critical. The extent of rotation of this control needed to tune from 3·8-3·5MHz can be increased by screwing down TC2 and TC3 and unscrewing the cores of L1 and L2 to compensate.



Rear view of the finished receiver.

Power Supply. Any supply giving about the outputs mentioned should be satisfactory. If a power pack has to be made, one with full-wave rectification is most suitable. This may employ a 250/0/250V 60mA, 6·3V (1·5A or 2A) transformer, with smoothing by means of two 16μF 350V capacitors and a 60mA choke.

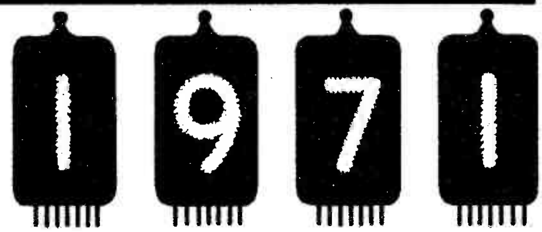
Speaker and Phones. A reasonably large 2/3 ohm speaker is most suitable with a cabinet or baffle.

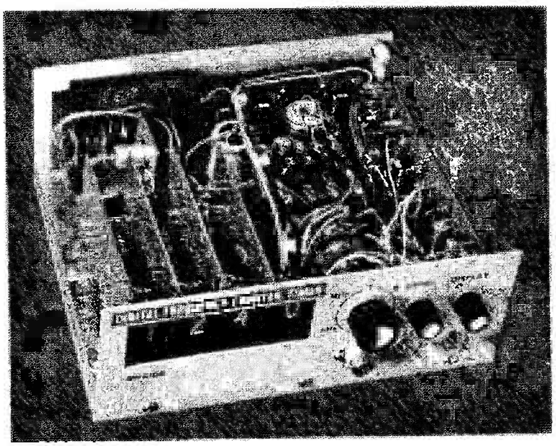
When phones are plugged in, the mis-match can generally be disregarded. Inexpensive surplus 600 ohm phones will be found to work well. It would be possible to use an external matching transformer for high impedance phones or to feed them through reliable isolating capacitors from V4 anode.

Aerials. Numerous transmissions were received with a short indoor aerial but changing to an outdoor wire tuned as for transmission purposes naturally gave a great increase in range and volume. In practice, any end-connected wire can be taken to A1 or A2 while the A2 connection is most suitable for short aerials. ■

* IN NEXT MONTH'S PRACTICAL WIRELESS

DIGITAL FREQUENCY COUNTER/TIMER





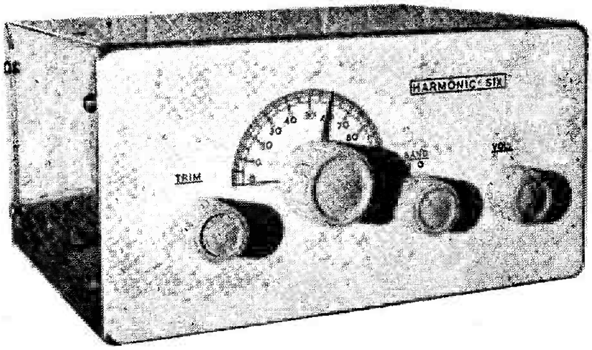
Yesterday's dreams have a habit of becoming today's realities in the field of electronics. Five years ago direct readout frequency meters cost so much that many companies flinched at the price but today inexpensive integrated circuits have brought these into the bracket for the home constructor.

Just imagine. Pop in any frequency (below 20MHz) and there you are—it's displayed before your eyes to the nearest cycle! The Digital Frequency Counter/Timer makes use of four digit neon numeral tube displays and uses the widely available "74" series of TTL i.c.'s.

Certainly this is a complex project—theoretically—but it's the i.c.'s that do the work, not you, and this project could be tackled by anyone who can wield a soldering iron.

ALSO:

THE 'HARMONIC SIX' RECEIVER



THE HARMONIC SIX RECEIVER

This is a six transistor superhet covering all the popular short wave bands and designed to power either a loudspeaker or headphones. The unusual feature is that there is no oscillator switching—instead the 2nd harmonic of the oscillator is used.

Standard parts are used throughout and this, together with the fact that it's designed by one of our top authors, makes this a first class project.

MINI-AMPLIFIER

Although measuring only 2" x 1" x 1", this amplifier, using four silicon transistors has an output of 250mW into a 25Ω loudspeaker. A multitude of uses can be found for this project which can be built for a total cost of no more than £1.

ALL IN THE SEPTEMBER ISSUE ON SALE AUGUST 6th

Fancy becoming a treasure hunter? Well, start here. We make no wild claims, just give you honest, proven results. Complete and detailed building instructions make this a suitable project for all levels.

HALVOR MOORSHEAD

WE thought very carefully before calling this article the PW Treasure Tracer. Certainly this sounds better than "metal locator" but could we justify the title? We think we can, especially after our test. We found nothing of great value but judging by the results we *could* have, that is, if there had been any there. Even if valuables are not found, certainly a whole lot of extremely interesting items will be and the history of an area of ground will yield up its secrets. However, your chances of finding coins are very good—about 150,000,000 coins are lost *every year* and a high proportion of these must be lost in areas where they can be found using a device of this type.

Not many months ago a hoard of Anglo-Saxon coins was found, using a metal locator, these were later auctioned for £9,000. It shows what can be done.

Metal locators work on a variety of principles and the author has experimented with a number of different circuits. Nearly all rely on the fact that metal objects distort magnetic fields. Complex designs have appeared from time to time making use of various effects—each claiming to be an improvement over others—but the author's experience has not borne out these claims. The principal used here—the Beat Frequency Type—is possibly the oldest and certainly the simplest. It needs only one wound coil, unlike many other circuits, and the sensitivity and results are excellent. We are deliberately not overstating our claims and the only figures for range etc. are those proved by our tests.

The Treasure Tracer comprises two low power r.f. oscillators working at about 130 kHz. One of the oscillators is screened inside the chassis and the frequency can be altered over a fairly wide range to match it close to the other. The second oscillator uses a frequency determined by the inductance of a winding which is used as the search coil.

In the absence of any material which will affect the inductance of this search coil, the oscillator is at one frequency. However when this coil is moved near some metal object, the inductance is altered slightly and the frequency of oscillation is changed. If the oscillators are set closely together an audio beat note is produced (equal to the difference in frequency) which may be amplified to feed a loudspeaker.

Finding a small copper clip (Item 16). The grass guard made from Perspex can be seen fitted under the coil framework.

Searching along were cart fitting places should ge

Let us assume that the search oscillator is working at 130·0kHz. The reference oscillator is adjusted to say 130·2kHz. The two signals are mixed together producing notes of $130 \cdot 2 - 130 \cdot 0 = 200$Hz. There is also another frequency produced, the sum of the two, 260·2kHz, but this can be ignored.

The presence of a metal object near the search coil will increase the inductance causing the frequency of the search coil oscillator to fall to say 129·8kHz. The beat note will now be $130 \cdot 2 - 129 \cdot 8 = 400$Hz so the raising of frequency of the beat note will thus indicate the presence of a metal object near the coil.

From this theory the Treasure Tracer was built, using a frequency below 150kHz to conform to regulations. Initial tests in the lab showed that the prototype was working reasonably well and that a definite beat note was obtained—but how would it work in practice?

THE TESTS

The first test was arranged at the PW offices. A couple of dozen telephone directories were piled two high (making for a thickness of at least two inches) and coins ranging from ½p to 50p were hidden under certain piles. All coins were found immediately, but there was an extra reading—this turned out to be the wiring under the floor!

These tests in themselves were interesting and we were slightly encouraged but how would the metal locator (for we were still calling it that at this stage) fare in a field test? Only one way to find out—arrange one.

One Monday in late May Eric Dowdeswell (PW Editorial), Peter Metalli (Art Editor), Jack Wood (Photographer) and the author set out for Canvey Island in South Essex to put it to the test.

The weather was fantastic and the beach was far from empty and under the puzzled eyes of day trippers we began our search, panning up and down the beach, just above the water line.

Our hearts fell. For several minutes the whistle remained unaltered. Up and down we panned and gradually we began to think that the journey was wasted. Then suddenly the note changed frequency—a very definite, strong reading. As we dug Jack Wood photographed us and the picture is that used on the cover. A quick dig produced a rusty hinge about three inches under the sand. We must have been unlucky to start with for after our first "find" we got readings every few yards. The items we found on this short stretch of beach and at other locations tried on the test are shown overleaf.

One thing cursed the search—silver paper. We found it everywhere and it accounted for over 75 per cent of all readings. We couldn't ignore these of course, for until we dug we didn't know what was causing the note to change frequency. The silver paper was from ice cream wrappings, cigarettes and sweets and even pieces so small that they were only found after extensive sifting, gave strong readings.

We altered our technique because of the sensitivity of the Treasure Tracer to small objects. As soon as we obtained a reading we carefully located the *exact* position before we began to dig—this could be done within an inch or two. As we dug we put the sand in two piles and checked at intervals with the Treasure Tracer that there was still a reading in the original position. If we had found nothing and the reading had disappeared we checked the two piles of sand. Invariably the metal was found in one of these. Even quite careful digging did not stop us missing several items the first time around.

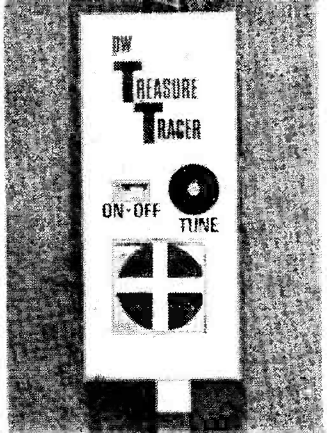
Our deepest find was at 9in. The strength of the reading confused us at first—it was too strong and over a fairly wide area. The "treasure" turned out to be an aerosol can for retouching cars, a beer can of similar size was found at 4in with less trouble. The reading at 9in. was strong and it would be fair to assume that if the can had been deeper it would still have been found.

We were very successful near the sea wall where people were sunning themselves but due to the numbers already there we could only try a few yards of this but it was here that we found our only coin—which turned out to be a 1966 penny, badly corroded. We had expected to find more money and because of our failure to do so we arranged a test. One person buried coins of various sizes in a marked off area and we tried to locate them. These tests were successful and convinced us that we could unfailingly find all coins at depths up to four or five inches and larger coins at even more.

an old track. All we found here s (Items 1 and 26) but such ›nerally be more fruitful.

Money! Right against the sea wall we found our only coin—a 1966 penny, badly corroded.

The one that got away! The tide came in so fast that before we had time to dig out the "find" the water put an end to it.



what we found

1. Cart fitting (?). Found on the old farm road at 2″ down.
2. Boiler clinker (?). Gave strong reading. 1″ down.
3. Sheet metal handle, badly rusted. Found in author's garden at $2\frac{1}{2}$″.
4. Iron Hinge. Our first find, 3″ under the sand.
5. Nail found under the beach, $\frac{1}{2}$″ down.
6. Copper gasket ring (?). Found under the beach at 6″.
7. Shrapnel. Author's garden at 2″.
8. Sharp metal spike. On the beach at 3″.
9. Screw eye (from clothes line ?). Author's garden, 2″ down.
10. Small piece of torn metal. Beach at 3″.
11. Copper tube (squashed). Author's garden, 2″ down.
12. Piece of unidentified iron. Beach at $1\frac{1}{2}$″.
13. File badly rusted. Garden at $2\frac{1}{2}$″.
14. Plant label (?). Zinc, garden at 4″.
15. Shrapnel. Garden at 1″,
16. Copper clip. Beach, found at 3″.
17. Shrapnel, gun metal, beach at 4″.
18. Screw-on bottle top, beach, 1″ down.
19. Shrapnel. Author's garden at 3″.
20. 1966 penny. Beach at 3″.
21. Encrusted iron fitting. Under the beach at $1\frac{1}{2}$″.
22. Thin copper tube (squashed). Beach at 2″.
23. Copper tube (squashed). Author's garden at 2″.
24. Piece of cast iron. Beach at 3″.
25. Nail with small piece of wood attached. Beach at 1″.
26. Cart fitting. Old farm road at 4″.
27. Galvanised washer. Author's garden at $3\frac{1}{2}$″. Looked just like a coin until cleaned up.

28 and 29 (not shown) Aerosol can and beer can. At 9″ and 4″.

As we progressed experience enabled us to locate more accurately and our ears became more and more sensitive to changes in the note.

Just one word of caution. The beach will provide finds of all types but be careful near the water's edge. The spray landing on the search coil sent it haywire and searching became almost impossible. Later tests carried out in the light rain proved fruitless for the same reason. Not only does the impact of the spray or raindrop change the note but water trapped in the turns alters the inductance of the coil. As the water evaporates the pitch of the note changes—the effect lasts several minutes during which searching is impossible.

The second part of the test was made on the outskirts of a nearby castle. Not unreasonably the custodians would not let us search in the grounds but recommended trying outside, pointing the way to the original approach roads. A number of items were found, though none of any great age.

The final test was conducted in the author's garden in north-east London. Surprisingly most of the items were found at the same depth under the lawn. When a reading was obtained a circle of turf about 6in. in diameter was cut out, the item was found and the earth replaced, laying the turf back in position; in this way no damage was done to lawn.

The house was built in 1913 and the lawn is probably original. The objects found were probably from the building process, spread out before turfing—though the file was probably lost by some workman long ago.

Some pieces of shrapnel were found. This is not really surprising for at the height of the London Blitz the fire from the anti-aircraft guns was so heavy that shrapnel apparently came down almost like "hail stones," according to a neighbour. Most of the shrapnel was cleared up but quite a lot would have buried itself in the ground.

A grass guard was developed from experience, this can be seen in the photographs. It is a piece of Perspex, 6×6in. fixed to the bottom of the search coil framework to stop blades of grass from touching the coil and so cause the beat note to change.

A total of four hours test searching was carried out to produce the finds shown. In that short period we became very much better at identifying signals and in the end knew exactly where to dig and even how deep we could expect to find the metal object.

HOW TO BUILD THE P.W. TREASURE TRACER

The circuit of Treasure Tracer comprises three distinct sections: the search coil oscillator, the reference oscillator and the audio amplifier.

The search coil oscillator is made around L1 which is wound on a wooden framework shown in Fig. 1. This is made up from two 6in. lengths of hardwood batten with a section of 1×¾in., though this section is not critical. These should be made into a cross by half-lapping as shown and small V shaped grooves cut into the ends. This framework must be rigid and if poor joints are made, these should be firmly glued.

The handle is made up from wood of the same cross section as the coil framework and about 4ft. in length, though this will depend upon the height of the user. The base of this should be cut at 45° and screwed firmly to the coil former. A normal type screw can be used; it will alter the inductance of the coil but as it is a constant it does not affect operation.

A small three way stand off tag strip should be mounted a few inches from the bottom to provide a firm anchorage for the coil wires. A thin enamelled copper wire should be used; the gauge is not too critical and 32 to 38 s.w.g. will do. If the wire has to be specially bought, 36 s.w.g. (as used in the prototype) would be a good choice. The start of the wire should be soldered to one of the outside terminal tags and 48 turns should be wound in the upper grooves, ending by fixing to the centre terminal tag.

The second part of L1 is wound in the lower

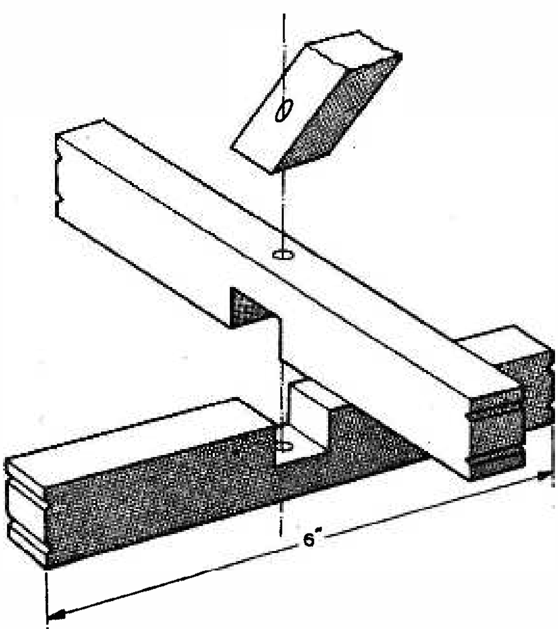
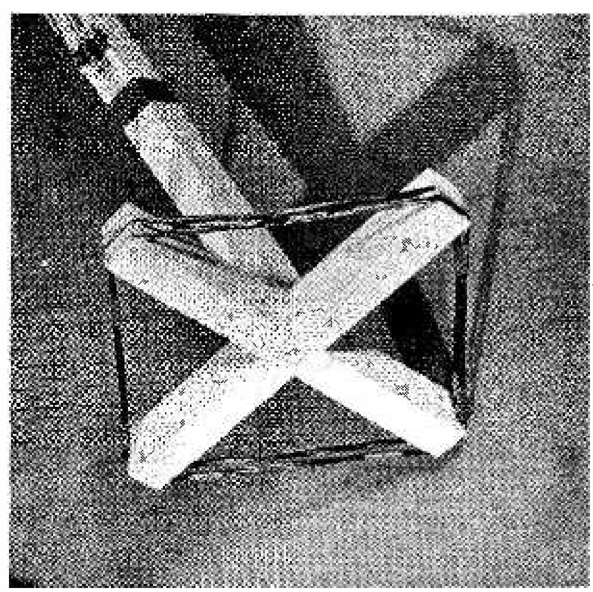


Fig. 1 : The construction of the search coil wooden framework.



The search coil. Note the terminal tag at the top left and the taping of the wires.

grooves, again 48 turns, anchoring at the centre and other outer terminal. Both coils should be wound in the same direction and the centre terminal used only as a convenient centre tap which is needed for the circuit.

All windings should be tight, including the leadups to the terminal tag. Once completed the windings should be taped together at several points to hold them firmly.

It should be emphasised that the successful operation of the Treasure Tracer depends largely on the care taken in the construction of this search coil and loose windings will make operation very difficult and unreliable.

L1 is connected into the collector circuit of Tr1 as shown in the circuit diagram in Fig. 2. C2, shown as a 500pF capacitor, is connected across the coil and this combination will resonate at about 130kHz. The value of C2 and C4 (in the reference oscillator circuit) should be of the same type and reasonably close in value; miniature 5 per cent polystyrene types are very good here and inexpensive. It doesn't matter too much what their values are as long as they are the same, but to stay within the regulation frequency band they should be over 390pF.

The components in the search coil oscillator are connected to form a Hartley oscillator, working at the frequency mentioned. R1 provides the base bias for Tr1 and C1 provides the feedback signal to maintain oscillation.

A low value resistor, R3, is connected in the emitter and this is shared by Tr2 which forms the reference oscillator.

L2 is a standard Denco LW aerial coil which is fitted with the three windings necessary. The main one (between points 1 and 6) is tuned by C4. Another of the windings is arranged to feed back to the base forming a blocking oscillator; this also carries the base bias to Tr2.

The shared emitter resistor R3 means that there is a mixing action in Tr2 and a degree of the search coil oscillator signal is mixed with that of the reference oscillator to make the beat note.

It is necessary to tune one of the oscillators to bring it close to that of the other and here the reference oscillator can be tuned over a wide range by altering the position of the ferrite dust core. The coil should be mounted as shown in Fig. 3 with a small knob fixed to the brass thread attached to the dust core.

The take-off point of the coil comes from the third winding of L2 (between pins 8 and 9). This is d.c. blocked by C5, detected by D1, smoothed by C6 and applied to the base of Tr3.

The signal here will be the beat note or an audio frequency represented by the difference in frequency of the two signals.

The base bias for Tr3 is provided by R5 with R6 acting as the collector load.

Tr4 further amplifies this audio signal and applies it to the 80Ω loudspeaker in the collector. R7 and C7 are included to raise the emitter voltage of Tr4 and to limit the quiescent current. The impedance of the

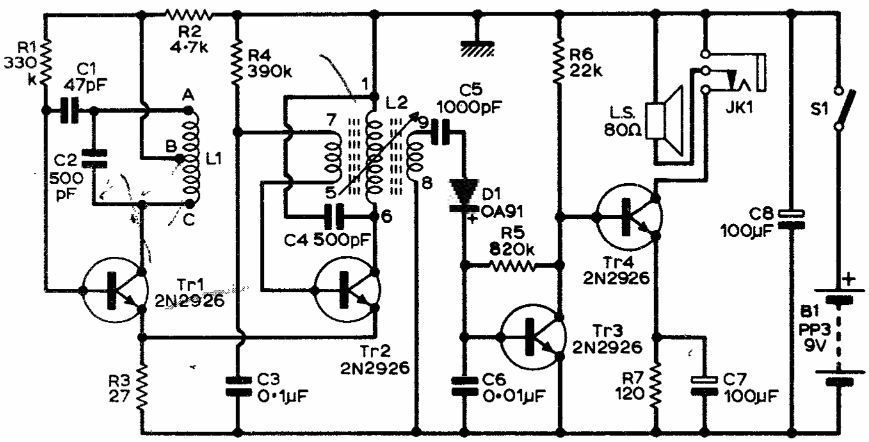


Fig. 2 : The complete circuit for the P.W. Treasure Tracer.

★ components list

Resistors

R1	330kΩ	R5	820kΩ
R2	4·7kΩ	R6	22kΩ
R3	27Ω	R7	120Ω
R4	390kΩ	All ⅛W, 5% types.	

Capacitors

C1	47pF	C5	1000pF
C2	500pF†	C6	0·01µF
C3	0·1µF	C7	100µF 6V
C4	500pF†	C8	100µF 25V
† see text			

Semiconductors

Tr1	2N2926	Tr3	2N2926
Tr2	2N2926	D1	OA91
Tr3	2N2926		

Miscellaneous

L1—see text and drawings
L2 Denco LW aerial coil, Type 1T
LS 75-80Ω miniature loudspeaker
JK1 3·5mm jack socket with cut-out switch
SW1 On-Off slide switch
B1 PP3, 9V battery
Chassis 6⅜ x 2¾ x 1⅞in., (H. L. Smith Ltd. 287/9 Edgware Road, London W.2.) 60p inc. postage.

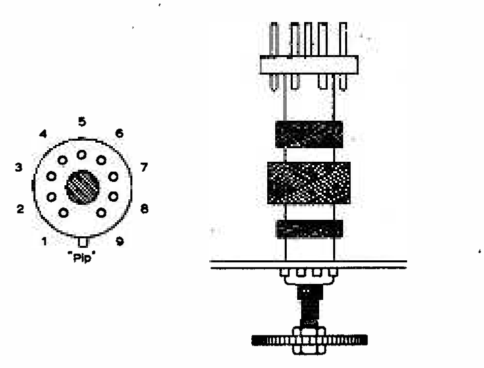


Fig. 3 : The pin numbering and mounting of L2.

loudspeaker can lie between 35Ω and 80Ω and various miniature types with impedances in this range are available. If difficulty is experienced in obtaining one of these, the loudspeaker can be replaced by a transistor output transformer (such as the Eagle LT 700) feeding a lower impedance loudspeaker.

There is a tendency for the two r.f. signals to lock together if they are within a few Hertz of each other. This is not too serious but the inclusion of R2, which drops the supply to Tr1, reduces this tendency. Theoretically the junction of R1 and R2 should be decoupled to the negative line using a $0{\cdot}1\mu F$ capacitor; this however made no difference in the prototype but may be included if Tr1 fails to oscillate.

Note that the chassis is connected to the positive rail rather than the more conventional negative line. This enables simple fitting of the jack socket, JK1, one connection of which has to touch the chassis.

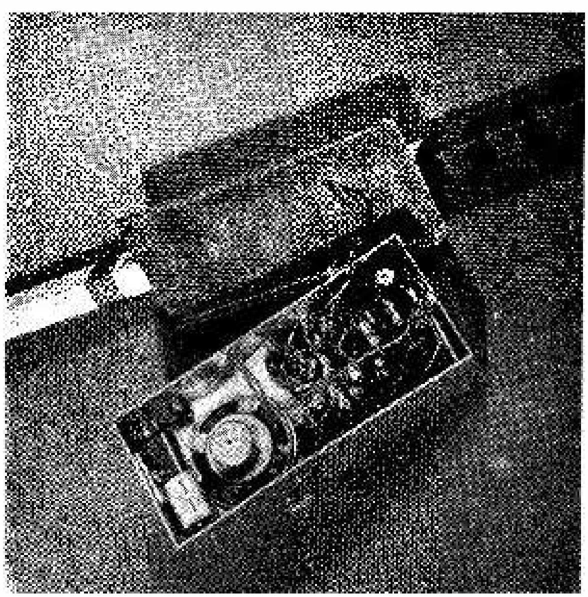
CONSTRUCTION

The majority of the components are mounted on a small piece of 0·15in. matrix Veroboard, 16 holes by 13 holes and this is shown in Fig. 4.

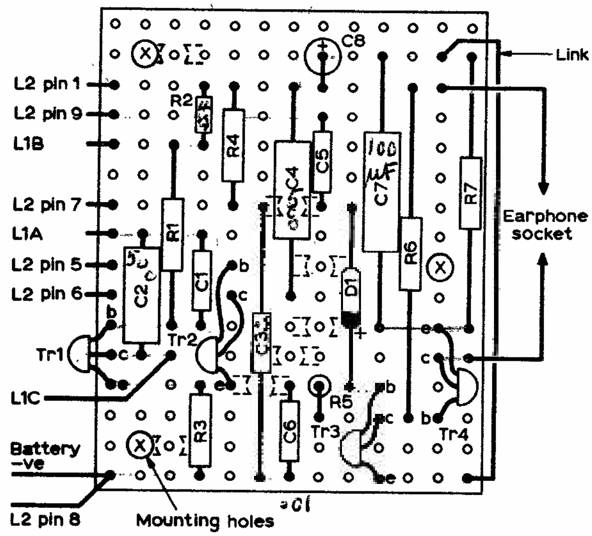
The chassis used in the prototype, and highly recommended, is available from H. L. Smith Ltd. (see components list) and the bottom of this is drilled as shown in Fig. 5. The three holes in a triangle are fitted with 1in., 4BA screws and the component board is mounted on these, spaced off by means of nuts.

The loudspeaker can be glued in place and the wiring between the Veroboard and the other components is shown in Fig. 6.

The recommended chassis comes with a lipped lid which is screwed to the wooden handle as shown in Fig. 7. A hole ¼in. in diameter is fitted with a rubber grommet to take the wires leading to the search coil L1. Stiff wire should be used to run between the chassis and the terminal tag and this should be firmly taped to the handle as shown in the photographs. A small loop is left before entering the chassis to enable it to be opened.



An internal view of the completed prototype.



indicates break in copper strip

Fig. 4 The component layout on Veroboard.

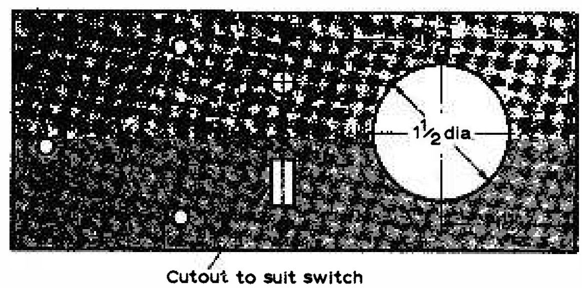


Fig. 5 : The drilling of the bottom of the chassis.

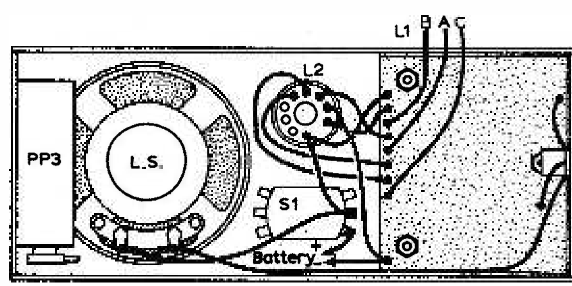


Fig. 6 : The wiring between the component board and the other components.

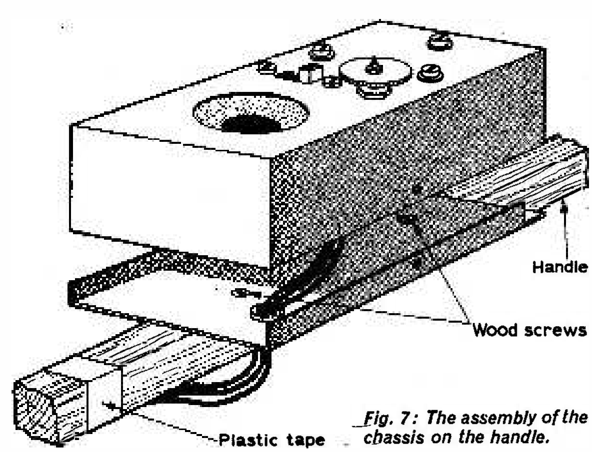


Fig. 7: The assembly of the chassis on the handle.

TESTING

Once all wiring is done a visual check should be made to ensure all is well and this being so, the Treasure Tracer can be switched on.

If all is correct the tuning of L2 will produce two positions where a strong beat note can be heard.

A number of weak signals may be heard at other settings. These are probably caused by radio signals on those frequencies but they are very low compared to the main signals.

The beat note should be set at the lowest stable audio note—probably between 50Hz and 200Hz. When a metal object is brought near L1 the note will either go up or down, depending on whether the search coil oscillator is working higher or lower than the reference oscillator.

By experience it was found that is was better to arrange for the note to go *down* in frequency when a metal object was approached but this is up to the user—a rising note may be preferred.

Certain objects—especially brass—go against the general trend and operate in reverse—causing the note to rise when iron and aluminium cause it to fall.

No volume control is fitted as the output from the loudspeaker is fairly low—about 75mW, though this proved sufficient and was not found too low even by the sea shore. Headphones or earpieces with impedances between 50Ω and 4000Ω all work when plugged into the socket—this automatically cuts the loudspeaker out if wired as shown.

The current consumption is not too high—it should certainly be under 20mA and several hours of searching are possible using the PP3 battery specified.

Before carrying out your first search, eliminate as much movement of the leadup wires as possible by taping them, as even a mild breeze will cause a change in note otherwise.

In testing it will be found that nearly all large objects cause some change in frequency—even laying the coil on the ground— but these changes will be minute compared to that caused by even a small piece of metal.

Do not expect to become an expert in a few minutes. The use of a device of this type needs a degree of skill and it took all of us several hours before we became reasonable at it. Now, after the test, we have used the detector to find a whole mass of new material, including more coins, but this was outside the testing period and the finds were not witnessed so we are not including later items in the list.

Well, where do you search? *Note that there are very heavy penalties for using such a device in areas scheduled as being of historical interest and there have been prosecutions for this.* However there is no need to search in such places and paths or roads that have been in use for centuries are a good place to start; river banks will also prove fruitful.

An excellent small book "A Fortune Under Your Feet" by E. Fletcher elaborates on this and is recommended reading for those encouraged by early results.

If you find something of interest, let us know. We are offering £2 for the most interesting letter we receive dealing with objects found. It doesn't have to be valuable, just as long as it is interesting. ■

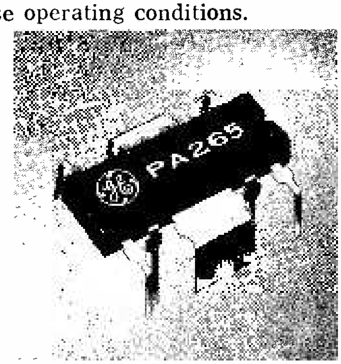
To conform with the Wireless Telegraphy Act (1949) a licence is required to use the Treasure Tracer described here.

Under Section 1(1) (Pipe Finder Licence) the band 16 to 150kHz can be used for equipment of this type.

A licence for five years costs 75p and can be applied for on a form obtainable from the Ministry of Posts and Telecommunications, Waterloo Bridge House, Waterloo Road, London S.E.1.

I.C. of the Month—*continued from page 310*

two heatsink tabs. If the i.c.'s are to be used to their full 5 watt rating some form of additional heatsinking is needed. This may take the form of directly soldering about two square inches of copper to each tab or alternatively to equivalent area of printed circuit board foil. At any rate, in most applications the full output ratings will not be approached so that the above precautions are necessary only for worst case operating conditions.



View of I.C. showing unusual heatsink tabs and staggered leads.

To find out the maximum output currents that the units can deliver all one has to do is to determine the product of the voltage drop across terminals 2 and 7 of the i.c. and the current drawn, making sure that the answer does not exceed 5 watts.

MAXWELL

by G8DSH

"He says never mind the beads—have you got any back numbers of Practical Wireless ?"

SERVICING
AN INTRODUCTION TO FAULT-FINDING

PART 4

H. W. HELLYER

NOW THAT GORDON KING HAS COVERED THE BASICS OF FAULT-FINDING CO-AUTHOR 'MAC' HELLYER DISCUSSES THE PROBLEMS OF RECEIVER ALIGNMENT WITH PARTICULAR REFERENCE TO THE TEST EQUIPMENT NEEDED FOR THIS TASK.

ENOUGH has been said by Gordon King in the earlier parts of this series to absolve me from a tedious description of the make-up of superhet circuitry. In this section, we shall now be able to concentrate wholly upon alignment of the a.m. and the f.m. receiver.

A little theory must creep in since the most practical of readers should still be blessed with some natural curiosity. We need to know why we are twiddling that screw, that slug, that bit of wire, and not just be content to follow a mechanical sequence of instructions.

Servicing consists very largely of using one's native wit to interpret or augment the information given by manufacturers. In many cases, handling a piece of equipment that may be obsolete or, even if new, backed by the most meagre data, one has to fall back on one's knowledge of basic principles and experience of designers' whims to solve some very tricky problems.

Our intention here is to provide a few short-cuts toward those neat solutions. So general principles have to be the order of the day. There will always be exceptions in design, so long as there are exceptions in men. Bravo! say I—there is no more hideous prospect than the "People's Set", which can be serviced by numbers, or, more likely if the double-entry cost-watchers have their way, thrown away when it goes wrong! We all saw what could happen, on page 1030 of the April issue of PW. ("The Committee Supet-FET".)

AM ALIGNMENT

Gordon King has said, already, that a.m. receivers are still stuck with capacitive tuning, although the f.m. receiver, and, particularly, the combination a.m./f.m. set, may have tuning gangs plus variable inductors plus potentiometer plus fixed tuning all wrapped up in one package.

If alignment has to be carried out, begin by sorting out the a.m. section, identifying the stages (see Part 2) and then making up your mind what kind of circuit you are about to tackle. This is assuming that you are not able to get the manufacturer's detailed information, always supposing he has got around to preparing it for publication!

The tuning I have spoken about is the 'front-end' tuning, where the frequency of an oscillator beats with that of the incoming signal to provide a steady intermediate frequency, the i.f. So, before we can tackle the front end, we must make sure the several

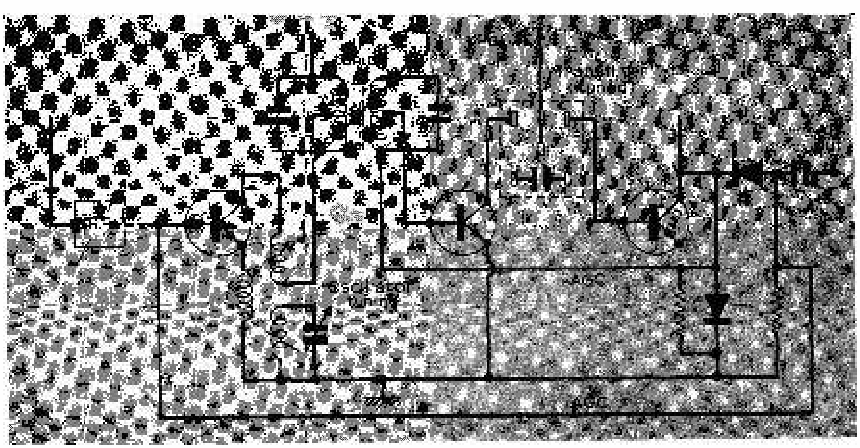


Fig. 1: The skeleton circuit of the tuned section of a typical a.m. receiver. The fixed tuned Transfilter, now becoming quite common, helps to reduce the amount of re-alignment required.

parts of the i.f. circuitry are doing their job. But before we can do this, it is necessary to check the audio section and the detector.

Let me refresh your memory with Fig. 1. Here we have a skeleton circuit of an a.m. receiver, showing the tuned circuits with which we are concerned here, the detector and a hint of the audio section that will follow. It is obvious that a signal injected at a post-detector stage must be at audio frequencies. In the old days, it was easy enough. A finger tapped on the appropriate valve grid, or on the 'hot' end of the volume control would produce a healthy 'buzz'. Mains pickup and the high impedance of the input circuits made this possible. With a battery-operated piece of equipment or the low-impedance circuitry of semiconductor devices, the 'disturbance test' type of operation is not so effective. It can, in fact, be positively dangerous.

SIGNAL INJECTION

The answer is to inject a signal of known characteristic (even if unknown precise amplitude), simply to verify that the following stages are working. We are not interested so much, at this point, in their exact efficiency, their lack of distortion, their overall output. For the following tests we need some method of indicating variations of output, either at the final part of the receiver—the feed to the loudspeakers—or at some earlier audio stage, where the readings may be more convenient.

It must be stressed again that when signal injection methods are employed, we are not expected to measure the output accurately. As Gordon King has explained, the quality of one piece of test equipment is determined by (a) the standards to which one must test the circuit, (b) the quality of associated gear and (c) the standard of testing we wish to apply.

Signal injectors are the easiest of all test instruments to make and apply, and there have been numerous suggested circuits in PW. We shall skip lightly past the subject, pausing only to remark that if you are thinking of alignment, it can be argued that you will be using a signal generator. There are very few of these that do not incorporate an audio output facility. There is your post-detector tester, ready made.

The 400Hz or 1kHz note we hear from the loudspeaker is suitable for rough tests and basic alignment in an emergency. It is certainly no more than a guide for precise circuit adjustment of the modern set. Visual alignment checking is needed so a meter, or some other visual indicating device, will have to be used. So this is where the ordinary multimeter can be pressed into service.

With valved equipment, nothing is easier than a low a.c. voltage-reading meter (say from 0-5V a.c.) across the loudspeaker or a dummy load. The dummy load, it should be said, has not been outdated by transformerless output transistorised receivers. For test and measurement purposes, the output circuit should always be correctly loaded.

Figs. 2(a) and (b) show alternative ways of indicating audio output, for both valved and transistorised equipment. We include these notes on valved equipment simply because the accent here is on servicing and it is in the nature of things that servicing will be required more often on older equipment. Measurement of anode current in an output

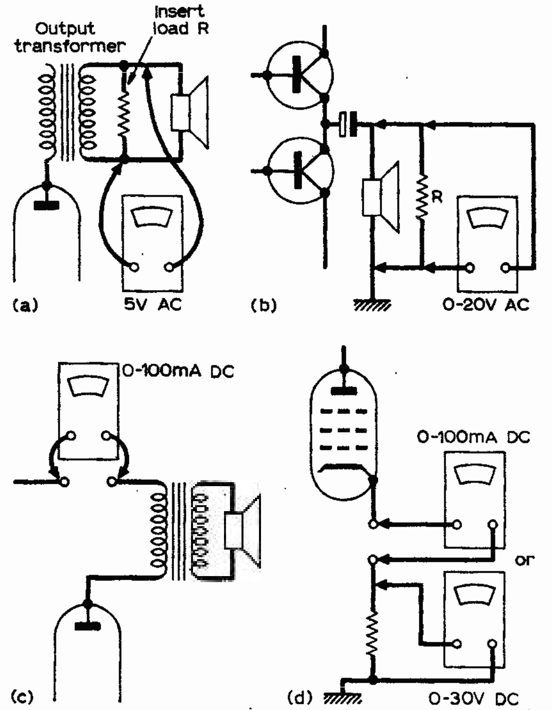


Fig. 2: Measuring output, (a) across dummy load or shunting speaker, (b) across speaker of transformerless stage, (c) current indication in series with anode load, (d) in series with cathode or voltage across bias resistor.

stage of valved equipment, either in the anode or cathode lead, is an alternative, where a low voltage d.c. meter, or a 0-100mA d.c. meter is available, Fig. 2(c) (d).

MEASURING OUTPUT

Breaking into the output stages of a transistorised amplifier for such alternative readings is neither easy nor desirable. Because of the low impedances of emitter circuits, voltage variations are too small to be of any great value, and should, in any case, be stabilised.

But let's do things properly. Let us consider the output power that we should get, and make arrangements to measure that. There are two things to consider here: audio power measurement and indication of standard audio output. They are not the same. As Gordon King will be showing later in greater detail, measurement of audio power is not a simple process, and interpretation of results must be made with great care.

Briefly, the expected outputs from general apparatus would be: (a) small transistorised radios, 500mW to 1 watt (b) larger radios, 1 watt to 3 watts (c) tape recorders and record players, 2-6 watts (d) small amplifiers, up to 10W (e) larger amplifiers, 10 watts upwards.

Standard outputs are related to the sensitivity of the apparatus. For example, a radio may be quoted as having a sensitivity of 25μV for m.w. reception, 40μV for l.w. reception and 1μV for both s.w. and v.h.f. reception. Alone, these figures mean nothing. They must be related to the standard audio output and to other factors such as signal-to-noise ratio. In the case of these quoted figures, the audio output would be 50mW for a s/n ratio of 6dB, relative to the 0dB figure of $1\mu V$.

This gives us a clue to the statement 'decibels below 1 volt' which may sometimes be used. 'Decibels below 1 milliwatt' is another alternative and 'field strength' yet another. The last term is employed to assess sensitivity when loop or ferrite rod aerials are used.

For now, we do not need to worry too much about all this. Practical service work very often consists of bringing up to scratch the circuits that may be only a little out of alignment. If components in tuned circuits have been replaced or if maladjustment has occurred, then the procedure is to check the alignment throughout and to make the small alterations found to be needed.

VISUAL DISPLAY

The oscilloscope is invaluable here, saving hours of careful tabulation and giving both the facility of viewing the result of the input signal and of measuring it. A secondary facility, often overlooked, but quite important, is the ability we have, when viewing a trace, of determining how much output is signal and how much noise and distortion—common causes of faulty results when only a meter is used.

We shall later look more closely at this matter of noise and distortion assessment. For now, a brief note on the practical alignment of a typical receiver, using a standard signal generator and a measuring device, augmented by an oscilloscope. Response curves are the usual method of measurement and, very often, a manufacturer will give no more than the expected curves in his service manual, referenced to some level and bandwidth. It is as well to be clear at this point, therefore, what we mean by response curves, reference levels and bandwidth.

Fig. 3 shows a selection of the graphs one would produce by plotting the output from the receiver (vertical axis) against the frequency at which the signal was applied (horizontal axis). It is possible to produce these curves from careful and detailed measurements but it is much simpler to feed to the receiver a signal which varies regularly across the bandwidth, locking this to the timebase of the oscilloscope and displaying the output from the detector of the receiver. Such an input signal is obtained from a sweep generator, or 'wobbulator' (see page 1038 PW April 1971).

The response characteristic of a superhet receiver is mainly that of its i.f. circuits, for the r.f. circuits are not so sharply tuned. Quite often, response testing and alignment concentrates on the i.f. circuits, leaving the r.f. section of the receiver to be aligned on one or two spot frequencies and checking the padding and trimming of the oscillator.

The acceptance band of a receiver has to take in the sidebands of the transmission for full handling of the higher frequency components of the modulation, but if it extends too far beyond this, the signal-to-noise ratio will suffer. A perfect response characteristic—an impossible one—is shown in Fig. 3 (a). All the frequencies within the passband are received with the same sensitivity; those outside the passband having no effect. In practice, the response curve may be more as (b), where the 'usable' bandwidth is that between the −3dB points. This is where output power falls by 3dB or half its maximum value.

Note, however, that the response curve may be neither as flat as (a), nor as gently peaked as (b). In fact, it may be double-humped, as in (d). One important point here is that the reference point, relative to the −3dB level, is the centre frequency of the passband, and not the peak of the humps.

Merely to state the frequency limits at which a curve is 3dB down is not enough. This tells us what the gain of the receiver is, but not the extent of the rejection of unwanted frequencies. Always plot beyond the −3dB points, as shown in the accompanying curves.

Making response measurements of the a.m. receiver with a low audio frequency modulating signal (example: 30% modulation at 400Hz), we feed the signal generator to the mixer input, as shown in Fig. 4. It is essential that the impedance from which the signal is derived is as low as possible. In the mixer input, the tuned circuits will not be at the intermediate frequency, so the low impedance is needed. Hence the two resistors, Ra and Rb, where

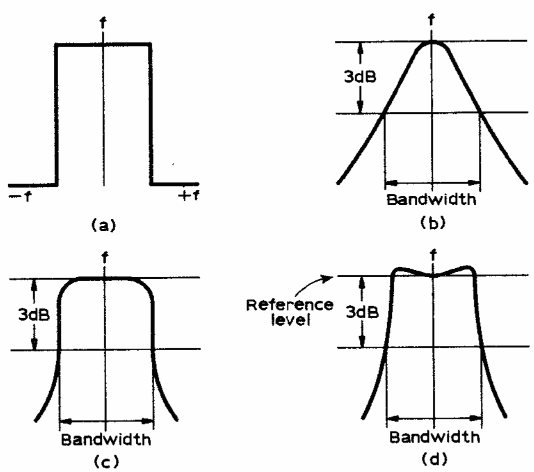


Fig. 3: (above) Response curves, carrier frequency f with +f and −f representing bandwidth limits. (a) Ideal curve, (b) peaked response, with bandwidth indicated at −3dB (c) flat tuning to give desired response, same peak level and bandwidth as (b) but quite different response. (d) double-hump tuning as approach to flat top response of (a)

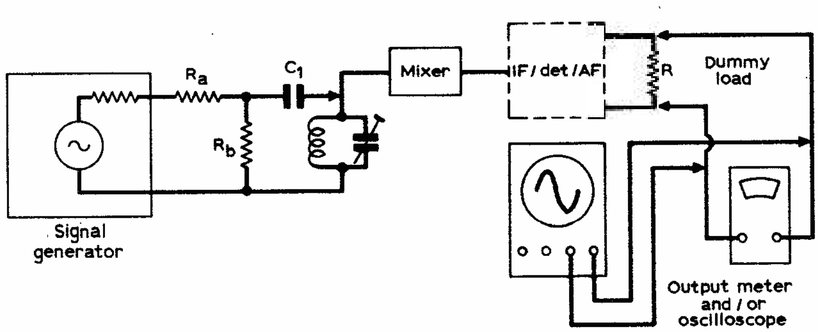


Fig. 4. (right) Instrument set-up for measuring i.f. response. Note attenuator resistors Ra and Rb, and isolating capacitor C1.

a reduction of the generator output impedance from the usual 50 or 75 ohms to as little as 10 ohms can be effected. The values are easily worked out: for a generator of 50 ohms output, to present a 10 ohm (very nearly) load to the mixer input, we need to make Ra around 40 ohms (nearest preferred value 39 ohms) and Rb 10 ohms. The choice of values gives a 10:1 voltage ratio also, just in case you want to work out sensitivity figures.

The value of C1 should be such as to make its reactance at the test frequencies no greater than 50 ohms. At an i.f. of 470kHz, C1 would thus be around $0 \cdot 01 \mu$F. Its inclusion is to prevent the d.c. bias conditions being upset.

Disabling the a.g.c. is the next consideration although the method of disconnecting the a.g.c. line and putting a fixed bias in its place may not be so simple with modern sets. Sometimes the manufacturer will indicate a method of killing the a.g.c. action. The need to do so is evident from an understanding of a.g.c. action, which has already been described.

If we feed to a receiver aerial input a signal varying between say a microvolt and a volt, we may find that at around 5-10 μV input, a 2:1 increase in input produces very nearly a 2:1 increase in output. But after about 100 μV input, the curve relating output to input flattens drastically, and it needs a good deal more 'in' to produce just a little more 'out'. The a.g.c. curve, in other words has a definite 'threshold value' with two fairly linear slopes, above and below that threshold. In fact, a.g.c. "quality" is often defined in terms of the mean slope of the curve above the threshold.

Assuming first that the a.g.c. is prevented from working, our tests would comprise first setting the generator to the reference frequency, with its output adjusted so that at full receiver gain the rated full output is obtained. The generator output is then attenuated to produce the 'standard' output, 50mW. The receiver's gain control can be used to set the output indicator to a convenient value and then left strictly alone.

The generator is swung over the required frequency band and output plotted relative to the reference. The bandwidth is the frequency difference between the 3dB 'down' points.

If the a.g.c. cannot be 'killed', there are alternative ways of going about the checking. We can tackle the problem 'backwards', measuring for a constant output for a 3dB increase of input, with the attenuator of the signal generator set to increase the test input by 3dB, then the two limiting frequencies where the monitor reading is returned to the reference level define the bandwidth.

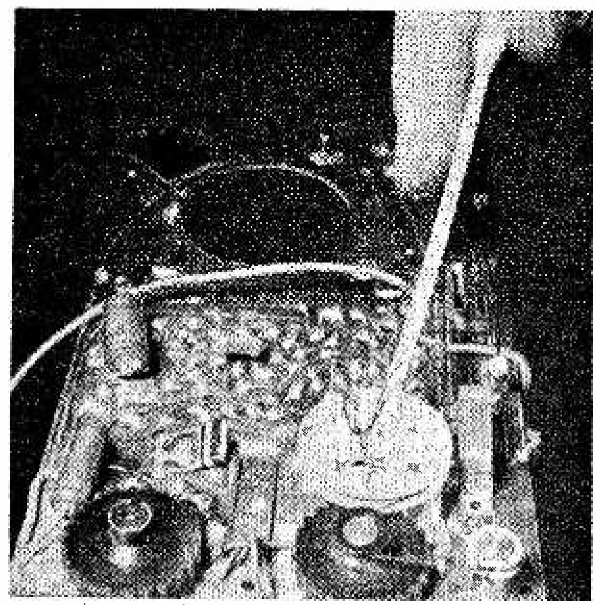
Another way of testing bandwidth without having to 'kill' the a.g.c. is to keep the carrier frequency of the generator constant and to vary the bandwidth. This cannot be done with the normal signal generator, as modulation frequency and depth are often fixed. But where a c.w. only output is obtainable and a separate audio generator is available to apply a varying input, then the r.f. generator can be set up to the central frequency and the modulation varied in frequency, without any change in depth, and a note made of the points at which the output reading (across the detector load, for utmost accuracy) is $0 \cdot 707$ of the reference level. These limits are the bandwidth, i.e., bandwidth is twice modulation frequency.

CW TESTS

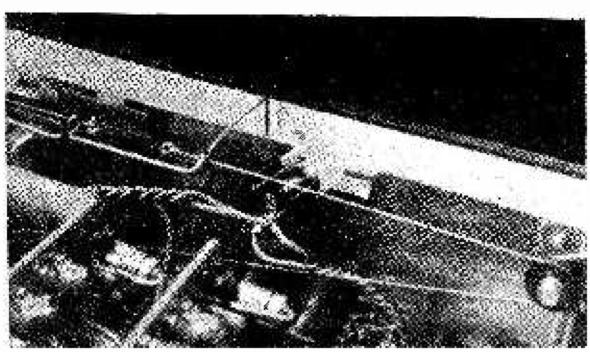
It is not so easy to align higher quality receivers. The sides of the response curve can appear deceptively steep, because of the relative phase shift of the sidebands. The way to overcome this possibility of error is to use a c.w. (unmodulated) input and to read off the d.c. voltage at the detector.

One snag: there may be some standing d.c. voltage. It can be allowed for and carefully taken into account by subtracting it from final readings. The use of a d.c. valve voltmeter or similar instrument allows us to back off the settings to obtain a new zero.

Working on s.s.b. receivers can be a good deal easier. Better-class communications receivers work also in the single-sideband mode and these can be aligned by using the beat between the input signal and the internally generated carrier, with a.g.c. switched off—which is usually possible with these sets.



Before attempting alignment it is essential that drums, cords, springs and attachments are in order. Always check traverse of pointer before making adjustments.



Close-up of am.ff.m. tuner showing part of a.m. ferrite rod aerial at left and drive cord and pointer.

PRACTICAL POINTS

Procedures must differ between makes and models. Some general rules follow:—

(1) Allow sufficient warming up time before making tests. On valved equipment, fifteen minutes for both receiver and test gear should be regarded as the minimum. Despite all the advertising, transistorised equipment does not 'warm up' to operating conditions 'in the twinkling of an eye'. One very famous hi-fi amplifier I recently tested took seven-and-a-half minutes for the current in the output stages to settle to a steady reading, and that is not exceptional.

(2) Check mechanical points. Dials and cursors, pointers and drums should be run from end to end of their travel and limits noted. Where datum points are provided by makers, these should also be checked before alignment commences. In general, maximum frequency (minimum wavelength) should be indicated when the capacitor plates of the usual ganged capacitor are fully unmeshed.

(3) Make any necessary adjustments to counteract backlash, so that a setting of the cursor or pointer accurately reflects the setting of the tuned circuits.

(4) Check before operations that the required trimming tools that are available. It is simply asking for trouble to use worn grub-screw drivers where hexagon-holed slugs are used, or when core slots are only suitable for miniature plastic tools. Some time ago *PW* presented a set of plastic trimming tools to readers. Mine are still in use, augmented from time to time by filed plastic knitting needles and crochet hooks.

(5) Cores of inductors, despite all our efforts and care, may jam. The only recourse then is to drill or chip them out, taking great care not to damage the former wall or the inductor. Resetting of new cores may need either a rubber band inserted in the core or the use of a non-hardening adhesive. There are core-locking compounds that provide an adequate fixing but still allow some adjustment.

(6) Finally—before starting, make sure that test gear is isolated and that there are no false return loops. Connect the neutral side of a.c./d.c. equipment to chassis if you have no isolating transformer and provide capacitive isolation, as previously described.

GENERAL PROCEDURES

Consider a combination a.m./f.m. receiver, as shown in skeleton form in Fig. 5. Crystal filters are used widely and we can expect to find this trend growing. No alignment is normally required except for the last stage, which will be peaked up to the intermediate frequency. A little care is needed here and some 'swing' about the nominal frequency may be necessary. A good idea is to peak the last i.f. to the input from a weak signal after the rest of the alignment has been done, bringing it into tune only temporarily at first.

Where tuned circuits are used throughout, inject a signal at the frequency changer that will produce a 50mW output across the appropriate load. As power in watts is the voltage squared divided by the resistance, we can work out the required reading. (For 3 ohms this will be 0·387V, for 8 ohms, 0·633 volts and so on.)

A meter that has a full-scale deflection of around 2·5V a.c. is required. Exact readings are not important at this stage as our aim is to maintain the output at the same level while bringing the circuits into tune, turning down the input as the gain increases. For this, the volume control will be turned to maximum, and if there are tone controls fitted, the treble control will be adjusted for the least top-cut.

Tuned circuits should be adjusted for peak output, starting at the rearmost and working toward the mixer. After initial peaking, go back over these adjustments. With some sets, there may be a tendency for one tuned circuit to 'pull' another, and readjustment should be made until no further improvement can be gained.

Where the response curve is humped, two peaks will be found as the signal generator is swung over the passband. In this case, the middle position should be used. Tune for the slight dip between the peaks.

IF REJECTION

Before readjusting the signal generator, remove it from the mixer input and apply the signal, still at intermediate frequency, to the **aerial** input, then tune any i.f. rejection circuit to give the **minimum** output. It is always wise to make this test early on, then rechecking after mixer alignment. For this test, increase the i.f. output from the generator and switch the receiver to the medium-wave band (where breakthrough could be bothersome), turning the tuning gang till the vanes are fully meshed, i.e. the low frequency end of the band.

Another rejection circuit that will be found nowadays is the 19kHz pilot tone filter. This is also tuned for minimum output with a strong 19kHz tone injected.

Alignment of the broadcast band is conveniently done at this point. Set the generator to around 600kHz (500m) and the pointer of the set to the same

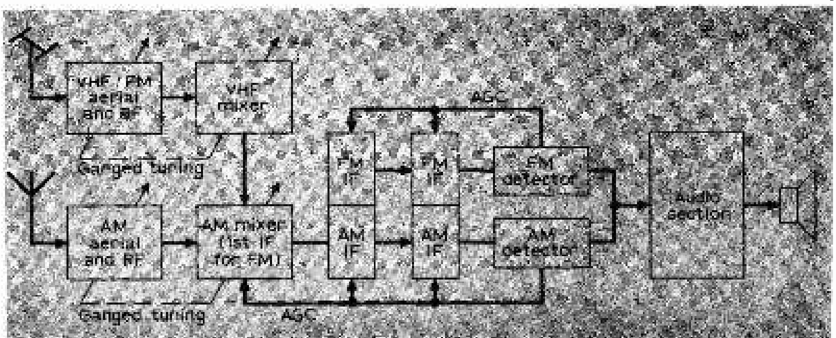


Fig. 5. Block diagram of combined a.m./f.m. receiver, with switching omitted, as a guide to following the alignment procedures described in the text.

frequency, after checking that it traverses the scale correctly, and reaches any datum points marked by the manufacturer with the correct scale indication.

Adjust the padder and/or the oscillator coil (if this is adjustable) and obtain maximum output. Then readjust to the other end of the band, setting the trimmer. Best procedure is to carry out these operations for the mixer first, then peak up the aerial circuits and return to the mixer for readjustment, then again to the aerial to make sure the circuits remain in tune. Adjustments of this nature take time and demand patience. Maybe this is why realignment of receivers can be a costly job! It is never good enough to make a perfunctory gesture of 'twiddling the cores'. The long wave adjustments can then be done.

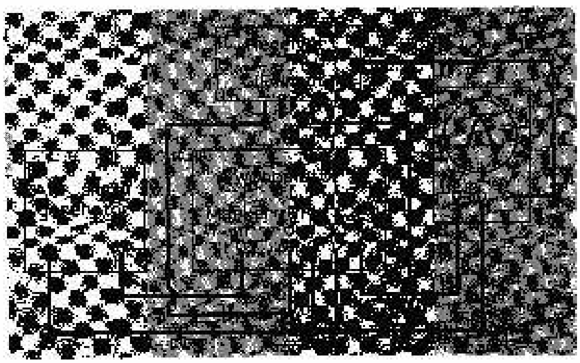


Fig. 6 Instrument set-up for checking i.f. response of f.m. receiver.

Do not attempt them in reverse order, as settings of the medium wave tuning can affect the long wave band. Similarly, where there are several short wave bands, first adjust the highest frequency band.

Long wave adjustment often consists of adjustment of one trimmer in the mixer circuits and one in the aerial circuits. There is rarely any need to check tracking over the band as carefully as one would with medium wave tuning, there being few stations available.

Short wave adjustment often requires slight movement of coil turns and care has to be taken with the dressing of leads. Tuning is considerably simplified by the omission of padders in the short-wave section of most receivers. Instead, we find coil adjustments, or core settings being made at the low frequency end of each band and trimming used at the high frequency end.

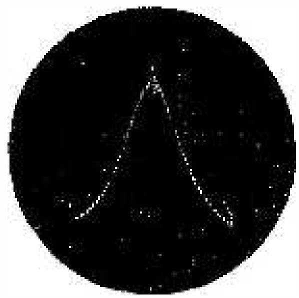
FM ALIGNMENT

Most adjustments to f.m. tuned circuits are carried out nowadays with the aid of a wobbulator and oscilloscope. Here, we find the output displayed, the signal swept over the response band and variable capacitors and coil cores adjusted to obtain the correct response curve. Addition of an a.m. marker generator aids the set-up, and the inter-connection of these instruments is shown in Fig. 6.

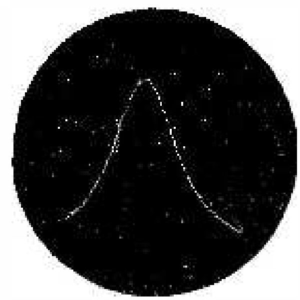
Because the average serviceman is unlikely to possess a wobbulator, we shall concentrate here on the adjustment of f.m. circuits using only an ordinary signal generator and a high-resistance meter. A more tedious job, but practically as efficient.

First requirement is a d.c. voltmeter, capable of reading around 10 volts, with a 20,000 ohms/volt sensitivity at least. This is connected across the d.c. load of the ratio detector, the aim here being to keep the reading to a set level, determined by circuit characteristics, by turning down the generator input as the circuits are brought into line.

With the generator tuned to the f.m. intermediate frequency (10·7MHz), and with the modulation switched off, the signal is injected at the mixer and



◀ Oscilloscope trace of response curve using wobbulator, with marker pip at top of curve (centre frequency f).



A similar response curve but this time the marker pip is placed at the —3dB level on one side of the curve. ▶

the i.f. circuits aligned for maximum output. The correct procedure, again, is to start at the rearmost and work forward, but even more care is needed and constant rechecking is necessary.

If a ratio detector is used, the next step is to note the output reading from this 'peaked-up' process, transfer the meter to the a.f. output capacitor and note that the reading is now exactly one-half of what it was before. The ratio detector winding is adjusted to achieve this.

After this, repeat the steps until no further improvement can be gained. It is important to ensure that later steps do not impair earlier results; hence this need for repeated operations.

The ratio detector is finally balanced. The coil that gave its 'half-volts' reading earlier is now readjusted for a minimum reading. The mean of these two is calculated: i.e., halfway between the maximum and minimum voltages that can be obtained by adjusting the coil of the ratio detector. This is the setting for correct alignment.

END OF PART FOUR

NEXT MONTH 'MAC' HELLYER WILL DISCUSS HOW FM STEREO SIGNALS ARE GENERATED AND TRANSMITTED. THEN FOLLOWS DETAILS OF TYPICAL STEREO DECODERS AND THEIR ALIGNMENT.

the european space race

Marconi sets the running with a multi-million pound contract for Skynet II.

by JOHN CHAPMAN

THE first communications satellite system to be designed and built in Europe will be a British venture. Marconi Space and Defence Systems, a member of the GEC-Marconi Electronics group, has won a multi-million pound Ministry of Defence contract to design and build two satellites to gradually take over the expanding military communications traffic currently being carried by "Skynet 1," a satellite built by the Americans for exclusive use by the British Armed Forces.

Skynet II will be more powerful than the existing satellite and will be one of the most advanced satellites in orbit in the world.

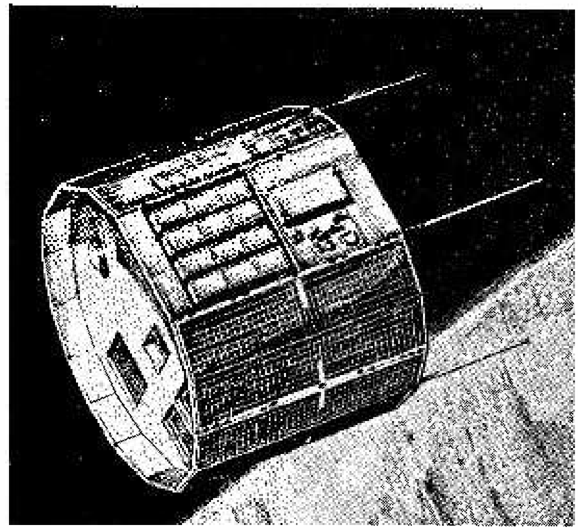
The first of the new satellites will be launched into a near synchronous orbit over the Indian Ocean in the first half of 1973. By this time the American built Skynet I will be approaching the end of its design life: the second of the new satellites will be used as a standby and launched later in 1973.

The GEC-Marconi group has already played a major role in the provision of ground stations for the Skynet system. Four 21-foot diameter dish transportable stations have been supplied by Marconi Space and Defence Systems at Stanmore and this part of the company is at an advanced stage in the development of a 3½-foot diameter aerial terminal (called SCOT) which can be mounted on a ship to provide the Royal Navy with further links into the Skynet system. Marconi Communications Systems, based at Chelmsford, built the first three earth terminals back in 1966. Two of these 40-foot diameter ground stations which were used with the satellite system built for the U.S. Government and used successfully by the American Armed Forces have now been modified to form part of the Skynet system.

Outlining the activities of Marconi Space and Defence Systems at Portsmouth, the company's manager Mr. M. Lovell said that their experience in spacecraft electronics has been developed over a period of about seven years in which time they have provided the satellite electronics for every British spacecraft programme to date.

The first of these was Aerial 3 (later called UK3), a satellite launched in May 1967 as part of a scientific programme. Although this satellite had a design life of a year, it was not switched off until 1968 and furthermore, the system was reactivated last September in order to check on the long-term reliability of the electronics equipment in a space environment.

The next important project was the X3 satellite which will be the first technological satellite to be launched in a Black Arrow launch vehicle. In this project Marconi engineers are responsible not only for the onboard electronics but also for satellite assembly, system test and the preparation of the



spacecraft for launch. By contrast with the earlier satellite, X3 features modular electronics systems built to conform with ESRO standards which are suitable for use in a wider range of satellites.

Marconi has also been heavily involved in the UK4 and UK5 satellites. The later satellite is packed with electronic equipment and offers two important advances to the experimenters taking part in the joint NASA/Science Research Council project. Firstly it will be possible to adjust the direction of the spin axis of the spacecraft using a propane attitude control system so that experimenters can scan space for objects of potential interest and then point a second set of experiments along the spin axis at selected sources. Secondly, through the use of the spacecraft's magnetic core stores, it will be possible to collect data around an orbit and to replay this upon command in a format most convenient for the experimenters.

CONSTRUCTION

The Skynet II satellite is to be built in the form of a cylindrical drum, with solar cells covering the entire curved surface to provide the power for all of the electronics. It will measure approximately 78 inches long with a diameter of 75 inches. Launch weight will be about 960 pounds.

An apogee motor contained in the satellite itself, and mounted along the major axis of the cylinder, will be used to transfer Skynet II into its synchronous orbit. It will be spin-stabilised at about 90 revolutions per minute from the time the second stage burning ceases and once placed in synchronous orbit by the solid fuel apogee motor, the communications antenna will be de-spun and controlled to point continuously at the earth.

Attitude control will be achieved by means of hydrazine jets which will be used to adjust the attitude of the satellite, both before the apogee motor burn, and subsequently for the life of the satellite after it has achieved the required synchronous orbit. Control movements will be provided by a single pair of jets located at the edge of the satellite and thrusting parallel to the axis of the satellite, with another pair of jets mounted in the curved surface of the satellite, and pointing radially out from the centre. These jets when fired will be pulsed to synchronise with the rotation of the satellite so as not to upset the high rate of spin which will eliminate any tendency of the satellite to rock, or even tumble and so interupt communications traffic.

During the initial manoeuvres and the final positioning, control communications will be carried out through an omnidirectional aerial system consisting of an array of cavity-back dipoles operating at S-band. This array is mounted in a single band round the complete circumference of the satellite. Once synchronous orbit has been attained and the satellite has been turned into the correct position with respect to earth, a single horn aerial mounted on the major axis of the satellite—at the opposite end to the rocket motor—will be brought into use to provide the main communications function of the satellite. This aerial whose beam-width is just sufficient to cover the entire visible portion of the earth's surface will be mechanically de-spun and aimed directly towards the centre of the earth.

Much of the technical detail of the electronic packages onboard Skynet II is, of course, classified. Presumably the transmitter/receiver operates in the GHz band using sophisticated multiplexing techniques to cope with the wide variety of traffic it will be called to handle. Also it will have to cope with a variety of powers, since the ground stations with which it will have to work range from tiny ship and shore-based portables with 3·5-foot diameter dish shaped aerials to the large 40-foot units having outputs measured in kW.

TECHNOLOGY SATELLITE

Much more information is available on the technology satellite X3 which is in the final stages of preparation for launching shortly. The satellite has been checked in the solar chamber at RAE Farnborough and at the time of writing it is being checked for magnetic inter-reaction at the ESRO European Space Technology Centre in Holland prior to installation on to a Black Arrow launcher.

The Black Arrow 'X' series of technology satellites is aimed at improving British technology in spacecraft and launch vehicles. All of the satellite systems are designed with future requirements in mind and some of the operational data equipment is duplicated in new experimental form to be proved in space.

Marconi has designed and built the power conditioning system, the telemetry transmitters, telecommand receivers and decoders and the data conditioning systems for the satellite to the relevant NASA and ESRO standards.

Although the power requirements of X3 is only 10 watts, the power conditioning system has been designed for future spacecraft in the series and is rated to supply up to 30 watts continuously, both in sunlight and eclipse conditions. A 6 ampere-hour nickel-cadmium battery charged by the solar cell array supports the equipment during eclipse periods.

Owing to the limitations of the pulse frequency modulation data system used on previous satellites, channel capacity has been increased through the

This picture shows the assembly of a welded circuit for an r.f. module. (Skynet II).

adoption of a modular pulse code modulation data system. Besides meeting the immediate requirements of the X3 satellite, the system could be expanded easily to cope with more complex data systems of future spacecraft.

The new data handling system uses a small number of standardised logic elements, such as shift registers and multipliers, packaged in all-welded "modules" assembled to form a complete telemetry system. Essential modules are duplicated to enhance system reliability.

The telemetry, tracking and command system makes use of an r.f. package comprising 6 sub-units based on common piece parts. Again the telemetry transmitter is duplicated to increase reliability. Two receivers are used and connected in polarization diversity configuration to minimise the effects of spin modulation of the r.f. signal—induced by the rotation of the satellite.

A completely new command decoder has been developed for X3. This operates on the NASA Tone-Digital Command Standards and provides a capacity of up to 70 commands per decoder address. Two of these are fitted to the satellite. For a transmitted command to have any effect on the satellite, the r.f. carrier frequency, the tone frequency, the relative timing and lengths of the tone bursts, and the number of bits per word must all be correct and the decoder must also recognise its allocated address followed by a valid execute code within a defined time period. Reasonably secure!

TOTAL CAPABILITY

Now that a British company has won its spurs in the space race, Marconi is in an ideal position to open up satellite communications for commercial applications. Already there are suggestions that countries like Canada and several in Africa where the population is spread over wide areas could make use of communications satellites feeding small ground stations such as the SCOT terminal being built for the British Armed Forces.

By the end of the decade radio and television direct from 'stationary' satellites could become a reality. The technology is here already—it seems to be more a matter of getting the economics right.

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2N696	20p	2N2925	22p	AC107	46p	BC153	19p	BFY50	23p
2N697	22p	2N2926	11p	AC126	20p	BC154	20p	BFY51	20p
2N706	12p	2N3053	27p	AC127	20p	BC157	12p	BFY52	23p
2N930	29p	2N3055	65p	AC128	20p	BC158	11p	BSX20	16p
2N1131	36p	2N3702	13p	AC153K	22p	BC159	12p	C407	17p
2N1132	40p	2N3703	13p	AC176	16p	BC167	11p	MC140	25p
2N1302	19p	2N3704	13p	ACY20	20p	BC168	10p	MPS6531	35p
2N1303	19p	2N3705	13p	ACY22	16p	BC169	11p	MPS6534	30p
2N1304	23p	2N3706	13p	AD140	56p	BC177	14p	NKT211	25p
2N1305	33p	2N3707	13p	AD142	50p	BC178	13p	NKT212	25p
2N1306	33p	2N3708	13p	AD149	60p	BC179	14p	NKT214	23p
2N1307	36p	2N3709	13p	AD161	33p	BC182L	10p	NKT274	18p
2N1308	36p	2N3710	13p	AD162	36p	BC183L	10p	NKT403	65p
2N1309	36p	2N3711	13p	AF114	30p	BC184L	11p	NKT405	79p
2N1613	23p	2N3794	15p	AF115	30p	BC212L	16p	OC71	29p
2N1711	26p	2N3819	35p	AF117	28p	BC213L	16p	OC81	25p
2N1893	54p	2N3906	35p	AF124	30p	BC214L	16p	OC83	20p
2N2147	95p	2N4058	13p	AF127	28p	BCY70	19p	ZTX300	17p
2N2218	34p	2N4059	10p	AF139	33p	BCY71	33p	ZTX301	17p
2N2218A	43p	2N4060	11p	AF239	36p	BCY72	15p	ZTX302	22p
2N2219	38p	2N4061	11p	ASY26	27p	BF115	23p	ZTX303	22p
2N2219A	58p	2N4062	12p	ASY28	27p	BF167	18p	ZTX304	27p
2N2270	62p	2N4124	18p	BC107	12p	BF173	19p	ZTX500	18p
2N2369A	19p	2N4126	27p	BC108	11p	BF194	14p	ZTX501	21p
2N2483	35p	2N4284	15p	BC109	12p	BF195	15p	ZTX502	25p
2N2484	42p	2N4286	15p	BC125	15p	BFX29	31p	ZTX503	22p
2N2646	54p	2N4289	15p	BC126	22p	BFX84	25p	ZTX504	52p
2N2904A	42p	2N4291	15p	BC147	10p	BFX85	34p	ZTX530	27p
2N2905	44p	2N4292	15p						

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82 Ω–220K Ω	E12	9	8	7
C	1/8W	5%	4·7 Ω–470K Ω	E24	1	0·8	0·7
C	1/4W	10%	4·7 Ω–10M Ω	E12	1	0·8	0·7
C	1/2W	5%	4·7 Ω–10M Ω	E24	1·2	1	0·9
C	1W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·8
MO	1/2W	2%	10 Ω–1M Ω	E24	4	3·5	3
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	7	7	6
WW	3W	5%	12 Ω–10K Ω	E12	7	7	6
WW	7W	5%	12 Ω–10K Ω	E12	9	9	8

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

Prices are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1p. on total value of resistor order)

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
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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5% full range E24 values; 400mW: 2·7V to 30V **15p** each 1W: 6·8V to 82V **27p** each 1·5W: 4·7V to 75V **60p** each Clip to increase 1·5W rating to 3 watts (type 266F) **4p**.

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Single gang linear	220 Ω, to 2·2M Ω	12p
Single gang log	4·7K Ω to 2·2M Ω	12p
Dual gang linear	4·7K Ω to 2·2M Ω	42p
Dual gang log	4·7K Ω to 2·2M Ω	42p
Log/antilog	10K, 47K, 1M Ω only	42p
Any type with ½A D.P. mains switch, extra		12p

Please note: only decades of 10, 22 and 47 are available within ranges quoted.

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250V 20% 0·01; 0·022; 0·033, 0·047 **3p** ea. 0·068; 0·1, 0·15 **4p**, 0·22 **5p**, 10%: 0·33 **7p**, 0·47 **8p**, 0·68 **11p**, 1μF **14p**. 1·5μF **21p**, 2·2μF **24p**.

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C426 range axial lead **6p each**
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Audio ..	5-pole 240deg.	15p	12p
Audio	6-pole	15p	13p

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

THE onset of fine, summery weather has caused the usual drop in the number of reports as DXer's leave their shacks for the great outdoors. Among the stalwarts who remained in their shacks was **John Trewick** of London Colney who used his Lafayette HE-40 and vertical whip to hear the following:—

9525 *RSA, South Africa* in English at 2020.
11820 *BBC, Ascension,* 'The Music Scene' at 2015.
15018 *Hanoi, Vietnam* with 'Letterbox' at 2000.
15170 *ELWA, Liberia* in French at 2030.
15185 *Helsinki, Finland* in English at 1800.
15195 *Ankara, Turkey* in German at 2100.
15265 *Kabul, Afghanistan* in English at 1800.
17730 *Havana, Cuba* with news in English at 2010.
21535 *NHK, Japan* with 'DX Corner' at 0800.
21535 *RSA, South Africa* with Folk Songs at 1120.

Howard Stephenson of Newcastle-upon-Tyne has used his Eddystone EC10, Mk. II receiver and Joystick antenna to hear some interesting stations including:—

3260 *R. Niamey, Niger,* African music at 2015.
3905 *All India Radio* in English at 2245.
3915 *BBC, Tebrau, Malaysia* relay at 2215.
4680 *HCWE1, R. Nac. Espejo, Ecuador* with Latin-American music at 0545.
4680 *HCWE1, R. Nac. Espejo, Ecuador* with Latin-
15395 *VOA, Tinang,* Philippines at 2200.

Ray Warren of Bury St. Edmunds has used his Astrad Auriga receiver and a Koyo 1661 receiver to hear the following:—

6195 *Tunis, Tunisia* in French at 0840.
6540 *Pyongyang, N. Korea* in English, 1900.
9489 *Radio Tirana, Albania,* English, 1830.
9570 *R. Nacional, Spain* in Spanish at 1540.
15180 *Radio Australia,* pop music at 0800.
15460 *Radio Kuwait,* news in English at 1830.

R. J. Downes of Bournemouth does not mention what equipment he uses but he heard:—

6010 *R.T. Belgium* in Dutch at 1430.
11710 *RAE, Argentina* in English from 2300 to 2400.
11965 *Trans Europe Radio* in English, 1345.
15160 *Ankara, Turkey* in English from 2200.
15185 *Nigeria B.C.* noted in English at 0715.

Derek J. Hart of Lancaster sent in the following list of stations which he has heard recently:—

6080 *Radio Berlin International* at 2037.
9505 *Radio Tirana,* Albania news at 2035.
9625 *Israel B.C.,* news at 2056.
9915 *All India Radio,* news at 2056.
11672 *Radio Pakistan,* news at 2045.
15125 *Radio Australia* to Pacific at 0830.

Nigel Williams of Caewern, Neath, Glamorgan, has a Lafayette receiver and a Joystick antenna with which he heard:—

4990 *Radio Kiev,* Ukraine, DX programme at 1945.
5015 *Windward Islands B.S.* to Europe at 2345.
6130 *Radio Tirana,* Albania in English at 2130.
7306 *Polish Pathfinders* in English at 1700.
15230 *BBC, Ascension* relay at 1710.
15250 *RSA, South Africa* at 1750.
21460 *HCJB, Quito,* Ecuador, DX programme at 1945.
21595 *Radio Canada International* at 1850.

C. Gibbs gives no indication of the equipment used but he managed to hear the following at his shack in Camberley:—

6020 *Radio Nederland* in English at 1515.
6025 *Radio Portugal* at 2125.
6025 *Radio Budapest,* Hungary in English at 2130.
7145 *Radio Warsaw,* Poland in English at 1600.
9535 *SBC, Berne,* Switzerland at 1115.
9730 *Radio Berlin International* from 1515.
9735 *NHK, Japan* in Japanese at 2012.
15325 *Radio Canada* in French at 2045.

A new reporter from Hessle in East Yorkshire is **Ian Jarvis** who owns a Lafayette HA-700 receiver and a 50 foot long aerial which enabled him to hear:—

7210 *The International Radio Service of the Red Cross* from Switzerland at 1200.
7290 *Trans World Radio,* Monaco at 1645.
9770 *Austrian Radio,* English for Europe at 2045.
11672 *Radio Pakistan* in English at 2015.
15130 *Radio Australia* in English at 0815.
15240 *Radio Sweden* in English at 2245.

The article in the May issue has prompted a number of queries as to which is the best receiver for the Broadcast Bands DXer. This is a very difficult question to answer but my general advice is to pick one of the following ex-military sets: CR100, AR88, R1155 or an HRO. If you prefer a new receiver the following two sets are good value for money: Lafayette HA-600 or Trio 9R59DE. Both these receivers retail at about £45, much better sets can be purchased if the money is available of course.

KJ Catalogue

KJ Enterpises announce their latest Leisure-sound Mail Order catalogue. There are 128 pages, containing stereo systems, record players of every variety, tape and cassette recorders, amplifiers, speakers, turntables, microphones, p.a. equipment, all types of recording tape, cassettes, books 8-track cartridge players, car radios, countless hundreds of accessories of every kind, radios, specialist furniture lines etc. As usual the majority of items are available at substantial discounts and where possible recommended retail prices are listed for direct comparison with KJ. Although this catalogue is automatically distributed to existing KJ customers it is available *FREE* on request, to anyone interested. *KJ Enterprises, 33 Bridle Path, Watford, Herts.*

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

YOUR chance this month to get a special QSL card. The Irish Radio Transmitters Society are off on a DX-pedition to Dalkey Island which is, according to the map, a small island off the coast of the Republic of Ireland (see if you can find it). Operating dates are 1200 on July 31 to 1200 on August 2. Operation will be A1 and A3a on all bands from 3·5 to 30MHz. **Sean Nolan,** EI7CD, says that the callsign to listen for is EI0DI and the station will QSL all contacts. Station will be operating from petrol generators, according to Sean, so if you intend to have a QSO—don't smoke.

D. Palmer (Glasgow), tells that ZS1MH has been heard operating a DX net several evenings on forty and is rumoured to be in on a similar net on eighty. Another one on forty is LU7ACC who, with the ZS, has been logged around 2145hrs. Aerial at the Glasgow location is described as a V-beam with arms approximately 170° which almost merits a dipole rating. Feeding the output to a balanced a.t.u. gives a significant improvement in signal to noise ratio. Receiver is a modified 19 set with a crystal filter which bagged: CP6EL, CT2AK, CX1AA, CX1BBR, JW7UH, LU8AJG, PY2ELZ, PY4BSZ, PY5OF, PY6JM, PY7BBD, VP2MM, ZS1JA all on 7MHz s.s.b.

S. Chack (Harrogate), comments that stations have been dying out rather earlier on 14MHz and says that 80 has been very good of late. Surprisingly though, his log is for 7MHY from which his best were HI3PY and JA6SM.

"The a.t.u. has been made from a cannibalised crystal set", says **Stefan Kaye** (Witney). Further admissions include a confession to using an AR88 to log these on 80; EA6BN, F6ABP/M, JY9WB, KV4FS, PY7BFN, PY0AD, VO1BT, ZC4IK, ZD7SD, ZS1MH, 4X4NJ, 6W8DY, 9G1DY.

S. Elsdon (Halesowen) warns, "You can be sure of hearing from me again soon", and promptly describes the gear as a CR-70A. Samuel also has a 240ft. long wire bent in the middle (nasty) and managed VK3IQ and VK3LR on 3·5MHz.

John Moore (Leicester) says he's come to the conclusion that people who don't tune the low ends of bands are missing about one-third of the DX. None-c.w. types please note. John also reminds that Italian prefixes are allocated according to area and range from I1 to I0. This might not be a bad idea for G stations and would make life on two metres and up a whole lot easier.

John's log shows GM3SVK/A back on from the Shetlands on topband together with OK1FJS. Twenty metres s.s.b. showed: EA8GZ, ET3DS, JA3IXL, JW5NM, LU8DB,PY1CCC, PY2ZAD, PZ1DF, TA3HC, UK9AAQ, VE8RX, VK3ATN, VK6KK, VO1CM, YB3AAY, YB0AAG, 9H1CD, 9Q5BV. Ten metres raised: JA1ZTC, LU9FAN, PY2EWF, UK9HAD, VE2ASZ, VE3BKA, VE3FIQ, W3DQD/YVI.

G. Kent (St. Leonards-on-Sea) uses a B40 receiver and the aerial is "a strand of Woolworth's wire", (sounds a bit of a thin story to me). Although only some 15ft. long (the aerial not G. Kent) the following were heard on 14MHz: CT1SG, JA4HM, JH1OTO, JM2HCA, K2OUS, VE3GMT, VE6MC, VK2WC, VK4DY, VK5ED, VK5NB, ZL4BX, ZP2KN, 4X4VB.

Someone's got a favourite band. Don't worry, your address at Satinforth Road, Ilford, Essex, is safe with me. I know you didn't sign the letter and just for that I won't tell anyone that you heard: CR4AJ, CR6EM, CR7FM, CT2AK, DU6MG, EA6AS, EA9AA, EL7TL, EP2BQ, ET3USA, FC8APT, G3DJK/P/W1, HC1HV, HR3VFJ, IS1PZR, JA1QJE, JA7JLB, JH1JLR, K7ZTM, KC4USP, KG4CS, KP4DCR, LU1CBR, LX1HD, MP4BEU, MP4BJE, OX3DL, PY2BDY, PY8ZZA, SV1AE, SV0WDD, SZ0SU/P, TI3E, TJ1DA, VQ9RK, VU2HLU, VU2REG, VS9MB, VS9MT, W3UBM/MM/1, WA4MOC/P/8R1, WA6DBP/P/4X4, W6DLE,/4X4, W6VLH, W9LGV,, YU2REE/MM (off coast of Cameroons), ZC4CB, ZD9BN, ZL1HA, ZS6ES, ZS6ON, 3B8CZ, 4U1ITU, 4X4IX, 4Z4GV, 4Z4HF, 5H3JR, 5N2AAF, 5N2ABG, 5Z4DV, 6W8BD, 7X2OM, 7X2SX, 8P6AJ, 9E3USA, 9H1R, 9H1V, 9M2BQ, 9N1MM, 9V1PX, 9X5WJ, all on 21MHz and probably s.s.b. too.

J. Iredale (Llandudno) expresses great delights at his newly-installed JR-500SE receiver (JDG's going all green again). A preliminary peep on 14MHz revealed: HK3CFM, LU2DEK, LX1BA, MP4BFO (resolves his own sideband?), SV0WW, WA6AUE, 4X4DK, 4Z4HF, 5X5NA.

A Hallicrafters S120 and a 66ft. end-fed located at Ilford allowed **Mark Marsden** to bag these on 20 s.s.b.: JA2OXF, JA7GY, HP9AVQ/MM, KX6DQ, TA6JB, TR8MC, VE6ARC, VK3CR, VK2AB, W3GLY/VS6, ZS5DJ, 4Z4HF.

Come into my antenna says **C. Henderson** whose aerial does bear a remarkable resemblance to a spider's web. Receiver is a B40 and the other antenna is a 120ft. long wire. Goodies on fifteen include: CR4BC, CR71C, HB9TE, HI8FED, KV4AD, OD5AO, PY2AAA, PY5EG, SU1BN, VE3BMB, VS9MT, XW8BP, YA2GNT, YV4YC, YV5BNR, ZC4MU, 4U1ITU, 4X4CW, 5N2AAJ, 9Q5RH, 9Y4RB. Crispin says that 20 metres has been excellent at round 0100hrs.

S. Wainwright (St. Helen's), 9R-59DE, PR30, 70ft. inverted L at 28ft., all s.s.b. on 14MHz: FG7TD, FM7AA, FM7WW, HZ1TA, JR6JU, KS6CY, PJ8DZ, VR6TC, WA8FPN/P/KS6, ZF1GC.

Happenings for July include: 3-4, topband contest; 3-4, two metre contest; 3-4, two metre listeners contest; 10-11, Field Day; 11, Worcester Mobile Rally, Upton-on-Severn; 18, 70cms open contest; 18, 70cms listeners contest; 10-25 listen for G3EKW/A at the Nottingham Festival '71. Augugst 7-8, WAE c.w. contest.

Logs, in alphabetical order please, to arrive by the 15th of the month to:
12 Gross Way, Harpenden, Herts.

THE MW COLUMN

OVERCROWDING on the medium waves has encouraged DXers to develop the MW loop aerial. This type of indoor antenna is both tunable and directional. Maximum pick-up is along the plane of the windings and there are two nulls—directions of little or no pick-up—opposite each other at right angles to the windings. These nulls enable DXers to reduce or eliminate interference simply by rotating the loop on its vertical axis so that stations such as Malaga 1007kHz can be heard with the null on Hilversum or Buenos Aires on 1070kHz with the null on CBA Moncton N.B. in Canada. Since a loop is an indoor aerial it can be used in locations where it would be impossible to erect an outdoor one. The writer invariably uses a loop in preference to a 90ft longwire as the overall performance is nearly always better.

R. Garwood of Bournemouth has asked for constructional details. The standard MW loop consists of 7 turns of plastic covered hookup wire wound in the shape of a square of 40in. side together with a one-turn coupling winding wound parallel and central to the main winding. The windings are supported on a frame made out of two pieces of 1 inch square wood joined at right angles at the centre to form an X. The turns are kept apart by means of four paxolin spacers which have saw cuts $\frac{1}{4}$in. apart along one edge to retain the windings. The spacers are fixed to the ends of the arms. The main winding terminates on a 500pF variable capacitor mounted at the centre of the loop. This is the tuning control. The single coupling winding ends at a small terminal block from which a 5ft. length of twin feeder (plastic covered lighting flex will do) connects to the receiver dipole input or to the aerial and earth terminals. The loop is fixed to a stand so that it can be rotated on its vertical axis.

To use the loop, tune in a station on the receiver, peak-up the signal with the loop tuning control and rotate the loop for optimum reception. As well as reducing co-channel interference, a loop will usually have a better signal-to-noise ratio then a longwire and it will often reduce cross-modulation, splash and occasionally static. **Ray Eaton,** a retired reader who lives in Brighton has been experimenting with loop aerials on frequencies up to 4MHz and reports some success.

South Americans are at their best in summer so now is the time to look for the rarer countries. Between 0100hrs GMT and sunrise listen for Radio Cruz del Sur on 1380 and Radio Mineria 1060kHz; both are 7,000 miles away in Chile. OAX4U 1010kHz Radio America is in Lima, Peru. It is normally a strong signal and has been logged already this year by a DXer in Norfolk. ZP4 1330kHz Radio Chaco in Paraguay and CP57 Radio Progresso 1090kHz in La Paz, Bolivia were heard last year while CP4 1020kHz also in La Paz is another recent catch from this difficult DX country. Conditions are at their best during the hour before dawn and the band is often alive with Latin Americans at this time.

CHARLES MOLLOY

Electronotes..

S. GINSBERG

IT'S those integrated circuits again. Different types appear on the professional market almost daily. A fairly recent one is of great interest since it could well affect a whole industry. This 16-pin dual in-line beast is called the TBA 631 and hidden within the confines of its diminutive carcass is a limiting amplifier, an f.m. coincidence detector, low frequency separator, low frequency preamplifier and self-balancing circuit, driver and audio amplifier. It's immediate application is in television receivers and the trend is that the average black and white receiver will be reduced to five integrated circuits (which should make the do-it-yourself t.v. builder jump for joy). Colour sets will need another two i.c.s.

There is more to it than merely simplifying construction, although from the manufacturing point of view this is extremely important. Servicing becomes an important aspect of many things, especially television receivers. If this trend of reducing a black and white set to five i.c.s continues, then the servicing aspect becomes a comparatively simple matter, since the would-be service man has, at worst, only to work his way round the set simply substituting "good" i.c.s. for each one in the set until the fault is cleared. This in turn implies that initial servicing in the home could be performed by an unskilled person.

It is not possible to fault the idea in terms of initial cost either, since the TAB 631 markets for around £2·80 for quantities of 1 to 24. Again, the chip in question will supply 3 watts into a 16Ω speaker for 10 per cent distortion with a 24V line. Limiting sensitivity of the unit is less than 100μV at 6MHz for the quoted output. The output stage is class B and is capacitively-coupled to the speaker. The r.f. amplification, demodulation and output separator section has it's own power supply terminations and will work at voltages from 4·5V to 15V. The quiescent current at 12V is typically 18mA and the frequency range of the r.f. stage is between 5kHz and 60MHz. Over 60dB of gain is available from the limiting amplifier alone, while a.m. rejection is given as better than 45dB. A few resistors and capacitors plus tuned circuits are all that are needed to get this chip perking happily.

While the cathode ray tube and power supply are still required and have not, as yet, been reduced to a chip, experiments in solid state readout devices look promising although many companies have these behind locked doors. With advances like this, the wristwatch television doesn't seem quite such a ludicrous idea after all.

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CBL31	85p	ECH42	66p	EM34	80p	PCC189	61p	PZ30	80p	UY41	40p	6AS7G	80p	6F8	40p	6SQ7	40p	12K5	50p	35A3	50p
CY31	35p	ECH81	51p	EM71	62½p	PCF80	51p	QQU02-6	£2·10	UY85	34p	6AT6	45p	6F6G	25p	6SR7	37½p	12K7GT	35p	35A5	55p
DAF91	41p	ECH83	40p	EM80	40p	PCF82	52½p	QQU03-10		U25	75p	6AU6	29p	6F11	32½p	6T8	32½p	12Q7G	25p	35B5	65p
DAF96	41p	ECH84	47½p	EM81	42½p	PCF84	47½p		£1·25	U36	75p	6AU6	30p	6F12	22½p	6U4GT	62½p	12SC7	25p	35C5	35p
DF91	45p	ECL80	40p	EM84	37½p	PCF86	61p	QV03-12	65p	U191	72½p	6BA6	47½p	6F13	35p	6U8	35p	12SG7	35p	35D5	65p
DF96	45p	ECL82	49p	EM87	55p	PCF200/1	81p	R19	65p	U193	41p	6BE6	60p	6F14	60p	6V6GT	32½p	12SH7	25p	35L6GT	47½p
DK91	57½p	ECL83	57½p	EN91	32½p	PCF801	61p	R20	75p	U301	85p	6BH6	42½p	6F15	55p	6X4	25p	12SJ7	25p	35W4	25p
DK96	57½p	ECL86	49p	EY51	40p	PCF802	61p	SU2150A	75p	W729	55p	6BJ6	42½p	6F18	40p	6X5GT	27½p	12SK7	40p	35Z3	55p
DL92	37½p	ECLL800		EY80	45p	PCF805	65p	TT21	£2·40	Z759	£1·22½	6BK7A	50p	6F22	33½p	6X8	55p	12SL7GT	40p	35Z4G	25p
DL94	37½p		£1·50	EY81	40p	PCF806	61p	TT22	£2·50	OA2	32½p	6BL8	35p	6F23	77½p	6Y6G	60p	12SN7GT	40p	35Z5GT	37½p
DL96	46p	EF39	52½p	EY83	55p	PCF808	67½p	U18/20	67½p	OA3	45p	6BN5	42½p	6F24	67½p	7Y4	60p	12SQ7	40p	50A5	65p
DM70	32½p	EF80	40p	EY86	40p	PCH200	70p	U20	67½p	OB2	32½p	6BN6	40p	6F25	75p	9BW6	42½p	12SR7	32½p	50B5	35p
DY86/7	40p	EF83	50p	EY87	42½p	PCL82	51p	U25	75p	OB3	50p	6BQ5	25p	6F26	35p	10C2	50p	14S7	80p	50C5	35p
DY802	42½p	EF85	41p	EY88	42½p	PCL83	61p	U26	75p	OC3	35p	6BR7	75p	6F28	70p	10D1	40p	20D1	45p	50L6GT	40p
E55L	£2·75	EF86	66p	EZ35	27½p	PCL84	51p	U31	45p	OD3	32½p	6BR8	95p	6F29	32½p	10D2	40p	20LI	£1·00	83A1	90p
E88CC	40p	EF89	40p	EZ40	45p	PCL85	52½	U37	£1·50	3Q4	40p	6BW6	82½p	6F30	35p	10F1	90p	20P1	50p	85A2	37½p
E130L	£4·50	EF91	42½p	EZ41	45p	PCL86	51p	U50	30p	3S4	35p	6BW7	69p	6J4	47½p	10F9	50p	20P3	60p	90AU	£2·40
E180F	95p	EF92	50p	EZ80	27½p	PD500	£1·52½	U52	30p	3V4	40p	6BX6	25p	6J5GT	30p	10F18	40p	20P4	£1·00	90C1	60p
EABC80	52½p	EF93	47½p	EZ81	27½p	PFL200	74p	U76	25p	5R4GY	55p	6BZ6	32½p	6J7	42½p	10L1	40p	20P5	£1·00	90CU	£1·25
EAF42	50p	EF94	77½p	EZ90	25p	PL36	64p	U78	25p	5U4G	30p	6C4	30p	6K6GT	50p	10LD11	55p	25C5	45p	807	47½p
EBC33	55p	EF95	62½p	GS10C	£5·00	PL38	90p	U191	75p	5U4GB	37½p	6C5GT	35p	6K7	32½p	10P13	55p	25L6GT	37½p	811A	£1·50
EBC41	47½p	EF183	56p	GY501	80p	PL81	51p	U201	35p	5V4G	40p	6CD6G	£1·40	6K8G	30p	10P14	£1·00	2524G	30p		
EBC81	32½p	EF184	35p	GZ30	37½p	PL81A	62½p	U281	40p	5Y3GT	30p	6CA4	27½p	6K23	50p			25Z6GT	50p	612A	£3·25
EBC90	47½p	E280F	£2·10	GZ31	30p	PL82	36p	U282	40p	5Z3	45p	6CA7	52½p	6K25	75p	12AB5	50p	30A5	40p	813	£3·75
EBF80	40p	EF800	£1·00	GZ32	47½p	PL83	51p	U301	57½p	524GT	40p	6CBC	27½p	646GT	45p	12AC6	37½p	30AE3	40p	866A	70p
EBF83	40p	EF804	£1·00	GZ33	80p	PL84	41p	U403	50p	6/30L2	75p	6CD6GA	£1·15	6L7	32½p	12AD6	37½p	30C15	75p	5642	60p
EBF89	40p	EF811	75p	GZ34	55p	PL500	82½p	U404	37½p	6AB4	32½p	6GG7	45p	6L18	30p	12A15	40p	30C17	80p	6080	£1·37½
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EC86	60p	EL41	55p	HL94	40p	PL508	£1·00	UBF89	40p	6AH6	50p	6CW4	62½p	6P1	60p	12AT6	25p	30FL1	75p		
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EC93	47½p	EL85	42½p	PABC80	40p	PY33	62½p	UCH81	54p	6AL3	42½p	6DC6	67½p	6R7G	35p	12AX7	30p	30L1	45p		
ECC81	40p	EL86	42½p	PC86/8	51p	PY80	32½p	UCL82	51p	6AL5	16p	6DK6	42½p	6S2	40p			30L15	85p	7199	75p
ECC82/3	42½p	EL90	32½p			PY81	41p	UCL83	61p	6AM5	25p	6DQ6B	60p	6S4A	55p	12AY7	67½p	30L17	85p	7360	£1·80
ECC84/5	42½p	EL91	25p	PC95	38p	PY800	41p	UF41/2	55p	6AM6	22½p	6DS4	75p	6SA7	37½p	12B4A	50p	30P12	80p	7586	£1·25
ECC88	55p	EL95	35p	PC97	41p	PY801	41p	UF80/5	37½p	6AQ5	32½p	6EA8	55p	6SG7	32½p	12BA6	32½p	30P18	35p	9002	32½p
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AW59-91	CME2303	£9·58½	£7·20
A59-15W	CME2301		
	CME2302		
	CME2303	£9·58½	£7·20
A59-11W	CME2305		
A59-13W	CME2306	£13·65	£10·97½
A59-16W	CME2306	£13·65	£10·97½
A59-23W	CME2305	£12·60	£10·50
A59-23W/R		£12·60	£10·50
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X5M	S/S	£1·39
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SN706	13p	SN4062	23p	AF124	13p	BC136	P/A	BF167	25p
SN706A	13p	SN4286	18p	AF125	20p	BC137	P/A	BF173	33p
SN930	28p	SN4291	18p	AF126	20p	BC138	P/A	BF178	35p
SN1132	33p	RCA		AF127	18p	BC142	30p	BF179	73p
SN1303	18p	40253	P/A	AF139	38p	BC143	P/A	BF180	35p
SN1305	23p	40398	P/A	AF178	45p	BC147	18p	BF181	33p
SN1306	25p	40458	P/A	AF179	45p	BC148	15p	BF184	25p
SN1307	25p	AC107	30p	AF180	53p	BC149	18p	BF191	23p
SN2614	30p	AC117	60p	AF181	43p	BC152	18p	BF195	28p
SN3826	30p	AC126	20p	AF186	67p	BC158	18p	BF196	43p
SN4905	P/A	AC127	25p	AF239	43p	BC169B	14p	BF197	32p
SN4914	P/A	AC128	20p	ASY28	28p	BC169C	15p	BF200	37p
SN1711	25p	AC176	25p	BA144	P/A	BC171	18p	BF224	30p
SN2147	73p	AC187	63p	BA145	P/A	BC175	28p	BF225	30p
SN2160	58p	AC188	38p	BA148	23p	BC183	23p	BF257	47p
SN2646	58p	ACY17	28p	BA155	P/A	BC184	23p	BFX29	35p
SN2905	40p	ACY20	25p	BA156	P/A	BC187	29p	BF161	P/A
SN2926		AD140	40p	BC107	15p	BC213L	27p	BF162	P/A
Green	14p	AD142	58p	BC108	15p	BCY32	38p	BF163	25p
Yellow	13p	AD149	58p	BC109	15p	BCY58	23p	BFY19	23p
Orange	13p	AD161	38p	BC113	28p	BCY70	20p	BFY50	23p
SN3053	28p	AD162	38p	BC114	38p	BD121	65p	BFY51	23p
SN3055	75p	AF102	58p	BC115	33p	BD123	83p	BFY52	23p
SN3392	20p	AF114	25p	BC116	63p	BD124	63p	BSX21	38p
SN3702	18p	AF115	25p	BC116A	38p	BD131	98p	P346A	25p

TIS43 40p

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TAKE 20

JULIAN ANDERSON

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

No. 28 TOUCH ALARM

WELL, we've only just made it this month as far as price limit is concerned but it is worth it, I hope. It is rather an unusual circuit and has not appeared before, as far as I am aware, in any form. The circuit is that of a "Touch Alarm" which does exactly what the title suggests; an alarm sounds off as soon as a metal plate is touched and stays on until the supply voltage is taken away. The metal plate can be all sorts of things, a safe, french windows, door handle, etc., etc., The applications and construction are left up to you but the circuit is not exactly complex and should take no more than a couple of hours to build once the components are assembled.

THE CIRCUIT

The first transistor, Tr1, is coupled in the common-collector mode (also known as the emitter-follower mode) with the base wired to the touch plate. The characteristics of this configuration are very high input impedance and low output impedance and this is the key to the operation.

The input impedance is roughly equal to the gain of the transistor times the emitter load resistor (here 6·8kΩ). The BC169C has very high gain figures, up to 900, but a more common figure would be 400. Therefore on this basis the input impedance is 400×6,800 which equals nearly 3MΩ. As soon as anything touches this base it biases the transistor on and the same voltage which has been applied to the base at very high input impedance, appears at the emitter at the same voltage level but at a usable impedance.

Most of you have dabbed a damp figure at the input of an amplifier and heard the resulting sounds, made up from radio signals and hum. Here we are making the best use of these signals and putting them to use. All sorts of "muck" is picked up when the plate is touched and this appears at the emitter as an a.c. voltage. The detector diode rectifies the signals and applies them across the capacitor C1. This charges up so that a positive supply appears at the junction of D1, C1 and R2. This voltage applies a bias via the resistor to the base of Tr2 which conducts and in turn applies bias to Tr3 and a pulse passes through the primary of the output transformer. However C2 is connected in a manner which causes the second two transistors to oscillate.

The beauty about the values and configuration used here is that once the alarm oscillator has started it is self-holding. That is, the pulses through C2 themselves bias Tr2 to maintain the cycle necessary for a continually sounding alarm. So it will be seen that R2 is only necessary to start the alarm which can only be switched off by disconnecting the battery supply. C3, which decouples the supply, is not essential but with a low battery it does help the operation.

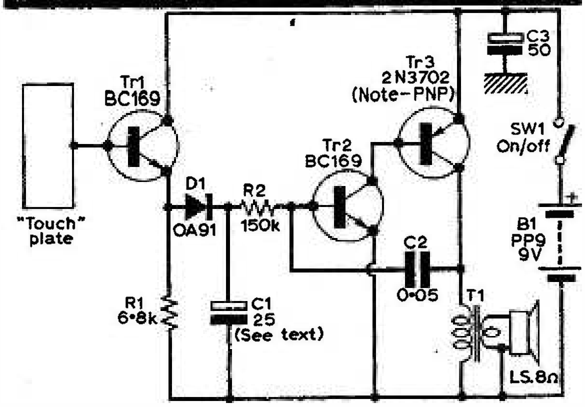


Fig. 1: The circuit of the touch alarm

★ components list

Tr1	BC169	11p†
Tr2	BC169	11p†
Tr3	2N3702	13p†
D1	OA91	5p†
R1	6·8kΩ, 10%, ¼W	1p†
R2	150kΩ, 10%, ¼W	1p†
C1	25μF, 25V Mullard	6p†
C2	0·1μF Mullard	4p†
C3	50μF, 25V Mullard	6p†
SW1	D.P.S.T. Toggle switch	5p*
T1	Transistor output transformer, Eagle LT700	20p‡
LS	6 x 4in, 3Ω loudspeaker	15p*
		98p

† Electrovalue Ltd.

* Padgetts Radio Stores

‡ Henrys Radio Ltd.

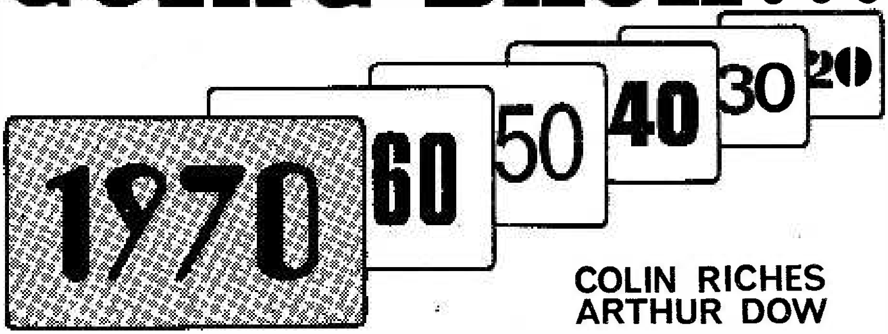
Prices are those advertised in June 1971 and may have changed. No allowance is made for minimum order costs or for postage and packing; this should be checked before ordering.

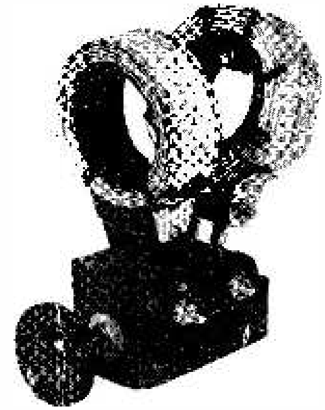
Current drain is important in all alarm circuits because if it is high, batteries, which are continually left on would rapidly run down. In the quiescent condition current consumption was measured as 1μA in the prototype as silicon transistors are used throughout, though when in operation this rises to over 20mA and a PP9 type battery has to be used.

C1 can be left out. If this is done the alarm is triggered by the slightest pulse—even by the switching on of fluorescent lights and this is a disadvantage. The inclusion of C2 has a slight delaying action as it takes time to charge up.

In certain locations the level of "muck" may be so high as to trigger the alarm *without* it being touched. In this case the value of R1 should be reduced to a suitable level which only triggers on touch; this also applies if a large touch plate is used. ■

GOING BACK...





COLIN RICHES
ARTHUR DOW

TITANIC DISASTER

We are at present compiling a Going Back article about the Titanic Disaster and the radio messages that were transmitted and received on that tragic day. If any readers have any information or photographs that they think may help us, we would be very glad to hear from them.

MR. WILLIAM COBBETT tells us that he has a Harmsworth's Wireless Encyclopedia which was published in 1923. He says that it contains many interesting features and drawings, etc., the preface being written by Oliver Lodge himself. Mr. Cobbett says that 50 years after the books were first published it is amusing to read a line that states, "It is with great hesitation that we predict the time when each individual will possess his own pocket wireless set."

Perhaps any readers of *Practical Wireless* requiring information on wireless in the 1920's would like to contact Mr. Cobbett at 15 Copford Road, Billericay, Essex.

By the way, he tells us that anyone wishing to purchase the books will have to wait another 50 years!

Mr. C. R. Gunn of 48 Aldwark Road, Liverpool, L14.ON6 asks if anyone could tell him whether Paris (Eiffel Tower) still transmits the 300 dot second Time Signal that it used to years ago on long wave. Mr. Gunn cannot recall the wavelength of the transmissions but says that it used to be very interesting as with a microphone in the case of the Grandfather clock and a phone earpiece on one ear together with the radio phone on the other ear, the times when the two signals coincided were noted and checked by the time given after the transmission.

Mr. Gunn also asks if there is a publication giving a list of long wave stations transmitting Morse and what are the longest wavelength stations today? So if there are any readers who have any information that may interest Mr. Gunn, please write to him at the above mentioned address.

Basil D. Van Der Syde, F.S.E.R.T., 30 Langdon Road, Parkstone, Poole, Dorset, BH14 9EH asks if anyone can date a pair of headphones he has containing a built-in crystal receiver. There is no makers name and the "cans" are about twice the normal depth. In the back of one there is a tapped inductance with a 20-position selector switch for tuning. This earpiece has two terminals marked A and E. The other earpiece has a centrally fitted crystal detector, part of which is missing but the cap end contains a piece of "galena" crystal. Also contained within this earpiece is a wind-up aerial of some 20 feet of wire-woven tape about $\frac{1}{2}$in. wide, and two small terminals marked "phones" (extension phones!). There is a Postmaster General approved stamp and the number 4145 printed on it. The crystal detector is integral with the small handle that winds the aerial in and the words "detector" prov. pat. printed below this—Mr. Van Der Syde mentions that when fitted with an 0A70 or similar diode, this set still provides fair MW signals (*Charles Molloy please note!*)

Many readers, we are sure, will remember our great colleague John Scott-Taggart. He used to bring out one "star" receiver for the home constructor every year in the magazine *Popular Wireless*. Mr. Van Der Syde says that checking over his collection of these magazines some years back, he was suddenly struck with the fact that the series was broken—that is that it began with ST100 then went to ST300, 400, 500 and so on up to about ST900—in other words no ST200! At first he thought his collection was not complete but this did not appear to be so. This made him wonder if there had ever been a ST200 design and if not, why not?—or if so, had it been withdrawn? He made many enquiries and at last managed to contact JST himself in about 1963. He wrote to him but in his reply, JST was unable positively to give any information about an ST200. He thought that there may have been one and that details may be found in one of his early radio books *Practical Wireless Valve Circuits* or its sequel *More Practical Valve Circuits* published by the Radio Press about 1924/25.

Can any readers help to clear up the mystery of the missing ST200? If so, please write to us (because this one has us puzzled) and we will pass your letters on to Mr. Van Der Syde.

Vintage enthusiast S. Ellis, 30 Pynne Close, Stockwood, Bristol 4 writes to ask if we have any information on the receiver used for the "Committee Superfet" article. Unfortunately we don't as this receiver was kindly donated to us by a reader who said that a relative of his had constructed it from a kit in the 20's (we would like to say here that Arthur Dow did not rip the set open and implant an inte-

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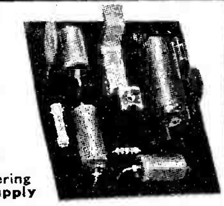

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BP 95=7495	4-bit up-down shift register	87p	77p	67p
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BP100=74100	8-bit Bistable Latches	£1·75	£1·65	£1·55
BP118=74118	Hex Set-Reset Latches	£1·30	£1·20	£1·00
BP121=74121	Monostable Multivibrators	87p	77p	67p
BP141=74141	BCD-to-Decimal Decoder/Driver	87p	77p	67p
BP145=74145	BCD-to-Decimal Decoder/Drivers	£1·80	£1·70	£·160
BP151=74151	8-bit Data Selectors (with Strobe)	£1·40	£1·30	£1·20
BP153=74153	Dual 4-Line-to-Line Data Selectors/Multiplexers	£1·40	£1·30	£1·20
BP191=74191	Binary Counter reversable	£3·50	£3·25	£3·00

Devices may be mixed to qualify for quantity price. Larger quantities—prices on application. (TTL 74 series only).

Data is available for the above series of I.C.'s in booklet form. PRICE 13p.

LINEAR I.C's

Type No.	Case	Leads	Description	Price 1–24	25–99	100
BP201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP701C—SL701C	TO-5	8	OP Amp.	63p	50p	45p
BP702C—SL702C	TO-5	8	OP Amp Direct O/P	63p	50p	45p
BP702—72702	D.I.L.	14	G.P. O.P. Amp (Wide Band)	53p	45p	40p
BP709—72709	D.I.L.	14	High Gain OP Amp	53p	45p	40p
BP709P—vA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP741—72741	D.I.L.	14	High Gain OP. Amp (Protected)	75p	60p	50p
µA703C—µA703C	TP-5	6	F.R.—IF Amp	43p	35p	27p
TAA263	TO-72	4	A.F. Amp	70p	60p	55p
TAAA293	TO-74	10	G.P. Amp	90p	75p	70p

TTL INTEGRATED CIRCUITS

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

PAK No.		PAK No.		PAK No.	
UIC00=12×7400N	50p	UIC42= 5×7450N	50p	UIC80= 5×7480N	50p
UIC01=12×7401N	50p	UIC50=12×7450N	50p	UIC82= 5×7482N	50p
UIC02=12×7402N	50p	UIC51=12×7451N	50p	UIC83= 5×7483N	50p
UIC03=12×7403N	50p	UIC60=12×7460N	50p	UIC86= 5×7486N	50p
UIC04=12×7404N	50p	UIC70= 8×7470N	50p	UIC90= 5×7490N	50p
UIC05=12×7495N	50p	UIC72= 8×7472N	50p	UIC92= 5×7492N	50p
UIC10=12×7410N	50p	UIC73= 8×7473N	50p	UIC93= 5×7493N	50p
UIC20=12×7420N	50p	UIC74= 8×7474N	50p	UIC94= 5×7494N	50p
UIC40=12×7440N	50p	UIC75= 8×7475N	50p	UIC95= 5×7495N	50p
UIC41= 5×7441AN	50p	UIC76= 8×7476N	50p	UIC96= 5×7496N	50p

UICX1=25×Asst'd 74's £1·50

Packs cannot be split but 20 assorted pieces (our mix) is available as PAK UICX1. Every PAK carried our BI-PAK Satisfaction or money back GUARANTEE.

DTL (Diode Transistor Logic) INTEGRATED CIRCUITS manufacturers "Fall outs"—out of spec. devices including functional units and part functional but classed as out of spec. from the manufacturers very rigid specifications. Ideal for learning about I.C.'s and experimental work.

Pak No.		Pak No.	
UIC930=12×µA930	59p	UIC948= 8×µA 948	50p
UIC932=12×µA 932	50p	UIC951 = 5×µA 951	50p
UIC933=12×µA 933	50p	UIC961 =12×µA 961	50p
UIC935=12×µA 935	50p	UIC9093= 5×µA 9093	50p
UIC936=12×µA 936	50p	UIC9094= 5×µA 9094	50p
UIC944=12×µA 944	50p	UIC9097= 5×µA 9097	50p
UIC945= 8×µA 945	50p	UIC9099= 5×µA 9099	50p
UIC946=12×µA 946	50p	UIC×925 Assorted 930 Series	£1·50

Packs cannot be split but 25 Assorted Pieces (our mix) is available as Pack UICX9. Every Pak carries our BI-PAK Satisfaction or money back guarantee.
Data Booklet available for the BP930 Series, PRICE 13p

ALL PRICES IN NEW PENCE.
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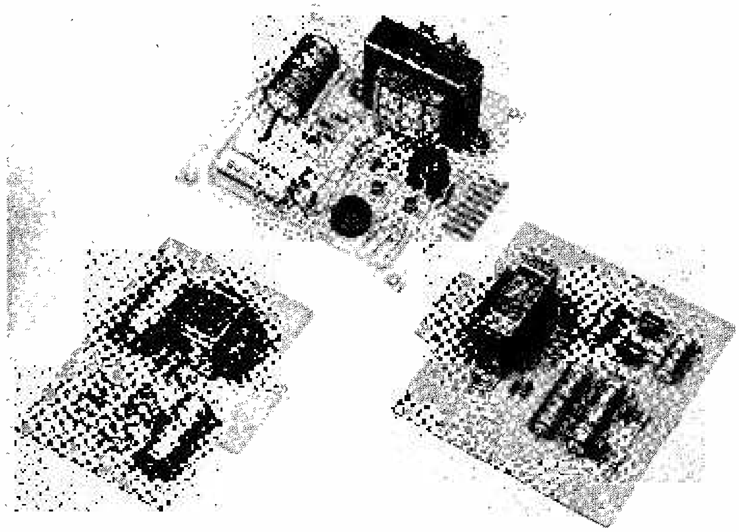
Postage and packing add 7p. Overseas add extra for Airmail. Minimum order 50p. Cash with order please. *GIRO No. 388-7006

PROGRESSIVE POWER SUPPLY MODULES

Based on many years experience in industrial electronics we have designed a carefully graded range of power supply modules. Intended for the serious constructor they are also suitable for Technical Colleges and other educational purposes.
Our design and manufacturing experience and component bulk buying capacity make it possible to offer modules built and tested at very modest prices. All modules are sold with a "Money Back" guarantee of satisfaction.
Built with the professional touch on specially designed printed circuit boards, all modules are fitted with edge connectors to permit easy insertion and removal. They may also be wired in where desired.



71Z RANGE. Basic zener stabilised P.U. with floating output. For general use including switching & op. amp. circuits. Size 4" x 4".

71Z9 ± 9v at 30mA
71Z12 ± 12v at 15mA
71Z15 ± 15v at 10mA
Price £3·95 each + £0·25 P & P

71ZR RANGE. A more complex circuit than the 71Z Range giving greater stability with changing loads and with reduced ripple content. Output current limiting is included for general protection. An ideal P.U. for electronic instruments and control circuits. Size 4" x 3".

71ZR9 + 9v at 40mA nom.
71ZR12 + 12v at 40mA nom.
71ZR15 + 15v at 40mA nom.
Price £4·50 each + £0·25 P & P.

71ZA. An extension of the **71ZR** embodying an error amplifier with current limiting and adjustable output voltage regulated to better than 1.5% for load and mains variations. Ripple better than 3mV. Size 4" x 4·4".

71ZA. 15v ± 3v at 100mA. Price £5·50 each + £0·25 P & P.

714. Special power unit suitable for the Audio Signal Generator described in the May issue. Price £4·20 each + £0·25 P & P.
Trade enquiries invited.

We are also distributors of the full range of Newmarket Transistors Limited's P.C. Modules

HARVEY HALL (Dept. P.W.), BRECKLAND WORKS, EARLS ST., THETFORD, NORFOLK.

LOOK AT THESE PRICES

CARTRIDGES
Acos GP67-2, GP91-35C £1·12½; Acos GP93-1 £1·33½; Acos GP94-1 £1·62½; Sonotone 9TAHC £1·97½. All above in makers' cartons. BSR X4H £1·50.

THIS MONTH'S SPECIAL OFFER
Garrard SP25 Mk. III with KS40A cartridge. In good quality teak plinth with perspex dust cover. Complete with all leads ready to use £20. SP25 Mk. III deck only less cartridge £11·87.

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4uF 150v 4p; 8uF 500v 15p; 10uF 150v 4p; 12uF 25v 4p; 16uF 450v 14p; 16uF + 16uF 450v 23½p; 30uF 10v 4p; 50uF 10v 4p; 100uF 9v 4p; 100uF 12v 4p; 150uF 12v 4p; 320uF 9v 5p; 1500uF 30v 19p; 10uF 16v 7½p; 5000uF 25v 50p; 10,000uF 25v 75p; 20,000uF 30v £1·05.

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Acos Mic 45 £1·12½; Acos Mic 60 99½p; Planet CM70 £1·50; Hand Mike 75p.

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Postage extra.

GEORGE FRANCIS (Dept PW),
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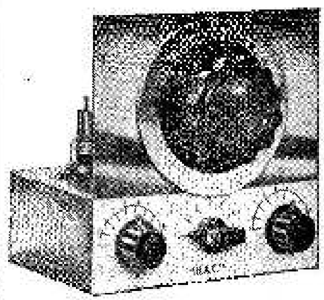
H.A.C. SHORT-WAVE KITS

WORLD-WIDE RECEPTION



Famous for over 35 years for Short-Wave Equipment of quality, "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Over 10,000 satisfied customers—including Technical Colleges, Hospitals, Public Schools, R.A.F., Army, Hams, etc.

NEW "DX" RECEIVER
Improved one-valve model "DX" mark 2.
Complete kit—price £3.30 (post & packing 20p.).
Customer writes: "Australia, India and America at loud volume."—"I am 14 years of age and have logged over 130 stations, plus countless Amateurs from all over the world."
Send S.A.E. for test report.
This kit contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Ready to assemble, and of course, as all our products—fully guaranteed. Full range of other S.W. kits, including the famous model "K" and "K plus" (illustrated above). All orders despatched by return. (Mail order only.) Send now for free descriptive catalogue & order form.

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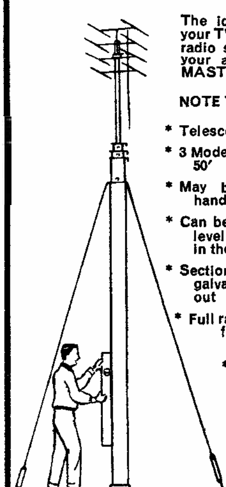
29 Old Bond Street, London W.1

PUT YOUR AERIAL WHERE IT CAN REALLY WORK!



The ideal way to boost your TV, amateur or 2-way radio signal is to mount your aerial on a TELO-MAST

NOTE THESE FEATURES

* Telescopes down to 10'
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Prices (carr. paid)	Mast only		Mast and Rigging Kit
U.K. Mainline	30'	£14·40	£19·95
	40'	£16·50	£25·50
	50'	£19·50	£31·50

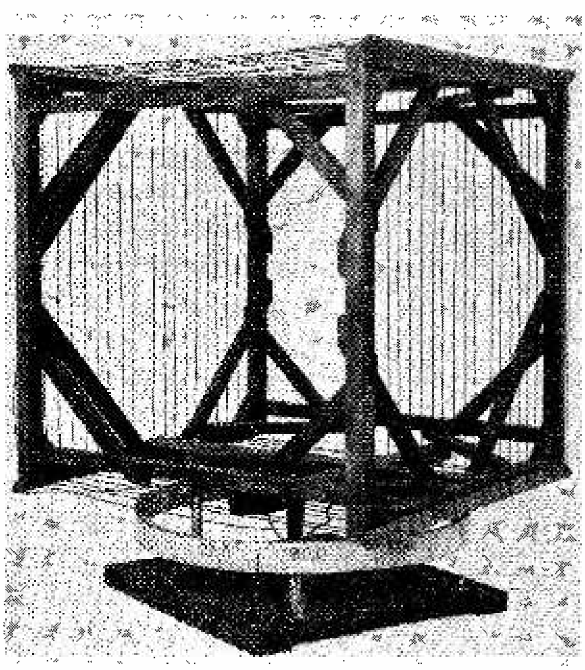
WESTERN ELECTRONICS (U.K.) LTD.
ROOM I.P.W. OSBORNE ROAD, TOTTON, SOUTHAMPTON SO4 4DN
Tel: **Totton 4930** Cables: **Aerial Southampton.**

grated circuit—it was a clever bit of camera trickery!). Anyway, Mr. Ellis says that in his set there are more wires with nothing at the end of them than there are connecting components. The components appear to be in good condition. There valves are included (PM1A, D210, PM1LF—possibly), the valve-holders are square and the four pins marked F, A, F, G. Stamped on the holders is the word "Benjamin" and "Genuine Bakelite."

There are two variable capacitors made by Ormond Engineering Co. each fitted with a dial similar to the "Committee Superfet". The coil is 7in. long and 4in. in diameter and is stamped "Trade ISOLO Mark" there are three windings of cotton or silk covered wire. Resistors are Dubilier Dumetohm which have the appearance of cartridge fuses, each one clipping into a holder. The capacitors have thumbscrew terminals as does a fully-shrouded transformer inscribed "Hollingwood" with markings for secondary, primary, grid, plpate, h.t.+ and +D. Also, one point to note is that there is a bracket attached to the base-board reading "Etherplus."

Once again, the staff of *P.W.* would like to hear more about this, so please drop us a line, and we'll pass the letters on.

Our aerial photograph is enough to make Dave Gibson's hair curl ("what hair?" shouts someone from the back row). What about strapping this one on the top of your wagon, Gibby and working a bit of mobile DX?



Actually it's an early frame aerial used for direction-finding in aircraft. The date is about 1916 and the photograph was lent to the Science Museum by the National Physical Laboratory.

In "Going Back" May 1971, we published a photograph which we captioned "Magnetic Detector". This should have read "Multiple Tuner" and we would like to thank all those readers who were kind enough to point this out.

PROJECT Autumn

Practical Wireless "Designer's Trophy" 1971

This year we are sponsoring another Project Autumn competition. The rules have been amended so that the PW "Designer's Trophy" 1971 will be awarded to the author of the best constructional article published in PW issues dated July 71 to March 72 inc.

NO DELAYS!

PAYMENT ON PUBLICATION

NO FORMS!

RULES

1. The winning entry will be chosen by a panel of judges from among articles published in issues of PW dated July 1971 to March 1972 inclusive. The Editor's decision on all matters arising will be final.
2. The winner of the competition will receive and retain outright the PW "Designer's Trophy 1971". Other prizes will be awarded to the best runners-up. Articles will be paid for as soon as possible after publication.
3. Articles submitted for the competition should conform to the general style of material published in PW and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
4. Articles should, preferably, be typed using double spacing, leaving wide margins, on one side only of each sheet. Circuit diagrams and any other drawings must be separate and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Components lists must also be separate and laid out to the standard PW format.
5. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Photographs may be identified by sticking a label on the reverse instead of writing on the back of the photograph itself.
6. Components used in the design must be readily available from retail sources.
7. Articles should be sent to the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. Authors will be advised as soon as possible of the acceptance or rejection of their articles. Equipment, the subject of an article must not be sent to the Editor until advised to do so.
8. Employees and staff of PW are not eligible for entry to this competition.

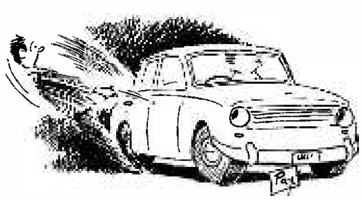
SUBMIT YOUR ARTICLES NOW

practically wireless commentary by HENRY

No. 82

Lil's in love

MOTORING correspondents are fond of telling us the tales of woe they experience with their new cars. Doors jam, windscreen wipers fail, handles fall off, and other, more technical failings begin to show after a short spell of use. "The suspension suffered badly



. . . experience with their new cars.

from hugging on anything more than a twenty-degree bend . . ."

They don't know the half of it. The benefits of mass production hit the radio industry long ago, and with all the paraphenalia of printed circuits and peripheral hardware, modern radio and audio equipment has reached its nadir of vulnerability.

Only last week we had a very expensive, very elaborate hi-fi amplifier on the bench, sighing dolefully. It coudn't sing; its protection circuits, which comprised more than half the twisted jungle through which we tried to hack our way, did their work too thoroughly. Every time a signal pushed past the preamps, Tr1 switched hard on, putting Tr2 "off" and interrupting the bias control of Tr3 which promptly bottomed. This overcame the zener regulation of Tr4 which is in the feedback line of . . .

Henry tuned in last week, hoping to brush up his faltering maths, and was greeted with the pontifical statement: "Mathematics is not so much about numbers as about sets."

Sets? Sets of what? Or did the Professor mean wireless sets? It might have been appropriate to our subject if he did, for the ensuing discussion was more philosophical than enlightening.

Some of the equipment that comes in for service within weeks of being sold must have been assembled under similar conditions. Perhaps, in the Buzzbox factory in Arnold's Wick, SW 19, the wires have got crossed and those overtime earners on Saturday mornings are listening to the cut and thrust of O-U discussion.

Well, not so much cut and thrust as snip and shove. Which may account for some of the untightened bearing clamps, twisted drive cords, unsealed iron-dust cores and knobs that fall off. The operator is away in a dream, lapped by the lulling voices. There used to be a saying in a radio factory where Henry once worked: "Lil's in love again."

It was invoked whenever we slaves of the troubleshooting department discovered a "run" of faults.

The inspectors would reject one set in five for "no-go" faults, normally. Then would come a spate of rejections, and we—the only true engineers in the factory, we averred, *not* excepting the designer—ran our delicate diagnostic probiscuses over them.

Hovering at our shoulder, the Production manager waited for the dread words: "R21 wrong value, should be 33k, not 33 ohms." We laid bets on the number of sets that Lil had allowed through as she dreamed over the new boy. The variables for handicapping were the rate of the conveyor, the alacrity of the Production manager and, top weight for the course, the slowness of the troubleshooter.

In that sort of job, every day was Saturday. Down in Arnold's Wick, SW 19, the Monday set, the rogue receiver, is the speciality of their range. After a week of use it hesitates and splutters.

We bang it. A knob falls off. We shake, and two programmes arrive together. The volume control adds its crackling obligatto and then the tiny loudspeaker squawks in protest. So we take it in for service.

The knowledgeable salesman shakes his head sadly. 'Perhaps the worst model they made," he pronounces. "You didn't buy it here of course?" His question is more a statement; that isn't the sort of trash they would sell. But they do, eventually, repair it, after weeks of waiting for irreplaceable parts that have to be ferried from Japan in a leaking sampan.

And within another week it splutters and coughs into silence. A little tense, we face the salesman again. Could we see the manager? Not, it seems, without an appointment, but they guarantee their work and condescend to look at it again.

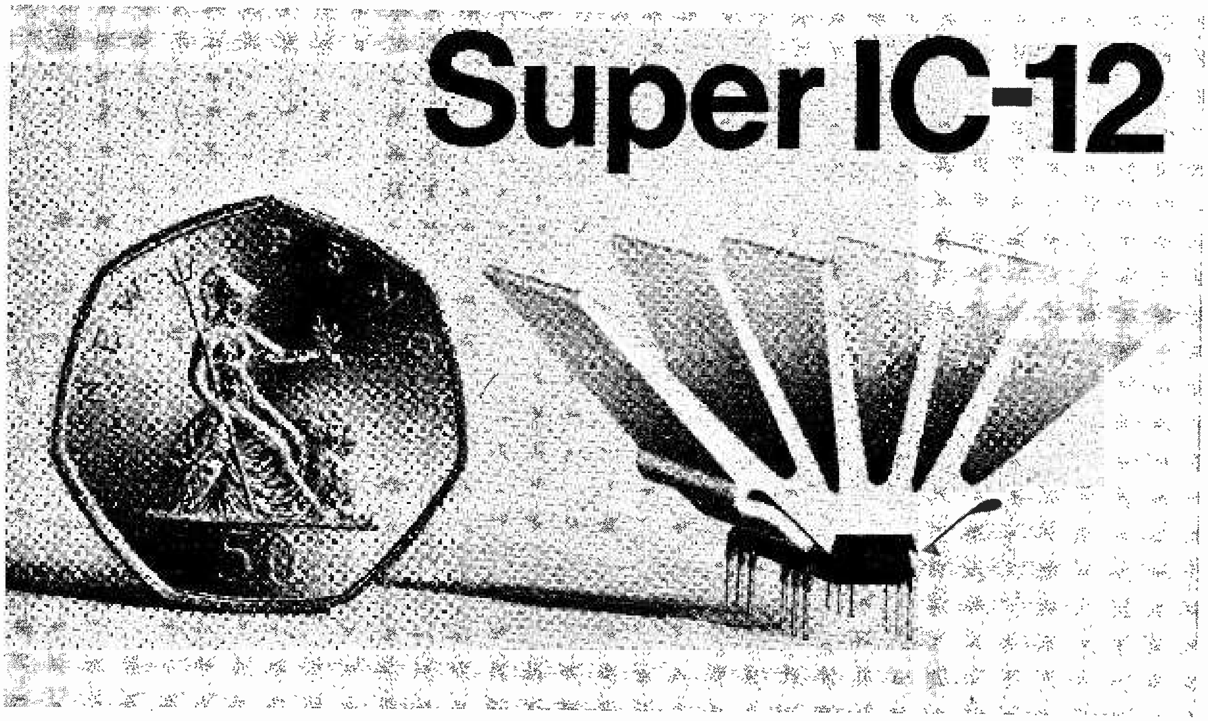
This time, again with a bill to pay, we are told that another vital component has failed. "Quite unforeseeable. The quality of the components used in these—er—less expensive receivers . . ." The

'Lil's in love again.'

work done on their last job, the guaranteed work, could not cover the eventuality of *that* component's failure.

It would have been better, less expensive, if we had faced up to the truth. Ours was a Saturday set, or a Monday set, or whatever day our Lil habitually assembles errors down in Arnold's Wick, SW 19. Better thrown away.

new



High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

Output power 6 watts RMS continuous (12 watts peak).
Frequency Response 5 Hz to 100KHz ± 1dB.
Total Harmonic Distortion Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.
Load Impedance 3 to 15 ohms.
Power Gain 90dB (1,000,000,000 times) after feedback.
Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).
Size 22 x 45 x 28 mm including pins and heat sink.
Input Impedance 250 Kohms nominal.
Quiescent current 8mA at 28 volts.
Price: including FREE printed circuit board for mounting. **£2.98** Post free

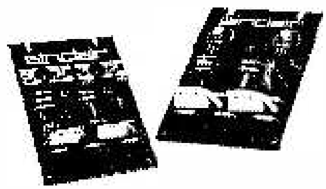
With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project 60 range such as the Stereo 60 and A.F.U. may be added. The comprehensive manual supplied with each unit gives full circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include car radios, oscillators etc. The very low quiescent consumption makes the Super IC.12 ideal for battery operation.

Sinclair Radionics Ltd., London Rd, St. Ives
Huntingdonshire PE17 4HJ
Telephone St Ives (048 06) 4311

sinclair

Sinclair Project 60

Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z50 units are interchangeable with Z.30s in all applications).***
Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms, using 50 volts.
Frequency response: 30 to 300 000 Hz ± 1dB.
Distortion: 0.02% into 8 ohms.
Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
Size $3\frac{1}{2} \times 2\frac{1}{4} \times \frac{1}{2}$ in.
Z.30
Built tested and guaranteed with circuits and instructions manual **£4.48**
Z.50
Built, tested and guaranteed with circuits and instructions manual. **£5.48**

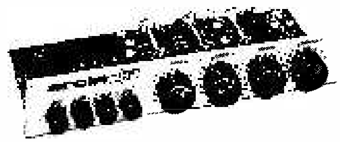
Power Supply Units

Designed specially for use with the Project 60 system of your choice.
Illustration shows PZ.5 to left and PZ.8 (for use with Z.50s) to the right. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stablised supply is essential.
PZ-5 *30 volts unstabilised* **£4.98**
PZ-6 *35 volts stabilised* **£7.98**
PZ-8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ-8 *mains transformer* **£5.98**

Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

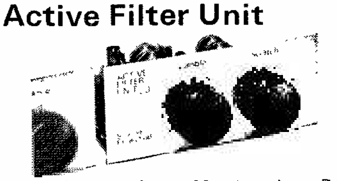
Stereo 60 pre-amp/control unit



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

SPECIFICATIONS
Input sensitivities: Radio–up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ± 1dB: 20 to 25,000 Hz. Ceramic p.u.–up to 3mV: Aux–up to 3mV.
Output: 250mV
Signal-to-noise ratio: better than 70dB.
Channel matching: within 1dB.
Tone controls: TREBLE + 15 to —15dB at 10KHz· BASS + 15 to—15dB at 100Hz.
Front panel: brushed aluminium with black knobs and controls.
Size: $8\frac{1}{4} \times 1\frac{1}{2} \times 4$ ins.
Built, tested and guaranteed. **£9.98**

Active Filter Unit

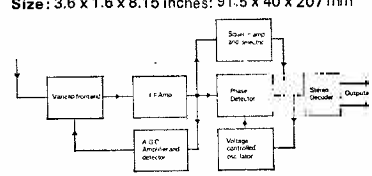


For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two stages of filtering are incorporated—rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28kHz to 5kHz. L.F cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1kHz (35V. supply) 0.02% at rated output.
Built, tested and guaranteed **£5.98**

Stereo FM Tuner

first in the world to use the phase lock loop principle
Before production of this tuner, the phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio over other systems. Now, for the first time, the principle has been applied to an FM tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Sensitivity is such that good reception becomes possible in difficult areas. Foreign stations can be tuned in suitable conditions and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

SPECIFICATIONS:
Number of transistors: 16 plus 20 in I.C.
Tuning range: 87.5 to 108 MHz
Capture ratio: 1.5dB
Sensitivity: 2μV for 30dB quieting: 7μV for full limiting.
Squelch level: 20μV.
A.F.C. range: ±200 KHz
Signal to noise ratio: >65dB
Audio frequency response: 10Hz—15KHz (±1dB)
Total harmonic distortion: 0.15% for 30% modulation
Stereo decoder operating level: 2μV
Pilot tone suppression: 30dB
Cross talk: 40dB
I.F. frequency: 10.7 MHz
Output voltage: 2 x 150mV R.M.S.
Aerial Impedance: 75 Ohms
Indicators: Mains on: Stereo on; tuning indicator
Operating voltage: 25-30 VDC
Size: 3.6 x 1.6 x 8.15 inches: 91.5 x 40 x 207 mm



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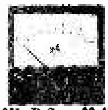
CLEAR PLASTIC METERS TYPE SW.100 100 x 80 mm.

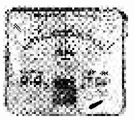
BAKELITE PANEL METERS TYPE S-80 80 mm. square fronts



50µA ...... £3·47½	20V. D.C. .. £2·97½	50µA ...... £3·12½	
50-0-50µA £3·37½	50V. D.C. .. £2·97½	50-0-50µA £2·97½	50V. D.C. .. £2·47½
100µA .... £3·37½	300V. D.C. £2·97½	100µA .... £2·97½	300V. D.C. £2·47½
100-0-100µA £3·25	1 amp. D.C. £2·97½	100-0-100µA £2·87½	1 amp. D.C. £2·47½
500µA .... £3·12½	5 amp. D.C. £2·97½	500µA .... £2·62½	5 amp. D.C. £2·47½
1mA ...... £2·97½	300V. A.C. £2·97½	1mA ...... £2·47½	300V. A.C. £2·62½
	VU Meter.. £3·75	20V. D.C... £2·47½	VU Meter... £3·37½

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4½in. × 4¼in. fronts.



	50mA .... £2·60
	100mA .... £2·60
	500mA .... £2·60
	1 amp. .... £2·60
	5 amp. .... £2·60
	15 amp..... £2·60
	30 amp..... £2·60
	20V. D.C... £2·60
	50V. D.C... £2·60
50µA .... £3·60	150V. D.C. £2·60
50-0-50µA £3·10	300V. D.C. £2·60
100µA .... £3·10	15V. A.C... £2·60
100-0-100µA £3·10	300V. A.C. £2·60
200µA .... £2·87½	S Meter 1mA £2·87½
500µA .... £2·75	VU Meter.. £3·60
500-0-500µA £2·60	1 amp. A.C.* £2·60
1mA ...... £2·60	5 amp. A.C.* £2·60
1-0-1mA .. £2·60	10 amp. A.C.* £2·60
5mA ...... £2·60	20 amp. A.C.* £2·60
10mA .... £2·60	30 amp. A.C.* £2·60

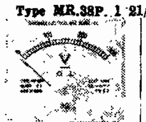
Type MR.52P. 2¾in. square fronts.

50µA ...... £3·10	10V. D.C. .. £2·00
50-0-50µA £2·60	20V. D.C. .. £2·00
100µA .... £2·60	50V. D.C. .. £2·00
100-0-100µA £2·37½	300V. D.C. £2·00
500µA .... £2·25	15V. A.C. .. £2·00
1mA ...... £2·00	300V. A.C. £2·00
5mA ...... £2·00	S Meter 1mA £2·10
10mA .... £2·00	VU Meter .. £3·10
50mA .... £2·00	1 amp. A.C.* £2·00
100mA .... £2·00	5 amp. A.C.* £2·00
500mA .... £2·00	10 amp. A.C.* £2·00
1 amp. .... £2·00	20 amp. A.C.* £2·00
5 amp. .... £2·00	30 amp. A.C.* £2·00

Type MR.65P. 3¼in. × 3¼in. fronts.

50µA ...... 3·37½	10V. D.C. .. £2·10
50-0-50µA £2·75	20V. D.C. .. £2·10
100µA .... £2·75	50V. D.C. .. £2·10
100-0-100µA £2·60	150V. D.C... £2·10
200µA .... £2·60	300V. D.C. £2·10
500µA .... £2·37½	15V. A.C... £2·10
500-0-500µA £2·10	50V. A.C... £2·10
1mA ...... £2·10	150V. A.C. £2·10
5mA ...... £2·10	300V. A.C. £2·10
10mA .... £2·10	500V. A.C. £2·10
50mA .... £2·10	S Meter 1mA £2·37½
100mA .... £2·10	VU Meter.. £3·37½
500mA .... £2·10	50mA A.C. *£2·10
1 amp. .... £2·10	100mA A.C.*£2·10
5 amp. .... £2·10	200mA A.C.*£2·10
10 amp..... £2·10	500mA A.C.*£2·10
15 amp. .. £2·10	1 amp. A.C.* £2·10
20 amp. .. £2·10	5 amp. A.C.* £2·10
30 amp. .. £2·10	10 amp. A.C.*£2·10
50 amp. .. £2·37½	20 amp. A.C.*£2·10
5V. D.C. .. £2·10	30 amp. A.C.*£2·10

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



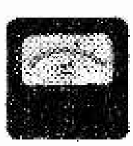
	200mA .... £1·37½
	300mA .... £1·37½
	500mA .... £1·37½
	750mA .... £1·37½
	1 amp. .... £1·37½
	2 amp. .... £1·37½
	5 amp. .... £1·37½
	10 amp. .. £1·37½
50µA ...... £2·00	3V. D.C. .. £1·37½
50-0-50µA £1·87½	10V. D.C... £1·37½
100µA .... £1·87½	15V. D.C... £1·37½
100-0-100µA £1·75	20V. D.C... £1·37½
200µA .... £1·75	100V. D.C. £1·37½
500µA .... £1·50	150V. D.C. £1·37½
500-0-500µA £1·37½	300V. D.C. £1·37½
1mA ...... £1·37½	500V. D.C. £1·37½
1-0-1mA .. £1·37½	750V. D.C. £1·37½
2mA ...... £1·37½	15V. A.C... £1·37½
5mA ...... £1·37½	50V. A.C... £1·37½
10mA .... £1·37½	150V. A.C. £1·37½
20mA .... £1·37½	300V. A.C. £1·37½
50mA .... £1·37½	500V. A.C. £1·37½
100mA .... £1·37½	S Meter 1mA £1·60
150mA .... £1·37½	VU Meter.. £2.10

Type MR.45P. 2in. square fronts.

50µA ...... £2·25	5 amp. .... £1·50
50-0-50µA £2·10	10V. D.C. .. £1·50
100µA .... £2·10	20V. D.C. .. £1·50
100-0-100µA £1·87½	50V. D.C. .. £1·50
200µA .... £1·87½	300V. D.C. £1·50
500µA .... £1·60	15V. A.C. .. £1·50
500-0-500µA £1·50	300V. A.C. £1·50
1mA ...... £1·50	S Meter 1mA £1·87½
5mA ...... £1·50	VU Meter.. £2·25
10mA .... £1·50	1 amp. A.C.* £1·50
50mA .... £1·50	5 amp. A.C.* £1·50
100mA .... £1·50	10 amp. A.C.*£1·50
500mA .... £1·50	20 amp. A.C.*£1·50
1 amp .... £1·50	30 amp. A.C.*£1·50

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.



	500mA .... £1·75
	1 amp. .... £1·75
	5 amp. .... £1·75
	15 amp..... £1·75
	30 amp..... £1·75
	50 amp..... £1·75
	5V. D.C. .. £1·75
	10V. D.C... £1·75
	20V. D.C... £1·75
	50V. D.C... £1·75
	150V. D.C. £1·75
	300V. D.C. £1·75
25µA ...... £3·50	30V. A.C.* £1·75
50µA ...... £2·37½	50V. A.C.* £1·75
50-0-50µA £2·25	150V. A.C.* £1·75
100µA .... £2·25	300V. A.C.* £1·75
100-0-100µA £2·25	500mA A.C.* £1·75
500µA .... £2·10	1 amp. A.C.* £1·75
1mA ...... £1·75	5 amp. A.C.* £1·75
1-0-1mA .. £1·75	10 amp. A.C.*£1·75
5mA ...... £1·75	20 amp. A.C.*£1·75
10mA .... £1·75	30 amp. A.C.*£1·75
50mA .... £1·75	50 amp. A.C.*£1·75
100mA .... £1·75	VU Meter .. £3·10

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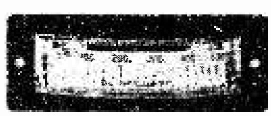
100µA ...... £4·25	50V d.c. .... £3·97
1mA .... £3·97	300V d.c. .... £3·97
50-0-50µA ... £4·25	
1-0-1mA..... £3·97	Dual range
1A d.c....... £3·97	500mA/5A d.c.£4·25
5A d.c. ...... £3·97	5V/50V d.c... £4·25
10V d.c. .... £3·97	

EDGWISE METERS



Type PE.70. 3 17/32in. × 1 15/32in. × 2¼ in. deep.

50µA ...... £3·00	500µA .... £2·60
50-0-50µA £2·87½	1mA ...... £2·37½
100µA .... £2·87½	300V. A.C. £2·37½
100-0-100µA £2·75	VU Meter.. £3·25
200µA .... £2·75	

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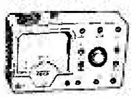

TECH PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000V. A.C. and D.C. 0/1/100/500mA. D.C. 0/100K. £1·97½. P. & P. 12½p.

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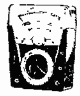

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30uA/3/30/300mA. 0/16K/160K/1.6M/16 Meg Ω. £5·50. P. & P. 15p.

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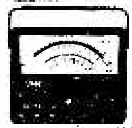

MODEL PL436 20kΩ/Volt D.C. 8kΩ/Volt A.C. Mirror scale. .6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600uA/60/600 mA. 10/100K/1 Meg/10 MegΩ. −20 to + 46db. £6·97½ P & P 12½

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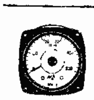
TMK LAB TESTER. 100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K Ω/Volt A.C. D.C. Volts: .5, 2.5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100uA, 10, 100, 500mA, 2.5, 10 amp. Resistance: 1K, 10K. 100K, 10MEG, 100 MEGΩ. Decibels: −10 to 49 db. Plastic Case with Carrying Handle. Size 7½in. x 6¾in. x 3¼in. £15·90. P. & P. 25p.



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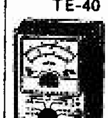

10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4 cps.-1·2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17·50. Carr. 25p.

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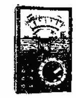
High quality instrument with 28 ranges. D.C.volts 1·5–1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. £17·50. P. & P. 30p. Additional probes available: R.F. £2·12½; H.V. £2·50.

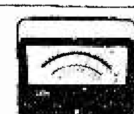
HONOR TE.10A. 20kΩ/Volt 5/25/50/250/500/2,500 v. D.C. 10/50/100/500/1,000 v. A.C. 0/50uA/2.5mA/250mA D.C. 0/6K/6 meg. ohm. −20 to +22 dB. 10–0, 100 mfd. 0.100–0.1 mfd. £3·47½. P. & P. 15p.



MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/.6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30uA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm −20 to +63 db. £5·97½. P. & P. 15p.

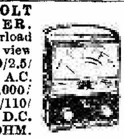
TMK MODEL MD.120 Mirror scale. 20k/Volt D.C. 10kΩ Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current 0-60uA/0 — 12/300mA. 0-60K/0-6 Mohms −20 to + 63 dB. £4·62½ P & P 15p

MODEL TE-90 50,000 O.P.V. Mirror scale, overload protection. 0/3/12/60/300/600/1,200 v. D.C. 0/6/30/120/300/1,200 v. D.C. .03/6/60/600mA. D.C. 16K/160K/1.6/16 MEGΩ. −20 to +63 db. £7·50. P. & P. 15p.



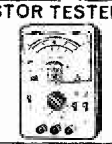
SKYWOOD SW-500 50K Ω/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. DC Current 20uA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels — 20 to +57 db. £7·50. P. & P. 15p.

MODEL AS-100D. 100KΩ/Volt. 5in., mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200 v. D.C. 0/6/30/120/300/600 v. A.C. 0/10uA/6/60/300MA/12 Amp. 0/2K/200K/2M/200MΩ. −20 to +17·bB. £12·50. P. & P. 17½p.



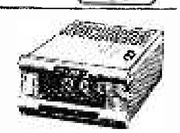
TE-900 20,000 Ω/VOLT GIANT MULTIMETER. Mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2.5/10/250/1,000/5,000 v. A.C. 0/25/12.5/10/50/250/1,000/5,000 v. D.C. 0/50uA/10/100/500mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £15. P. & P. 25p.

FTC-401 TRANSISTOR TESTER



Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

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: 5¼in. x 2 13/16in. x 83/16in.
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2G301	20p	2N3417	37p	2S102	25p	BC116	15p	BFX12	22p	NKT224	22p
2G302	19p	2N3439	130p	2S103	25p	BC118	15p	BFX13	22p	NKT225	22p
2G303	20p	2N3440	97p	2S104	25p	BC119	47p	BFX29	30p	NKT229	30p
2G306	30p	2N3564	17p	2S301	47p	BC121	20p	BFX30	30p	NKT237	35p
2G308	30p	2N3565	15p	2S302	47p	BC122	20p	BFX37	30p	NKT238	25p
2G309	30p	2N3566	22p	2S303	57p	BC125	15p	BFX44	37p	NKT240	27p
2G371	15p	2N3568	25p	2S304	72p	BC126	25p	BFX68	67p	NKT241	27p
2G374	20p	2N3569	25p	2S501	32p	BC134	15p	BFX84	25p	NKT242	20p
2G381	22p	2N3570	125p	2S502	35p	BC135	15p	BFX85	32p	NKT243	62p
2N388A	49p	2N3572	97p	2S503	27p	BC136	15p	BFX86	25p	NKT244	17p
2N404	21p	2N3605	27p	3N83	40p	BC137	15p	BFX87	27p	NKT245	20p
2N696	15p	2N3606	27p	3N128	70p	BC138	37p	BFX88	25p	NKT261	20p
2N697	16p	2N3607	22p	3N140	77p	BC140	35p	BFX89	62p	NKT262	30p
2N698	25p	2N3638	18p	3N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N699	42p	2N3638A	20p	3N142	55p	BC147	15p	BFY11	42p	NKT271	20p
2N706	9p	2N3641	18p	3N143	67p	BC148	11p	BFY18	25p	NKT262	20p
2N706A	11p	2N3642	18p	3N152	87p	BC149	15p	BFY19	25p	NKT274	20p
2N708	15p	2N3643	20p	40050	55p	BC152	17p	BFY21	42p	NKT275	20p
2N709	45p	2N3644	25p	40250	52p	BC153	35p	BFY24	45p	NKT278	25p
2N718	25p	2N3645	25p	40251	55p	BC154	35p	BFY29	40p	NKT281	27p
2N718A	30p	2N3691	15p	40309	32p	BC157	15p	BFY30	40p	NKT401	87p
2N726	25p	2N3692	18p	40310	45p	BC158	15p	BFY41	50p	NKT402	90p
2N727	25p	2N3693	15p	40311	35p	BC159	15p	BFY43	62p	MKT403	75p
2N914	17p	2N3694	18p	40312	47p	BC160	35p	BFY50	22p	NKT404	62p
2N916	17p	2N3702	12p	40314	37p	BC167	15p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	40315	37p	BC168B	14p	BFY52	22p	NKT406	62p
2N929	22p	2N3704	12p	40316	47p	BC168C	15p	BFY53	17p	NKT451	62p
2N930	24p	2N3705	10p	40317	37p	BC169B	14p	BFY56A	57p	NKT452	62p
2N937	52p	2N3706	10p	40319	55p	BC169C	15p	BFY76	42p	NKT453	47p
2N1090	22p	2N3707	12p	40320	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1091	22p	2N3708	8p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	10p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1132	25p	2N3710	10p	40326	37p	BC175	22p	BSX20	17p	NKT736	35p
2N1302	17p	2N3711	10p	40329	30p	BC177	22p	BSX21	37p	NKT773	25p
2N1303	17p	2N3713	187p	40344	27p	BC178	20p	BSX26	45p	NKT781	30p
2N1304	22p	2N3714	200p	40347	57p	BC179	22p	BSX27	47p	OC16	50p
2N1305	22p	2N3715	222p	40348	52p	BC182	12p	BSX28	32p	OC19	37p
2N1306	24p	2N3716	290p	40360	42p	BC182L	10p	BSX60	82p	OC20	75p
2N1307	24p	2N3773	240p	40361	47p	BC183	10p	BSX61	62p	OC22	50p
2N1308	29p	2N3791	275p	40362	57p	BC183L	10p	BSX76	15p	OC23	60p
2N1309	24p	2N3819	34p	40370	32p	BC184	15p	BSX77	20p	OC24	60p
2N1507	17p	2N3820	57p	40406	57p	BC184L	12p	BSX78	25p	OC25	37p
2N1613	21p	2N3823	75p	40407	40p	BC186	25p	BSY24	15p	OC26	25p
2N1631	35p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	62p
2N1632	30p	2N3854A	27p	40409	55p	BC212L	12p	BSY26	17p	OC29	62p
2N1637	30p	2N3855	27p	40410	62p	BC213L	12p	BSY27	17p	OC35	50p
2N1638	27p	2N3855A	30p	40412	50p	BC214L	15p	BSY28	17p	OC36	62p
2N1639	27p	2N3856	30p	40467A	57p	BCY10	27p	BSY29	17p	OC41	22p
2N1701	110p	2N3856A	35p	40468A	35p	BCY30	24p	BSY32	25p	OC42	25p
2N1711	24p	2N3858	25p	40528	72p	BCY31	30p	BSY36	25p	OC44	17p
2N1889	32p	2N3858A	30p	40600	57p	BCY32	50p	BSY37	25p	OC45	12p
2N1893	37p	2N3859	27p	40603	50p	BCY33	20p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	AC107	30p	BCY34	25p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	AC126	20p	BCY38	30p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	150p	AC127	24p	BCY39	60p	BSY51	32p	OC72	12p
2N2193A	42p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	37p	OC74	30p
2N2194A	30p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	22p
2N2217	27p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	22p
2N2218	29p	2N3901	97p	AC176	22p	BCY54	32p	BSY79	45p	OC77	30p
2N2219	31p	2N3903	25p	AC187	25p	BCY58	22p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	AC188	27p	BCY59	22p	BSY95A	12p	OC81	20p
2N2221	25p	2N3905	30p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2222	29p	2N3906	30p	ACY18	24p	BCY70	20p	C450	15p	OC82	25p
2N2222A	35p	2N4058	16p	ACY19	24p	BCY71	30p	GET102	30p	OC82D	15p
2N2297	30p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	20p	OC83	25p
2N2368	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	15p	OC84	25p
2N2369	17p	2N4061	12p	ACY22	16p	BCY79	30p	GET118	20p	OC139	25p
2N2369A	17p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	32p
2N2410	42p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	ACY40	14p	BD112	50p	GET880	30p	OC171	30p
2N2484	32p	2N4249	15p	ACY41	25p	BD116	112p	GET887	15p	OC200	40p
2N2539	22p	2N4250	18p	ACY44	40p	BD121	65p	GET889	22p	OC201	60p
2N2540	22p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	75p
2N2613	27p	2N4255	42p	AD149	47p	BD124	80p	GET896	22p	OC203	40p
2N2614	30p	2M4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	47p	2N4285	17p	AD161	35p	BD132	85p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	AD162	35p	BDY10	137p	MAT100	25p	OC206	90p
2N2712	25p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	30p	OC207	75p
2N2713	27p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OCP71	42p
2N2714	30p	2N4289	15p	AF115	25p	BDY62	100p	MAT121	30p	ORP12	50p
2N2904	29p	2N4290	15p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	32p	2N4291	15p	AF117	20p	BF117	47p	MJ420	112p	ORP61	42p
2N2905	37p	2N4292	15p	AF118	44p	BF152	38p	MJ421	112p	P346A	22p
2N2905A	40p	2N4294	17p	AF121	30p	BF154	38p	MJ430	102p	ST140	15p
2N2906	25p	2N4303	47p	AF124	22p	BF158	28p	MJ440	95p	ST141	20p
2N2906A	27p	2N4964	15p	AF125	19p	BF159	57p	MJ480	97p	TIS34	62p
2N2907	30p	2N4965	18p	AF126	16p	BF163	35p	MJ481	125p	TIS43	40p
2N2923	15p	2N5027	52p	AF127	16p	BF167	25p	MJ490	100p	TIS44	12p
2N2924	15p	2N5028	57p	AF139	28p	BF170	33p	MJ491	137p	TIS45	12p
2N2925	15p	2N5029	47p	AF178	42p	BF173	30p	MJE340	62p	TIS46	12p
2N2926G	12p	2N5030	42p	AF179	45p	BF177	30p	MJE370	95p	TIS47	12p
2N2926O	12p	2N5172	12p	AF180	50p	BF178	25p	MJE371	87p	TIS48	12p
2N2926Y	12p	2N5174	52p	AF181	40p	BF179	30p	MJE520	87p	TIS49	12p
2N3011	24p	2N5175	52p	AF186	39p	BF180	35p	MJE521	87p	TIS50	17p
2N3014	25p	2N5176	45p	AF239	30p	BF181	35p	MPF102	42p	TIS51	12p
2N3053	24p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	TIS52	12p
2N3054	49p	2N5245	45p	AF280	47p	BF184	25p	MPF104	37p	TIS53	22p
2N3055	72p	2N5246	42p	AFZ11	32p	BF185	25p	MPF105	37p	XB112	12p
2N3133	25p	2N5249	67	ASY26	25p	BF194	17p	MPS3638	32p	XC141	35p
2N3134	30p	2N5265	325p	ASY27	31p	BF195	15p	NKT124	42p	ZTX107	14p
2N3135	25p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	11p
2N3136	25p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	17p
2N3390	25p	2N5307	37p	ASY50	25p	BF198	42p	NKT128	27p	ZTX300	11p
2N3391	20p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	17p
2N3391A	30p	2N5309	62p	ASY54	25p	BF224	20p	NKT137	32p	ZTX302	18p
2N3392	17p	2N5310	42p	ASY67	45p	BF225	20p	NKT210	30p	ZTX303	18p
2N3393	15p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	27p
2N3394	15p	2N5355	27p	ASZ21	37p	BF238	22p	NKT212	30p	ZTX500	16p
2N3402	22p	2N5356	32p	AUY10	150p	BF244	32p	NKT213	30p	ZTX501	16p
2N3403	22p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	22p	ZTX502	20p
2N3404	32p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
2N3405	45p	2N5367	57p	BC109	10p	BFW88	23p	NKT216	37p	ZTX504	40p
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CA3041	109p
CA3042	109p
CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	160p
CA3050	185p
CA3051	134p
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CA3064	120p
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FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
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FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p

FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC10	250p
IC12	250p
L900	40p
L914	40p
L923	40p
MC724P	66p
MC780P	247p
MC788P	82p
MC790P	124p
MC792P	66p
MC799P	66p
MC1303L	262p
MC1304P	275p
MC1305P	386p
MC838P	549p
MC1435P	345p
MC1552G	461p
MC1709CG	94p
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PA222	437p
PA230	100p
PA234	100p
PA237	185p
PA246	245p
PA424	235p
PA264	447p
PA265	497p
SN7400	25p
SN7401	25p
SN7402	25p
SN7403	25p
SN7404	25p
SN7405	25p
SN7406	80p
SN7408	25p
SN7409	25p
SN7410	25p
SN7411	25p
SN7413	50p
SN7420	25p

SN7430	25p
SN7440	25p
SN7441AN	100p
SN7442	100p
SN7446	125p
SN7447	110p
SN7448	100p
SN7450	25p
SN7451	25p
SN7453	25p
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SN7460	25p
SN7472	40p
SN7473	45p
SN7474	45p
SN7475	100p
SN7476	45p
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SN7486	50p
SN7490	100p
SN7492	100p
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SN7495	100p
SN7496	100p
SN74107	45p
SN74153	190p
SN74154	220p
SN74160	180p
SN74161	180p
SN74164	220p
SN74165	225p
SN74192	225p
SN74193	225p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA811	445p
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6SL7	35p	ECH35	60p	U281	40p
6SN7	35p	ECH42	70p	U282	40p
6SQ7	40p	ECH81	30p	U301	40p
6U4	60p	ECH83	40p	U801	£1·00
6V6G	25p	ECL80	40p	UABC80	35p
6V6GT	32p	ECL82	35p	UAF42	55p
6X4	30p	ECL83	65p	UBC41	50p
6X5G	30p	ECL86	40p	UBC81	40p
6X5GT	27p	EF37A	60p	UBF80	40p
10C2	50p	EF39	40p	UBF89	35p
10F1	90p	EF40	50p	UCC84	49p
10P13	55p	EF41	65p	UCC85	40p
10P14	£1·10	EF42	70p	UCF80	55p
12AT6	30p	EF80	25p	UCH21	60p
12AT7	30p	EF85	35p	UCH42	70p
12AU7	30p	EF86	30p	UCH81	35p
12AX7	30p	EF89	28p	UCL82	35p
12AV6	33p	EF91	33p	UCL83	60p
12BA6	35p	EF92	40p	UF41	60p
12BE6	35p	EF183	30p	UF80	35p
12BH7	40p	EF184	35p	UF85	40p
19AQ5	35p	EH90	40p	UF89	35p
20D1	45p	EL34	50p	UL41	65p
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AA129	10p	BAY38	25p	OA9	10p
AAZ13	10p	BY100	15p	OA47	7p
AAZ15	12p	BY103	22p	OA70	7p
BA100	15p	BY122	37p	OA73	10p
BA102	22p	BY124	15p	OA79	9p
BA110	32p	BY126	15p	OA81	7p
BA111	27p	BY127	17p	OA85	7p
BA112	70p	BY164	57p	OA90	7p
BA115	7p	BY210	35p	OA91	7p
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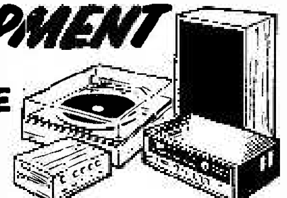

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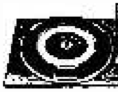

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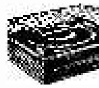

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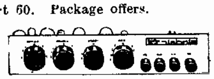

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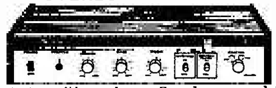

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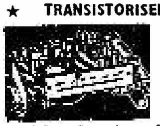

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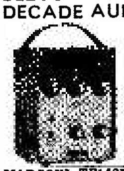

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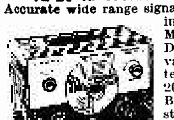

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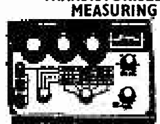

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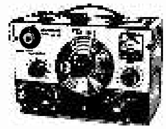

2 pF-2000 mFd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. **Brand New £17·50.** Carr. 37½p.

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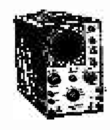

3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps-1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps -800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. **£37·50.** Carr. 50p.

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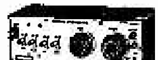

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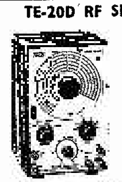

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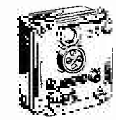

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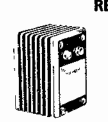

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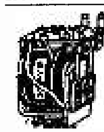

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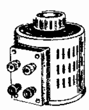

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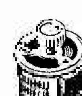

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Transistors etc. AC126 **12½p**. AF115 **20p**. AF116 **15p**. AF117 **20p**. OA5 **7½p**. OA10 **7½p**. OA81 **7½p**. OA85 **7½p**. OC23 **32½p**. OC25 **30p**. OC26 **37½p**. OC28 **42½p**. OC35 **42½p**. OC44 **14p**. OC45 **12½p**. OC71 **12½p**. OC72 **12½p**. OC75 **12½p**. OC81 **12½p**. OC81D **12½p**. OC82D **12½p**. OC170 **20p**. OC171 **12½p**. Many more in list. **S.D.R.** BY100 800piv **14p**. **6 amp series:** BYZ13 300piv **20p**. BYZ12 600piv **25p**. BYZ11 900piv **30p**. BYZ10 1200piv **35p**. (Charges 6½p up to 11, paid for 12 and over). **Sub-Min Transformers: OUTPUT** 3 Ω for OC72 etc.) **14p** (up to 6, 6½p). **MULTIMETER**. Our famous 20000 Ω per V **£4·62½** (15p). Details and other in list. **SOLDERING IRON**. Slim, modern, British highspeed 8¾", all parts replaceable, highest quality, full guarantee: **£1·07½** (10p). **DIAMOND STYLII** Replacements for BSR TC8/LP, TC8/S, TC8LP/STEREO: COLLARO 'O' : RONETTE BF 40LP: Garrard GC2/LP and GC8/LP: ACOS GP65/67, all at **40p** (6p). ACOS GP73, GP91: BSR ST4 (ST3, ST5), ST8 (ST9): SONOTONE 8TA, 9TA, 9TAHC: PHILIPS AG3306, 3060 (3063, 3066, 3301, 3302, 3304); Garrard GKS25, GCM21, GCS23, and many more 'Garrard' etc. types. All at **75p**. (6p). All are of the very highest quality. **DOUBLE DIAMOND**: ST4 (ST3, ST5); ST10 (ST9, ST8): 9TA, 9TAHC, 3306, GP91 (For GP92, GP93, GP94 cartridges): GP91-SC for all GP91-SC Cartridges. All at **£1·50** each (6p). **PICK-UP CARTRIDGES**. All Standard fittings and stylii. Mono GP67/2 **80p**. STEREO-COMPATIBLE (MONO) GP91/SC **£1·10** STEREO GP93 **£1·30** STEREO CERAMIC GP94 **£1·95** SONOTONE STEREO 9TAHC (DIA.) **£2·40**. GOLDRING G850 **£4·87½**. G800 **£8·50**. G800E **£13·50**. G800 SUPER E **£19·50** (6½p all types or Reg. Post, 22½p). STYLII FOR ALL ABOVE TYPES, including GOLDRING available. **RECORDING TAPE**. Still the finest quality British Mylar available: Standard 5" 600ft. **36p**. 5¾" 900ft. **50p**. 7" 1200ft. **56p**. LONG PLAY 5" 900ft. **50p**. 5¾" 1200ft. **56p**. 7" 1800ft. **90p**. (7½p on 5" and 5¾", 9p on 7"). **MICROPHONES** Crystal Mic 91, hand/desk **81p**. MIC45. Curved metal hand-grip **£1·00**. CM21 Grey hand desk **62½p**. Stick '60' **£1·02½**. CM70 "Planet" machined metal tapered stick type with neck cord, adaptor to fit floor stands **£1·47½** (all 9p). LAPEL (or hand) with clip **32½p** (6p). All are fitted with leads. **Dynamic MS10** 50K Ω for desk, tapered with base and slide-out adaptor **£1·97½**. **MS11**. Similar, but fixed on swivel swan neck to switch-fitted base, **£2·22½** (Either 15p). **Type 209 Cardioid ball**, 50K/600 Ω, omni-dir., built-in vol. control, on/off switch, special lead, handle (as good as money can buy) **£6·30**. UD130 Uni-Dir. Ball., mesh, 50K/600 Ω, Adap., cable, jack plug **£4·80**. (20p). DM160. omni-dir., Ball, 50K Cable adaptor **£3·87½** (all at **27½p**). **MICROPHONE INSERTS**. Dia., 1·75" OR 0·9" either size **27½p** (6p). **EARPIECES** with lead and min. jack plug (2·5 or 3·5 mm., state which). Magnetic 9p Crystal (3.5 only) **24p** (Up to 3 for 6p on any). **HEADPHONES** De-luxe STEREO 8-16 Ohms **£2·47½**. Same, fitted vol. control each earpiece **£4·20**. Both have lead and stereo jack plug (17½p.) High Res. 2000 ohm. Adjustable **92½p** (7½p). **SPEAKERS** 12" ROUND fitted tweeter, 3 or 15 Ω (state which) **£1·87½** (27½p) or for Stereo **£4·25** pair, carr. paid 2½" 3 OR 8 Ω (state which) **37½p** (6p). **EMI** 13" × 8", 3, 8 or 15 Ω (state which) **£2·12½** (25p) L.W with two tweeters and crossover network 15 Ω **£3·75** (25p). **VIBRATORS**. 12V 4-pin non-synch. 121HD4, 2¾" ex. pins. **27½p**. 12V 7-pin Synch. (12SR7) **62½p**. (Both types 6½p per vibrator). **CONNECTING WIRE**. Packs of 5 coils asstd. cols. ea. coil 5yds. Solid core **14p** (6p). Flexible **16p** (7½p). Super thin for transistor wiring **16p** (6p). **PICK-UP WIRE**. Super thin twin flex, screened and sheathed **6p** yd. (6p up to 6yds.—over free). **RETRACTABLE Flex. Leads.** (Curlies) Phonoplug each end 12ft. **30p**. 6ft phono plug/phono socket other end **25p**. 12ft **42½p** (6p per lead all types). SEND S.A.E. for full free lists—Small 3W and 7½W trans. amplifiers, Electrolytics, Vol. Controls, all types of radio switches, car and portable expanding aerials, Meters, Test prods, all types of Brit. and Cont. standard and min. plugs and sockets SDR's, Thyristors, cros. clips (various) terminals, etc. etc. and "Special Offer" lines at lowest possible prices.

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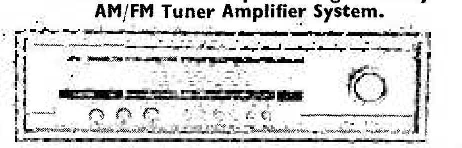

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UCL83	.49
UF41	.50
UF42	.60
UF80	.35

UF85	.34
UF86	.63
UF89	.30
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OA90	.13
OA91	.09
OA95	.09

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OC24	.38
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OC29	.63
OC35	.32
OC36	.43
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OC45	.11
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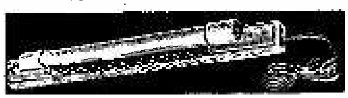

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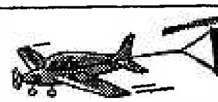

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6F23	·70	DF96	·35	ECH81	·28	KT66	·82	PL81	·46	UCH81	·32
6F25	·60	DK91	·27	ECL80	·33	N78	·85	PL82	·31	UCL82	·34
25L6GT	·22	DK92	·41	ECL82	·31	PC86	·49	PL83	·34	UCL83	·49
30C15	·62	DK96	·37	ECL86	·37	PC88	·49	PL84	·31	UF89	·30
30C18	·63	DL92	·28	EF39	·22	PC97	·39	PL500	·64	UL84	·32
30F5	·72	DL94	·37	EF80	·24	PC900	·35	PL504	·65	UY85	·27
30FL1	·62	DL96	·37	EF85	·28	PCC84	·31	PY32	·54	Z77	·18
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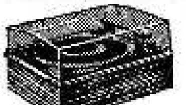

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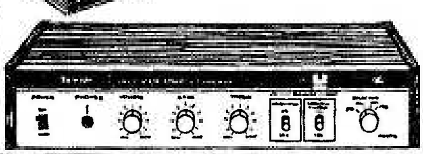

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35D5	0.70	9003	0.50	EC90	0.33	ECLL800	1.50
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35W4	0.30	AZ31	0.55	EC92	0.35	EF39	0.40
35Z3	0.60	CBL1	0.80	EC93	0.50	EF40	0.50
35Z4G	0.30	CBL31	0.90	EC8010	2.25	EF41	0.65
35Z5GT	0.40	CY31	0.35	ECC40	0.60	EF42	0.70
50A5	0.70	DAF96	0.42	ECC81	0.33	EF80	0.25
50B5	0.45	DF96	0.42	ECC82	0.30	EF83	0.55
50C5	0.40	DK40	0.55	ECC83	0.30	EF85	0.35
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EF91	0.33	EZ81	0.28	PF86	0.60	U281	0.40
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EL34	0.50	N78	1.45	PL508	0.90	UBF80	0.40
EL36	0.50	PABC80	0.40	PL509	1.30	UBF89	0.35
EL37	1.25	PC86	0.60	PL801	0.80	UBL1	0.50
EL41	0.55	PC88	0.60	PM84	0.50	UBL21	0.60
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EL86	0.40	PCC89	0.50	PY83	0.38	UCH43	0.75
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EM71	0.75	PCF87	0.85	QQV03-20A	5.25	UF80	0.35
EM80	0.40	PCF801	0.50	QQV06-4A	5.50	UF85	0.40
EM81	0.60	PCF802	0.50	TT21	2.65	UF89	0.35
EM84	0.35	PCF805	0.75	TT22	2.80	UL41	0.65
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EN91	0.35	PCH200	0.70	U26	0.75	UY1N	0.50
EY51	0.40	PCL81	0.50	U31	0.45	UY11	0.65
EY80	0.45	PCL82	0.35	U37	1.50	UY41	0.45
EY81	0.40	PCL83	0.65	U52	0.33	UY82	0.50
EY83	0.55	PCL84	0.45	U76	0.30	UY85	0.30
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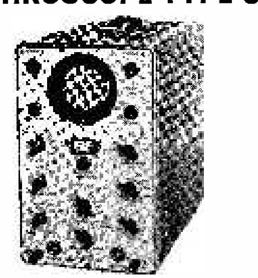
2N698	0.40	2S746	0.30	BCY72	0.20
2N705	0.70	AC113	0.15	BCZ11	0.40
2N706	0.15	AC125	0.30	BD121	0.80
2N708	0.20	AC126	0.25	BD123	0.95
2N753	0.25	AC127	0.20	BF115	0.20
2N929	0.30	AC128	0.20	BF167	0.25
2N930	0.35	AC132	0.35	BF173	0.30
2N987	0.35	AC153	0.25	BF181	0.25
2N1131	0.40	AC154	0.15	BF184	0.25
2N1132	0.45	AC156	0.23	BF185	0.20
2N1184	1.25	AC157	0.20	BF194	0.20
2N1301	0.40	AC169	0.10	BF195	0.15
2N1302	0.25	AC176	0.25	BF196	0.20
2N1304	0.25	AC187	0.30	BF197	0.20
2N1305	0.25	AC188	0.30	BFW87	0.30
2N1306	0.25	ACY17	0.30	BFW88	0.25
2N1307	0.30	ACY18	0.20	BFW89	0.23
2N1308	0.40	ACY19	0.25	BFW91	0.20
2N1309	0.35	ACY20	0.20	BFX88	0.25
2N1613	0.25	ACY21	0.20	BFY17	0.40
2N1711	0.30	ACY22	0.15	BFY19	0.60
2N1756	0.75	AD140	0.80	BFY50	0.25
2N2147	0.75	AD149	0.50	BFY51	0.20
2N2160	1.25	AD161	0.35	BFY52	0.25
2N2217	0.30	AD162	0.35	BSY26	0.25
2N2218	0.40	AF114	0.25	BSY27	0.30
2N2219	0.45	AF115	0.30	BSY28	0.30
2N2369A	0.25	AF116	0.25	BSY65	0.20
2N2477	0.65	AF117	0.20	BSY95A	0.20
2N2646	0.60	AF118	0.45	OC16	0.75
2N2905	0.50	AF125	0.25	OC22	0.65
2N2923	0.15	AF127	0.25	OC23	0.60
2N2924	0.15	AF178	0.40	OC24	0.60
2N2926	0.15	AF180	0.35	OC25	0.40
2N3053	0.30	AF181	0.35	OC26	0.30
2N3055	0.75	AF186	0.50	OC28	0.60
2N3133	0.35	AF239	0.40	OC29	0.65
2N3134	0.50	AFZ11	0.45	OC30	0.75
2N3391	0.20	ASY26	0.25	OC35	0.50
2N3392	0.15	ASY27	0.30	OC36	0.60
2N3393	0.15	ASY28	0.30	OC42	0.30
2N3394	0.15	ASY29	0.30	OC44	0.20
2N3395	0.20	ASY54	0.25	OC45	0.20
2N3402	0.15	ASY74	0.50	OC70	0.20
2N3403	0.15	ASY77	0.35	OC71	0.15
2N3404	0.35	ASY82	0.20	OC72	0.25
2N3414	0.20	ASY86	0.20	OC73	0.40
2N3415	0.15	ASZ16	0.70	OC75	0.25
2N3416	0.25	ASZ17	0.75	OC76	0.25
2N3417	0.25	ASZ18	0.75	OC78	0.25
2N3702	0.15	ASZ21	0.50	OC78D	0.20
2N3703	0.15	BC107	0.15	OC81	0.25
2N3704	0.20	BC108	0.15	OC81D	0.15
2N3707	0.20	BC109	0.20	OC83	0.20
2N3709	0.15	BC113	0.40	OC139	0.35
2N3710	0.15	BC118	0.30	OC140	0.40
2N3819	0.35	BC134	0.30	OC141	0.60
2N3906	0.30	BC147	0.20	OC170	0.25
2S002	1.00	BC148	0.15	OC171	0.25
2S004	1.00	BC149	0.15	OC200	0.30
2S034	1.00	BC152	0.15	OC202	0.65

SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight.
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2·5-10-30-100-300-1000·3000 μsec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1·5·20-100 μ sec + 5%.
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BY130	450 p.i.v.	800 mA	10np
BY127	600 p.i.v.	1 Amp	15np
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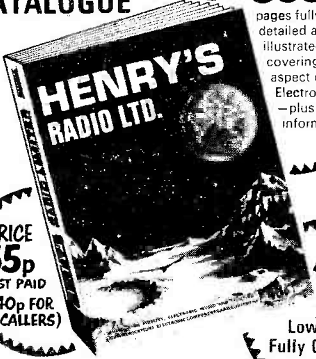

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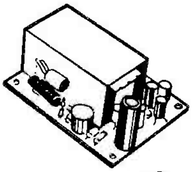

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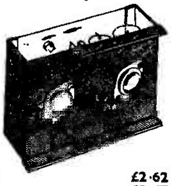

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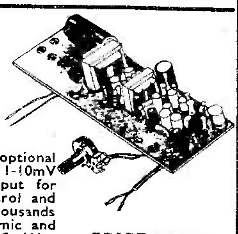

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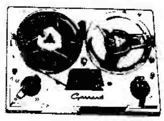

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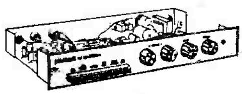

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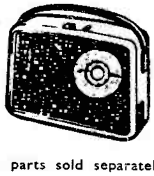

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