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NEWS & VIEWS

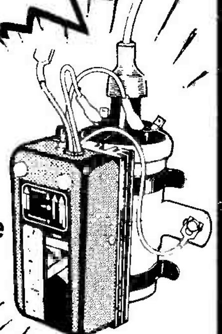
FOR OUR CONSTRUCTORS

GENERAL INTEREST

Our September issue will be published on August 4th
(for details see page 39)

The latest kit innovation! from Sparkrite

Sparkrite — is featured by Shaw Taylor in "DRIVE IN"



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- Smoother running
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Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins
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Inc. V.A.T. and P.P.	QUANTITY REQ'D.
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TACHS PULSE SLAVE UNIT £3.35	

Please state polarity pos. or neg. earth
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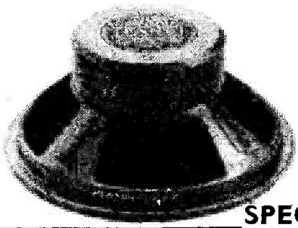
Improved appearance — higher sensitivity



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HIGH POWER "CROSS-OVERS"

HPX1R (3·5KHz)
HPX2R (5KHz) £3·25

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the MIGHTY MIDGETS

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MINIATURE

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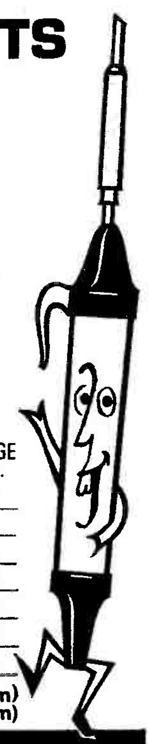

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SPARE BITS	44p	—
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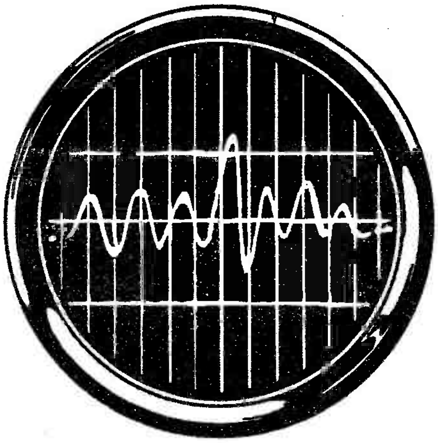
LOOK! Here's how you master electronics.

....the practical way.



This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

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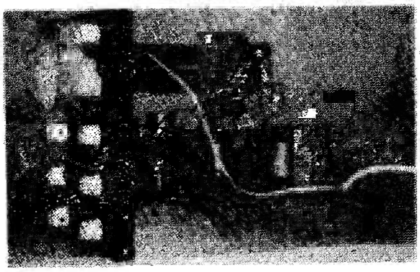

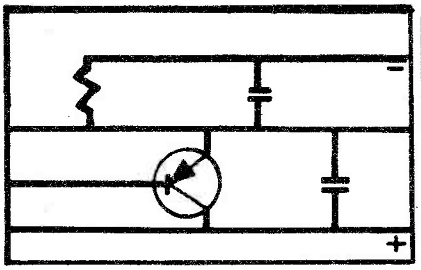

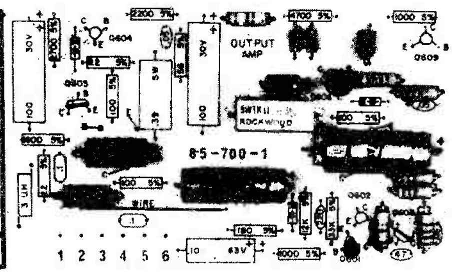

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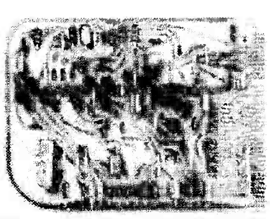

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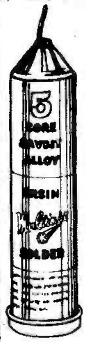

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handy solder dispenser

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

Size 5 58p

For soldering fine joints

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Size 19A 63p

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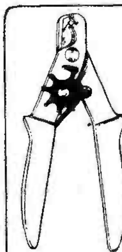

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Fitted with unique 8-gauge selector and handle locking device. Sprung for automatic opening. Strips flex and cable in seconds.

Pat. No. 1443913

Model 8B 97p

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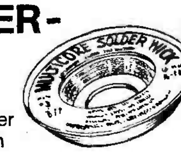

Absorbs solder instantly from tags, printed circuits etc. Only needs 40–50 Watt soldering iron. Quick and easy to use. Non-corrosive.

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SRX-30

For the advanced, keen short wave listener, the choice of receiver has usually been between cheap and nasty or very good but very expensive equipment. We think that the SRX-30 will provide that listener with excellent performance at a reasonable cost and is the answer to this eternal problem.

The SRX-30 provides **AM, CW, USB** and **LSB** reception on all frequencies from 500 kHz to 30MHz. All right, so does your Sooper Blooper Mk. 3 but you can't set the Sooper Blooper dial to the frequency you want and be sure that it's correct! **The SRX-30 tuning system** is so simple to operate. You have a dial reading in MHz from 0-29 and a main tuning dial reading 0-1000 kHz. So—if you know that Radio Slobovia is broadcasting on 10.295 MHz, you set the MHz dial to 10, the kHz dial to 295 and there you are. The MHz dial setting is not critical, as stability is guaranteed by a triple mixing drift cancelling system, thereby overcoming another problem in your Sooper Blooper Mk. 3; drift.

A further drawback to cheap receivers is massive image interference on the higher frequencies due to the use of a low IF, typically 455 kHz. The cure for this problem is the use of a high IF and the SRX-30 employs a first IF of around 40 MHz—so goodbye to first IF images. You could of course find the same system as this in the Racal RA17 series receivers; after all, the SRX-30 has copied the basic idea from this very receiver. The big drawback to the RA17 (apart from the price !!) is that unless you have the muscles of a prize fighter, lifting the RA17 may send you for a holiday at **Hernia Bay** (staying at the Truss House?).

To summarize, the SRX-30 covers 500 kHz to 30 MHz with excellent dial readout and reset accuracy; it has all mode (AM, CW, SSB) reception and is equally at home in broadcast or amateur bands; it has all the facilities of a top class communications receiver, RF gain, fine tuning, selectable sidebands, built in loudspeaker, operation from ac mains or 12v. Dc, rugged construction and super styling and all at an attractive price—£158 inc. VAT. Carr £3.

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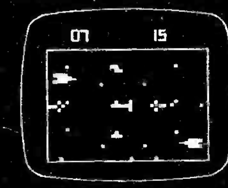
TANK BATTLE T.V. GAME



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TANK BATTLE AY-3-87 10 I.C. (Normal Price) £21·50 OUR PRICE **£10·90**

TANK BATTLE PRINTED CIRCUIT BOARD
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£28.00 STEREO PAIR + p & p £5.50

SPEAKERS AVAILABLE WITHOUT CABINETS. It's the units which we supply with the enclosures illustrated Size 13" × 8" (approx.) woofer, (EMI), 2½" app. tweeter, and matching crossover components. Power handling 15 watts rms, 30 watts peak. + p & p £3.40 £17.00 per stereo pair

COMPACT FOR TOP VALUE These infinite baffle enclosures come to you ready mitred and professionally finished. Each cabinet measures approx. 12" × 9" × 5" deep, and is in wood simulate. Complete with two 8" (approx.) speakers for maximum power handling of 7 watts. 8Ω. per stereo pair £8.50 + p & p £2.20

SPEAKERS Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18½" × 13½" × 7½" (approx.). Duo III, 20 watts rms, 40 watts peak, 27" × 13" × 11½" appx

Duo IIb £17 PER PAIR p & p £6.50 Duo III £52 PER PAIR p & p £7.50

DECCA 20 WATTS STEREO SPEAKER stereo pair This matching loudspeaker system is hand made, kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated cones with rolled P.V.C. surrounds, two 3½" diameter approx. domed tweeters complete with crossover networks. 8Ω £4.00 p & p. £20.00

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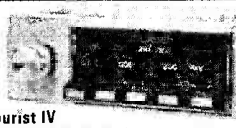
Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simply connects into your existing slave or external amplifier. p & p £6.50 £64.00



Tourist IV

CAR RADIO KIT For the experienced constructor only

Output 4 watts into 4 ohms. Complete with speaker, baffle and fixing strip, for the experienced constructor only. The Tourist IV has five push buttons, four medium band and one for long wave band. The tuning scale is illuminated and attractive small aluminium control knobs for manual tuning and volume control. 12 volts pos or neg (altered internally). Size approx. 7"x2".4¼". £12.50

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2 PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2. Stereo pre amp for magnetic, ceramic and auxiliary inputs. **illus.** OUR PRICE p+p £1.00 **£6.95**

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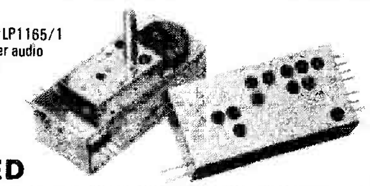

ACCESSORIES Suitable power supply parts including mains transformer, rectifier, smoothing and output capacitors. £1.00 p+p **£1.95**

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

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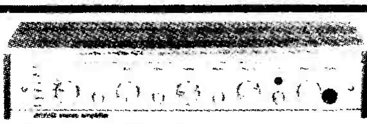


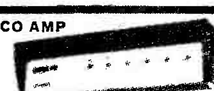
20 x 20 WATT STEREO AMPLIFIER £29.90 p & p £2·50

Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Functions switch for mic. magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets. DIN speaker and input sockets, plus fuse. 20 + 20 watts rms. 40 + 40 watts peak.

30 x 30 WATT AMPLIFIER KIT For the experienced constructor complete in every detail. Similar facilities as Viscount IV amplifier. 60 + 60 peak. £29.00 p. & p. £2·50.

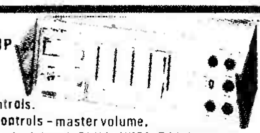
AVAILABLE NOW built and fully tested with output 30 + 30 watts rms. 60 + 60 peak. £39.00 p. & p. £2·50.

SPECIAL OFFER: PACKAGE PRICE WITH 30 x 30 KIT MkII version, operates into 4 to 15 OHMS speakers. Designed by R & TVC for the experienced constructor. Complete in every detail, facilities as Viscount IV amplifier 60 + 60 peak. Supplied with 2 Goodmans Compact 12" bass woofer with cropped 14,000 Gauss Magnet. 30 watt rms handling + 3½" approx. tweeters and crossovers. £49.00 p & p £4·00



50 WATT MONO DISCO AMP £29·95 p & p £2·50 Size approx: 13¾" × 5½" × 6¾" 50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

SPECIAL OFFER The above 50 watt amp plus 4 Goodmans Type 8P, 8" speakers. Package price £45·00 + £4·00 p & p..



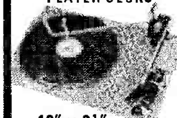
70 & 100 WATT MONO DISCO AMP Size approx. 14" × 4" × 10½". Brushed aluminium fascia and rotary controls. Five vertical slide controls - master volume, tape level, mic level, deck level. PLUS INTER-DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

70 watt 140 watt peak £57 p & p £4.00

100 watt £65

ADD-ON STEREO CASSETTE TAPE DECK KIT Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control for mating with mechanism. Specifications: Sensitivity - Mic. 0.85 mV " 20K OHMS, Din. 40mV " 400K OHMS: Output - 300mV RMS per channel " 1KHz from 2K OHMS source: Cross Talk - -30db: Tape Counter - 3 Digit - Resettable: Frequency Response - 40Hz -8KHz ± 6db Deck Motor - 9 Volt DC with electronic speed regulations: Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject. £19.95 p & p £2.50

Opt. extras: Mains transformer to suite £2.50 + £1 p & p.



CHASSIS RECORD PLAYER DECKS 12" × 8¼" approx

GARRARD DECK CC10A Record changer with cue, stereo ceramic cartridge. £7.95 p & p £2.00

BSR MP60 TYPE Single play record deck less cartridge. £15.95 p & p £2.55

Cartridges to suit above

Acos. magnetic stereo £4.95

Ceramic stereo £1.95

BSR automatic record player deck cueing device and stereo ceramic head. p & p £2.55 £9.95

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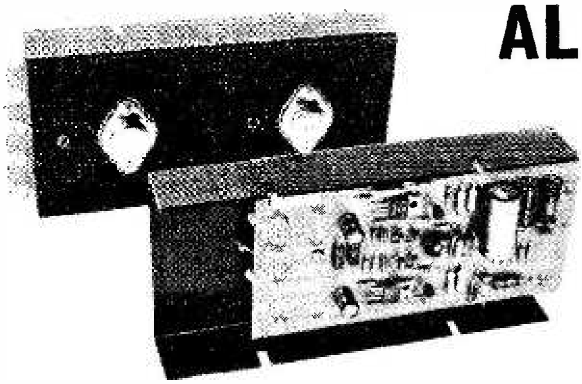

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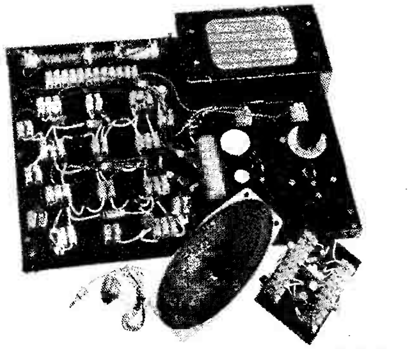

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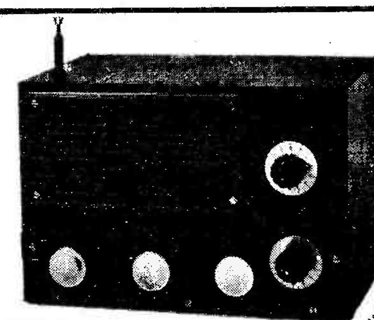

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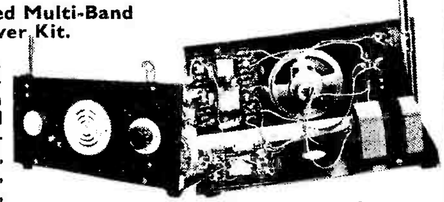

Complete kit of parts
£7·95 + P & P and Ins. 90p

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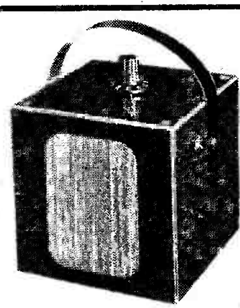

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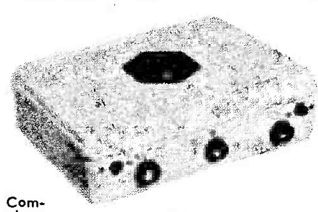

Complete kit of parts including construction plans

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● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 5" × 3" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc.

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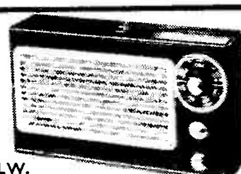

Build this exciting new design. Now with 7 Transistors and 4 diodes. MW/LW. Powered by 9V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. × 5¼in. × 2½in. approx. All parts including Case and Plans.

Total Building Costs **£6·95** + P & P and ins. 90p

ALL PRICES INCLUDE VAT

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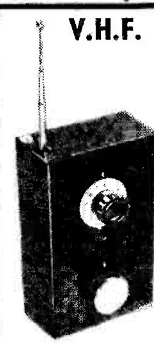

Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc. All parts including case and plans

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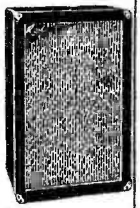

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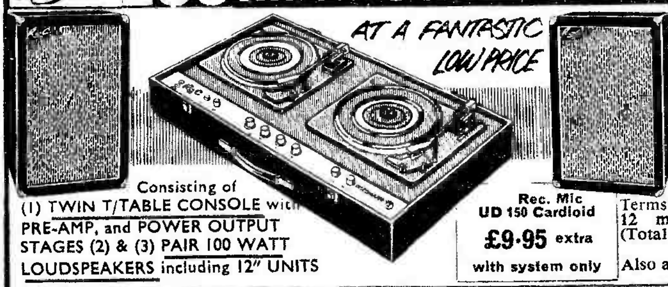

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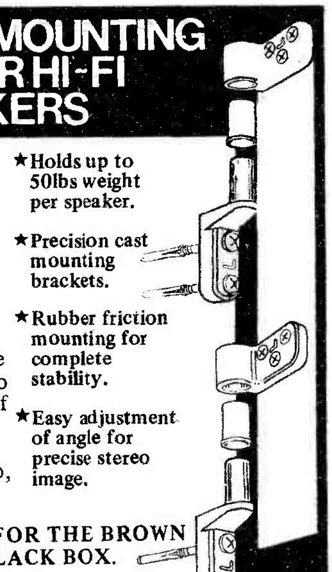

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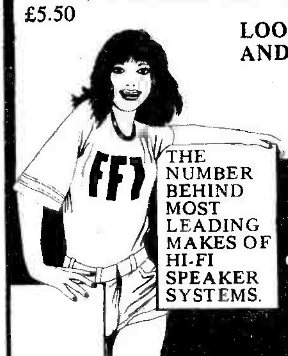

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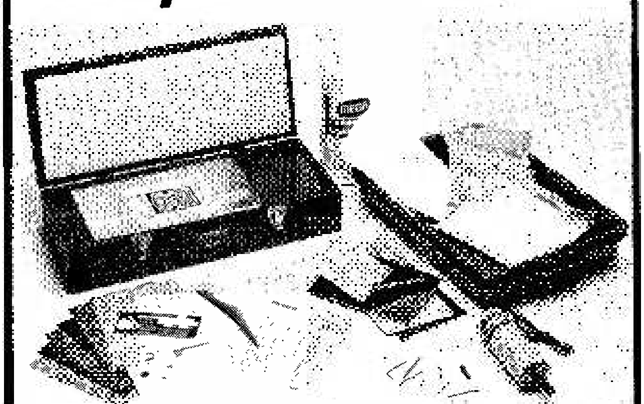

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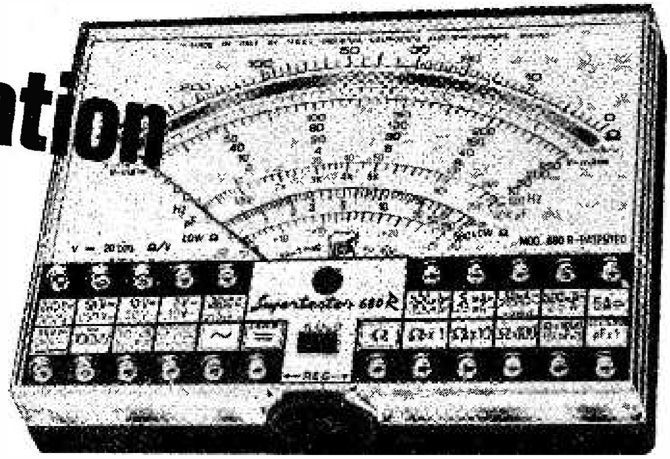

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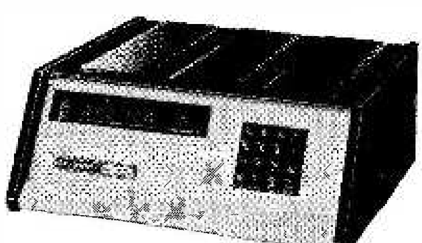

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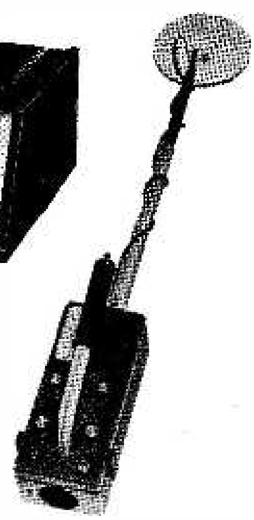

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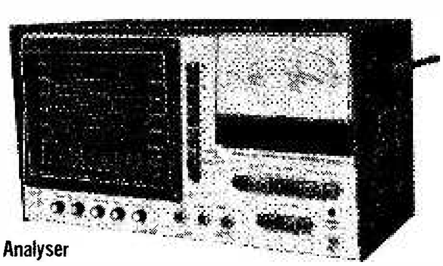

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PC900†	1·00*
PCC84†	0·45*
PCC88	0·65*
PCC89†	1·05*
PCC189†	1·00*
PCF80	0·96*
PCF82†	0·50*
PCF86†	0·75*
PCF87†	1·00*
PCF200†	1·15*
PCF201†	1·10*
PCF801†	0·60*
PCF802†	0·88*
PCF805	1·44*
PCF806	1·44*
PCF808	1·44*
PCL82†	0·80*
PCL83†	0·92*
PCL84†	0·75*
PCL85†	0·96*
PCL86†	0·85*
PCL805/85†	0·96*
PD500	3·60*
PFL200	1·12*
PL36†	1·12*
PL81	1·12*
PL81A†	1·12*
PL82	0·60*
PL83†	0·55*
PL84†	0·60*
PL504/500†	1·20*
PL508†	1·60*
PL509†	2·72*
PL519†	3·60*
PL801	1·10*
PL802†	3·00
PY33	0·68*
PY81†	0·72*
PY82	0·55*
PY83	0·70*
PY88†	1·16*
PY500A†	1·60*
PY800/81†	0·92*
PY801	0·92*
QQV02-6	9·90
QQV03-10†	2·00
QQV03-20A†	10·50*
QQV06-40A†	13·00*
R17	1·65
R19	1·00
R20	1·44
U18-20	2·50*
U25	1·16*
U26	1·44*
UABC80†	0·58*
UAF42	0·75*
UB41	1·25*
UBC41†	0·75*
UBF89	0·60
UCC84	0·75*
UCC85†	0·55*
UCF80	0·75*
UCH42	1·20*
UCH81†	0·65*
UCL82†	0·50*
UCL83	1·44*
UF41	1·00*
UF80†	0·50*
UF85†	0·65*
UF89†	0·55*
UL41	1·00*
UL84†	0·85*
UM80	1·00*
UY41†	0·75*
UY85†	0·65*
1B3GT†	0·65*
1R5†	0·55*
1S5†	0·40*
1T4†	0·40*
2AS15	10·00
2D21†	0·80
3A5	1·35
3CX100A5	20·00
3S4†	0·75*
3V4†	1·00*
4CX250B	17·50
5R4GY†	1·00*
5U4G	1·52*
5U4GB	2·26*
5V4G†	0·65*
5Y3GT	0·85*
5Z3	1·50*
5Z4G	1·12*
5Z4GT	1·00*
6-30L2	1·56*
6AB7	0·75*
6AC7	0·75*
6AF4A†	0·70*
6AG7	0·75*
6AH6†	0·70*
6AK5†	0·50*
6AK6	0·95*
6AL5†	0·30*
6AM4	2·30*
6AM5	3·85*
6AM6†	0·65*
6AN5	2·50*
6AN8A†	0·70*
6AQ5†	0·85*
6AR5	0·70*
6AS6†	0·80*
6AS7G†	1·50*
6AT6†	0·65*
6AU5GT	4·28*
6AU6†	0·55*
6AV5GT	3·74*
6AV6†	0·50*
6AW8A†	1·00
6AX5GT	3·10*
6B7	0·75
6B8	0·75
6BA6†	0·50*
6BA7	5·12*
6BA8A	3·75
6BC4	3·71
6BE6†	0·45*
6BH6†	1·20*
6BJ6†	1·20*
GBK4	4·21*
6BL6	85·00
6BL7GT	3·86*
6BN8	0·80*
6BQ7A	1·55*
6BR7	4·00*
6BR8†	1·20*
6BS7	4·00*
6BW6	3·75*
6BW7	1·40*
6BX7GT	4·96*
6BZ6	1·78*
6C4†	0·55*
6CB6A†	0·85*
6CD6GA	4·90*
6CG7	1·72*
6CH6	4·42*
6CL6†	0·75*
6CW4	7·24*
6D2†	0·30*
6DK6	2·49*
6DQ6B	3·90*
6EA8	2·21*
6EB8	2·12*
6EW6	0·80*
6F6	0·75
6F23	1·60*
8F28	1·16*
6H2N	0·75*
6H3N	0·75*
6H6	0·75*
6J4†	0·75*
6J6†	0·55*
6J7	0·75*
6K4N	0·75*
6K6GT	0·75*
6K7	0·75*
6K8	0·75*
6KD6	4·79*
6L6G	2·50*
6L6GA	1·50*
6L6GT	0·85*
6L6GC	1·75*
6L7	0·75
6N2P	0·75
6N3P	0·75
6N7	0·75*
6P25	3·60*
6Q7	0·80*
6R7	0·80*
6SA7	0·80*
6SC7	0·80*
6SF7	0·80*
6SH7	0·80*
6SJ7	0·80*
6SK7	0·80*
6SL7GT†	0·70*
6SN7GT†	0·70*
6SQ7	0·75*
6SR7	0·75*
6SS7	0·75*
6U5G	2·00*
6U8†	0·40*
6U8A†	0·55*
6V6GT†	0·65*
6X4†	0·60*
6X5GT†	0·80*
7B7	1·00*
7C5	1·75*
7C6	1·25*
7H7	1·00*
7R7	1·50*
7S7	2·25*
7Y4	0·75*
7Z4	0·75*
12AT6	0·45*
12AT7†	0·50*
12AU6	0·55*
12AU7†	0·45*
12AV6	0·60*
12AV7	2·84*
12AX7†	0·55*
12AY7†	0·82*
12B4A†	1·00*
12BA6	0·50*
12BE6	1·60*
12BH7†	0·60*
12BY7†	0·80*
12E1	7·10
30C15	1·56*
30C17	1·56*
30C18	1·44*
30F5	1·60*
30FL1/2	1·12*
30FL12	1·72*
30FL14	1·44*
30L1	0·84*
30L15	1·72*
30L17	1·72*
30P4	0·92*
30P19	1·12*
30PL1	1·32*
30PL13	1·72*
30PL14	1·68*
30PL15	1·72*
35W4	0·60*
50C5	0·70*
85A2	1·50
90AG	7·26
90AV	7·18
90C1	1·50
90CG	5·74
90CV	13·30
92AG	7·26
92AV	7·16
150B2	1·80
150C2	1·50
150C4	2·30
211	5·00
723AB†	8·00
807†	1·00
811A†	3·80
812A	8·35
813†	10·00
833A	30·00
866A	8·85
872A	13·75
931A	12·24
2050	2·50
5642	5·26*
5654	3·61*
5651	1·80*
5670	2·86*
5814A	2·60*
6080†	5·85*
6146A	5·58*
6146B	4·65
6159	6·00
6442	15·00
6973	3·52
7586	11·38
7587	19·60
7868	3·94*
8068	5·50
8136	2·44

INTEGRATED CIRCUITS

Type	Price
7400	0·20
7401	0·20
7402	0·20
7403	0·20
7404	0·26
7405	0·23
7406	0·55
7407	0·55
7408	0·28
7409	0·28
7410	0·20
7412	0·26
7413	0·45
7416	0·40
7417	0·40
7420	0·20
7422	0·25
7423	0·35
7425	0·35
7427	0·35
7428	0·50
7430	0·20
7432	0·36
7433	0·37
7437	0·42
7438	0·37
7440	0·22
7441AN	0·92
7442	0·78
7447AN	1·20
7450	0·20
7451	0·20
7453	0·20
7454	0·20
7460	0·20
7470	0·35
7472	0·36
7473	0·36
7474	0·40
7475	0·59
7476	0·42
7480	0·60
7482	0·85
7483	1·00
7484	1·00
7486	0·40
7490	0·52
7491AN	0·85
7492	0·60
7493	0·70
7494	0·80
7495	0·80
7496	0·90
7497	3·67
74100	1·75
74107	0·45
74109	0·86
74110	0·57
74111	0·86
74116	1·89
74118	0·95
74119	2·00
74120	1·10
74121	0·45
74122	0·60
74123	1·00
74125	0·80
74126	0·80
74128	0·80
74132	0·80
74136	0·68
74141	0·85
74142	3·00
74143	3·00
74144	3·00
74145	1·00
74147	2·45
74148	2·00
74150	1·75
74151	0·90
74154	2·00
74155	0·90
74156	0·90
74157	0·90
74159	2·50
74170	2·60
74172	5·00
74173	1·75
74174	1·57
74175	1·00
74176	1·10
74178	1·65
74179	1·65
74180	1·65
74190	1·48
74191	1·48
74192	1·25
74193	1·25
74194	1·25
74195	1·10
74196	1·20
74197	1·60
74198	2·25
74199	2·25
76013N	1·75*
LM309K	1·50
TAA570	2·30*
TAA630S	3·50*
TBA480Q	1·84*
TBA520Q	2·30*
TBA530	1·98*
TBA540Q	2·30*
TBA550Q	3·22*
TBA560CQ	3·22*
TBA673	2·19*
TBA700	1·52*
TBA720Q	2·30*
TBA750Q	2·07*
TBA990Q	2·99*
TCA270Q	2·99*
TCA760A	1·38*

DIL Sockets

Type	Price
8 PIN	0·15
14 PIN	0·15
16 PIN	0·17

BASES

Type	Price
BG7 unskirted	0·15
B7G skirted	0·30
B9A unskirted	0·15
B9A skirted	0·30
Int Octal	0·20
Nuvistor base	0·55
Loctal	0·55
8 pin DIL	0·15
14 pin DIL	0·15
16 pin DIL	0·17
Valve screening cans all sizes	0·30

CRT'S

Type	Price
1CP31	31·00
2AP1*	8·50
2BP1*	9·00
3BP1	8·00
3DP1*	5·00
3EG1*	7·00
3FP7*	3·00
3GP1	6·00
3JP1*	8·00
3JP2*	8·00
3JP7*	10·00
3KP1*	15·00
3RP1*	35·00
4EP1	25·00
4EP7	25·00
4EP11	25·00
5ADP1	35·00
5BP1*	10·00
5CP1*	5·00
5CP1A	40·00
5FP15A	5·00
5UP7*	5·00
DG7-5	25·00
DG7-32	36·00
DH3-91	31·00
DH7-11	68·00
VCR97*	5·00
VCR138*	10·00
VCR138A*	12·50
VCR139A*	8·00
VCR517A*	10·00
VCR517B*	6·00
VCR517C*	6·00
Tube Bases	0·75

*=Surplus
VAT 8%

3 BP1 TUBE AVAILABLE FROM STOCK
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E & O.E.

SEMICONDUCTORS POTS & IRONS

SOCKETS

1611	8 pin DIL	£0·13
1612	14 pin DIL	£0·14
1613	16 pin DIL	£0·15
1614	24 pin DIL	£0·40
1615	28 pin DIL	£0·45
1616	TO18 Transistor	£0·12
1617	TU3 Transistor	£0·35
16117	TO5 Transistor	£0·12

VOLTAGE REGULATORS

Positive	
MVR7805 v.a. 7805 TO220	£1·00
MVR7812 v.a. 7812 TO220	£1·00
MVR7815 v.a. 7815 TO220	£1·00
MVR7824 v.a. 7824 TO220	£1·00
Negative	
MVR7905 v.a. 7905 TO220	£1·40
MVR7912 v.a. 7912 TO220	£1·40
MVR7915 v.a. 7915 TO220	£1·40
MVR7924 v.a. 7924 TO220	£1·40
v.a. 723C TO99	45p
72723 14 pin DN	45p
LM309K TO3	£1·50

ZENER DIODES

400mw *(Bzy88) DO7 Glass encapsulated* range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v.
No. Z24 8p ea.

1w-1·6w *Plastic and metal encapsulated* Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v
No. Z13 15p ea.

10w *Metal stud type SO10 case.* Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.
No. Z10 35p ea.

SILICON RECTIFIERS

200mA		
IS920	50v	£0·06
IS921	100v	£0·07
IS922	150v	£0·08
IS923	200v	£0·09
IS924	300v	£0·10
1 Amp		
IN4001	50v	£0·04½
IN4002	100v	£0·05
IN4003	200v	£0·06
IN4004	400v	£0·07
IN4005	600v	£0·08
IN4006	800v	£0·09
IN4007	1000v	£0·10
1·5 Amp		
IS015	50v	£0·09
IS020	100v	£0·10
IS021	200v	£0·11
IS023	400v	£0·13
IS025	600v	£0·41
IS027	800v	£0·16
IS029	1000v	£0·20
IS031	1200v	£0·25
3 Amp		
IN5400	50v	£0·14
IN5401	100v	£0·15
IN5402	200v	£0·16
IN5404	400v	£0·17
IN5405	600v	£0·21
IN5407	800v	£0·25
IN5408	1000v	£0·30
10 Amp		
IS10/50	50v	£0·19
IS10/100	100v	£0·21
IS10/200	200v	£0·23
IS10/400	400v	£0·35
IS10/600	600v	£0·42
IS10/800	800v	£0·51
IS10/1000	1000v	£0·60
IS10/1200	1200v	£0·69
30 Amp		
IS30/50	50v	£0·56
IS30/100	100v	£0·69
IS30/200	200v	£0·93
IS30/400	400v	£1·25
IS30/600	600v	£1·76
IS30/800	800v	£1·94
IS30/1000	1000v	£2·31
IS30/1200	1200v	£2·88
60 Amp		
IS70/50	50v	£0·75
IS70/100	100v	£0·84
IS70/200	200v	£1·80
IS70/400	400v	£1·75
IS70/600	600v	£2·25
IS70/800	800v	£2·50
IS70 1000	1000v	£3·00
BYX38/300 6A	300v	£0·45
BYX38/600 6A	600v	£0·60
BYX38/300 Rev 6A	300v	£0·45
BYX38/600 Rev 6A	600v	£0·60

POTENTIOMETERS

CARBON POTS (Linear Track)

Single gang with wire end terminations, 6mm × 50mm plastic shaft 10mm bushes supplied with shake proof washer & nut. Tolerance ± 20% of resistance.

1831 1k ohms £0·26* 1836 47kohms £0·26*
1832 2k2ohms £0·26* 1837 100kohms £0·26*
1833 4k7ohms £0·26* 1838 220kohms £0·26*
1834 10kohms £0·26* 1839 470kohms £0·26*
1835 22kohms £0·26* 1840 1Meg £0·26*
1841 2M2 £0·26*

CARBON POTS (Log Track)

1842 4k7ohms £0·26* 1846 100kohms £0·26*
1843 10kohms £0·26* 1847 220kohms £0·26*
1844 22kohms £0·26* 1848 470kohms £0·26*
1845 47kohms £0·26* 1849 1Meg £0·26*
1850 2M2 £0·26*

DUAL CARBON POTS (Lin Track)

These high quality dual gang pots are fitted with wire end terminations and 6mm × 50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance ± 20% but matched to within 2db of each other. VC3

1851 4k7 £0·78* 1855 100kohms £0·78*
1852 10kohms £0·78* 1856 220kohms £0·78*
1853 22kohms £0·78* 1857 470kohms £0·78*
1854 100kohms £0·78* 1858 1Meg £0·78*
1859 2M2 £0·78*

DUAL CARBON POTS (Log Law)

1860 4k7ohms £0·78* 1864 100kohms £0·78*
1861 10kohms £0·78* 1865 220kohms £0·78*
1862 22kohms £0·78* 1866 470kohms £0·78*
1863 47kohms £0·78* 1867 Meg £0·78*
1868 2M2 £0·78*

SINGLE GANG SWITCHED (Lin Law)

These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1. Switch rating 1·5amps at 250v AC.

1870 4k7ohms £0·60* 1874 100kohms £0·60*
1871 10kohms £0·60* 1875 220kohms £0·60*
1872 22kohms £0·60* 1876 470kohms £0·60*
1873 47kohms £0·60* 1877 1Meg £0·60*
1878 2M2 £0·60*

SWITCHED POT (Log Track)

Specification as VC2 but track having (log) law.

1879 4k7ohms £0·60* 1883 100kohms £0·60*
1880 10kohms £0·60* 1884 220kohms £0·60*
1881 22kohms £0·60* 1885 470kohms £0·60*
1882 47kohms £0·60* 1886 1Meg £0·60*
1887 2M2 £0·60*

DUAL GANG LOG-ANTI-LOG POT

1888 Track specification as dual gang pots VC3 as above, but tracks mounted to log-anti log action. £0·75*

SPECIAL VOLUME CONTROLS

A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance ± 20% 1/8watt rating.
1889 £0·27* VC8

MINIATURE ROTARY VOL CONTROL

5kohms log law with on/off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.
1890 £0·54* VC9

WIRE WOUND POTS

A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut.
VC6
1891 10ohms £0·80 1895 220ohms £0·80
1892 22ohms £0·80 1896 470ohms £0·80
1893 47ohms £0·80 1897 1kohms £0·80
1894 2 0ohms £0·80 1898 2k2ohms £0·80
1899 4k7ohms £0·80

PRE-SET POTS HORIZONTAL MOUNTING

Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screw driver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2·54mm. All tracks are linear law.
VC7
1801 100ohms £0·08* 1808 22kohms £0·08*
1802 220ohms £0·08* 1809 47kohms £0·08*
1803 470ohms £0·08* 1810 100kohms £0·08*
1804 1kohms £0·08* 1811 220kohms £0·08*
1805 2k2ohms £0·08* 1812 470kohms £0·08*
1806 4k7ohms £0·08* 1813 1Mohms £0·08*
1807 10kohms £0·08* 1814 2M2ohms £0·08*
1815 4M7ohms £0·08*

PRE-SET POTS VERTICAL MOUNTING

Miniature type for transistor circuits. Wiper adjustment is made by a screw driver slot. Designed to fit 2·54mm pitch board. All tracks are linear law.
VC7
1816 100ohms £0·08* 1823 22kohms £0·08*
1817 220ohms £0·08* 1824 47kohms £0·08*
1818 470ohms £0·08* 1825 100kohms £0·08*
1819 1kohms £0·08* 1826 220kohms £0·08*
1820 2k2ohms £0·08* 1827 470kohms £0·08*
1821 4k7ohms £0·08* 1828 1Megohms £0·08
1822 10kohms £0·08* 1829 2M2ohms £0·08
1830 4M7ohms £0·08*

ANTEX IRONS

O/No. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. £3·65

O/No. 1947. Replacement element for 1943 iron. £1·90

O/No. 1944. Iron coated bit 3/32" for 1943 iron. £0·46

O/No. 1945. Iron coated bit 1/8" for 1943 iron. £0·46

O/No. 1946. Iron coated bit 3/16" for 1943 iron. £0·46

O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. £3·40

O/No. 1952. Replacement element for 1948 iron. £1·90

O/No. 1949. Iron coated bit 3/32" for 1948 iron. £0·46

O/No. 1950. Iron coated bit 1/8" for 1948 iron £0·46

O/No. 1951. Iron coated bit 3/16" for 1948 iron. £0·46

O/No. 1931. Highly popular X25 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength. £3·40

O/No. 1935. Replacement element for 1931 iron. £1·60

O/No. 1932. Iron coated bit 1/8" for 1931 iron. £0·50

O/No. 1933. Iron coated bit 3/16" for 1931 iron. £0·50

O/No. 1934. Iron coated bit 3/32" for 1931 iron. £0·50

O/No. 1953. SK1 soldering kit—this kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet 'how to solder'. In presentation display box. £5·30

O/No. 1939. ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring, suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. £1·40

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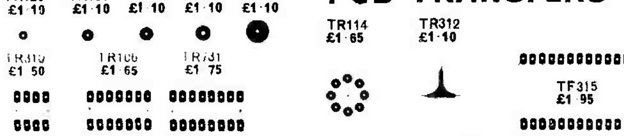
TR310 £1·50 | TR106 £1·65 | TR731 £1·75
TR114 £1·65 | TR312 £1·10
TF315 £1·95



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1505	FLV310 led	2	GREEN	£0·19
1506	FLV410 led	2	YELLOW	£0·19
1510	BDL707 display	3	RED	£0·80
1511	BDL747 display	3	RED	£1·50
1512	BDL727 display	3	RED	£1·80
1514	ORP12 Light dependent resistor			£0·55
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100V RMS	BR2/100	£0·48
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400V RMS	BR2/400	£0·58
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400	THY3A/400	£0·42
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AC117K	£0·34	BC135	£0·15*	BD189	£0·78
AC121	£0·20	BC136	£0·18*	BD190	£0·78
AC122	£0·14	BC137	£0·18*	BD195	£0·90
AC125	£0·18	BC139	£0·32	BD196	£0·90
AC126	£0·18	BC140	£0·30	BD197	£0·95
AC127	£0·18	BC141	£0·26	BD198	£0·95
AC128	£0·18	BC142	£0·22	BD199	£0·99
AC128K	£0·26	BC143	£0·22	BD200	£0·99
AC132	£0·20	BC145	£0·46	BD201	£0·80
AC134	£0·20	BC147	£0·08*	BD202	£0·80
AC137	£0·20	BC148	£0·08*	BD201/202	£1·70
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AC142	£0·20	BC151	£0·22*	BD203/204	£1·70
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AC167	£0·20	BC169	£0·12*	BD236	£0·58
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ACY22	£0·28	BC207	£0·11*	BF157	£0·28
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ACY28	£0·21	BC209	£0·12*	BF159	£0·35*
ACY29	£0·35	BC212	£0·11*	BF160	£0·30*
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ACY31	£0·25	BC213	£0·11*	BF163	£0·30*
ACY34	£0·25	BC213L	£0·11*	BF164	£0·50*
ACY35	£0·25	BC214	£0·12*	BF165	£0·50*
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BC108	£0·08	BD137	£0·35	BFX30	£0·30
BC108A	£0·08	BD138	£0·40	BFX84	£0·22
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BC113	£0·16*	BD176	£0·60	BFY50	£0·18
BC114	£0·16*	BD177	£0·68	BFY51	£0·18
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OC20	£1·85	2N599	£0·46	2N4059	£0·14*
OC22	£1·50	2N696	£0·13	2N4060	£0·14*
OC23	£1·50	2N697	£0·12	2N4061	£0·12*
OC24	£1·35	2N698	£0·12	2N4062	£0·12*
OC25	£1·00	2N699	£0·32	2N4284	£0·18*
OC26	£1·00	2N706	£0·10	2N4285	£0·18*
OC28	£0·80	2N706A	£0·12	2N4286	£0·18*
OC29	£0·95	2N707	£0·48	2N4287	£0·18*
OC35	£0·80	2N708	£0·14	2N4288	£0·18*
OC36	£0·90	2N711	£0·30	2N4289	£0·18*
OC41	£0·20	2N717	£0·30	2N4290	£0·18*
OC42	£0·22	2N718	£0·25	2N4291	£0·18*
OC44	£0·24	2N718A	£0·50	2N4292	£0·18*
OC45	£0·20	2N726	£0·29	2N4292	£0·18*
OC70	£0·24	2N727	£0·29	2N4921	£0·65*
OC71	£0·15	2N743	£0·20	2N4923	£0·65*
OC72	£0·24	2N744	£0·20	2N5135	£0·10*
OC74	£0·26	2N914	£0·15	2N5136	£0·10*
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OC77	£0·50	2N930	£0·18	2N5194	£0·56
OC81	£0·22	2N946	£0·40	2N5245	£0·40
OC81D	£0·24	2N1131	£0·18	2N5294	£0·34
OC82	£0·24	2N1132	£0·18	2N5296	£0·36
OC82D	£0·30	2N1302	£0·15	2N5257	£0·32
OC83	£0·26	2N1303	£0·18	2N5458	£0·32
OC84	£0·38	2N1304	£0·18	2N5459	£0·35
OC139	£1·20	2N1305	£0·18	2N5551	£0·36*
OC140	£1·15	2N1306	£0·25	2N6027	£0·34
OC169	£0·35	2N1307	£0·25	2N6121	£0·70
OC170	£0·35	2N1308	£0·30	2N6122	£0·70
OC171	£0·35	2N1309	£0·30		
OC200	£0·38	2N1599	£0·35	2S301	£0·50
OC201	£0·95	2N1613	£0·20	2S302	£0·43
OC202	£1·20	2N1711	£0·20	2S302A	£0·43
OC203	£0·85	2N1889	£0·45	2S303	£0·56
OC204	£0·90	2N1890	£0·45	2S304	£0·71
OC205	£1·15	2N1893	£0·30	2S305	£0·80
P346A	£0·35	2N2147	£0·75	2S306	£0·80
P397	£0·45	2N2148	£0·70	2S307	£0·80
		2N2160	£1·00	2S321	£0·57
R20008B	£2·50	2N2192	£0·38	2S322	£0·43
R2010B	£2·60	2N2193	£0·38	2S322A	£0·43
		2N2194	£0·38	2S323	£0·57
ST140	£0·15	2N2217	£0·22	2S324	£0·71
ST141	£0·20	2N2218	£0·22	2S325	£0·71
		2N2218A	£0·20	2S326	£0·71
		2N2219	£0·20	2S327	£0·38
TIC44	£0·29*	2N2219A	£0·24		
TIC45	£0·35*	2N2220	£0·20		
TIP29A	£0·40	2N2221	£0·20	40311	£0·38
TIP29B	£0·52	2N2221A	£0·22	40313	£0·95
TIP29C	£0·50	2N2222	£0·20	40316	£0·95
TIP30A	£0·50	2N2222A	£0·20	40317	£0·40
TIP30B	£0·60	2N2368	£0·18	40326	£0·40
TIP30C	£0·60	2N2369	£0·14	40327	£0·45
TIP31A	£0·45	2N2369A	£0·14	40346	£0·45
TIP31B	£0·47	2N2411	£0·25	40347	£0·65
TIP31C	£0·49	2N2412	£0·25	40348	£0·80
TIP32A	£0·49	2N2646	£0·47	40360	£0·36
TIP32B	£0·51	2N2711	£0·22	40361	£0·36
TIP32C	£0·53	2N2712	£0·22	40362	£0·38
TIP41A	£0·49	2N2714	£0·22	40406	£0·45
TIP41B	£0·51	2N2904	£0·18	40407	£0·35
TIP41C	£0·53	2N2904A	£0·21	40408	£0·52
TIP42A	£0·53	2N2905	£0·18	40409	£0·75
TIP42B	£0·55	2N2905A	£0·20	40410	£0·75
TIP42C	£0·57	2N2906	£0·16	40411	£2·76
TIP2955	£0·65	2N2906A	£0·19	40430	£0·95
TIP3055	£0·50	2N2907	£0·20	40476	£1·60
TIS43	£0·24	2N2907A	£0·22	40494	£0·70
TIS90	£0·22*	2N2923	£0·15*	40495	£0·80
		2N2924	£0·15*	40512	£1·35
		2N2925	£0·15*	40594	£0·90
UT46	£0·22	2N2926G	£0·09*	40636	£1·10

74 SERIES TTL IC'S

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
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7401	£0·11	7428	£0·33	7473	£0·25	74107	£0·27	74164	£0·85
7402	£0·11	7430	£0·12	7474	£0·25	74110	£0·45	74165	£0·85
7403	£0·11	7432	£0·22	7475	£0·29	74111	£0·67	74166	£0·95
7404	£0·11	7433	£0·30	7476	£0·25	74118	£0·80	74174	£0·86
7405	£0·11	7437	£0·23	7480	£0·44	74119	£1·18	74175	£0·66
7406	£0·26	7438	£0·23	7481	£0·85	74121	£0·24	74176	£0·74
7407	£0·27	7440	£0·12	7482	£0·68	74122	£0·39	74177	£0·75
7408	£0·13	7441	£0·50	7483	£0·70	74123	£0·46	74180	£0·84
7409	£0·13	7442	£0·54	7484	£0·88	74141	£0·74	74181	£1·60
7410	£0·12	7443	£1·88	7485	£1·25	74136	£0·55	74182	£0·74
7411	£0·17	7444	£1·88	7486	£1·95	74145	£0·62	74184	£1·18
7412	£0·20	7445	£0·65	7489	£2·32	74150	£0·95	74190	£1·00
7413	£0·24	7446	£0·65	7490	£0·64	74151	£0·58	74191	£1·00
7414	£0·50	7447	£0·65	7491	£0·37	74153	£0·58	74192	£0·95
7416	£0·26	7448	£0·60	7492	£0·30	74154	£0·95	74193	£1·00
7417	£0·26	7450	£0·56	7493	£0·75	74155	£0·60	74194	£0·89
7420	£0·12	7451	£0·12	7494	£0·80	74156	£0·60	74195	£0·82
7421	£0·20	7453	£0·12	7495	£0·62	74157	£0·60	74196	£0·88
7422	£0·16	7454	£0·12	7496	£0·92	74160	£0·78	74197	£0·85
7423	£0·23								
7425	£0·19	7460	£0·12	74100	£1·00	74161	£0·78	74198	£1·45
7426	£0·23	7470	£0·25	74104	£0·39	74162	£0·78	74199	£1·45

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Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
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CD4001	£0·18	CD4016	£0·50	CD4027	£0·60	CD4044	£0·94	CD4071	£0·23
CD4002	£0·18	CD4017	£0·98	CD4028	£0·98	CD4045	£1·49	CD4072	£0·23
CD4006	£0·98	CD4018	£1·00	CD4029	£1·15	CD4046	£1·30	CD4081	£0·20
CD4007	£0·18	CD4019	£0·55	CD4030	£0·55	CD4047	£1·10	CD4082	£0·23
CD4008	£0·98	CD4020	£1·10	CD4031	£2·20	CD4049	£0·55	CD4510	£1·30
CD4009	£0·58	CD4021	£0·98	CD4035	£1·30	CD4050	£0·55	CD4511	£1·50
CD4010	£0·58	CD4022	£0·90	CD4037	£0·95	CD4054	£1·10	CD4516	£1·40
CD4011	£0·20	CD4023	£0·20	CD4040	£0·95	CD4055	£1·40	CD4518	£1·25
CD4012	£0·20	CD4024	£0·80	CD4041	£0·80	CD4056	£1·35	CD4520	£1·25
CD4013	£0·52	CD4025	£0·20	CD4042	£0·82	CD4069	£0·40		

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£1·05*	LM301	£0·39*	MC1456	£1·40*	72709	£0·46*	SN76110	£1·50*
CA3014	£1·70*	LM304	£1·60	MC1466	£4·50	709P	£0·25*	SN76115	£1·90*
CA3018	£0·75*	LM308	£1·46*	MC1469	£2·95	UA710C	£0·40*	SN76660	£0·75*
CA3020	£1·70*	LM309	£1·50	MC1496	£0·98*	74710	£0·30*	SL414A	£1·95*
CA3028	£1·02*	LM320-5v	£1·50	NE536	£3·50*	UA711C	£0·32*	TAA550B	£0·35
CA3035	£1·70*	LM320-12v	£1·50	NE515	£3·50*	72711	£0·32*		
CA3036	£1·35*	LM320-15v	£1·50	NE540	£1·50*	UA723C	£0·45	TAA621A	£2·00*
CA3042	£1·50*	LM320-24v	£1·50	NE550	£0·95	72723	£0·45		
CA3043	£1·85*	LM380	£0·85*	NE555	£0·32	UA741C	£0·24*	TAA621B	£2·50*
CA3046	£0·80*	LM381	£1·55*	NE556	£0·82	72741	£0·24*		
CA3052	£1·60*	LM3900	£0·65*	NE561	£3·55*	741P	£0·20*	TAA661	£1·65*
CA3054	£1·35*	MC1303L	£1·48*	NE562	£3·95*	UA747C	£0·70*	TAD100	£1·30*
CA3075	£1·50*	MC1304	£1·90*	NE565	£1·75*	72747	£0·79*	TBA540	£2·20*
CA3081	£1·50*	MC1310	£0·95*	NE566	£1·50*	UA748	£0·35*	TBA800	£0·80*
CA3089	£2·16*	MC1312	£1·90*	NE567	£1·80*	72748	£0·35*	TBA810	£1·05*
CA3090	£4·25*	MC1330	£1·20*	UA702C	£0·46*	748P	£0·35*	TBA820	£0·80*
CA3123	£1·90*	MC1350	£1·20*	72702	£0·46*	SN76013N	£1·75*	TBA920	£3·40*
CA3130	£0·93	MC1351	£1·20*	UA703	£0·25*	SN76023	£1·75*	TCA270S	£2·20*
CA3140	£0·90	MC1352	£1·40*	UA709	£0·25*				

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
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AA120	£0·08	BB104	£0·15	BY133	£0·21*	OA5	£0·60	OA202	£0·08
AA129	£0·08	BAX13	£0·07	BY164	£0·51	OA10	£0·35	SD10	£0·06
AAY30	£0·09	BAX16	£0·08	BY176	£0·75*	OA47	£0·08	SD19	£0·06
AAZ13	£0·15	BY100	£0·22	BY206	£0·30	OA70	£0·08	IN34	£0·07
AAZ17	£0·15	BY101	£0·22	BYZ10	£0·45	OA79	£0·13	IN34A	£0·07
BA100	£0·10	BY105	£0·22	BYZ11	£0·45	OA81	£0·13	IN914	£0·05
BA102	£0·32	BY114	£0·22	BYZ12	£0·45	OA85	£0·13	IN916	£0·06
BA148	£0·15	BY124	£0·22*	BYZ13	£0·40	OA90	£0·07		
BA154	£0·12	BY126	£0·15*	BYZ15	£0·41	OA91	£0·07	IS148	£0·08
BA155	£0·14	BY127	£0·16*	BYZ17	£0·36	OA95	£0·07	IS44	£0·05
BA156	£0·14	BY128	£0·16	BYZ18	£0·36	OA182	£0·13	IS920	£0·06

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400	TR12a/400	£0·71	400	TR100a/400	£1·12

6 Amp Volts	TO66 Case No.	Price	10 Amp Volts	TO220 Plastic Case No.	Price
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200	TR16a/200	£0·61			
400	TR16a/400	£0·77			

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Chicken & Egg

NEW developments in electronics tend to fall broadly into two categories. Some appear to be the result of someone saying "Here's an idea or an i.c. that will do something that's never been possible before—what can we use it for? The results are often rather gimmicky and pointless and remind me of a course in "Design" which I attended a few years back. There, each project team was given a portable videotape recorder and camera and told to go out and find something to record. A definite case of a means looking for an application.

Other new pieces of equipment seem to announce that their designers have done a tremendous amount of research into what people need, and then proceeded to pack the maximum facilities possible into the product.

Happily there were several examples of the latter type among new items on display at the recent round of London radio and TV trade shows. Perhaps it is a little unfair to mention some without mentioning all, but two particularly took my fancy. From Ferguson somes a clock radio which they have nicknamed (with some justification) "The Great Little Time Machine". This has two time zone settings (BST and GMT?), two alarm time settings (husband and wife?), day and month calendar, forward and reverse setting facility (no more advancing 23½ hours to achieve a half-hour earlier call) and Long, Medium and v.h.f. bands, (ready for the new frequency plan in November). Add to this all the usual facilities and the bonus of auto-dimming of the clock display and you have a very handy item for the bedside table.

Those of you who have ever caught the end of a radio announcement and thought "That sounded as if it could be of interest, I wonder what it was", may find their salvation in a fascinating new system by Intermetall Semiconductors of the ITT group. Based on "bucket-brigade" i.c.s., this continuously stores the last 15 seconds or so of a sound transmission, which may be repeated at the press of a button. So that subsequent announcements are not missed, the recorded speech is compressed in time by removing pauses between words. This process continues until the replayed speech catches up with real time and then normal speech is resumed. Altogether very cunning, and a delightful example of someone recognising that a new technique could be adopted to solve an age-old problem!

Geoffrey C. Arnold

PRINTED CIRCUIT BOARDS SERVICE FOR *PW* PROJECTS

It has now been decided, commencing with our issue dated September 1978, to enlarge the facilities for the supply of p.c.b.s to readers by authorising additional suppliers. It is hoped that readers may benefit from being able to purchase boards as part of component kits, thereby reducing the number of separate orders for a project.

For some time, most p.c.b.s published in *Practical Wireless* have been available exclusively from Reader's PCB Services Ltd., P.O. Box 11, Worksop, Notts. who will continue to be a supplier and to whom we would wish to say thank you for helping us to get the service started.

Applications for permission to reproduce boards for resale purposes must be made to the editor.

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

RAE

The Mid-Warwickshire College of Further Education notify us that they will be offering the City & Guilds, RAE Course No. 765 in September 1978.

Enrolment will be on September 7th and 8th. The course will be one evening each week for approximately 30 weeks and is intended to prepare students for examination No. 765-1-02. *Mid-Warwickshire College of Further Education, Department of Engineering, Warwick New Road, Leamington Spa CV32 5JE. Tel: (0926) 311711.*

Hello Thistle

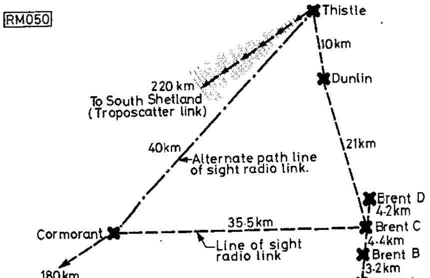
North Sea oilmen in the Brent oilfield will soon be able to telephone each other thanks to new equipment now being installed by Marconi engineers.

Shell (UK) Ltd placed a contract worth over £300,000 with Marconi Communications Ltd, a GEC-Marconi Electronics company, for the installation of radio equipment that will establish a communications link between offshore stations, and also back to the mainland.

Phase one of the contract will be to link Dunlin and Brent A, B and D by line-of-sight radio equipment and also to connect Dunlin to BNOC's Thistle platform, Thistle having a troposcatter terminal relaying back to the new Post Office terminal in South Shetland. Phase two will connect Brent C and Cormorant into the system and establish a line-of-sight microwave link between Cormorant and Thistle.

Finally, there will also be a troposcatter link from Cormorant to South Shetland and the line-of-sight microwave link between this platform and Thistle will complete the triangulation for alternate path operation.

RM050



Computer Clubs

I am informed of the existence of two northern sub-groups of the Amateur Computer Club, whose object is to help anyone who has an interest in computers, microprocessors etc.

For details of joining the groups those in the North East should contact: *Thomas Turnbull, 49×9th Row, Ashington, Northumberland NE63 8JY,* and those in the North West: *David Wade, 26 Wolsey Close, Radcliffe, Manchester M26 0AG.*

Special Event

Yeovil Amateur Radio Club will be running a special event station for Air Day at RNAS Yeovilton, Somerset on Saturday 5th August. Call-sign GB3FAA. For further information contact: *John Howard, 127 Goldcroft, Yeovil, Somerset BA21 4DD.*

Diary notes

The Telford Mobile Rally Group are organising a rally for radio amateurs at Town Centre Malls of Telford, New Town, Salop, on Sunday 10th September, 1978—starting at 11am. There will be many trade stands and exhibits. Details from: *Martyn Vincent G3UKV, 9 Sleapford, Long Lane, Telford, Salop.*

The British Amateur Electronics Club are holding their Amateur Electronics Exhibition this year at the Centre of the Esplanade, Penarth, S. Glamorgan, between 15th and 22nd July 1978. As before all proceeds will be given to the Cancer Research Campaign. Further information from: *Cyril Bogod, "Dickens", 26 Forrest Road, Penarth, Glam.*

The British Amateur Radio Teleprinter Group is holding its annual convention at Harpenden Public Hall, Harpenden, Herts. on Saturday 15th July, 1978—starting at 11am. There will be trade stalls, demonstrations and lectures, including one on Microprocessors by G3PLX, which is expected to attract particular attention. Details from: *J. P. G. Jones GW3IGG, Heywood, 40 Lower Quay Road, Hook, Haverfordwest, Dyfed SA62 4LR.*

The 1978 Harrogate International Festival of Sound is to be held at The Harrogate Exhibition Centre, Harrogate. The public are invited on Saturday 19th and Sunday 20th August from 11.00am until 9.00pm and admission will be free of charge. Trade days are Monday 21st and Tuesday 22nd August, when admission will be by ticket, available from the organisers in a special dealer invitation pack. Further information from *Stan Smith and Peter Hainsworth of: Exhibition and Conference Services Ltd., Claremont House, Victoria Avenue, Harrogate, North Yorkshire. Tel: (0423) 62677.*

Microprocessor terminal

Soon to be launched on the home market is the SR100 series Minitype computer terminal from Warren Logic Ltd.

Designed specifically as a low cost teletype or v.d.t. replacement, it is expected to cost less than £300.

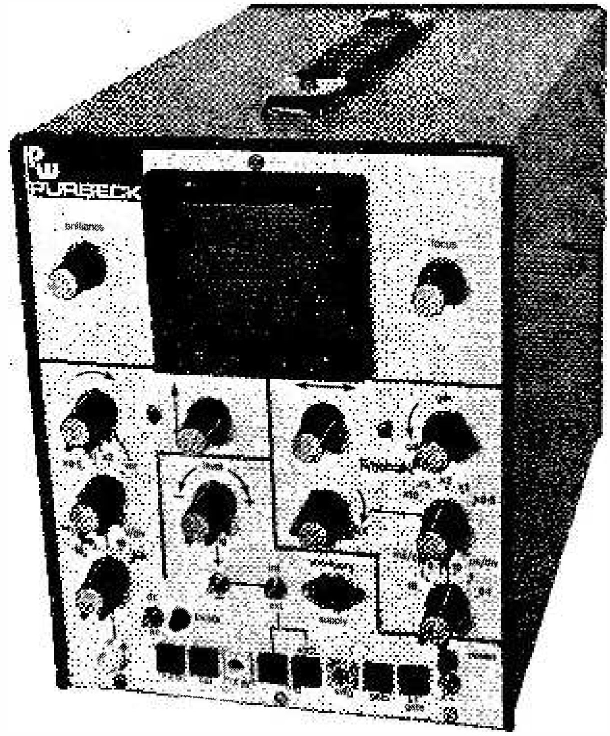
A teletype compatible keyboard with full ASCII capabilities is used. The display section consists of fifteen alphanumeric sixteen segment l.e.d. elements which utilize a sixty-four character ASCII subset. The On-Line mode of operation is full duplex and a local facility is also provided. Both E.I.A. and 20mA current loop operation are standard and any baud rate between 50 and 240 baud may be selected by an eight pin d.i.l. module.

For further details contact: *Warren Logic Ltd., Hockley Road, Brosley, Salop, TF12 5HT. Tel: (0952) 883010.*

PW "Avon"

Those constructors of the "Avon" 2m Transmitter, who intend purchasing transistor types 2N4427 and BLY83 from Watford Electronics should note that the prices quoted in their advertisement are wrong. The correct prices for these transistors are: 2N4427 90p plus 8% VAT and BLY83 £8·50 plus 8% VAT.

PW 'purbeck'



Part 5

OSCILLOSCOPE

IAN HICKMAN

This month's instalment deals with the trigger circuits, timebase generator and X output amplifier, all contained on board 4. Figs. 2 and 4 show the component and wiring side of the board and Fig. 1 gives the complete circuit diagram.

The trigger input (either from front panel SKT5 or 6 or from the trigger pick-off stage of the Y amplifier board) is first buffered, amplified and squared up and then passed to a polarity selector gate IC403a which inverts it or not under control or front panel switch 85.

So now we have a squared-up waveform at standard TTL logic levels applied to trigger gate IC402d.

Let's assume the time base hasn't been triggered for some time, so that flyback is complete. Then the output of the control bistable will be a logic 0 (about +0·2V) and the emitter of Tr406 will be negative by a few hundred millivolts.

As the current through its emitter resistor always exceeds the current supplied by the constant current generator Tr404, diode D404 will hold C12 at about 0V and the inverting input of the end-of-flyback comparator IC406 will be slightly negative. IC406 will therefore apply a logic 1 (about +3·8V) to the trigger gate.

The control bistable IC404a is positive edge triggered. Therefore when the output from IC403a goes negative, causing the output of the 2 input nand gate IC402 to go positive, IC404a's Q output will go to a logic 1. D404 will therefore be cut off and the constant current source will start to charge up C12 linearly.

Meanwhile, once triggered, further edges will have no effect on the control bistable and anyway, shortly after the start of the scan, the inverting input of IC406 will go positive, putting a logic 0 on IC402d. The latter's output will therefore sit at logic 1 until the end of retrace (flyback). When the scan reaches +3V, the output of IC405 will change from a logic 1 to logic 0, resetting IC404a. The Q output will therefore fall to 0V, cutting off Tr406, the whole of the current through R429 then being available to charge C12 back down negative.

As soon as the recharge commences, of course, the output of IC405 returns to a logic 1, removing the reset from IC404a.

However, not until the end of flyback will IC406 re-enable IC402d by applying a logic 1 to it, preventing early retriggering of the scan. It doesn't matter whether IC403a output is positive or negative when IC406 re-enables trigger gate IC402d, either way the first edge out of the latter will be negative going.

The control bistable will only be retriggered on a positive edge, i.e. on the first negative edge from IC403a following the appearance at IC402d of a logic 1 from end-of-flyback comparator IC406.

With a basic understanding of the circuit operation, we can now look in more detail at the complete circuit diagram. Emitter follower Tr401 drives the trigger amplifier IC401 via two 150Ω resistors in

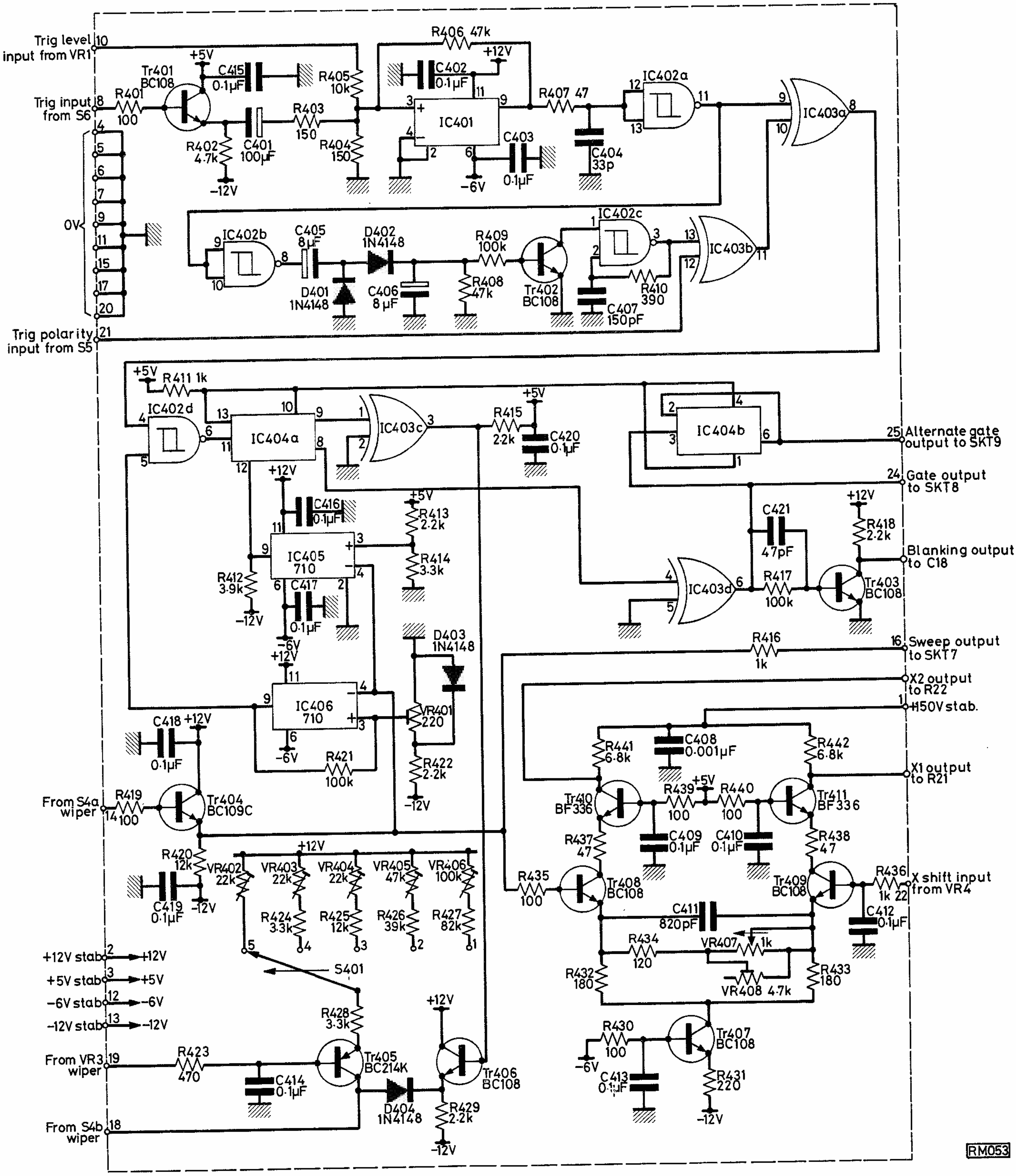


Fig. 1: The circuit diagram of the trigger circuits, timebase generator and X output amplifier, all on board 4

series, providing a low source impedance.

At their junction a current injected via R405 provides a variable offset voltage at pin 3, giving control of the trigger level. The gain and bandwidth of the 710 are so great that despite the low source impedance there is a possibility of oscillation as a low frequency input is passing through the triggering point.

This would lead to false triggering and is prevented by applying a small amount of positive feedback via R406, thus introducing a small hysteresis. The output of IC401 drives IC402a, a two input nand Schmitt trigger circuit used as a buffer. The 710 will only drive one standard TTL load and so cannot drive both IC402b and IC403a directly.

The sudden change in loading on the 710 when IC402a switches can cause the 710 to retrigger falsely. This is prevented by the retardation network R407, C404.

The brightline circuit IC402b to IC403b works as follows. If IC402a is producing a squared-up trigger waveform, the output of IC402b will be detected by D401 and 402, charging C406 up positive. Current through R409 will keep Tr402 bottomed and the output of IC402c must therefore remain permanently high (logic 1). If the other input of exclusive or gate C403b is low, its output will be high. Under these conditions the output of IC403a will be an inverted version of its input. Conversely, if pin 12 of IC403b is high, IC403a output will not be inverted. This provides trigger polarity selection.

If there is no trigger input to the board or RV1 is right at either end of its travel, IC402a output will sit permanently at either a logic 0 or a 1. With no a.c. output from IC402b for the diodes to detect, after about a second, C406 will be discharged and Tr402 will turn off.

With pin 1 now high, IC402c will oscillate, since if its output is high, C407 will charge up via R410 until pin 2 reaches the trigger point and the output drops to a 0 and conversely. As IC403a and b are exclusive-or gates, the output must change whenever one of the inputs changes.

The square wave generated by IC402c will thus be passed to the trigger gate IC402d, operating the timebase and providing a trace when there is no trigger available.

If the square wave produced by Tr402c were of a very low frequency, on the fast time-base setting a very rapid scan would be followed by a much longer pause before retriggering.

This would result in a very dim trace. IC402c therefore oscillates at a very high frequency, giving a non-triggered trace brightness independent of time-base speed setting.

Note that IC402c output could have been taken straight to pin 10 of IC403a and IC403b inserted between the latter and IC402d.

However, mixing the polarity control in with IC402c "off line" minimises the number of gate delays in the main trigger path. This in turn enables more of the leading edge of a wave form to be seen.

The basic operation of the ramp generator section has already been described, but there are several points of detail worth noting. The D input, pin 13, of IC404a is tied to +5V, i.e. logical. Therefore the "Q" output, pin 9, will go high when a positive edge appears at pin 11. IC403c is a non-inverting buffer and the pull-up resistor R415 takes its output right up to +5V when high, taking the emitter of Tr406 to about +4·4V.

The end of trace comparator IC405 resets the control bistable when the ramp reaches +3V, so there is no danger of D404 tending to turn on before the end of the ramp. VR401 is set so the end-of-flyback comparator only re-enables the trigger gate when the ramp voltage is within a per cent or so of the value at which it would rest if IC404a was never triggered.

★ components

Resistors

¼W 5% carbon film

47Ω	2	R407, 437, 438
100Ω	6	R401, 419, 430, 435, 439, 440
120Ω	1	R434
150Ω	2	R403, 404
180Ω	2	R432, 433
220Ω	1	R431
390Ω	1	R410
470Ω	1	R423
1kΩ	3	R411, 416, 436
2·2kΩ	5	R413, 415, 418, 422, 429
3·3kΩ	3	R414, 424, 428
3·9kΩ	1	R412
4·7kΩ	1	R402
10kΩ	1	R405
12kΩ	2	R420, 425
39kΩ	1	R426
47kΩ	2	R406, 408
82kΩ	1	R427
100kΩ	3	R409, 417, 421

5W Wire Wound

6·8kΩ	2	R441, 442

Potentiometers

Miniature vertical skeleton preset

220Ω	1	VR401
4·7kΩ	1	VR408
22kΩ	3	VR402, 403, 404
47kΩ	1	VR405
100kΩ	1	VR406

¼ inch diameter spindle

1kΩ	1	VR407

Capacitors

Ceramic

33pF	1	C404
47pF	1	C421
150pF	1	C407
820pF	1	C411
1nF (500V)	1	C408

30V disc ceramic

0·1μf	13	C402, 403, 409, 410, 412, 413, 414, 415, 416, 417, 418, 419, 420

Electrolytic

8μF 16V	2	C405, 406
100μF 10V	1	C401

Semiconductors

Diodes

1N4148	4	D401, 402, 403, 404

Transistors

BC108	7	Tr401, 402, 403, 406, 407, 408, 409
BC109C	1	Tr404
BC214K	1	Tr405
BF336	2	Tr410, 411

Integrated circuits

SN72710	3	IC401, 405, 406
SN7474	1	IC404
SN7486	1	IC403
SN74132	1	IC402

Switches

1p. 6w.	1	S401

Miscellaneous

Printed circuit board (1) (Watford Electronics)
Test pins and sockets (3)

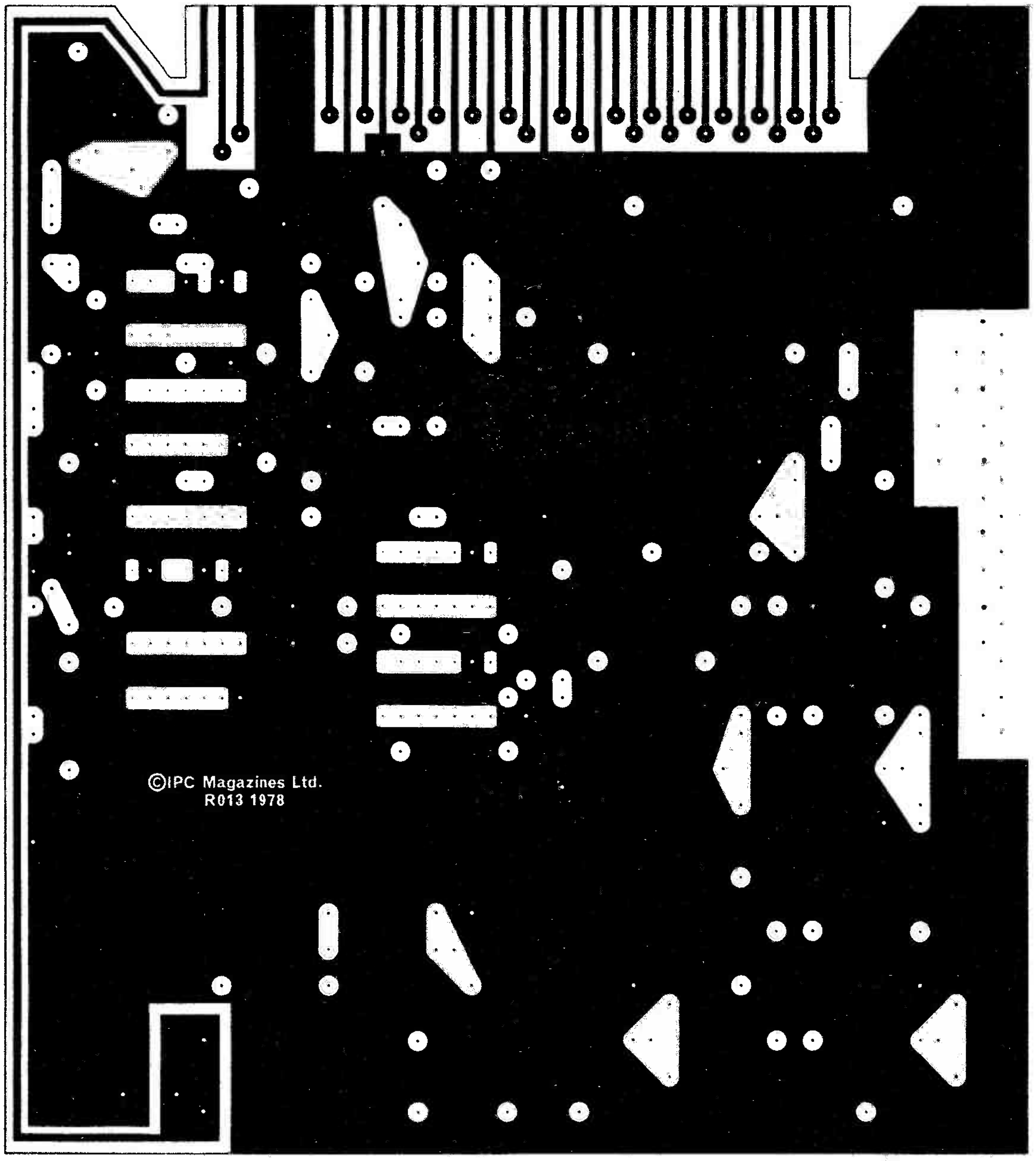


Fig. 3: The copper ground plane pattern of board 4

and 1 on alternate traces. IC403d also drives Tr403, which is cut off during the scan and bottomed during retrace. The collector wave-form is used to blank the c.r.t. during flyback.

Besides driving the comparators IC405 and 406, emitter follower Tr404 makes the ramp wave form available at SKT 7 (sweep output) via R416 and drives the X deflection amplifier.

This is basically similar to the Y deflection amplifier, but driven unbalanced at Tr408 with the X shift voltage fed in at Tr409.

In view of the more limited frequency response which suffices for the X amplifier, a single frequency compensation capacitor C411 is used in the emitter circuit. The Calibrated position for VR407 is fully anticlockwise, corresponding to minimum gain. RV408 allows this value of gain to be set to the required value.

WARNING
Extra care must be taken when working on any part of this instrument while power is switched on. 1100 volts can kill. When delving into the insides of the scope for any reason with power on keep one hand in your pocket.

Owing to the larger deflection voltage required for the X plates, the collector resistors of TR410 and 411 are returned directly to +150V.

With a higher supply voltage than the Y amplifier, the current is reduced, about 10mA in each transistor, to keep the dissipation of the BF336s the same.

Having completed the construction of Board 4, check each power supply pin to 0V with an ohmmeter to make sure none is short circuit and centre all preset potentiometers except VR401, which should be set with the wiper at the earthy end. Set VR407 fully anticlockwise.

Plug the board into the mainframe, remove the temporary 47kΩ and 100kΩ resistor chain and con-

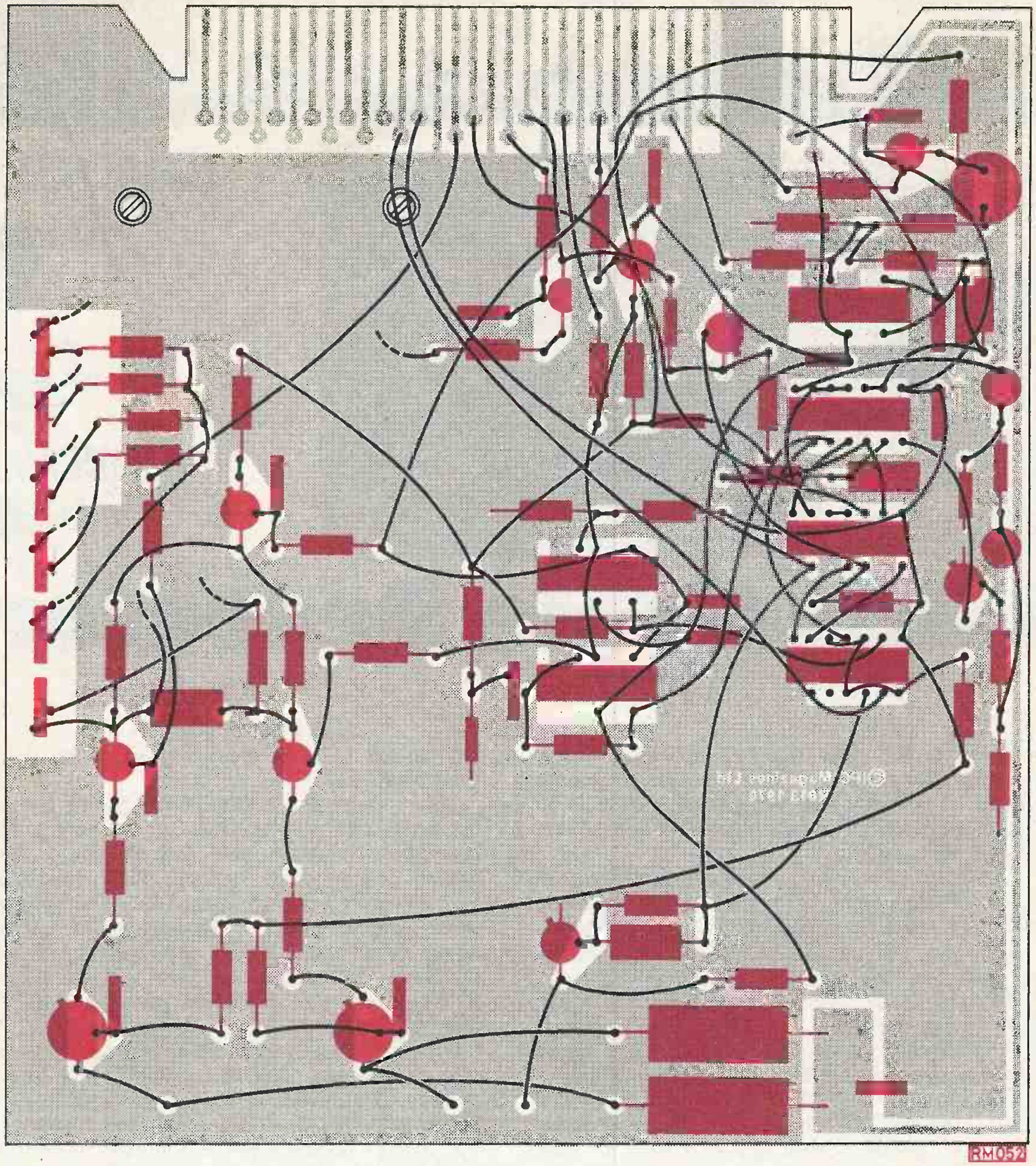


Fig. 4: Back wiring of board 4 in relation to the components. This layout of the wiring should be followed to avoid any possibility of instability occurring

nect the X plates via R21 and R22 and sockets to pins X1 and X2 of the board.

Connect one lead of C18 to c.r.t. pin 3 (one of the tube base mounting holes—which are not used—can be fitted with a solder tag to support the lead) and the other via a socket to the blanking output of the board.

Set RV3 fully clockwise, S4 to position 2 and S401 to position 5. Plug in briefly and check that all stabilised supply voltages are normal, indicating no shorts anywhere.

A trace should appear on the screen—the tube may need rotating a little if it is not horizontal, but the spigot should be somewhere near the top. It is safest to turn off first, remember there is −800V around! Next, set S401 to position 2 and connect SKT3 to SKT1. With S3 and S301 both in position 3, two or three cycles of the 50Hz Cal. square wave should appear on the screen.

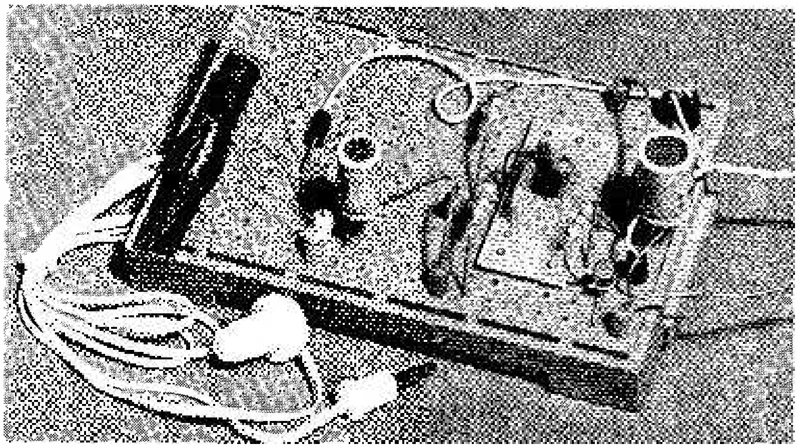
If the waveform is running through, adjusting RV1 should synchronise it, provided of course that S6 is in the Internal position.

The trace should start with a positive or with a negative edge according to the position of S5. Now set S401, Timebase Multiplier, to position 5 (X 0·5). Rotate the wiper of RV401 away from the earthy end of its track until the trace stops running and then set it back just a few degrees beyond the point where the trace starts to run again.

These tests show that Board 4 is basically operational; setting up is covered in next month's instalment.

Next month we will deal with the case and other mechanical details.

μ-DeCnology



DAVID GIBSON

5

THIS MONTH

'Mains Cable Detector'

This month's circuit uses the 741 op. amp. in a closed loop inverting mode to form a sensitive mains cable detector. A simple but very useful device it can save certain disaster when deciding where to bang nails, etc., into walls.

When a.c. mains current flows in a conductor there is a magnetic/electric field surrounding the conductor, albeit a very weak field. If this field comes within range of our search coil (L1) then the fluctuating 50Hz field from the conductor will induce tiny voltages and currents in the coil L1. These can be quite clearly heard in the earpiece.

On test, the circuit shown could easily and positively detect the presence of a mains cable to a small Ni Cad battery charger laid on a bench at a distance of 12 inches. A simple, small bar magnet could also be 'heard' when passed within some 3 to 4 inches of the search coil.

The complete circuit of the mains cable detector is shown in Fig. 1, it can be built on a μDeC in less than 15 minutes and takes only 20 minutes to transfer to a piece of matching Blob Board. The inverting closed loop amplifier IC1 has its output fed to C3. By connecting the earpiece recommended between the positive plate of C3 and the negative line the circuit will function well, although it would be wise to reverse the polarity of C3 if this circuit configuration is settled as permanent. In Fig. 1 an additional stage of amplification is afforded by the addition of only two components, R4 and Tr1.

The total measured current drawn by the circuit with 3V applied was only 0·6mA and battery life should be very long indeed if the device is used intermittently. A magnetic microphone was tried as a small loudspeaker in place of the earpiece. This worked well but increased the current drawn to 1·4mA. The microphone had an impedance of 300Ω. Note that a lower impedance should not be used and that small 8Ω loudspeakers would be unsuitable in the circuit as shown.

The value of C2 should be found by experiment for optimum results. This is extremely simple with the μDeC because one simply 'plugs in' different values of capacitor in turn. The capacitance shown will work well but various values from 10pF to 0·1μF were tried. In general, the best value will lie between about 80pF and 350pF. The effect of adding this capacitor across the feedback resistor R3 is to make it frequency conscious and to attenuate the higher frequencies.

This is sensible for two reasons. Firstly we are only interested in 50Hz, which is a very low frequency. Secondly, without this capacitor the circuit becomes a h.n.c. circuit (Horrible Noise Oscillator!). The values of the input and output capacitors C1 and C3 are not all critical. Low values were selected because they would present less resistance/impedance to the lower frequency of interest. However, even using 0·1μF in each case still gave excellent results.

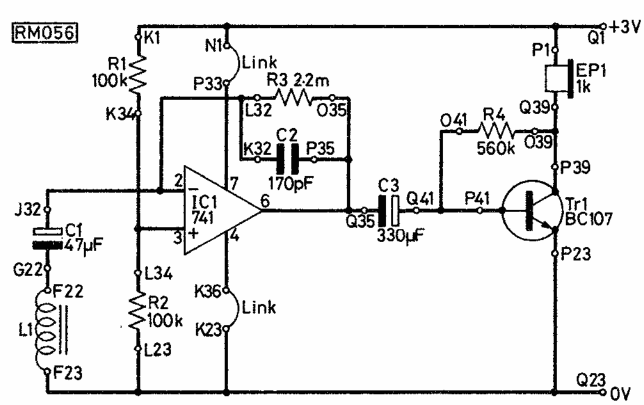


Fig. 1: Circuit diagram of the cable detector

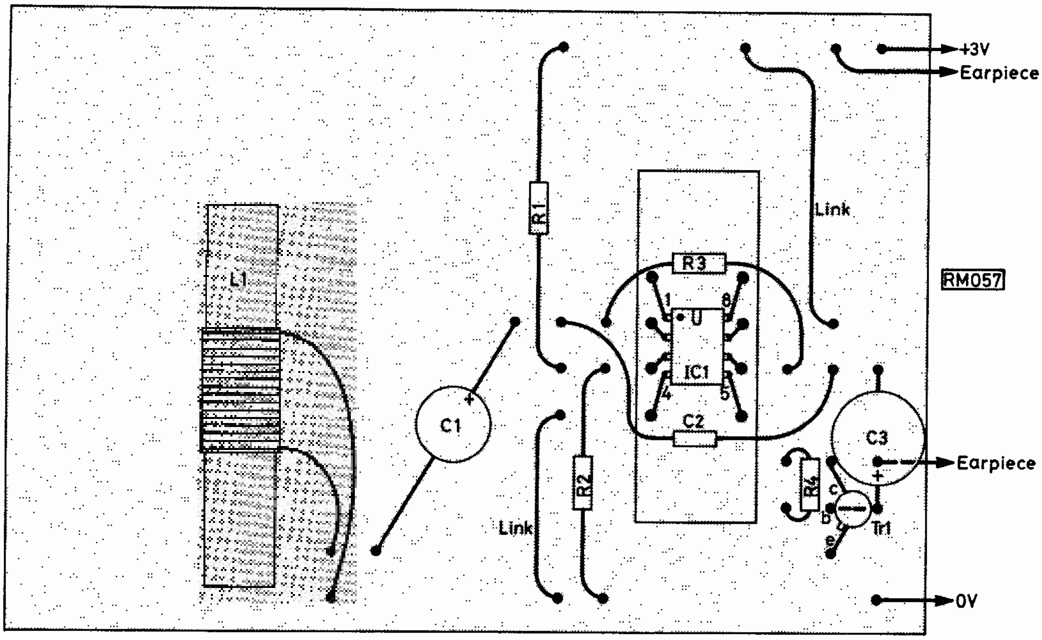


Fig. 2: Layout of the mains cable detector on a μDeC. The same layout can be used to build the circuit permanently on a matching Blob Board

The search coil L1 was simply an old relay. The contacts connections were ignored. The one used was a midget 700Ω type, but almost any kind should work well. For the constructionally-minded a few hundred turns of, say, 30 s.w.g. enamelled copper wire wound higgledy-piggledy on a 2 inch piece of ferrite rod (any diameter) should also work.

The circuit might also be used as a telephone amplifier. This can be useful where you might require another person to listen to a conversation. One of the small telephone pick-up devices with a little rubber sucker may be plugged in directly in place of L1. The telephone pick-up could also double as the search coil for the cable detector operation.

Sensitivity of the circuit can be damped by reducing the value of R3 to 820kΩ. Experimenters might like to insert a potentiometer in place of R3. Connect the outer tags on the potentiometer to μDeC holes L32 and 035 (i.e. in place of R3), and connect the middle tag to either of the others. It is suggested that a 1MΩ potentiometer be used.

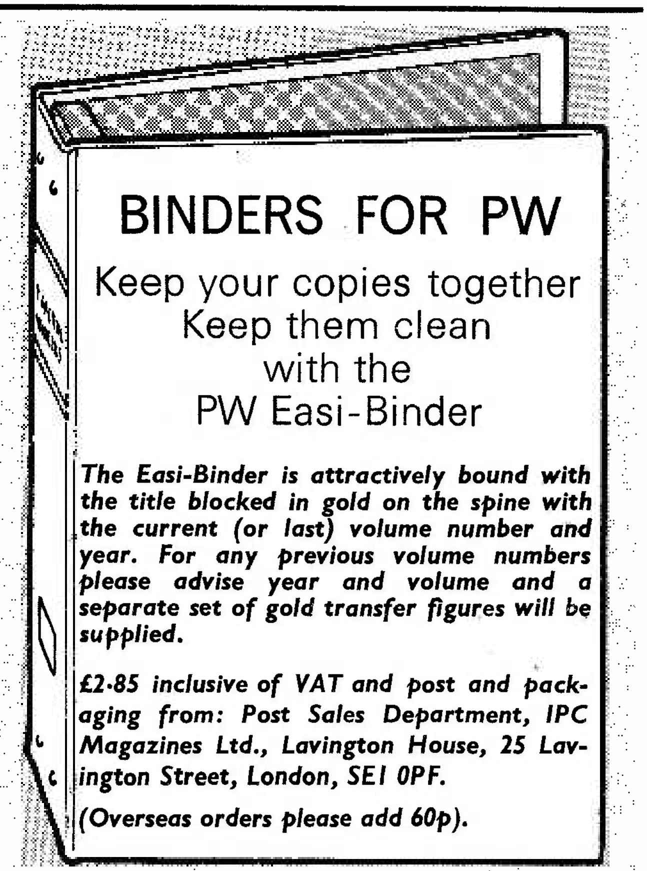
For best results, the earpiece should be an Acos red spot 1kΩ type. All others tried were found to be inferior in terms of sensitivity. A crystal microphone was also tried in place of the earpiece and this worked tolerably well provided that a 560kΩ resistor was wired in parallel with it to provide a d.c. path for the collector of Tr1.

If (like the writer) a permanent circuit is required, the device could be transferred to a matching piece of Blob Board and the components then soldered into position. The Blob Board is then stuck directly to the inner wall of the case using a generous blob of Bostick to its plain side. You will also need an on/off switch—not shown in Fig. 1, the search coil should be mounted inside the case for protection and two small (3mm) holes drilled just above the coil and in both sides of the box.

When using the device, the wall is swept for maximum pick up. A long knitting needle is then pushed gently through both holes and the container drawn away up the knitting needle to reveal a locating point. This can then be marked lightly with a pencil and a further sweep made to trace the cable. ●

★ components

R1	100kΩ	IC1	741 op amp (8-pin DIL)
R2	100kΩ	Tr1	BC107
R3	2·2MΩ	L1	relay coil 700Ω
R4	560kΩ	EP1	earpiece Acos red spot 1kΩ
C1	47μF		μDeC
C2	170pF		μDeC jumper leads
C3	330μF		3V battery



Introduction to LOGIC ~ 2

S.A. MONEY

Last month we started our exploration of digital logic by examining the characteristics of digital signals and the AND gate circuit. In a real logic system the AND type gate alone will not allow us to perform all of the operations that we might need. Obviously we shall need some other types of logic gate if we are to produce a logic system.

The OR Gate

Let's go back to our simple electrical lamp and switch circuit. This time however, instead of having the two switches connected in series, we shall have them in parallel as shown in Fig. 9. Now we have produced a different type of logic gate function. Here the lamp will light if either of the switches is closed. In logical terms, the output is *1* when input A OR B is at *1*. As one might expect, this type of gate is called an OR gate.

We can of course make up an OR gate by using discrete diodes, using the circuit shown in Fig. 10. If we compare this with a diode AND gate, we see that it is in effect an AND gate which has been turned upside down whilst the diodes have had their polarity reversed.

If input A goes to *1* diode D1 conducts and pulls the output up to *1* by driving current through resistor R. Input B will have the same effect upon the output. Only if both A and B inputs are at *0* will both diodes turn off to leave the output at the *0* level.

We can now draw up a truth table to show the various logic states that can exist in a 2-input OR gate (Table 3).

Table 3

Input A	Input B	Output Y
0	0	0
1	0	1
0	1	1
1	1	1

In fact the OR gate is effectively complementary to the AND gate. For an AND gate the output is *1* only when all of the inputs are at *1*, whilst for the OR gate the output is at *0* only when all of the inputs are at *0*. If we changed all of the *1*s for *0*s and vice versa in the OR-gate truth table, we should end up with the same set of logic conditions as we had in the AND-gate truth table. For an OR gate we can also say that if any one or more of the inputs is at *1* the output will be at *1*.

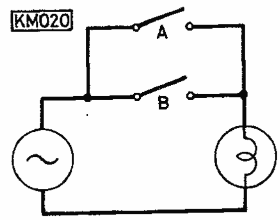


Fig. 9: Electrical OR gate

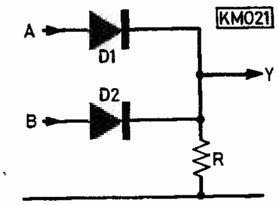


Fig. 10: Diode OR gate

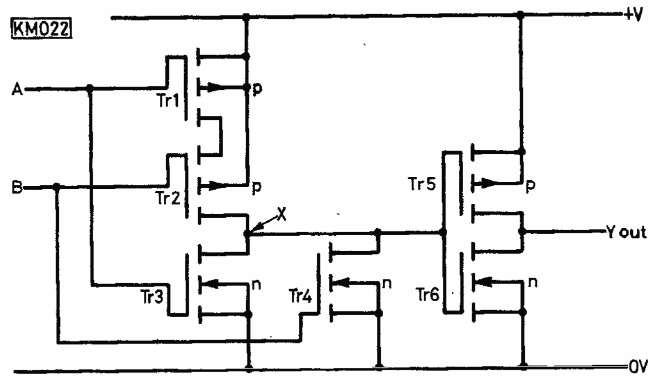


Fig. 11: A typical CMOS OR gate

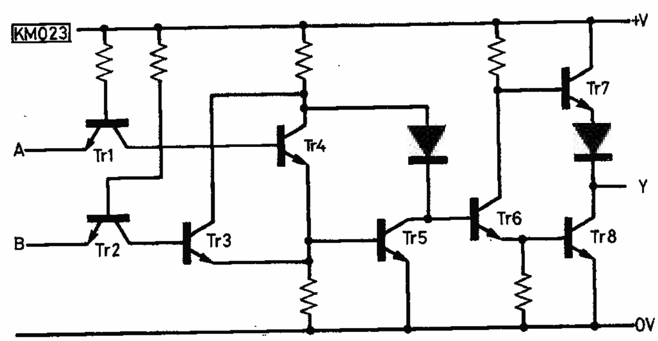


Fig. 12: A typical TTL OR gate

In CMOS logic devices, the OR gate arrangement looks similar to the CMOS AND gate except that it has effectively been turned upside down so that the *p* transistors are now in series and the *n* transistors are in parallel. A circuit for a typical CMOS 2-input OR gate is shown in Fig. 11. If either of the inputs is at *1*, then either Tr3 or Tr4 will be turned on to bring point X down to the *0* level. This produces a *1* level at the output because of the inverting action of the output stage itself.

In the case of the TTL type devices, the circuit of an OR gate is rather different from that of an AND gate and is shown in Fig. 12.

OR Gate Symbol

Once again, because of the complex nature of the gate circuit, a special symbol is used to denote an OR gate. This one takes the shape of a shield, with the output line coming from the pointed end of the shield as shown in Fig. 13(a). For convenience in drawing an OR gate with a large number of inputs this symbol may be modified to that shown in Fig. 13(b). The symbols we shall use in this series are those of American MIL STD 806B. Alternative symbols are used in other standard systems.

Actual OR-gate integrated circuits come in a similar range of combinations to the AND-gate types. In the CMOS range we have the 4071 which is a quadruple 2-input OR gate arrangement. Then there are the 4075 (triple 3-input OR gate) and the 4072 which contains two separate 4-input OR gates. These are shown together with their connections in Fig. 14.

In the TTL series, the OR gate is not very popular and only one variety is available. This is the 7432 which contains four separate 2-input OR gates as shown in Fig. 14(d).

When designing actual logic systems we shall, from time to time, want to use OR gates which have more inputs than those available as standard circuits. These larger OR gates can be built up by cascading several smaller OR gates as shown in Fig. 15. Here an 8-input OR gate has been produced by using two 4-input gates feeding a 2-input gate. If any input of G1 goes to *1* then its output goes to *1* and hence the output of G3 will also go to *1*. Similarly a *1* applied to any of the inputs of G2 will produce a *1* at the output. Thus the combination will behave as if it is an 8-input OR gate.

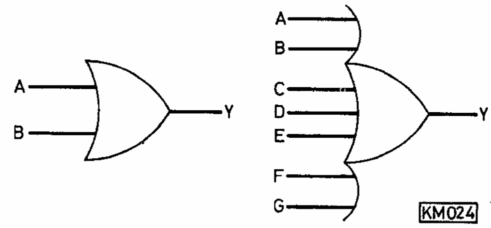


Fig. 13: OR gate symbols

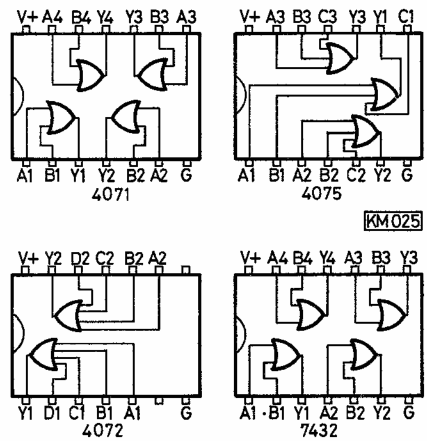


Fig. 14: Some actual OR gates

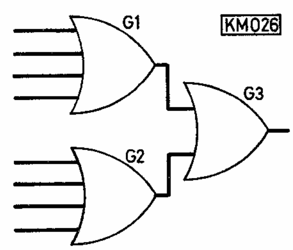


Fig. 15: Cascading OR gates to provide more inputs

Using OR Gates

How might we use OR gates in practice? Let us once again consider our automatic hot drinks machine, and see how it might be organised using logic. For a start we'll assume that some mechanical valves are used to control the flow of coffee, tea, milk etc. into the cup and that these valves are operated by solenoids driven from the logic.

When a *1* signal is applied to a solenoid the associated valve will deliver a metered amount of coffee, tea, etc. into the cup. If a *0* signal is applied to the solenoid the valve will remain closed.

Suppose we allow for six basic drink combinations, each of which is selected by a push button on the front of the machine. In this case these will give black or white coffee, which may be sweet or not as desired. Other options will be tea (with milk) which may be either with or without sugar. There are six inputs to our logic system and four outputs to control the valves for tea, coffee, milk and sugar. A suitable arrangement for the logic is shown in Fig. 16.

Let us start by looking at the coffee output line. This must go to *1* whenever any of the buttons calling for a coffee drink is pressed. We can produce the output required by feeding the signals from the four buttons selecting coffee combinations to a 4-input OR gate (G1). The output from this gate drives the coffee control valve.

If we consider the milk output signal this must be set to *1* when white coffee or tea has been selected. Again we have four inputs which are fed to an OR gate G2 to provide the drive for the milk control solenoid.

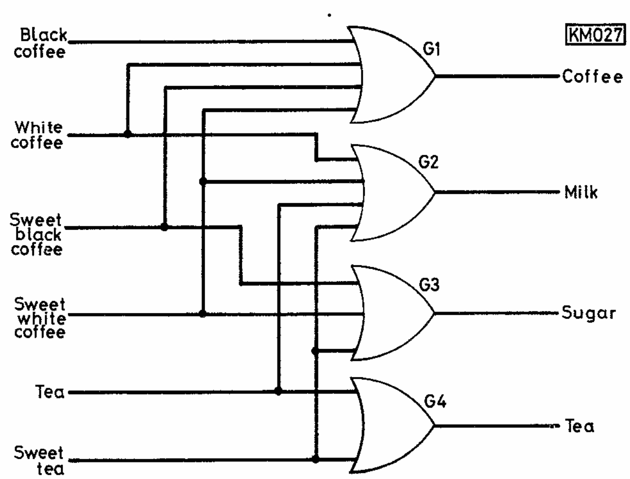


Fig. 16: Logic circuit for a hot drinks machine

For tea there are only two combinations which need a *1* output so here a 2-input OR gate G4 is used for the tea control signal. Finally for sugar control we can OR together all of the inputs that require sugar and here we need a 3-input OR gate G3 to produce the output.

This basic logic scheme could now be extended to allow for more combinations such as lemon tea, chocolate and maybe even cold drinks such as Coca Cola or lemonade by adding more inputs and more OR gates.

The Inverter

Apart from the AND and OR type gates, we need one more basic logic function which is called the inverter. This produces a *1* output for *0* input and vice versa.

Suppose we have a 2-input AND gate with signals A and B applied to its inputs. Now assume that we want to achieve a *1* output when A is at *1* but B is at *0*. In a simple AND gate the output would be *0*. Now suppose we invert the B input so that a *1* is applied to the input of the gate when the actual B input is *0*, then we shall get a *1* out of the gate if A is *1* and B is *0*.

A logic inverter might be a simple transistor stage as shown in Fig. 17. When *0* is applied at the input the transistor is cut off and the output line will go to the *1* level. If a *1* input is applied, the transistor will turn on and its collector voltage will fall to zero to give a *0* output. Such an inverter stage might have been used with discrete diode logic in the days before integrated logic circuits appeared.

In TTL and CMOS logic an inverter usually consists of simply the output stages of a gate circuit which with most logic types gives a logical inversion.

The symbol used for an inverter is shown in Fig. 18. Here the triangle indicates an amplifier whilst the small circle on the output line indicates that the logic signal has been inverted.

Actual inverter devices usually come in groups of six to a package. In the TTL range the standard version is the 7404 which is shown in Fig. 19(a) whilst the CMOS equivalent is the 4049 shown in Fig. 19(b).

Logic Equations

The theory of logic systems is by no means new. The ancient Greeks had already worked out many of the ideas but in the mid 19th century mathematicians, such as George Boole, developed logic as a branch of mathematics. Now a logic system could be reduced to mathematical equations and operated upon by special algebra called Boolean algebra. We shall not go into the theory of logic in a mathematical sense, but it is useful to understand the shorthand used to describe a logic system.

If we take a simple 2-input AND gate we can write down its operation as the equation

$$Y=A.B$$

Here the inputs have been named as A and B and the output is called Y. In a logic system the signals may be denoted by letters such as A, B, etc. or they may be given names such as DATA, CLOCK etc. In the equation for the AND gate the full stop between A and B signifies an AND function, so the equation can be translated as output Y equals input A AND input B.

For the OR function a + sign is used, so that for a 2-input OR gate the logic equation would become,

$$Y=A+B$$

If there were three inputs to the OR gate the equation would then become,

$$Y=A+B+C$$

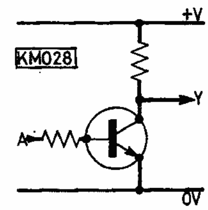


Fig. 17: A transistor inverter stage

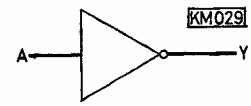


Fig. 18: The inverter symbol

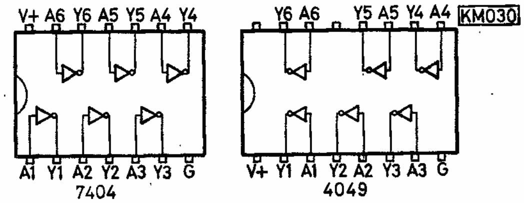


Fig. 19: Some actual inverter packages

We can make up much more complex logic equations by mixing both OR and AND functions so that we might have,

$$Y=(A.B)+(C.D)$$

Here brackets have been added to make it clear which of the logic operations go together. In this case if both A AND B go to *1*, OR, if both C AND D go to *1*, the output Y will go to *1*. The logic arrangement which will produce this equation is shown in Fig. 20.

What happens if we put an inverter into the system? Any logic signal which has been inverted is denoted by a bar drawn over the name of the signal. So for a simple inverter the logic equation will be

$$Y=\bar{A}$$

Such an inverted signal might be referred to as BAR A or alternatively NOT A, where A is the name of the signal. Thus we might have,

$$Y=\bar{A}.B$$

This means that output Y will go to *1* when input A is *0* ($\bar{A}=1$) AND B is at *1*.

Now by using only these three types of logic unit, the AND gate, the OR gate and the INVERTER we can build up virtually any logic system.

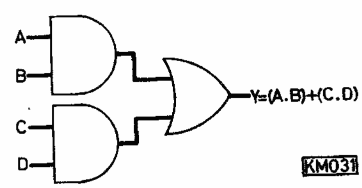


Fig. 20: Combining gates to produce a more complex function

The NAND Gate

If you look up a data book of TTL devices, the first one you are likely to meet is the 7400 which is described as a quadruple 2-input NAND gate. So what is a NAND gate and why should we need one anyway? Basically the NAND gate is simply an AND gate followed by an inverter, built up as a single device. One advantage of this type of gate is that we can produce all of our logic systems by using just one type of gate rather than three.

In the NAND gate the function is similar to that of an AND gate except that the output is inverted so that the truth table becomes as shown in Table 4.

Table 4

Input A	Input B	Output Y
0	0	1
1	0	1
0	1	1
1	1	0

The symbol used for a NAND gate is similar to that for the AND type except that it has a circle at its output to indicate logic inversion. This is shown in Fig. 21. The logic equation for a NAND gate will be,

$$Y=\overline{A.B}$$

where the bar over the A.B indicates the inversion of the complete logic signal at the output of the gate.

If we take a NAND gate and join all of its inputs together in parallel it will become a simple inverter. If we feed the output of a NAND gate through an inverter it will perform the same function as an AND gate, since the extra inverter will cancel out the action of the one inside the NAND gate. By inverting each of the input signals to a NAND gate we can produce the OR function. Here if any of the inputs goes to *1* the actual signal applied to the NAND gate goes to *0* and hence the output of the NAND gate must go to *1*, thus producing the same result as an OR gate. You can check all of these actions by looking at the truth tables and working out the various states of the inputs and outputs of these combinations of NAND gates.

In TTL the NAND gates come in the same combinations as the AND types, giving four 2-input gates (7400) three 3-input gates (7410) and two 4-input gates (7420). Each of these arrangements has the same pin layout as the AND counterpart. In NAND gates however we can also have an 8-input gate (the 7430). For CMOS the 2, 3 and 4-input gates are the 4011, 4023 and 4012 respectively, and they have the same pin configuration as the AND versions. There is an 8-input gate in CMOS which has the number 4068.

The NOR Gate

Having produced a NAND gate we might now consider the possibility of combining an OR gate with an inverter. This will in fact produce what is called a NOR gate. Like the NAND gate it has the advantage that you could build up any logic system by using just NOR gates instead of having AND, OR and INVERT functions.

In the NOR gate a *1* applied to any of its inputs will produce a *0* to the output. Conversely the output can only become *1* when both inputs are at *0*. This produces the truth table shown in Table 5.

Table 5

Input A	Input B	Output Y
0	0	1
1	0	0
0	1	0
1	1	0

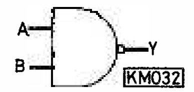


Fig. 21: A NAND symbol

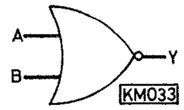


Fig. 22: A NOR symbol

As we might expect, the symbol for a NOR gate is like that for OR but with a circle on the output line to show that the output is inverted. This is shown in Fig. 22. We can write down the action of a NOR gate as

$$Y=\overline{A+B}$$

Practical devices are the 4001, 4025 and 4002 in CMOS, which are the NOR equivalents of the 4071, 4075 and 4072 respectively and have the same pin connections. In addition to these there is the 4078 which is an 8-input NOR gate. In TTL there is also quite a range of NOR gates giving two inputs (7402), three inputs (7427) and four inputs (7425).

By inverting the output of a NOR gate we can get an OR gate and by inverting its inputs we can produce an AND gate, so the NOR gate alone can be used to build up almost any logic function.

Changeover Gate

Let's see how we might use some of the gates that have been described. One frequently used function is to simulate a changeover switch. Here we want to pass either input A or input B through to the output according to the state of a control line C. Such a circuit can be built up from NAND gates as shown in Fig. 23, which also shows the equivalent switch circuit.

When control input C is a *0*, gate G3 is effectively closed and its output remains at *1* irrespective of the state of the B input. Gate G1 acts as an inverter and G2 is therefore held open and allows input A to pass through to the input of G4. Since the other input of G4 is at *1*, signal A passes through to the output. The inversions in gates G2 and G4 cancel out to leave A uninverted at the output. When C goes to *1*, G2 closes and G3 opens to let input B pass through to the output.

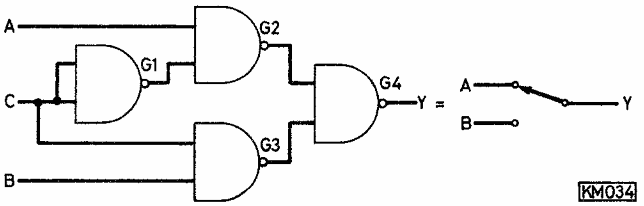


Fig. 23: Logic circuit of a changeover gate, and its electrical equivalent

This changeover gate function can of course be made up by using other combinations of gates and inverters and as an exercise you might like to work out some of these alternatives. Generally the circuit shown is convenient because it can be implemented by using a single 7400.

The Multiplexer

We can expand the idea of a changeover switch to produce a multiway switch similar to our old friend the rotary switch. Such an arrangement of logic is normally called a multiplexer.

In Fig. 24 we show the logic for a 4-way multiplex switch. The control signals C1 to C4 are arranged so that only one of them can be at *1* at any time. If C1 were at *1* then signal A would pass through G1 and since G5 is an OR gate it will also pass through G5 to the output. Gates G2, G3 and G4 will be off because one of their inputs is at *0* and hence they will have no effect on the state of G5. The number of inputs can be expanded by adding more AND gates and having more inputs to the final OR gate. If desired, multi-bank switches can be produced by having a series of parallel multiplexer circuits with the control inputs connected in parallel across the banks.

Because multiplexers are often used, special logic devices are available such as the 74151 which is an 8-input single-bank multiplexer in one package.

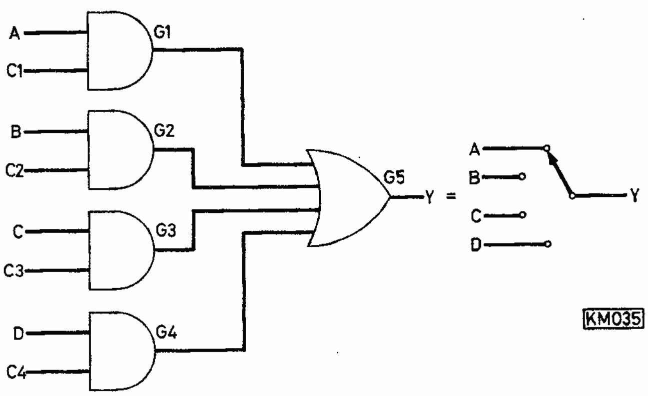


Fig. 24: Logic circuit of a multiplexer, and its electrical equivalent

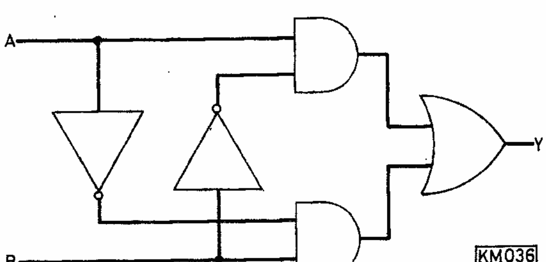


Fig. 25: A logic circuit for an EXCLUSIVE OR gate

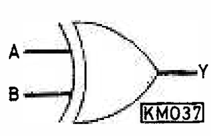


Fig. 26: EXCLUSIVE OR gate symbol

The EXCLUSIVE OR Gate

There is one further special gate function which it is worthwhile to investigate. When we looked at the OR gate you will remember that the output went to *1* when either input A or input B **or both** went to *1*. There are occasions however when we would like the output to go to *1* if A or B was at *1* but to remain at *0* if both of the inputs went to *1*. A gate that performs this action is called the EXCLUSIVE OR gate.

Such a gate arrangement can be built up as shown in Fig. 25. Here the two AND gates are detecting the input conditions A = *1*, B = *0* and A = *0*, B = *1* and these are the only states where there will be a *1* at the output.

The EXCLUSIVE OR gate has its own special symbol as shown in Fig. 26. In logic equations too it uses a special symbol which is a + enclosed in a circle so that for a 2-input gate we get the equation,

$$Y = A \oplus B$$

The truth table for this type of gate is shown in Table 6.

Table 6

Input A	Input B	Output Y
0	0	0
1	0	1
0	1	1
1	1	0

Normally, EXCLUSIVE OR gates are produced with only two inputs and the standard package is to have four separate 2-input gates in one device. In TTL this is the 7486, and in CMOS it is the 4070.

We shall see later that the EXCLUSIVE OR gate is useful when comparing patterns of bits, and can also be used as a switched inverter device which will allow us to invert a signal on command from another signal.

At this point we have looked at most of the useful types of gate, although there are of course many other combinations in both TTL and CMOS which can sometimes be useful, but whose functions can be reproduced by a mixture of the gates we have looked at already.

Next month we shall go on to look at the other major group of logic devices, namely the flip-flops.

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A.M. RECEIVERS
DEVICES & CIRCUITS
PART 1

M. J. DARBY

The construction of an amplitude modulation (a.m.) receiver can be considerably simplified by the use of one of the semiconductor devices which have been especially developed for this particular application. This and future articles will review the various types of device available and include a selection of typical circuits which the reader can construct and with which he can experiment.

Practical constructional details will not be included, since a variety of circuits are covered and constructional details for specific receivers are regularly included in our pages. Audio amplifier sections will not be included since the audio output from any of the receiver circuits can be fed into a standard audio amplifier. Integrated circuits will be used throughout, since this reduces the number of components used compared with discrete (separate) transistor designs.

Amplitude Modulation

The amplitude of an a.m. signal varies at the frequency of the audio signal concerned. For example, one may consider a 1MHz radio frequency carrier wave (which is far above the level of human hearing) and which varies in amplitude at an audio frequency of 1kHz. When a receiver is tuned to this signal, the 1kHz frequency will be heard from the loudspeaker.

Amplitude modulation is used on long, medium and short wave transmissions. Frequency modulation can be used at much higher frequencies (e.g. f.m. sound at about 90MHz) for high quality reception, but cannot be used with advantage at relatively low frequencies.

A.M. receivers are usually simpler than f.m. receivers and it is therefore sensible for a beginner to commence with a.m. circuits. Signals at the high f.m. frequencies cannot be received from distant transmitters, so if you wish to receive a signal from a station more than about 50 to 100 miles away, it will be an a.m. signal you will select. However, the fact that distant a.m. signals can reach your aerial inevitably means that one is much more likely to experience interference from unwanted signals than with f.m. reception.

T.R.F. or Superhet?

There are two main types of a.m. receiver, the so-called "t.r.f." (tuned radio frequency) and the superheterodyne or "superhet". The t.r.f. type is far simpler than the superhet, so the beginner who wishes to experiment is strongly advised to commence with a t.r.f. circuit.

In a t.r.f. receiver the incoming signal is amplified, detected or demodulated in a stage which converts the radio frequency wave into an audio signal and the audio signal is then amplified so that it can feed a loudspeaker or an earphone.

In a superhet the incoming signal is changed in frequency to another radio frequency signal known as the intermediate frequency. It is convenient to obtain most of the selectivity (or ability to reject interference from adjacent signals) at this intermediate frequency before the signal is demodulated and fed to an audio amplifier and hence to a loudspeaker.

A t.r.f. receiver can give good audio quality provided there are no interfering signals, thus if you require a simple bed-side or kitchen receiver for local programmes, a t.r.f. circuit will be satisfactory.

If, however, you wish to receive stations from Europe on medium waves or even from other continents on short waves, one will normally obtain much better results using a superheterodyne receiver.

T.R.F. Circuits

The remainder of this article will be devoted to t.r.f. circuits mainly for the purpose of helping the beginner. Numerous t.r.f. circuits have been published using discrete transistors, but a unique integrated circuit was released some years ago which has been designed especially for use in t.r.f. receivers.

This device is the Ferranti ZN414 which is ideal for use by the home constructor and is readily available. It requires only a low voltage power supply and provides a very high gain when used in a simple circuit.

The ZN414 is encapsulated in a simple transistor metal envelope, and the pin connections are shown in Fig. 1. There are only three leads, these being input, earth, and a common lead for output and the positive voltage supply.

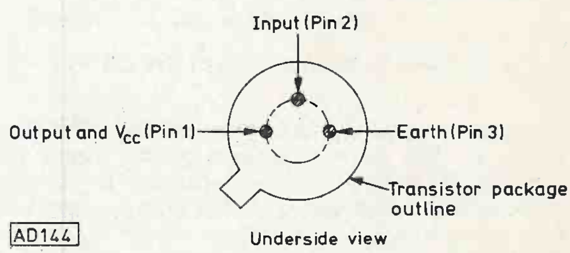

Fig. 1: Pin connections of the ZN414

ZN414 basic circuit

A basic t.r.f. receiver circuit using the ZN414 device is shown in Fig. 2. The inductance L1 is a winding on a ferrite rod or slab aerial which will be described in detail later. This inductance must

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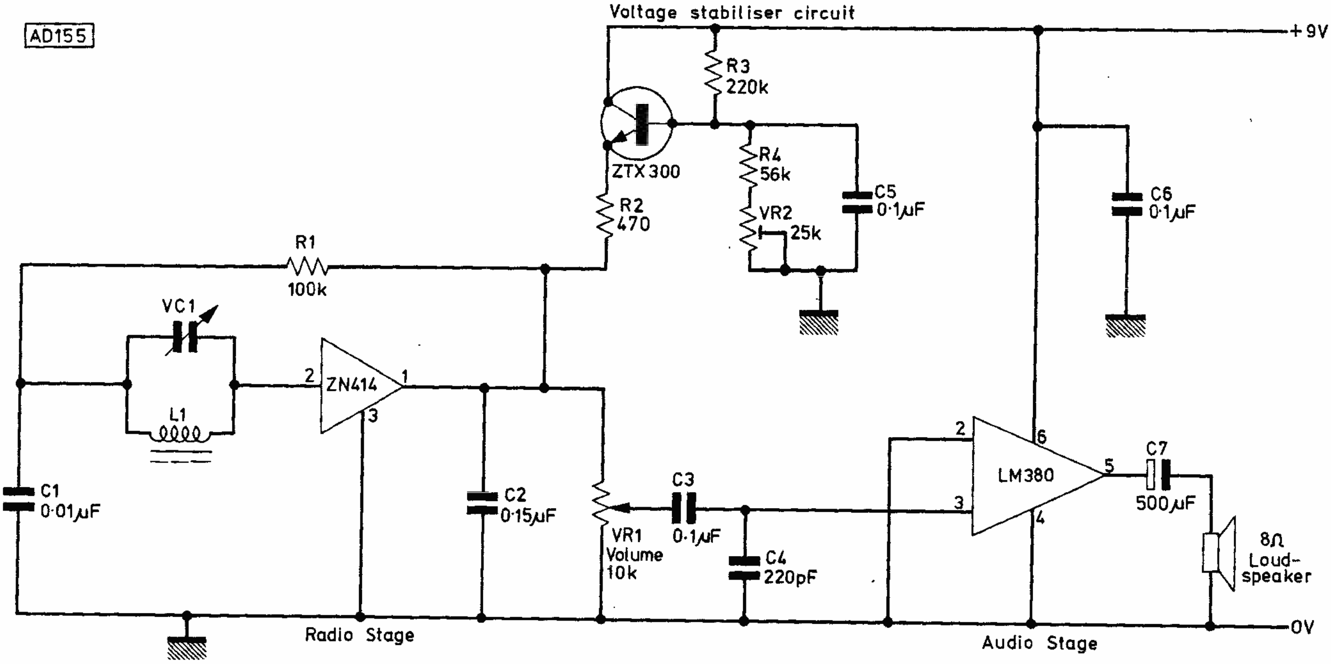

Fig. 6: A small loudspeaker radio receiver circuit, using a single transistor voltage stabiliser circuit

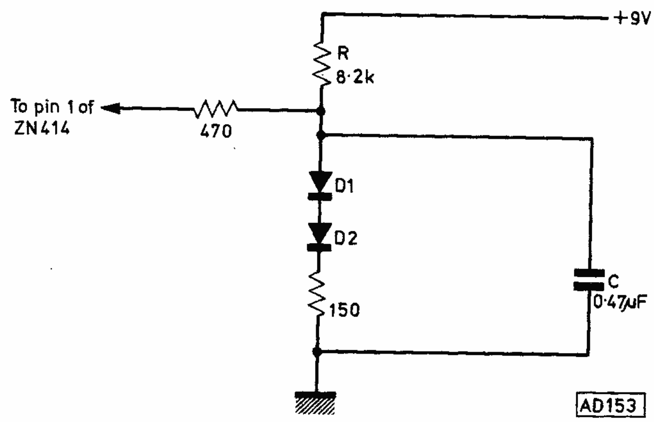

Fig. 6(a): An alternative voltage stabiliser using two silicon diodes

It is normally preferable to employ at least a single transistor amplifier stage (such as that shown in Fig. 5) so that the requirements of the earpiece are far less critical and a cheaper earpiece is satisfactory. A volume control is also incorporated in the Fig. 5 circuit, whilst the two forward biased diodes limit the voltage across the ZN414; the Ferranti BAW 37A double diode may be used here.

Loudspeaker circuits

The audio output from a ZN414 circuit can be fed to almost any audio amplifier which can drive a loudspeaker. Audio amplifiers using discrete transistors have been published for use with the ZN414, but simpler circuits can be made using an integrated circuit audio amplifier.

A small loudspeaker radio receiver circuit is shown in Fig. 6. In this circuit the ZN414 device is fed from a simple single transistor voltage stabiliser circuit so that the gain is almost independent of the power supply voltage used. If no stabiliser circuit is used, the gain will fall considerably as the battery ages. The supply voltage to the ZN414, and therefore the gain, can be set by means of VR2. The audio signal passes through the d.c. blocking capacitor C3 to the input of an integrated circuit audio amplifier. C4 helps to remove any radio frequencies from the audio signal and prevents spurious noise.

The LM380 was selected for this circuit partly because an extremely simple circuit can be employed, but also because it contains protection circuits. If the output of this device is shorted to ground accidentally, the output current will be limited to a safe value so that the device is not destroyed. In addition, if the device becomes so hot that it is in danger of failing, the output current is automatically reduced until it cools to a safer temperature.

Diode stabilisers

An alternative to the transistor voltage stabiliser of Fig. 6 involves the use of two series connected forward biased silicon diodes in the circuit of Fig. 6(a). The larger the value of R, the greater the gain of the ZN414. The voltage drop across this resistor is added to the voltage drop of about 1·3V across the two forward biased diodes.

It is also possible to employ a small light emitting diode instead of the two silicon diodes of Fig. 6(a), but the current required to enable the light emitting diode to provide a reasonable light output will be greater than that required by the Fig. 6(a) circuit. In other words, the value of R must be reduced.

Frequencies

The variation of the ZN414 gain with frequency is typically similar to that shown in Fig. 7. The peak gain is at about 1MHz, but the device can be used with a reasonable gain from about 100kHz up to about 3MHz. However, one should remember that the gain is much reduced near these limiting frequencies. The lowest frequency for reasonable gain is set by the values of the internal coupling capacitors shown in Fig. 2, whilst the maximum practicable frequency is determined by the properties of the internal transistors in the device.

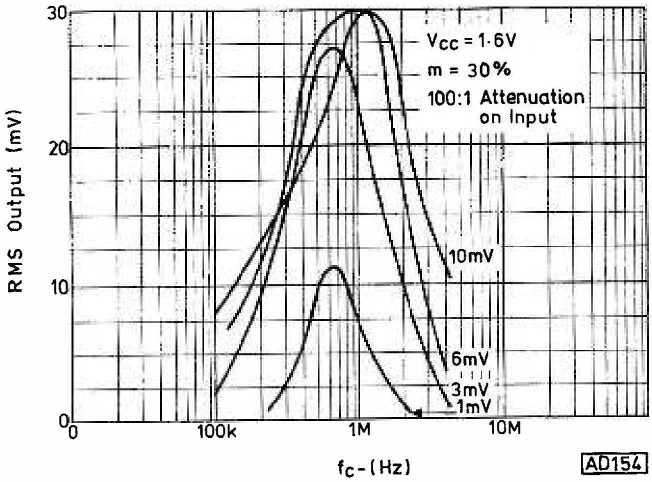

Fig. 7: Frequency response of the ZN414

It can be seen from Fig. 7 that there is a considerable difference in the output voltage as the input rises from 1mV up to 3mV, but any further increase in the input voltage produces a relatively small change in the audio output level owing to the a.g.c. action.

Aerial

The aerial may consist of a ferrite rod about 12cm in length with 55 to 65 turns of 28 gauge wire wound as a single layer for medium wave. The long wave coil may consist of some 250 turns of 38 gauge single silk covered wire wound in a random way with turns on top of one another, as indicated in Fig. 8. The exact number of turns will depend on the value of the tuning capacitor placed in parallel with the coil (typically 200pF).

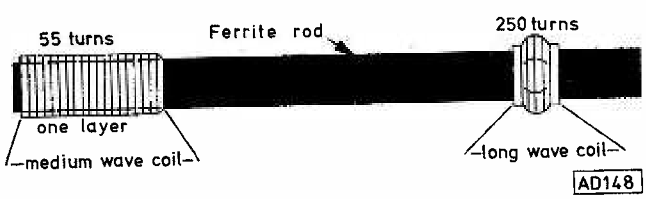

Fig. 8: The ferrite rod aerial with l.w. and m.w. coils

Only one aerial coil has been shown in the circuits of Figs. 2, 4, 5 and 6. If both medium and long wave coils are required, the switched circuit of Fig. 9 may be used with any of these circuits. It is important that the aerial coil should have a high Q (magnification) so that reasonable selectivity is obtained.

If one requires an extremely small receiver (possibly using the circuit of Fig. 4), there will not be enough space for a reasonably long ferrite rod aerial in the case. One can employ a ferrite slab with only a medium wave coil wound on it in such receivers; the slab should not be less than about 3cm in length unless one intends to use the receiver only fairly close to a transmitter. A longer ferrite slab will produce a greater signal voltage.

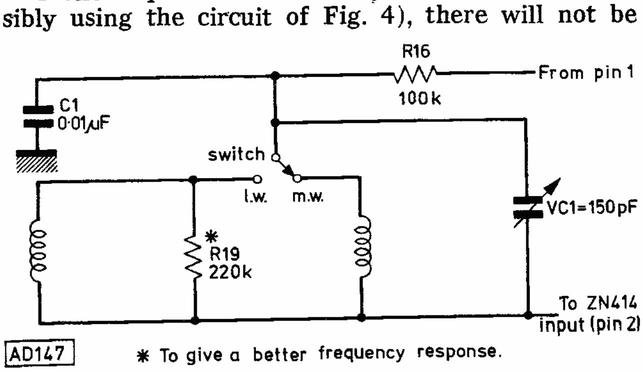

Fig. 9: Switching circuit for l.w. and m.w. coils

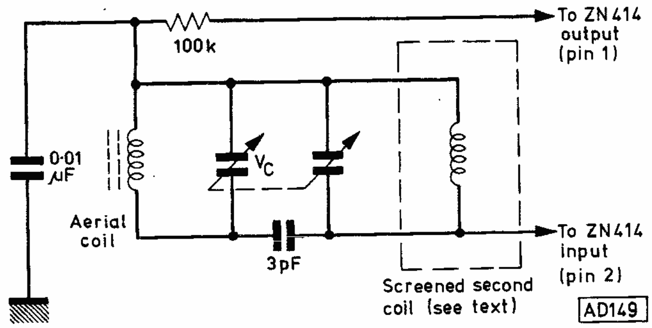

Fig. 10: A double tuned circuit for greater selectivity

If greater selectivity is required, a double tuned circuit can be used before the ZN414 as shown in Fig. 10, but this requires careful alignment for optimum performance. The Q factors of the two tuned circuits should be similar. If the two tuned circuits are not correctly matched, each station may be received at two points in the band. This type of double tuned circuit is especially useful when one has a larger external aerial coupled to the ferrite rod. The lead from the external aerial should be connected to a few turns of wire around the ferrite rod, the other end of the winding preferably being connected to earth.

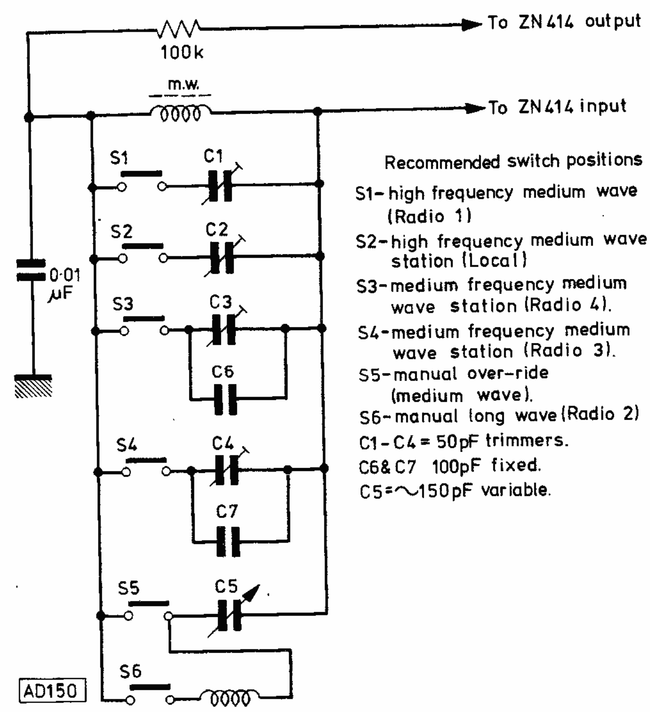

Fig. 11: A six position switching circuit

The circuit of Fig. 11 shows how four pre-selected stations may be selected by the push buttons S1 to S4. The buttons S5 and S6 enable the normal medium and long wave bands respectively to be tuned by means of the variable capacitor C5.

Next month we will consider superheterodyne receivers for a.m. reception.

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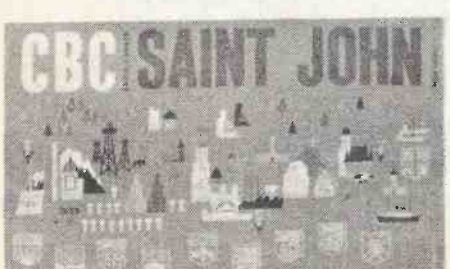
QSK	Can you hear me between your signals and if so can I break in on your transmission?	I can hear you between my signals; break in on my transmission.
QSL	Can you acknowledge receipt?	I am acknowledging receipt.
QSM	Shall I repeat the last telegram which I sent you (*or* some previous telegram)?	Repeat the last telegram which you sent me (*or* telegram(s) number(s) . . .).

CHARLES MOLLOY

In official lists of the "Q" codes—the comprehensive system of abbreviations used by professional telegraphy operators to speed the exchange of traffic —the meaning of each code is clearly defined.

Many of these codes have been adopted by other services, such as broadcasting, and by the amateur radio fraternity. For each class of user, the same abbreviation can have a quite significantly different shade of meaning.

To the transmitting amateur, a QSL is an acknowledgment of a successful two-way radio contact established with another amateur, and normally takes the form of a specially printed card. To this are added a note of the date, time and frequency of the contact, and brief technical details of the equipment used.



For the broadcast band listener, the radio contact is, of course, strictly one way, and the situation therefore differs again.

Broadcast Band QSLs

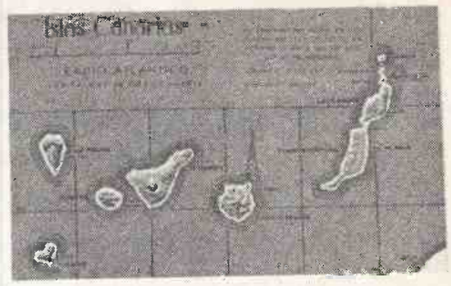
What is a QSL? is a question sometimes asked by newcomers to the hobby. According to the March 1978 bulletin of the International Short Wave Club, "a QSL is an acknowledgement". International broadcasters like to hear from their listeners, many of whom are not DXers and in reply these stations issue QSL cards which are really mementos of the occasion. The cards themselves are often colourful. On one side there may be a photograph, a design of some sort or even the station's callsign, while on the other side there will be the acknowledgement and perhaps some information that would confirm that the listener did in fact hear the broadcast.

It is the last factor that causes difficulty for some DXers. Though many will be content to have a card that can be shown to others and perhaps kept in a photograph album, the serious DXer who is interested in obtaining a diploma from a DX club, or who simply wants to be able to prove his reception, will be disappointed. As the ISWC puts it, "To prove reception the document that one receives from the station should be plainly endorsed with the date, time and frequency". Such a reply is called a verification (verie for short) and this is what the majority of DXers hope to receive in return for a reception report.

The current QSL card from Radio Australia is an example of a pleasant QSL that is also a verie. It is a card with a colour photo on one side and the sort of details that the serious DXer would want, on the other side. Even here, the purist might complain that it should have stated my address. The card came inside an envelope!

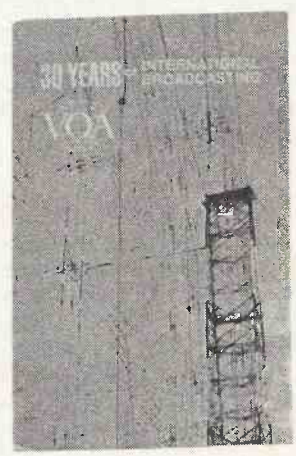
DX clubs consider QSLs and Veries to be a major part of their activities. The Twickenham DX Club for example, recently produced a 16-page QSL Survey which summarises verification details submitted to their "QSL Report". Broadcasting stations are listed by country. The frequency band verified, number of verifications received from 1974-76 and 1976 to March 1978, the type of verification (card, letter, folder), whether return postage is recommended and the time taken to receive a reply, are all listed in this comprehensive survey. Copies can be obtained from the TDXC, 13 Tennyson Avenue, Twickenham, TW1 4QX for four 7p stamps in the UK or for 3IRCs surface mail or 5IRCs airmail to any other part of the world.

A final word on QSLs comes from Peter Gatehouse of Buckingham, who refers to a recent communication from Radio Canada International which says that to receive a QSL card from Radio Canada International one has to be on the mailing list! Programme schedules will be sent free but QSLs will not be sent to people not on the mailing list. Write to RCI Publicity and Audience Relations, PO Box 6000, Montreal, Canada H3C 3A8. Clearly, this type of QSL is intended for listeners rather than DXers.



Medium Wave

The medium wave DXer invariably resides outside the service area of his DX and this should be kept in mind when writing to a station. The reception report is unlikely to be of any value to the station and one is depending on goodwill for a reply. So, always include return postage, either an International Reply Coupon, currently 25p at main Post Offices, or as unused postage stamps of the country concerned. These are obtainable from stamp dealers (philatelist shops).



Send the reception report to the Chief Engineer, if possible in the language of the country, as there will not be an international department to deal with listeners' letters. Many radio clubs supply report forms in a number of languages, Spanish and Portuguese being the most useful. Try to convince the station that you really did hear them as they may be surprised to hear from you. Station announcements, slogans, weather report details, time checks, news items are the sort of material to mention and these can be heard at programme changes which usually occur on the hour or half hour.

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EM Gauge Society

Introduction to the Problem

Many model railways use the solenoid type of point motor to operate the point blades from a central control panel. Although the manufacturers claim that these units will operate at a supply of 12 to 20 volts they rarely do so reliably and it is generally better to operate them at around 30 volts. This ensures that they throw properly and overcomes any resistance due to mechanical deficiencies inherent in the design. A typical point motor is shown in the photograph, along with the unit which forms the subject of this article.

The coils forming the solenoids have a d.c. resistance of around 2Ω each and it does not take much imagination to see what happens when 30 volts is applied to the motor. If the armature sticks or the operator leaves the switch on for any length of time then some 15 amps will flow (assuming that the power supply is capable of delivering this current) and 450W will be generated as heat. The end result is that the solenoid coil burns out.

Solution and Circuit Description

The situation can be avoided by using a capacitor discharge system to provide enough energy to ensure that the armature is thrown over but not enough to burn out the coils if the operating switch is left on.

The circuit shown in **Fig. 1** uses a transistor to switch off the charging current to the operating capacitor C2 whenever the output is connected to the 0V line by a low resistance such as a motor coil.

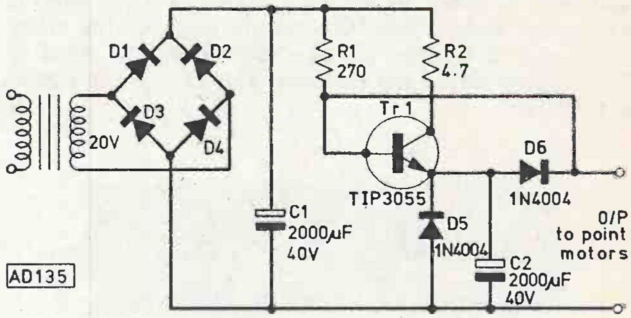


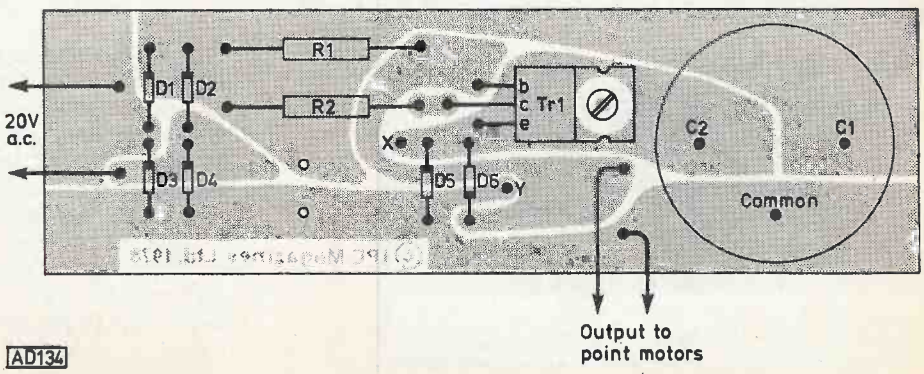
Fig. 1 The complete circuit diagram

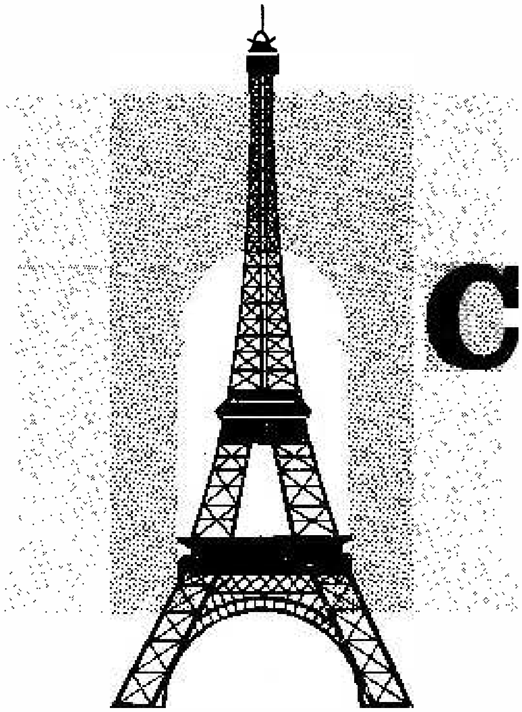
When the load is removed from the output the base of Tr1 is unclamped and Tr1 is turned on allowing current to flow through R2 to charge C2. The low value resistor R2 is used to limit the maximum charging current and its value is not critical. R1 limits the current which flows when the load is left applied and C2 has fully discharged. When C2 is fully charged and there is no load on the output, Tr1 is turned off via D6. Any small loss of charge due to leakage is made up automatically. Diode D5 provides reverse voltage protection for C2, preventing back e.m.f. damage due to the transients produced when the current in the solenoid coil changes rapidly.

Power Supply and Switching

The power supply is a conventional bridge rectifier circuit with a large reservoir capacitor C1. The input

Fig. 2: The component layout. (Note; The two unmarked holes are for alternatively mounting C1 remote from the p.c.b.)





PARIS Components SHOW

DAVID GIBSON

With a record attendance by nearly 82,000 visitors, the Salon International des Composants Electroniques 1978 chalked up yet another international success. This giant electronics exhibition, held each year in Paris, attracted over 1345 registered exhibitors from 30 countries and spread itself over an area of 60,900m^2.

Exhibits ranged from Ham radio equipment and accessories to laser trimming equipment, from single components to highly complex instrumentation and, of course, microprocessors.

In this latter area it was interesting to see a microprocessor timer kit. This offered a choice of 21 programmes plus a digital readout of time. The unit has many applications but suggested text included ideas like, automatically waking you up in the morning (you can programme in different times for different mornings), switching on your egg and boiling it to perfection, switching the heating on and off plus putting lights on an off during the evenings to deter burglars. The input keyboard (supplied with the kit) has buttons for each day of the week, a one to nine set of tabs, plus an am/pm button although the digital clock can be switched to read either 12 hours or 24 hours.

Readers wanting to conduct underwater experiments in the bath (?) or elsewhere will be pleased to hear of a special transducer shown by a French company. An electret (an electrostatic transducer) for underwater applications has been developed. The air gap which is commonly present in such transducers has been replaced by a compressible, very high resistivity material which is held in intimate contact (lovely wording those French use!) with the electret. This design suppresses the drawbacks which result from the presence of air in such transducers—variation of sensitivity as a function of immersion depth for example. The advantages claimed for the new device are a sensivity higher than 30μV/μBar (−90dB relative to 1V/μBar), broad bandwidth, and an acoustic impedance close to that of water. The company is understood to be making some experiments with an array/antenna of electrets which could prove interesting for listening underwater.

One device causing raised eyebrows was the "Snapistor". This is a thick film resistor network on a ceramic substrate. Pre-scribed lines on the back of the substrate divide it into ten parts. Each part can be snapped off, one by one, and each snap increases the remaining resistance by 20%. This gives a five-fold increase in resistance when all nine parts have been broken off. Applications suggested are; to set the gain of a transistor stage, or to set up the voltage of a voltage regulator. Here, one could use one Snapistor for coarse adjustment, and another for fine setting. Various ranges of resistance values were offered. These in-included; 100Ω to 520Ω, 10kΩ to 52kΩ, 33kΩ to 520kΩ, and 100kΩ to 520kΩ. The resistance values are +20%, TCR +100p.p.m./°C and operating temperature range −40°C to +125°C. Power handling capability depends on how much snapping you've done. If they are unsnapped (i.e. all sections are in circuit) then the power capability is 250mW; with just a lonely one segment, power is 50mW. Maximum voltage is 100V.

Signs of things to come. A complete data terminal in an attache case. It comprises a full keyboard, all necessary electronics, and a small collapsible television screen which folds down. The station may be used over a standard telephone via a modem, and can chat to computers and data terminals anywhere in the world

Trends were not hard to spot. Many people offered microprocessors—either a single chip, or with a complementary keyboard, or as a complete kit of parts with a manual.

Motorised rotation of f.m. antennas featured strongly. These came complete with a nicely styled box. The box shows you which way your aerial is pointing and the whole array is controllable from your living room. Many companies showed results, including a BBC2 test card which had superb definition.

One dealer displayed an impressive array of Yaesu Ham equipment. Interesting to see the FT-301D solid state transceiver. It has a digital readout and uses no valves at all, not even those ubiquitous 6146's in the final. The unit runs from 12V direct—ideal for mobile work, although a separate mains p.s.u. is available which includes a digital clock and an automatic callsign sender for the c.w. enthusiast. Price was horrendous and interest high!

French giant Thomson-CSF took a huge number of stands, indeed their particular alleyway was signposted "Avenue de Thomson-CSF". Along this Avenue was found an "Easy-to-use Super-Noticon". This turned out to be Thomson's latest addition to its range of low-level TV camera tubes. The Super-Noticon really is super, too. It can view a scene without trouble even on a cloudy and moonless night. The French boffins mumbled something about sensitivity down to 10^{-5} lux.

Also on the Thomson stand were a number of quartz resonators which achieve 300MHz in fundamental mode. Close by were a number of devices described as piezoelectric but using Lithium Tantalate and not quartz. These synthetic single crystal devices have inherent properties suited to the production of wideband filters in the 0·08 to 35MHz band. A stand spokesman hinted at possibilities that this frequency could be raised to 400MHz in the not-too-distant future.

Surface wave filters were a feature on the Siemens stand. The company has succeeded in laying these down on a lithium nobate substrate. The technique is to lay down tiny fingers of conducting pattern which intermesh (but do not touch) rather like the teeth of a comb. The result is that the signal can be made to pass along these closely coupled subminiature antennas which are frequency sensitive and thus have a filtering action. Although other materials made the surface wave filter a reality, high cost and low consistency were deterrents. Lithium Nobate is claimed to overcome these problems The filter has the great advantage that it has no coils or capacitors. First applications are in the i.f. strips of TV sets. Siemens has already manufactured filters to suit British standards and markets. The standard package size on the stand was 19 × 16 × 5mm with five terminals brought out at one side.

The French Amateur Radio Association—Reseau des Emetteurs Français —had a real live repeater satellite on show. Unlike other repeater stations which are fired aloft from places like Cape Canaveral, the French decided to try a much cheaper method. They attached their 144MHz repeater station to a balloon and let it loose. The highest one of these repeaters (there have been about nine) has reached is 31,400 metres. The "flight" can be up to 24 hours long, then the balloon bursts and the repeater parachutes back to earth. The REF has around 12,000 members in France in some 250 Ham radio clubs. Annual subscription is 120 French Francs.

The French Ham v.h.f. radio repeater Anjou 009, which was sent up by balloon on September 25th 1977 and returned to earth via parachute. It is one of a series which have been launched by French Amateur Radio enthusiasts.

One normally associates Sprague with capacitors, but visitors to the stand in Paris found quite a number of useful i.c.s on display. A good one to watch for is the ULN-2283B. This is a little audio chip which offers 1W output with 12V applied. It will function from −40°C right up to a very hot +85°C. Gain is claimed to be 43dB and the i.c. will function at voltages down to only 3V. The circuit shown on the Sprague stand gave an idea of the simplicity when using the ULN-2283B. Apart from the chip and loudspeaker, only two capacitors plus a volume control are required.

The new Philips personal bleeper system looked a good idea. The tiny pocket receiver, besides have a bleep "you're wanted" facility, also boasts an alphanumeric readout. Speech facilities can be added, too, if required. By using a standard code, say from one to nine, a message can be sent very easily. Thus a number 3 displayed would mean outside telphone call; number 6 might mean return to the office etc.

At more official levels, the exhibition literature had some intriguing headings. How about "Universal elastic banana plug"? Upon my breathless arrival I was shown a banana plug whose spring arrangement assures good electrical contact with any diameter socket from 3·9mm to 4·5mm in diameter. After 100,000 pluggings in and out (no, I didn't) the plug still has a contact resistance between it and its socket of only 0·8 milliohms. Maximum current is 15A.

A fascinating device was one which varied the inductance of a coil—useful in tuning up aerials no doubt. The main coil has its windings composed of silver-plated tape-like metal. One end of this is fixed, but the other goes across to another former, which is motor driven. When power is applied to the motor, it simply unwinds turns off the coil onto the secondary former and thus the original coil has its inductance decreased. By deriving the motor power drive command from a signal fed back from an s.w.r. bridge, aerials may be loaded automatically from transmitters even when the frequency is changed by quite a large amount.

Solar cell enthusiasts will be pleased to hear that production of professional industrial components is driving the prices down and they could well make an appearance on the Amateur market before very long. One French company is talking of 500,000 cells of 57mm diameter for 1978, and the production has already dropped the price by 30% at the beginning of this year.

Still in terms of economical power, Lithium batteries were commonly offered. One of these would give 300µA for 100,000 hours. Couple this with a CMOS circuit and your battery replacement problems could be over. Carrying this capacity to the 30mA mark would give 1,000 hours of operation. The operating temperature range of these batteries is impressive; from −65°C up to +160°C.

Smallest radar I've seen was on the Jay Electronique stand. It measures 126mm × 60mm × 70mm. It's called a guarding radar because its power dissipation is 22mA at 12V, and it is undisturbed by small things, such as passing birds, insects etc. Its range is fully adjustable from 0 to 15 metres.

In the heavier machinery part of the exhibition was a machine for winding wire onto toroids. It does this at the rate of 2,000 turns/minute. Have you ever thought—how do you automatically wind onto a ring or toroid?

Experimental Broadcasting Satellite for Japan

A new high-power experimental broadcast satellite was launched from Cape Canaveral in April for the National Space Development Agency (NASDA) of Japan. It will doubtless be the forerunner of many new satellites designed to provide high-quality experimental colour television reception in regions of the world where the terrain makes it difficult or impossible to receive high-quality signals from normal earthbound television transmitters. The spacecraft was constructed for NASDA by the Space Division of the US General Electric Company of Valley Forge, Pennsylvania under contract to the Tokyo Shibaura Electric Company (Toshiba).

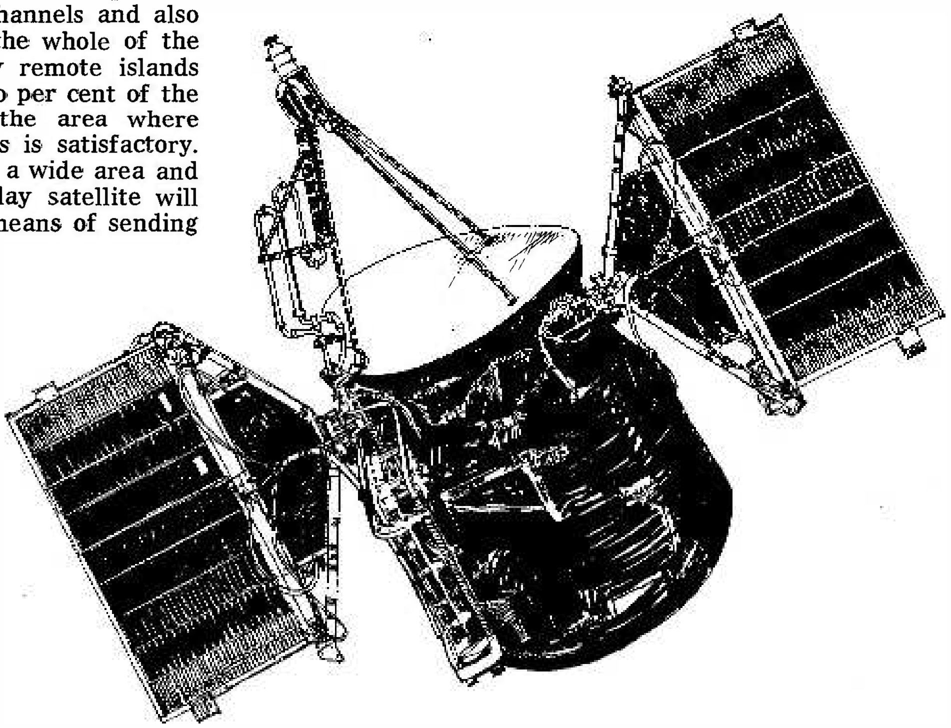
This BSE (Broadcast Satellite Experimental) craft weighs 678kg and was sent into orbit by a Delta 2194 rocket. Onboard propulsion jets propelled the satellite into a geosynchronous orbital position at longitude 110°E, and the control system will be able to maintain its position to $\pm 0 \cdot 1°$ in latitude and longtitude.

Television and voice signals will be sent from the Japanese mainland to the satellite using frequencies in the 14·0 to 14·5GHz band, and the satellite will then relay these signals back to ground using frequencies in the 11·7 to 12·2GHz band. It will provide two high-quality colour television channels and also voice communication circuits over the whole of the Japanese mainland and over many remote islands and mountainous regions. About two per cent of the Japanese population are outside the area where reception from existing transmitters is satisfactory. Japan has many islands spread over a wide area and it is thought that a high-power relay satellite will provide an economic and effective means of sending television signals to such regions.

Receiving stations

If a satellite relay system is to be an economical proposition, it is essential that the cost of each of the numerous small receiving stations shall be minimised. This implies that the power transmitted by the satellite must be quite high—especially if the power is beamed to cover a relatively wide area of a country.

The experimental broadcast satellite has been designed with this particular objective in mind. Many satellites use a cylindrical array of solar cells which are spinning in space so that the spacecraft is stabilised. However, such spin-stabilised craft have the disadvantage that only a small proportion of the solar cells are receiving the maximum amount of energy from the sun at any one time. The experimental broadcast satellite therefore employs three-axis stabilisation with its solar cells on arrays of extended arms; all of the solar cells in such a satellite can be directed towards the sun at all times (except during eclipses of the satellite by the earth) and therefore maximum power is available. The solar cells of the satellite provide a minimum power of at least 780W.



The Japanese BSE satellite. The aerial reflector can be seen in the centre and the solar cells on each side.

The receiving stations will employ parabolic antennae, but owing to the high power level transmitted by the satellite and the fact that only Japan will be included in the transmitted beam, the parabolic reflectors of the receiving aerials can be as small as 1m in diameter. (This may be contrasted with the huge 30m diameter aerials used for international satellite communications which provide about 900 times the gain of a 1m aerial). In many cases, a single receiving station will be able to feed the received signals to a whole district, but cheap receivers will be able to be used in individual homes in remote districts. The satellite has an expected life of three years and many signal strength measurements will be made at various points in the reception area so that this experimental satellite can be used as a model for future craft.

Command and control signals will be transmitted to the satellite from ground stations in Japan in the S and Ku microwave bands. It is interesting to note the tendency to use higher and higher frequencies for satellite communications with earth stations in order to obtain more bandwidth and hence a greater information carrying capacity.

Future developments

The basic design of this satellite can be readily adapted to provide both expanded telephone, data and television services and in addition to incorporate educational and health care transmissions to the developing countries in future satellites. Some satellites of the future will be operated by one nation, whereas others will be jointly operated by a group of small nations. All are situated in a geostationary orbit some 36,000km above the equator where they remain at the same position above the earth's surface. They are expected to have a very great impact on health and medical care in many of the developing countries. ●

SPECIAL ANNOUNCEMENT

PRINTED CIRCUIT BOARDS SERVICE FOR *PW* PROJECTS

It has now been decided, commencing with our issue dated September 1978, to enlarge the facilities for the supply of p.c.b.s to readers by authorising additional suppliers. It is hoped that readers may benefit from being able to purchase boards as part of component kits, thereby reducing the number of separate orders for a project.

For some time, most p.c.b.s published in *Practical Wireless* have been available exclusively from Reader's PCB Services Ltd., P.O. Box 11, Worksop, Notts, who will continue to be a supplier and to whom we would wish to say thank you for helping us to get the service started.

Applications for permission to reproduce boards for resale purposes must be made to the editor.

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Aug 77	Morse Code Tutor Cards (SRBP)	A037	4·75+15	☐
Sept 77	Jubilee Electronic Organ	A038	19·00+75	☐
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HOTLINES

A REVIEW OF RECENT DEVELOPMENTS
In general, the author does not have any more information on products than appears in the article.

Go West

If inflation is hitting you and/or you are intending to take a job in electronics, think about the USA. The IEEE (Institution of Electronic and Electrical Engineers) out there reckons that its members' salaries have kept well ahead of inflation over the past two difficult years—and they're still well ahead. Average annual salary is put at around 27,500 dollars, and some members have confessed to raking in 70,000 dollars.

No, I don't have any membership forms!

Watch what you say

Microprocessors seem to be creeping into practically everything these days. There's even one lurking in a new system under development which will recognise continuous speech. The basic unit has a 16 word vocabulary. Each word is converted/translated into a pattern generated by a spectrum analyser. This pattern, representing the word, is then stored in a memory bank.

When the system hears words, it nips along to its memory bank and rummages around comparing the words it's hearing with the words it's "learned". If it finds a match you get a response.

One particular version of the system was hooked up for a demonstration and arranged to respond to single word commands. The whole affair was coupled to the telephone network via a suitable interface. When the system was instructed to hunt through the files of the New York Times Information Bank (which was hundreds of miles away) it did just that. It took less than a minute to display, on a video terminal, abstracts of the particular topic selected.

Intelligent to credit cards

And that's not the end of the microprocessor—yet. They're doing things with them in France, too. Like one company that is actually putting one (albeit a mighty thin one) into a bank credit card. When you think that the familiar 14 or 16-pin in-line package contains only a very tiny, thin chip, then if one can do away with all that bulky packaging a very thin circuit indeed can be had. The exact method of fabrication is still under wraps but the future looks extremely promising. Unlike many credit type cards which can only "store" a very limited amount of information on magnetic stripe, these microprocessor beasties will be able to store lots of things, like the balance in the account which would be easily updated at every transaction. Perhaps they might even put a radio receiver chip in there somewhere: do I recognise someone saying "Hear hear"?

High Power

Hams (radio Amateurs) will remember their first experiments with transistors, particularly using them to generate r.f. Some of the early Ginsberg experiments on 1·8MHz with these three-wire fuses were, to put it kindly, expensively disastrous! One watt was, in the early days, quite something. This contrasts with the new power field effect transistors just out which will happily give 100W of c.w. at 175MHz. Certain advantages are claimed by the manufacturers. For example they tell that the devices draw very little input current and things like biasing and modulating are simpler than with bipolar devices. They also tolerate load mismatches and in terms of distortion they are ahead of bipolars. Third order distortion is reckoned to be about the same as a similar size bipolar component, but because the f.e.t. devices have a square law characteristic the higher order distortion is between 5 and 10dB less.

Spot your Tank

So there you are, peering at your video screen, looking for the enemy. But its difficult. Tanks, for example, can be camouflaged quite cunningly. One answer is to employ a computer with built-in edge detection routines. These things take the data from the sensor and tell the computer to enhance all the straight lines. This crafty dodge has the effect of outlining man-made objects quite dramatically. But we have a problem—the process involves using things called algorithms and these can take some 10 seconds. By that time, our unfriendly tank crew could have done some very nasty things to both you and your algorithm.

However, tank spotters among you can now rest easy because a solution is at hand. The answer has been to use a charge-coupled device which acts extremely fast—almost in real time to all intents and purposes. If you want to be more precise, the manufacturers say it works up to 1,000 times faster than a general purpose computer. The technique employed is subject to a patent and is quite ingenious.

The chip receives the image signal from the electronic camera (another c.c.d. used for the sensor) and gives it to three separate parallel shift registers. Each register takes just one line at a time and so at any instant these registers hold three contiguous lines of the image. Backing these are 20 edge-detection algorithms which are so arranged that they are able to treat the three lines held by the registers as a 3×3 array of nine separate little picture elements.

The straight edge components of the signal are located simultaneously in 2D i.e. in both vertical and horizontal planes. This is achieved by part of the chip continuously calculating the difference in picture signal between the separate picture elements in the little 3×3 array.

And to think I was impressed by the first op amp.

Micropot

If I mention the word "potentiometer" you will probably have a mental picture of a pot about 25mm diameter with a spindle which is always too long and has to be hacked off! But what about the latest potentiometers which are so small you can get a dozen or so on your fingernail? These truly minute pots are only 0·172in. in diameter and 0·1in. high. Presumably a magnifying glass and micro-screwdriver come with each.

Ginsberg

THE PW 'AVON' 2 metre f.m. transmitter

PART 2 BRIAN L. PHILLIPS G8FWM

Board 3—Power Amplifier (Fig. 7)

If a greater power output is required, then Board 3 may be fully constructed as shown and will be found to deliver around 10 watts r.f. output with a 25 volt supply to the final two stages. It is also quite feasible to construct just one amplifier, or two, or three, etc., depending on requirements.

Merely using the single Tr1 on this board will produce about ¼-watt, whereas including Tr2 will increase this to about 1 watt. In each case, the aerial filter will connect adjacent to the appropriate tuning capacitors and the remainder of the circuit is omitted.

Do not apply more than 15 volts to Tr1 and Tr2 as in this configuration Tr2 especially is running near to its maximum rating.

In the completed power amplifier, the two BLY83 transistors are bolted direct to the metal case and holes are drilled in the board for the transistor body to sit in ensuring good heat transfer. Push-on heat sinks are fitted to Tr1 and Tr2, which are wired to the board conventionally.

Readers who intend to operate the Avon Transmitter should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

The board layout for etching is shown in Fig. 8 and Fig. 9 illustrates the component positions.

The aerial filter consists of a parallel-tuned circuit offering low attenuation to the 2m signal, but is effective in reducing harmonic and spurious emissions to an acceptable level.

★ components

BOARD 3

Resistors

⅛ Watt 20%

47Ω	2	R2, 3

2 watt 10%

82Ω	1	R1

Capacitors

Ceramic 50V

2200pF	4	C2, 4, 6, 8
0·01μF	2	C5, 10

Polycarbonate

0·1μF	2	C3, 7
0·47μF	2	C1, 9

Trimmers

3-30pF	Ceramic	8	TC1-8
3-25pF	Airspaced	1	TC9

Semiconductors

2N3866*	2	Tr1, 2
BLY83*	2	Tr3, 4

Inductors

RFC1, RFC2	10 turns 24 s.w.g. enamelled copper, close-wound on 1MΩ carbon resistor
RFC3, RFC4	7 turns 24 s.w.g. enamelled copper 6·3mm dia. self-supporting and spaced 1 turn apart
RFC	All other chokes 3 turns 24 s.w.g. enamelled copper on ferrite bead
L1, 3, 5, 7, 11	1 turn 18 s.w.g. enamelled copper 6·3mm dia.
L2, 4, 6, 8, 10	3½ turns 18 s.w.g. enamelled copper close-wound on 1MΩ carbon resistor
L9	2 turns 18 s.w.g. enamelled copper 6·3mm dia.

Miscellaneous

Heatsinks. Push-on types 85° c/w for Tr1, 2. RS type 401.409

SKR 50Ω BNC socket (Aerial to receiver)

SKA 50Ω F & E type SO239 socket (Aerial input)

*If difficulty is experienced in obtaining the transistors for this project, they are stocked by Technomatic Ltd., 54 Sandhurst Road, London NW9.

Case Foxall T4108 (Watford Electronics)

Chassis Foxall T2004 (Watford Electronics)

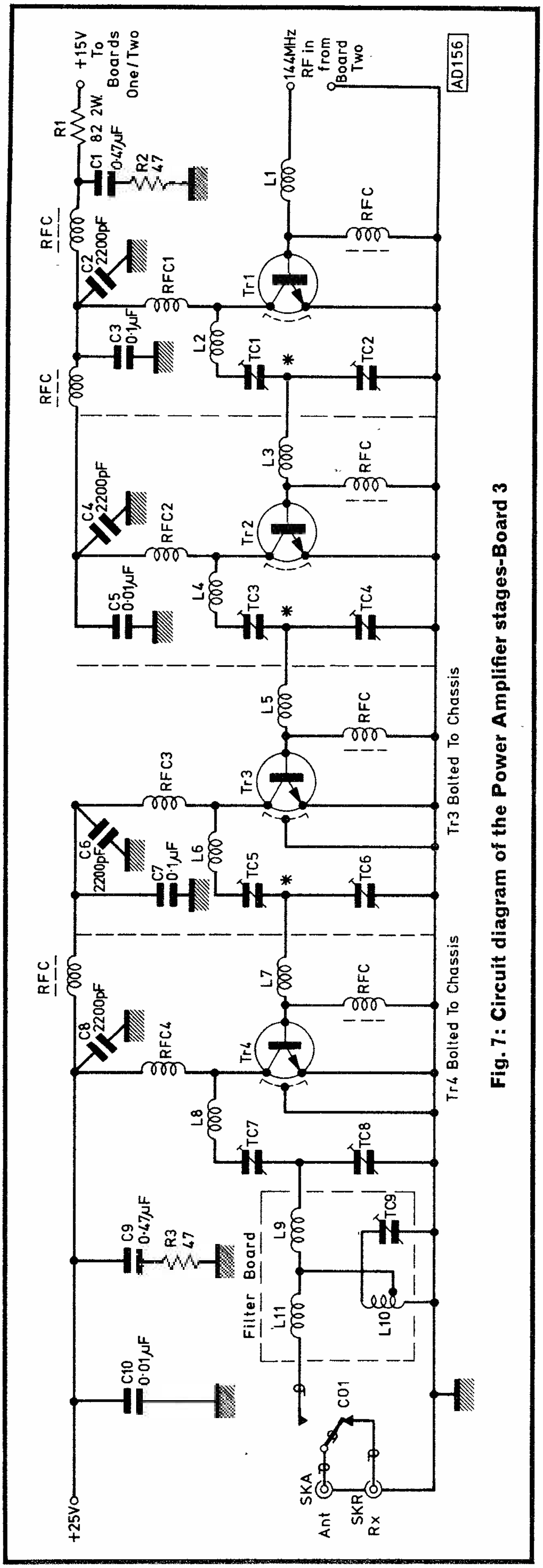


Fig. 7: Circuit diagram of the Power Amplifier stages-Board 3

Two small inductors either side of the tuned element resonate at the second and third harmonics respectively and further reduce the possibility of radiation at these frequencies.

A small, separate board supports the filter and is mounted close to the chosen output stage.

The low level r.f. input from Board 2 is coupled to Tr1 base via a short length of miniature 50Ω co-axial cable. Inductor L1 provides a match into the base/emitter junction of the transistor with L3, L5 and L7 of the following stages.

Each stage is in class C and there is therefore no d.c. bias required. Each positive half-cycle of the r.f. sinewave input turns the transistors on and the flywheel effect of the collector tuned circuits modifies this pulsed signal to a sinewave again.

To allow a d.c. path from base to emitter, small ferrite-cored r.f. chokes are used from base to ground. These are marked "r.f.c." on the diagrams and they are all wound in a smiliar manner, including the three used in the supply line decoupling.

The inductors RFC1 and RFC2 are wound on ½ watt 1MΩ resistors, their leads being used to anchor the windings.

All remaining r.f. chokes are air-spaced types and pictorial details are given in Fig. 12.

Note that the high-power output and driver are fed directly from the 25 volt d.c. supply whilst the remainder of the transmitter, with the exception of the display, is fed from an integrated circuit regulator type 7815. This device has short-circuit and over-temperature protection, and delivers a constant 15 volts at up to 1 amp.

Its inclusion is not necessary if a reasonably stable d.c. supply is available, and of course the entire transmitter can be operated from 12 volts at reduced output.

Relay Switching (Fig. 10)

The incoming 25 volt supply has a diode D1 (BY127) inserted in series with its positive line as protection against polarity reversals. Relay RLA is the keying relay, and is operated by the microphone pressel switch or by the "send" toggle on the facia of the transmitter. The co-axial relay CO is the aerial changeover, and operates through contact RLA3 of the keying relay.

On operating the microphone pressel switch, RLA operates, RLA1 completes the circuit to the 15 volt regulator, RLA2 illuminates the status l.e.d. "send", RLA3 energises the co-axial changeover relay CO and RLA4 applies the 25V to the BLY83 final amplifiers.

The "send" switch S3, located on the front of the transmitter merely overrides the microphone switch and provides a latching facility, enabling the transmitter to be permanently keyed.

Switch S1 "cal" enables the transmitter to be keyed at very low power by removing the 25 volts to the power amplifiers. Contacts S1a close, completing the RLA coil circuit; RLA1 closes, RLA2 changes over but the "send" l.e.d. is prevented from operating by S1c. The CO relay circuit is completed by RLA3, RLA4 closes but the 25 volts is prevented from reaching the power amplifiers by S1b, which is open.

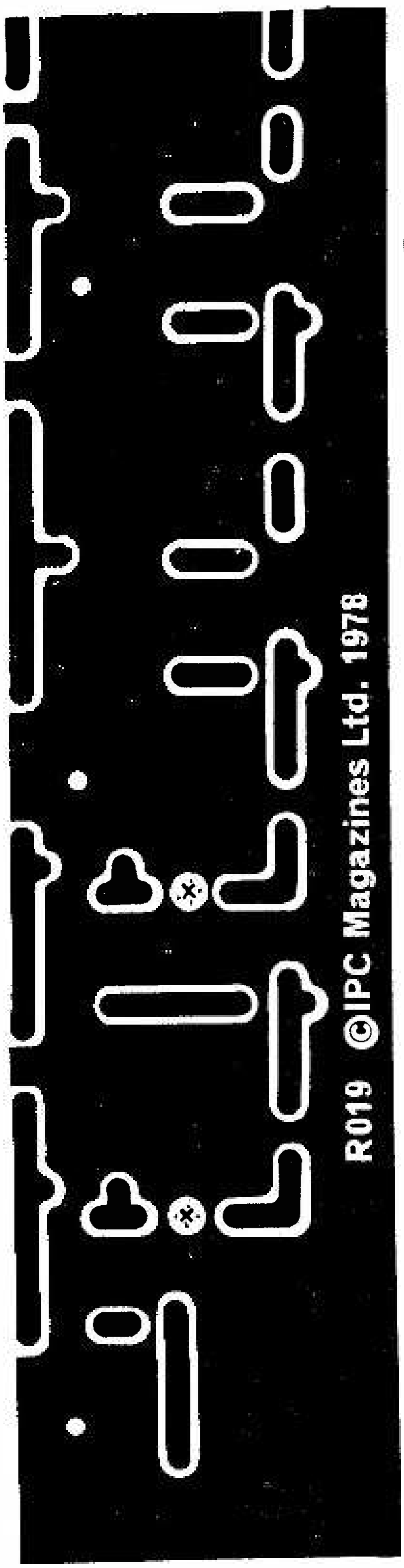
The "tune" facility S2a again energises RLA; S2b disables the 25 volt supply to the power amplifiers and operates the "net" l.e.d., whilst S2c prevents the aerial changeover relay CO from operating.

An additional contact set on RLA can be used to provide a loop make or break facility for receiver muting and sufficient contacts on the d.c. input plug have been provided for this option.

Tuning

Each transistor collector is series-tuned to give a low impedance feed to the following stage and ultimately to the aerial. The trimmer furthest from the board edge in each section—i.e. TC1—tunes the coil, and the other—TC2—is adjusted for maximum drive into the next stage.

This arrangement has proved to be both reliable and stable in operation. Tests with the prototype indicated that however badly out of alignment the board was, negligible stray oscillations or spurious signals were produced. Should the board be well off tune, there will be no output.



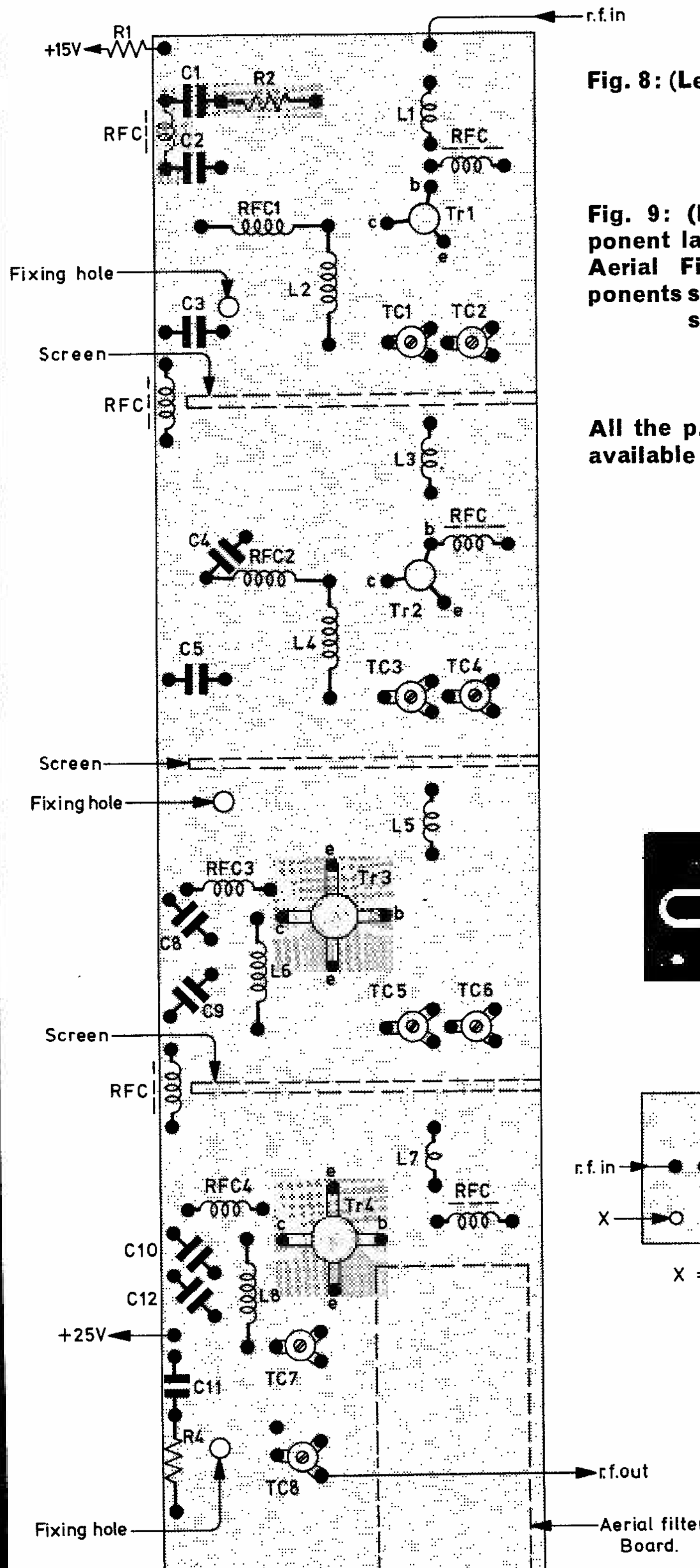
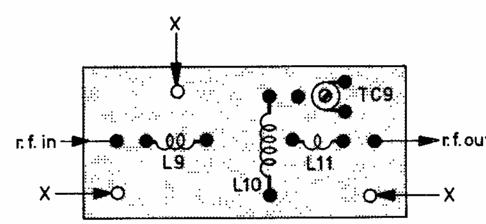


Fig. 8: (Left) Copper side layout of Board 3

Fig. 9: (Right and below) Component layout of Board 3 and the Aerial Filter Board. Note components soldered directly to copper side of the p.c.b.s

All the p.c.b.s for this project are available from: PW Reader's PCB Service



X = 1/16" holes for ground leads to main board.

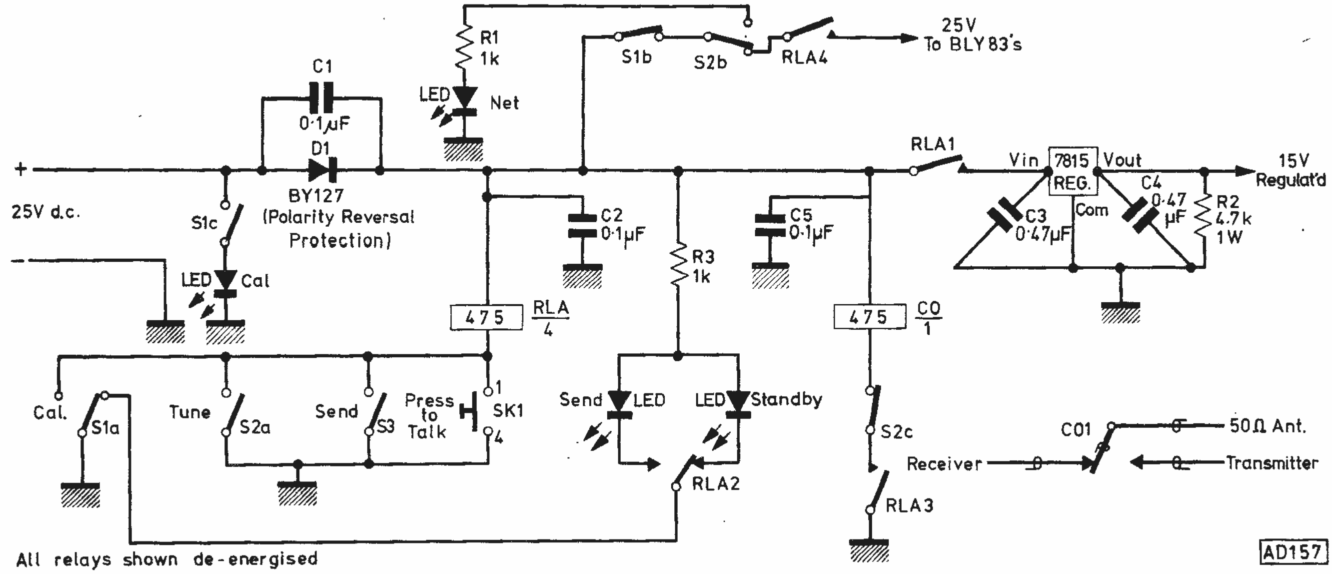


Fig. 10: Circuit diagram of the switch and relay wiring

Decoupling

Notice on the circuit diagram the extensive use of capacitive decoupling on the power supply lines. Various values are used to give broadened effectiveness and the specified types are particularly important here.

A characteristic of the r.f. power transistor is that generally speaking it will not withstand high switching transients, such as those produced by relays. Filters are therefore included from the supply rail to ground thus reducing the charging effects on the line as the voltage is applied and removed.

★ components

POWER SUPPLIES AND SWITCHING ARRANGEMENTS

Resistors		
1/8 watt 20%		
1kΩ	2	R1, 3
2 watt 20%		
4·7kΩ	1	R2
Capacitors		
Ceramic 50V		
0·01µF	3	C1, 2, 5
0·047µF	2	C3, 4
Semiconductors		
Diodes		
BY127	1	D1
Regulators		
7815	1	+15 Volts
Relays		
RLA	6 c.o. Siemens plug-in type 475Ω or RS 349.169, with base	
CO	12-24 Volt co-axial relay. Magnetic Devices or RS type 349.686	
Switches		
S1, 2, 3	4-pole double-throw miniature toggle RS type 316.816	
Miscellaneous		
4 l.e.d. indicators		

Hardware Notes

The prototype was constructed in a Foxall T4108 instrument case on a Foxall T2004 chassis specifically made for this enclosure (see Fig. 11).

The boards are bolted directly to the chassis, with the exception of the oscillator (Board 1), which is supported by small insulated pillars and secured by 6BA PK screws. Construction is not too critical, provided clearance for the switches etc on the front panel is allowed and sufficient room is made available for the relays, co-axial sockets and power jack.

Three different types of 50Ω co-axial connector were used to avoid confusion or the accidental insertion of wrong cables. The aerial input is an SO239, the aerial output (to receiver) a BNC and the v.f.o. input a miniature BNC: power is applied via a 4-way McMurdo connector.

Tuning (Boards 1 and 2)

After checking for correct values and component positioning, power can be applied to Boards 1 and 2 having first made the necessary r.f. connections with miniature 50Ω co-axial cable. Temporarily solder a 60-80Ω ½ watt resistor across the output and ground, i.e. across TC7. Set all trimmers mid-way and the slugs in L1 (Board 1) and L1 (Board 2) to the centres of their respective coils. Do not connect Board 3 at this stage.

With a diode probe connected to a suitable meter (f.s.d. 50-150mA) and with power applied to both boards, check the oscillator output and tune TC1 on board 2 for maximum signal at the base of Tr2. Loosely couple L1 to a receiver tuned to 24MHz and a strong signal should be detected. Establish that TC1 tunes this frequency by turning it through 360°, when a rise and fall in output should be produced.

Place the probe on the base of Tr3 and adjust TC2 or maximum. Now transfer it across TC7, adjust TC4 and TC5 for maximum level, peaking TC6 and TC7. Repeat all tuning until no further improvement can be obtained.

Signs of erratic tuning indicates either an incorrect crystal harmonic from L1 or some other source of instability.

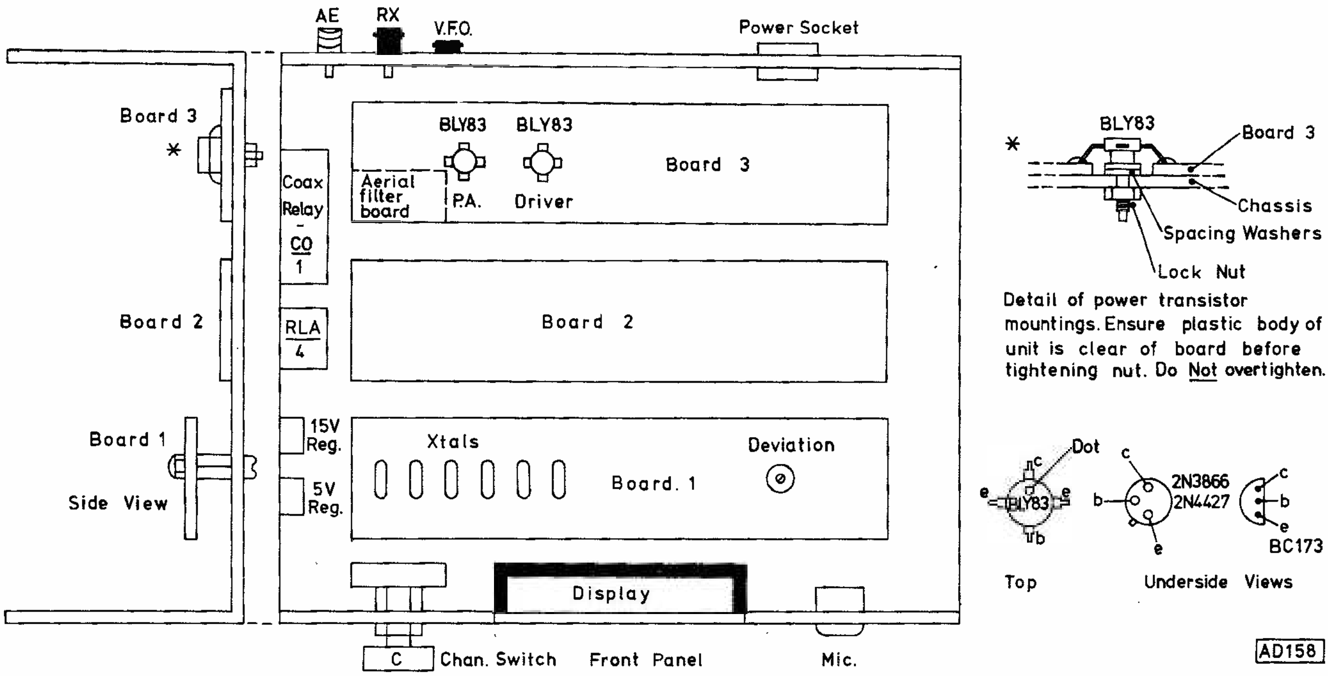


Fig. 11: Suggested chassis layout and details of transistor connections

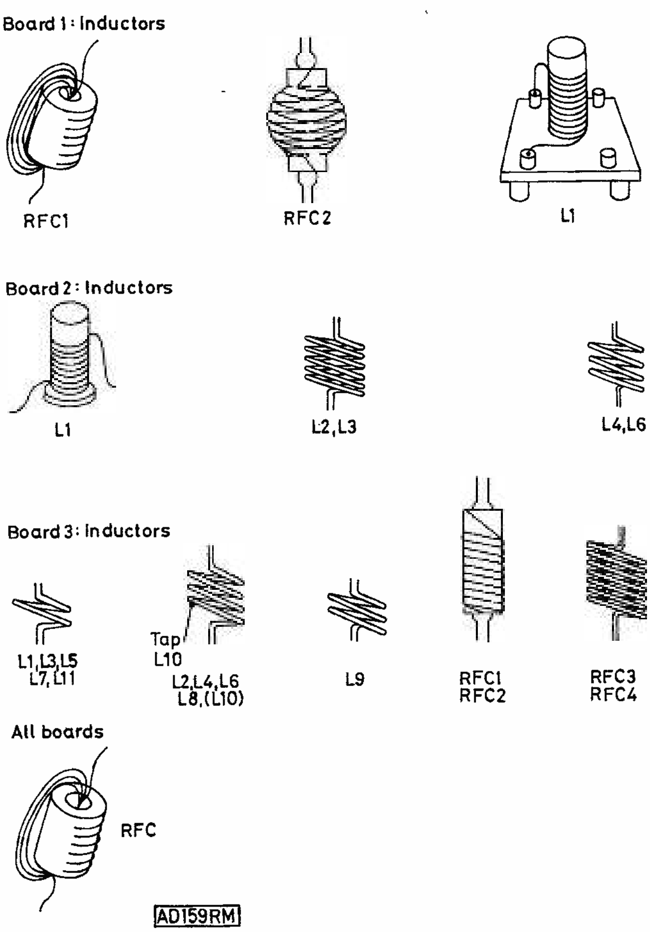


Fig. 12: Pictorial details of inductors

quite hot, as they are designed for temperatures of 150°C. The section of chassis around the power output transistors will become warm after a few minutes operation.

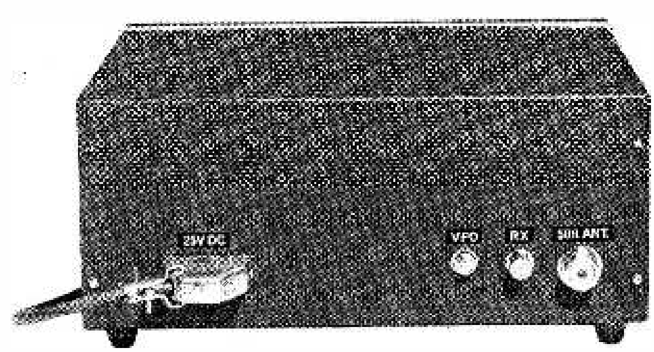
Remove the power from the transmitter and the link across the aerial filter. Re-apply voltage and adjust TC9 for maximum output: a sharp point should occur where maximum power is reached.

Remove the dummy load and couple an aerial via an s.w.r. bridge to the transmitter. Key the unit and re-adjust TC7, TC8, TC9 for maximum forward reading. The setting will most likely differ from that used when tuning into the dummy load, due to a variation of impedances.

Channel Frequencies

As previously discussed, a number of crystals covering several frequencies within the 2-metre band can be utilised. Each crystal will have an associated trimmer and capacitor, the precise frequency being set by means of a counter or calibrated receiver.

NOTE: In compiling the components lists for part 1, a few inconsistencies occurred. The following values are correct:
Board 1. R5-15kΩ, R6—8·2kΩ, R11—68kΩ, R15—10kΩ
Board 2. R4—10kΩ, R13—56Ω, C3—0·1μF
Also on Fig. 3 page 46; C18 should be shown in parallel with R15.



Next month we will consider the digital display and power supplies for the Avon.

Battery Power Supply for
The PW ECOMONY TIMING STROBE

G.GOULD

If, like myself, you live on the top floor of a high-rise block of flats then you will appreciate the problems involved in using the *PW* Economy Timing Strobe featured last February.

The need to use the mains supply to power the strobe tube seriously limits its use to those who have easy access to a suitable mains socket.

If the strobe could be made to operate from the car battery then its usefulness would be improved immensely.

The power supply described here is both simple to build, cheap and can be fitted into the case used for the original version.

The inverter shown in the circuit diagram produces around 400V and is a conventional inverter circuit using one transistor to convert the d.c. supply to a.c. ready for transforming up to 400V at the secondary of the transformer.

As the circuit is so simple and uses few components the construction can take any convenient form such as Veroboard or a small tag strip.

The transformer bobbin is wound with about 150 turns of 29 s.w.g. enamelled copper wire which is covered with a layer of insulating tape. This winding, which is the secondary, should almost fill the bobbin leaving just enough room for the primary and feedback windings (8 turns and 4 turns respectively). Take care to note the start and finish of the primary and feedback windings as this is important to ensure that the inverter oscillates.

The two ferrite pot cores can then be bolted together with the bobbin inside and the finished transformer secured by the central bolt to a convenient place in the box.

The small piece of Veroboard or tag strip can be bolted using the same bolt as shown in the drawing.

A standard line fuse should be inserted in the cable which is to be attached to the live terminal of the car battery to give protection against short circuits and other disasters which might possibly occur during use.

The basic circuit of the inverter can be used to power a standard 2 foot long fluorescent tube as an emergency lighting unit. In this case D1 and C1 should be omitted and R1 changed to 220Ω. The unit can then be run from a 6V lantern battery.

The method of connecting the strobe unit to the Number 1 plug lead suggested in the original article and the subsequent Extra Data published in the April issue may prove difficult to use on some engines and a modification is to use a length of Bowden cable outer sleeving to provide a flexible take-off point instead of the rigid 4BA stud. The 4BA stud should of course be fitted to the end of the flexible cable. ●

★ components

Resistors
1W 5%

820Ω	1	R1
220Ω	1	R2

Capacitors
Polyester 250V

10μF	1	C1

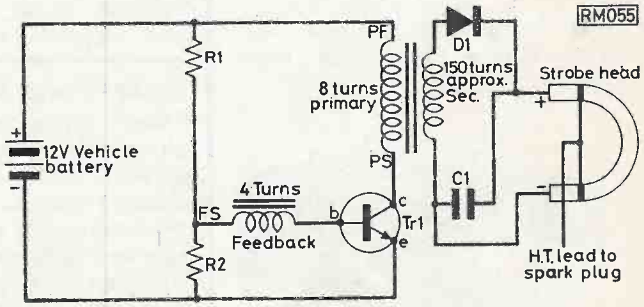
Semiconductors
Diodes

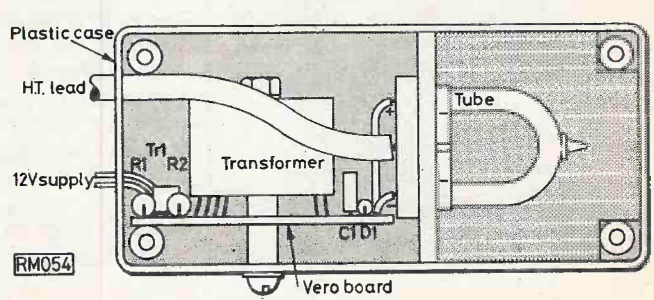
BY127	1	D1

Transistors

2N3055	1	Tr1 (TIP3055 or other similar power type)

Miscellaneous
- Transformer, Ferroxcube FX2242 potcores with bobbin
- Twin core cable
- H.T. cable
- 29s.w.g. enamelled copper wire
- Automobile line fuse assembly
- Croc. clips for connecting to battery. (2)





Circuit diagram and layout for battery-powered strobe

PRODUCTION LINES

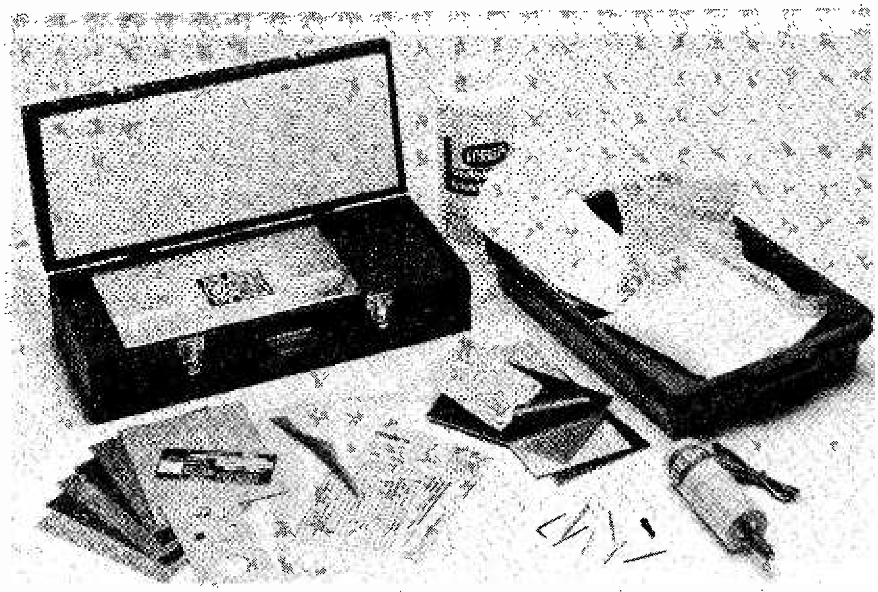
alan martin

Telephone Charge Clock

Trying to calculate the cost of a telephone call while you are actually making it is an almost impossible mental exercise. An attractive new unit by Monitel now makes the process simplicity itself. All that is required of the caller is to select the appropriate charge band, as listed in the Post Office dialling code book, and start the clock at the appropriate moment. The microprocessor-based circuitry does the rest, displayed the accumulating charge continuously on an l.e.d. display, and taking account of the time of day, and the day of the week. The unit is programmed by means of a punched card, and in the event of a change in charge rates, can be reprogrammed by inserting a new card supplied by the makers.

When not in use, the display functions as a conventional digital clock. Produced in similar style and colours to Post Office telephones, the Monitel Telephone Charge Clock is available in a UK version, retailing at about £29, and an International version at about £39. The latter also copes with a selection of the charge bands for overseas calls.

Further details are available from *Monitel Limited, Berechurch Road, Colchester CO2 7QH.*



Light work

Mega Electronics Ltd. have introduced a comprehensive kit which enables the preparation of artwork for, and the production of, both printed circuit boards and front panels or labels.

Known as the Photolab Kit, it consists of an ultraviolet exposure unit, draughting aids and film, positive resist coated epoxy glass laminate sheets, developing and etching trays, label and panel materials, high-speed drill, and all the requisite developers.

The Photolab Kit has been designed for use by both the amateur constructor and the professional engineer. It has been introduced to fill the gap between commonly used '1-off' prototype p.c.b. production methods and the facilities offered by the existing, larger kits currently available. However, with its pricing at only £49·50, complete, and its ability to handle p.c. boards and labels of up to 228 × 152mm, it is anticipated that the kit will have wide ranging appeal in both sectors of the market.

Available from: *Mega Electronics, Ltd., 9 Radwinter Road, Saffron Walden, Essex CB11 3HU. Tel: (7099) 21918.*

Tele-View Module

Texas Instruments have recently announced the production in quantity of their VDP11 combined Viewdata/Teletext decoder module. It uses a microprocessor system based on the familiar TMS 9980, which performs Viewdata decoding, and if used with a remote control system, a code-converting PROM on the input lines enables the codes to be chosen by each customer. An internal TV sync. generator is included, and this is automatically switched in when Viewdata is selected. Auto-dialler telephone numbers are controlled by a four-pole DIL switch, and the unit also features terminal identification.

The complete p.c.b. module (300× 165mm) is available from *Texas Instruments Ltd., Manton Lane, Bedford,* priced at approximately £250, depending upon options selected; a version of the VDP11 with expanded memory in the microprocessor system, suitable for editing terminals, is expected to be available shortly.

PCB aids

A comparatively new product is available which will be of great benefit to engineers and amateurs who need to make their own printed circuit boards.

The Alfac Electro range of dry transfers contains almost 100 different patterns for making printed circuit layouts, quickly and accurately. As the symbols are etch resistant, they can be used for making 'one-off' printed circuits by direct application on to copper clad boards.

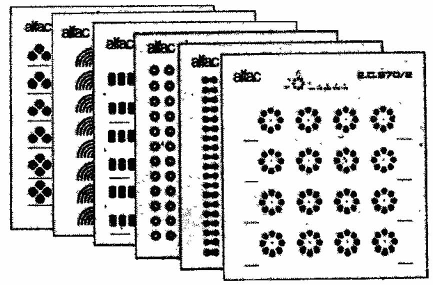
They are simple to use, and need no

special 'fixing' since the double action adhesive used, prevents the patterns from moving once they are laid down. The quality of the ink used avoids any cracking enabling users to obtain a very fine detailed finish.

They are available in a range of patterns and sizes and give correct spacing for integrated circuits and transistors. Also available are a range of lines and rounded corners etc., thus enabling a highly professional standard of finish to be achieved.

Alfac Electro transfers are economical in price and are available in handy blister packs which are ideal for storage. They do not deteriorate with age and if left on their backing sheets can be used after months of storage. Each blister pack contains 5 sheets of patterns and costs £1·30.

Further details and catalogue can be obtained by writing to the sole UK agents for Alfac; *Pelltech Ltd., Alfac Electro Division, 6 Church Green, Witney, Nr. Oxford.*



A selection of some of the patterns available

LETTERS

Pen-Pal

Sir: I am a Ghanaian boy of seventeen years old. I am a first year apprentice in radio and TV servicing. I plan to start a course in radio and TV servicing, and I would be happy if you can help me to correspond with any beginner or experienced radio and TV technician from anywhere and of any age.

Francis K. Acquaye
c/o Mr. K. Agyei
Box 756
Takoradi
GHANA

CQ-CQ

Sir: It seems a long time since I saw a "CQ" column in *PW*, and I wondered whether any reader could loan me for no more than just a few hours, the assembly instructions, or even just the circuit-diagram only, of the Tandy's "ArcharKit" Timing-light Kit, Cat. No. 28-4061.

This kit is discontinued, and the instructions were missing. In spite of exhaustive enquiries, Tandy have been unable to turn a replacement set up.

Jim Robson
47 Rosewood Crescent
Newcastle upon Tyne
NE6 4PR

KINDLY NOTE!

Portable P.A. Amplifier, December 1977

In Fig. 3, three additional breaks are required in the Veroboard tracks, as follows:—

1. Between +ve end of C4 and bottom end of R1.
2. Between top end of C3 and top end of C5.
3. Between bottom end of C5 and bottom end (−ve) of C12.

Band II FM

Sir: I would like to hear from any of your readers who are interested in long-distance Band II v.h.f. (f.m.) reception. I have made contact with several people in the immediate locality, and feel sure that there are others who find the possibility of alternative good-quality programmes (both mono and stereo) interesting.

Some years ago a series of articles on Band II topics, written by Mr. Austin H. Uden, appeared in *Hi-Fi News*. If any reader knows of an address where Mr. Uden can be contacted, I would be grateful if they could send me details.

G. P. Stanbury
275 Meadgate Avenue
Great Baddow
Chelmsford
Essex CM2 7NJ

Mains Plugs

Sir: I read with interest your editorial about plugs and fuses (*PW*, May, p 18).

It may be of interest to compare the situation here with that in America. Over there, there is only one kind of plug configuration, so all appliances come with the plug already fitted. However, there are no fuses in plugs, nor switches on outlets. Most appliances have two-pin plugs, with no earth pin, though all outlets accept three-pin plugs.

Perhaps this country could combine the advantages of the two systems by standardising on a single type of plug. Then manufacturers could supply equipment with plugs and fuses already in place.

M. A. Covington
Cambridge

The proposed 16A "International" plug and socket has most of the features of the American plug described in this letter. Ed.

Sir: The recent comments in *PW* about 13A plugs have been most interesting.

May I point out that it is good practice to wire such a plug so that there is more slack in the earth lead than in the other two. Then, if the cable is wrenched from the plug, the earth lead is the last to part company, maintaining the safety of the equipment.

Plugs like those mentioned in May's *PW*, which accommodate equal length leads, do not encourage this practice. They should have the earth connection point even nearer the cable grip.

E. F. Chase
Titchfield, Hants

IMAGE REJECTION FILTER

R.A.PENFOLD

Image Rejection Filter

Use of the superheterodyne principle enables highly efficient communications receivers to be produced, but these sets are not totally free from flaws. The main drawback experienced with most s.w. superhet receivers is what is termed the "image response." This is a secondary response of the set which at high frequencies is often nearly equal to the main response, or "primary" signal.

The image response is produced because there are actually two possible difference frequencies for each oscillator frequency. One is equal to the oscillator frequency minus the i.f., and this is conventionally the main response. The other is equal to the oscillator frequency plus the i.f. Thus in order to convert a 1MHz signal to an i.f. of 455kHz, the oscillator would operate at 1·455MHz, and the image response would be at 1·91MHz (1·455MHz+0·455MHz).

Reducing the Image Response

Usually the image response is attenuated by using one or more parallel tuned circuits ahead of the mixer in the basic manner shown in **Fig. 1(a)**. Theoretically, a parallel tuned circuit has a very high impedance

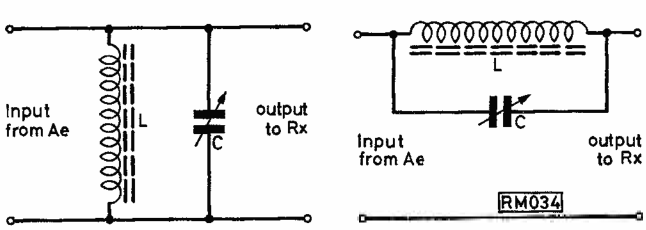


Fig. 1(a) Parallel-tuned, parallel-connected tuned circuit, and Fig.1(b) parallel-tuned, series-connected tuned circuit

at its resonant frequency and a low impedance at other frequencies. By tuning the circuit to the desired input frequency the input signal should pass unhindered and the image signal should be largely shunted to earth.

A practical tuned circuit does not achieve anything like perfection, and there will be some attenuation of the desired signal and perhaps only modest attenuation of the image signal. Several factors determine just how much attenuation of the image signal can be obtained, and one of the most important is the ratio of the input signal frequency to i.f.

In our example of an image response at 1·91MHz, produced by a 455kHz i.f. this response is at virtually double the original. Even a single tuned circuit would be sufficient to greatly attenuate the image response. If the same receiver were to be tuned to a frequency of 10MHz the image response would be at 10·91MHz, which is less than 10% higher than the primary signal. Therefore, the image rejection of a receiver falls away with increasing frequency, and on many sets it falls to a surprisingly low level. For example, a typical s.w. receiver might have two tuned circuits ahead of the mixer, an i.f. of 455kHz, and an image rejection of about 20dB at 14MHz, which means that the set is only ten times more sensitive on the primary frequency than it is on the image frequency. At higher frequencies the image rejection would be further reduced.

Problem Area

In practice it tends to be on the 20 metre amateur band that a lack of image rejection becomes most troublesome. This is because the image response overlaps the 19 metre broadcast band, and strong signals from that band can often largely obliterate the h.f. end of the 20 metre band. This only occurs with receivers having an i.f. in the 455 to 470kHz range, but unfortunately this probably includes the majority of communications receivers in amateur hands. The author experienced this difficulty with his Trio QR666 receiver, and it was this that prompted the construction of the simple filter which forms the subject of this article.

Rejection Filter

Probably the most obvious way of increasing the image rejection of a set is to insert an extra parallel tuned circuit in the r.f. signal path, as in **Fig. 2**.

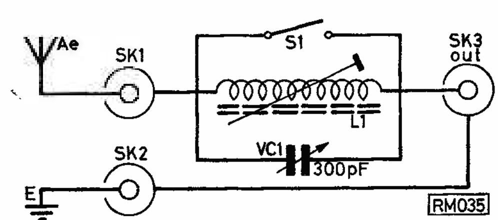


Fig. 2: The circuit of the rejection filter—a parallel-tuned, series-connected tuned circuit, modified to make its response variable

Here the tuned circuit responds to the image frequency rather than the primary signal. As mentioned earlier, a parallel tuned circuit has a very high impedance at resonance, and so this should result in almost total suppression of the image signal and the wanted signal can pass with virtually zero losses.

The practical circuit of **Fig. 3** clearly does not achieve perfection, but can provide a high degree of image rejection. A signal breaking through at about S9 or so can be reduced to less than S1, and the wanted signal is only very slightly attenuated.

The circuit is very straightforward with VC1 and L1 forming a variable tuned circuit which can be adjusted over the range 12MHz to 30MHz approximately. S1 enables the tuned circuit to be shorted out when the filter is not required.

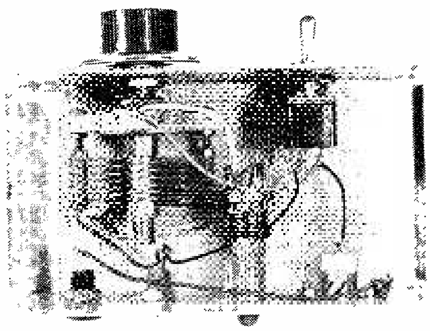


Fig. 3: A photograph of the practical layout, which is simple enough to construct from the theoretical circuit details

★ components

VC1	Approx. 300pF to 400pF air spaced variable.
L1	See text.
S1	S.P.S.T. toggle type.
SK1	Red wander socket.
SK2	Black wander socket.
SK3	Flush mounting coax socket.

Miscellaneous
Metal case.
Control knob.

Construction

L1 consists of $6\frac{1}{2}$ turns of 0·9mm diameter enamelled copper wire wound around the bottom part of a Denco $\frac{3}{8}$in (9·5mm) coil former. This is fitted with an iron dust core which is adjusted so that the threaded part of the core is flush with the top of the coil. If preferred, a ready made coil can be used. Suitable types are Denco Range 5 blue aerial or yellow r.f. coils. Use the winding between pins 1 and 6, and ignore any others. The tuning capacitor can be any good quality air spaced type having a maximum value in the range 300 to 400pF.

Using the Filter

The filter is coupled to the receiver via a short length of coaxial cable. When an interfering signal is noted, it is merely necessary to switch the filter in and adjust VC1 to null this signal. ●

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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

As promised last month I should like to discuss the question of what makes a callsign or prefix "rare". It arises with those listeners who start to keep a log of stations heard in the amateur bands.

The newcomer who has just heard his first American amateur, probably on 20m s.s.b., is a little put out when more experienced listeners do not share his initial excitement. In fact, thousands of such stations can be heard, as our beginner will soon appreciate!

He'll go on to log calls from around the world and tick them off against a prefix list. He'll notice that some countries, like the US, are divided into call areas comprising groups of states. On the other hand G2, G3, G4, G5, G6, G8 and several other derivatives could all be in the same block of flats, in England!

Some of the prefixes are hard to find but periods spent listening during the wee small hours will always produce a few more. Certain countries do not appear to have any amateurs at all, frequently due to political reasons. Some "countries" are no more than reefs or small islands that are uninhabited until a group of amateurs form themselves into a DXpedition in order to put a new country in the log of thousands of amateurs.

It is very important to note that **distance** does not come into the question as to whether a call is rare or not. Due to skip it might be next to impossible to log a station in GU (Guernsey) on 20m, while capturing all the VK areas without difficulty. The purpose of the log extracts each month is to alert readers to the comparatively few rare calls that have appeared recently.

Details of time and precise frequency are not required because of the time that the information takes to get into print. The date and band and mode is sufficient. An excellent prefix list with much other useful information costs just 40p from Geoff Watts, 62 Belmore Road, Norwich NR7 0PU. No amateur can afford to be without it.

Talking about sunspot curves, a plot of rainfall against letters received here would be very interesting! Lousy weather so plenty of mail this month!

Newcomers

Having read this column for the last three years **Paul Bown** at 2 Sunnyside, Theale, Reading, Berks has at last acquired a receiver. Unfortunately it seems to need a bit of attention, not doing much above 20MHz, and Paul is very keen to get on 10 and 15m. So, can anyone help with a manual for the Skywood CX203? Replies direct to Paul, please.

Four months on the bands with an FRG7, and a good log, hardly qualifies **J. S. Goodier** of Marple, Cheshire as a newcomer. He is now keen enough to start studying for the RAE! He thinks he may have to go it alone but I hope my advice to contact his local radio club and technical college may avoid that.

Round the Shacks

Dave Greenhalgh BRS39965 in Poynton, Cheshire found two goodies in VK9NGE on Norfolk Is. and VR1AR in the Gilbert Is. on 10m. I hope **Bill Rendell** down in Truro, Cornwall won't mind if I mention him in this section. He has been lapsed for seven years but is hard at it again with a 1961 Heathkit AR3 four-valve set plus preselector and a very short wire in the attic. Naturally, selectivity is a problem and I fear that something a bit better may be the only answer. Bill reckons the lads and lasses would do a better job communicating if they stuck to the proper phonetic alphabet instead of the "homebrew" variety.

An AR88 and 120ft of wire brought in strings of Japs on 10m for **Brian Harrison** in Hastings, Sussex while in Tetbury, Glos. **Jim Rowland** is putting the finishing touches to a Heathkit HR1680. He finds the components a bit "fiddly" compared to those of the '20s! **Dick Smith** reckons he is the only SWL in Porthcawl, Mid-Glamorgan but I doubt it very much! He has a Codar MC3 t.r.f. set with pre-selector, a.t.u., 100ft of wire and an "artificial earth" whatever that is! Could be a collection of quarter wave wires all joined to the set's chassis. A CR100 will, hopefully, be added to the strength in the holidays.

Army type **Sgt. Anderson,** Dennis, also BRS36591, reports back to the column after wandering around Jamaica and the Sudan. Wonder if he saw my old tribander still up there in Khartoum? Dennis now has a Venus SS2 for SSTV and getting good results, with RAE studies going on apace aided by G8LVB. **John Whiting**, Fareham, Hants, has done well in the Pacific area with a sort of vee beam with 90ft legs, with the feed from one end.

G. M. Davies of Rhyl, N. Wales has been SWLing for 25 years and has reached the FRG7 stage, but wishes the Fine Tune were a lot finer and doesn"t and two rather sharp nulls. It is the nulls that are of use to the DXer. A loop is used to null out QRM. It is not used to peak up DX.

How to use the Loop

A loop is very easy to use. For example, with the loop pointing in any direction, tune the receiver to 782kHz and peak up the mixture of stations heard, using the loop's tuning control. East Germany and Portugal are on 782. Now rotate the loop slowly around its vertical axis. In one position East Germany should be heard reasonably clear of QRM while in another position Portugal will appear. Similarly on 989kHz where from this QTH Madrid can be heard clear of the jamming that is normally on this channel. Similar results can be obtained with a transistor portable that has an internal aerial. The whole receiver must be rotated and the two nulls on most models will be along the length of the receiver parallel to the tuning scale.

When DXing with a loop, rotate it for optimum results. North American DX often suffers from QRM from Latin America and the two are easily separated. The loop may not always null out QRM. North American DX sometimes has European QRM coming from the opposite direction from the DXer and the loop cannot help on this occasion. On the other hand European QRM can nearly always be nulled out when listening to South America.

Advantages and Disadvantages of Loops

The only disadvantage the loop has is its low pick-up compared with a long wire. My 40 inch loop has a pick-up somewhere between that of my 90ft longwire and a ferrite rod aerial. It is claimed that the standard 40 inch loop has a pick-up equivalent to a 30ft long-wire 10ft above the ground and although I have not done comparative tests I think this value is about right.

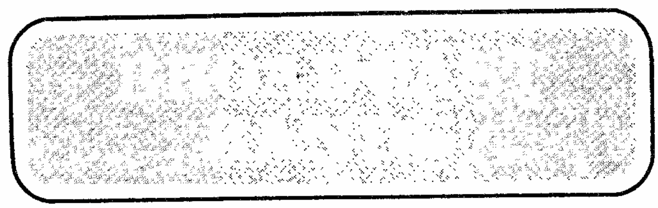
The loop has a number of advantages in addition to its ability to reduce QRM. It is an indoor aerial and can be used in locations where a long wire could not be erected. Some excellent DX comes from readers who live in multi-storey flats. A loop will nearly always improve the signal-to-noise ratio and if static is coming from one direction, perhaps from tropical thunderstorms in the south in summer, then the static can be eliminated when listening to North America to the west. DXers claim that a "cleaner" signal is sometimes obtained when using a loop and surprisingly, this is true. Overloading, sideband splatter, cross-modulation, when reduced can leave a much cleaner DX signal on some receivers. Loops are not made commercially in the UK so you will have to make your own. This is not a disadvantage. A lot of satisfaction is to be had from quite a simple device that you can easily make yourself and that will on occasion produce quite startling results.

Problems with Loops

Reader **John Cook** of Southend-on-Sea has constructed the loop described in the 1976 edition of the *World Radio and TV Handbook*. The tuning capacitor is a 365pF variable and the loop works well between 525kHz and 1250kHz, but on higher frequencies John has to switch out the tuning capacitor. Try reducing the number of turns. You should then be able to tune to 1605kHz but you may then not be able to tune as low as 525kHz. If so, switch in additional capacitance (220pF should do) whenever you want to reach the l.f. end of the band. The general rule is; if you cannot tune to the h.f. end, remove turns and if you cannot reach the l.f. end, increase the tuning capacitance.

As a rough guide, 100ft of wire will be found to be the correct length to wind most loops irrespective of size. On this basis a loop of 4ft size would have six turns, though it might be possible to squeeze in another turn or two if the self capacitance of the winding and the minimum value of the tuning capacitor are low.

A number of readers, including John, ask for details of a suitable pre-amplifier for use with a loop. My advice is, do not use a pre-amp, at least until you have some experience handling a loop. Even then a pre-amp is of limited value. The same applies to the use of a preselector on the medium waves. DX on this band is often quite strong and it is interference, some 80 megawatts in Europe, that is the problem. High selectivity, not high gain, is what is required and a loop pre-amp or preselector may easily overload the receiver.



SHORT WAVE BROADCASTS
by Charles Molloy G8BUS

During the early days of wireless, Saturday was aerial cleaning day when enthusiasts used to scrub their aerials with steel wool to remove corrosion and hopefully, bring about improved reception. While it is not suggested that this practice should be resurrected it is a fact that outdoor aerials do require maintenance now and again and summertime, when the days are long and the weather is kind, is the time to do it. Several years ago I discovered with horror that my long wire was no more than a 10ft lead-in, as the joint between lead and aerial had corroded away!

It can be rather annoying if an aerial comes down during the winter when the weather makes repair work difficult and even hazardous. I take down my long wire every summer to examine it for mechanical weakness or breakage. It is only the active part of the aerial between the insulators, that needs to be copper wire. The parts between insulators and supports can be of stronger material such as steel wire or nylon rope. Leakage is not a great problem when an aerial is used with a modern receiver but if the aerial is down then it only takes a moment or two to clean the insulators and it might just make a difference when you are chasing weak DX. Dirty insulators and bad connections can also cause crackles.

Summer is also the time to experiment with aerials. If you have a long wire then why not try a vertical or a whip? An ounce of practice is worth a ton of theory. If you have the space, try making your aerial longer to see if it makes any difference. Height is usually

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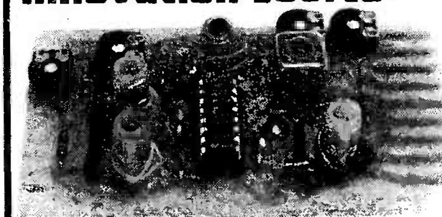

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Transistors for RF : The latest UHF T pack types eg. 1.8GHz PNP only 0.86p. 2N4427* £1.30, BF900 latest generation MOS 0.80* As usual, you get the latest information and ideas from AMBIT.

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LED size	2.5x5mm	5mm	clip
red	17p	14p	2p
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(clip for 5mm types only) All first grade

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The Ambit you all know and love for its unique service to wireless, now brings you the One Stop Technology Shop. A complete range of logic devices, including CMOS, TTL and the increasingly favoured Low Power Schottky versions. Plus all the usual voltage regulators & linears. Combine this with our unique capability in wireless devices, ranging from coils to the latest semiconductors, the uniquely information packed 'Tecknowledgey' catalogue (45p), and you need look no further for your semiconductors- and most other types of modern components. We still want to maintain a separate identity for the unique wireless service of Ambit - so please keep orders for the OSTS (left hand side of this page) and AMBIT (right hand side) seaparetly totalled - although one pp and one combined payment is sufficient - made out to Ambit International, please. Postage is 25p per order, VAT to be added at the rate indicated (*=8%).

2 Gresham Road, Brentwood, Essex. & finishes here.

Solar noise was frequently heard at 28 and 50MHz with normal communications receivers and dipole aerials on May 3rd, 5th, and 7th and large bursts were recorded at 136MHz at 1201 (8 mins) on the 6th and 1213 (37 mins) on the 8th. Noise storms were recorded on May 1st, 4th, and 18th. On April 30th, Henry, using his spectrohelioscope, counted 5 large sunspots, 6 small ones, 3 bright plages and on May 3rd he saw a baby flare. Another look on the 17th revealed 10 spots in 5 separate groups.

Aurora

After that April 28th burst, and with more solar activity on May 1st and 3rd, it was not surprising that auroral events began during the afternoon of April 30th and rolled around, with varying intensity until the small hours of May 4th. Between 1555 and 1720 on April 30th, **John Branegan**, GM8OXQ, Saline, Fife, heard tone-A, c.w., signals from G, GI, GM, PA0, SM and beacon signals from GB3ANG, GI, LER, and VHF on 2m. John found it impossible to access OSCAR-8 during the aurora while the satellite was to the north of his QTH. Alan Baker heard GMs on the 30th and around midnight on May 1st/2nd, Barry Ainsworth had s.s.b. contacts with GM4COX and GM8ODN and a c.w. contact with GM4CXM. At 2354 on May 2nd, Alan worked GI5SJ, at 0013 on the 3rd he worked GM4BYF and heard GI4GVS and GM8FFX.

Around 2215 on May 1st, Neil Clarke heard tone-A beacon signals from GB3CTC, GB3GI, DL0PR and SK7VHF and auroral s.s.b. from 7 Gs, 5 GMs, 1 GI, 1 GW, 1 ON, 1 PA0 and 3 DCs. At the same time John Branegan heard several of his GM colleagues "piling up the Continentals on both c.w. and s.s.b., with Gs in the London area very prominent". Between 1645 and 1850 on May 3rd John heard tone-A c.w. from Russian and Swedish amateurs, meanwhile I heard auroral signals from G8LIC, Middlesbrough, G8AZA, Scarborough, 11 east-European f.m. broadcast stations (67-73MHz), Meldrum TV sound (58·25MHz), GI4GVK and **Mike Rowe**, G8JVE, some 10 miles south of me at East Preston, Sussex. Mike also heard GI4GVK and GI4GVS, while at nearby Lancing, Roy Bannister worked GW2HIY and GM4EYF on c.w., and further east in Newhaven, Alan Baker heard 4 Gs, 1 GI, 1 GM and a GW.

Around 0249 on the 4th Alan had auroral QSOs with a couple of GMs and a GW, and agreed with Barry, Roy and myself that GM4COK was the most consistent auroral signal in southern England. Having weighed all this up, **Charlie Newton**, G2FKZ, London, RSGB auroral co-ordinator, is studying the relationship between large individual solar bursts and aurora and would appreciate any information you can give him. Between 1534 and 1738 on May 9th John Branegan worked G8LIC and G8MJG via aurora and heard strong c.w. signals from G, GI, GW, LA, and beacons DL0PR, GB3GI, LER, and VHF.

10m Band

Harold Brodribb, St. Leonards-On-Sea, Sussex and Alan Baker reported that the 10m band was dead on April 20th and, periodically, on other days ionospheric disturbances menaced the BBC's World Service transmissions on the h.f. bands. On most days between April 20th and May 18th, John Branegan, **Gordon Goodyer**, BRS37345, Petworth, Sussex, Neil Clarke, and myself received strong signals from the Cyprus beacon, 5B4CY, project TESSA beacon ZE2JV, and occasionally A9XC, Bahrain, and DL0IGI when sporadic-E was present. Neil reports that on April 29th and May 3rd, 10m was open from 0800 until 2000 with signals from South Africa, South America, Israel and Russia. Gordon logged a host of Ws around 1840 on May 6th and Middle East stations during the afternoon of the 7th, while on the 14th he received s.s.b. signals from 30 countries from Japan to South America and Russia to South Africa.

Sporadic-E

The 1978 Sporadic-E season (northern-Hemisphere) began at 0800 on April 26th when I received both sound (56·25MHz) and picture (49·75MHz) on the R1 television channel with only dipole aerials feeding my R216 v.h.f. receiver and JVC 3060 television receiver. At the same time I heard strong f.m. signals from seven east-European broadcast stations (66-72MHz) and during the morning of May 1st, I watched part of Russia's May Day parade on R1. A most intense Es disturbance occurred between 0900-1100 on May 13th when I received very strong signals from 33 broadcast stations (65-73MHz), European radiotelephone signals in Band I and on Ch.R1 I watched an ice hockey match. There are many transmitters on the R1 system and periodically (typically sporadic-E) one picture would fade out and another take its place. At 1241 on the 15th, a test card appeared on R1, and reference to Roger Bunney's book, *Long Distance Television*, revealed that the station was Televidnie Sovietskogo Soiuza (USSR) using test card pattern 0249.

Tropospheric

Conditions on v.h.f. improved greatly between May 6th and 18th, during which time the atmospheric pressure fluctuated from 30·0in to 30·5in and down again. On the 6th, Mike Rowe worked 3 Ds, 8 Fs, 5 ONs, and 6 PA0s on 2m s.s.b. and during the afternoon of the 7th he had a 59 QSO with DK8VRA. Mike runs a TS700G, with a home-brew 50 watt linear to an 8-element crossed Yagi. At 2240 on the 9th, Neil Clarke heard a PA0 calling through his local 2m repeater, GB3NA, R3, and on s.s.b. he heard 17 PA0s and 7 DCs working UK stations from Kent to Wales and north to Scotland.

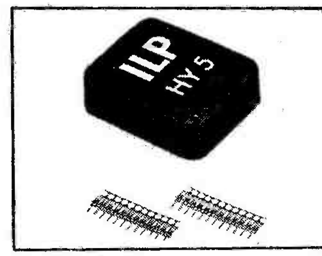
During the afternoon of the 7th G4GNX had 2m s.s.b. QSOs with PA0WRL/P, F1ENH/P and DC9DZA, and on the 10th both **Andrew "Jim" Lyon**, G8LPY, Worthing, and G4GNX heard signals through the French repeater, FZ3THF, R4. On the 11th, Jim worked Roy Bannister, holidaying in Yorkshire, via GB3PI, R6. Like Mike Rowe, Jim uses a TS700G to an 8-element crossed Yagi and they are both now equipped for 70cm operation. In a c.w. contact on the 10th PA0DOG told G4GNX that PA0MI had worked into Russia via the aurora on May 1st, and at 2028 on the 15th G4GNX had a 2m c.w. QSO with F6BCK.

Band II FM DX

Guy Stanbury, Chelmsford and **Bob Dewick**, Southminster, Essex, are keenly interested in Band II DX. Guy uses a home-brew receiver built from Ambit International modules and Bob has a Trio KT7001. Both stations use two Fuba Uka Stereo '8's aerials stacked vertically and rotatable. Guy sent a detailed

15—240 Watts!

HY5
Preamplifier



The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4·7kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.

Price £5·22 + 65p VAT P&P free.

HY30
15 Watts into 8Ω

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

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

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

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω; DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.

Price £5·22 + 65p VAT P&P free.

HY50
25 Watts into 8Ω

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

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

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

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

Price £6·82 + 85p VAT P&P free

HY120
60 Watts into 8Ω

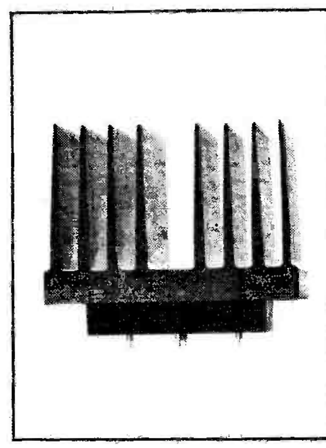
The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

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

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

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

Price £15·84 + £1·27 VAT P&P free.



HY200
120 Watts into 8Ω

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

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

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

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

Price £23·32 + £1·87 VAT P&P free.

HY400
240 Watts into 4Ω

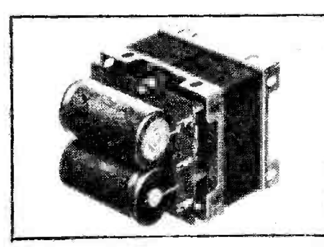
The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead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

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

APPLICATIONS: Public address—Disco—Power slave—Industrial

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

Price £32·17 + £2·57 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £5·22 plus 65p VAT. P/P free.
PSU50 suitable for two HY50's £6·82 plus 85p VAT. P/P free.
PSU70 suitable for two HY120's £13·75 plus £1·10 VAT. P/P free.
PSU90 suitable for one HY200 £12·65 plus £1·01 VAT. P/P free.
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log containing some 49 stations heard, both mono and stereo, between 87-104MHz on May 9th, and 68 stations on the 10th. His logs are impressive and give comparable signal strength for the British and Continental stations. The strongest signal on these two days was Lopik 3s, 96·80MHz. Guy, Bob and myself would like to hear more from readers on this subject.

Microwaves

On April 2nd, **Peter Kerry**, G8ARO and **Don Hayter**, G3JHM, established their portable 3cm equipment, with an 18in dish, on the Hogs Back, Surrey, and worked G8BDJ and G8GKV, situated 40km away on Chanctonbury Ring, Sussex, at good strength. On May 1st, Peter set up the same gear on top of an 80ft high residential tower block, 320ft a.s.l., at Highgate and received the London 3cm beacon, GB3LBH, at 25km, 48dB above the noise. Peter points out that only 30dB of this was produced by the 18in dish. At 0950 on May 3rd he recorded a 2dB increase in noise when he pointed the dish towards the sun compared with cold sky.

OSCAR

John Branegan told me on May 6th "As of today, I have worked 20 countries by satellite" and at 1310 on May 9th he made his first transatlantic QSO with W2BAX, New Jersey, through OSCAR-8. John is now operational on OSCAR-7, Mode A and OSCAR-8, Modes A and J and has had over 70 QSOs via satellite in his first 10 weeks on the air.

Down under

Anthony Mann, Applecross, Western Australia, says "If sunspot activity keeps on increasing, the start of the next sporadic-E season (southern hemisphere) in October or November ought to see some really high MUFs to the north". Between 1325-1545 on April 16th he received for the first time, via F2, signals on Ch.R1 (Russian) sound, Ch.E3 video and Japanese amateurs on 50·1 and 52·0MHz.

April 13th was another memorable day for Anthony with E2 and R1 in around 1100 and out at 1810, and late night transequatorial skip producing Korean Broadcast Service, 44·3MHz, and Ch.E2 West Malaysia from 2220 to 2255. The only other evening T.E. skip observed by Anthony this autumn was on March 12th from 1915-2015, with KBS 44·3MHz and 44·9MHz and Radio Peking, 45·3MHz. Around 35MHz on April 3rd, 8th, and 9th he heard "This is Radio Call Paging Service of Oklahoma City".

From your letters

"I have just come back to radio as a hobby" writes **R. Horsfield**, Sandbach, Cheshire, "having started in the early 50s with an R1155, and after using a R210 have ordered an FRG7 digital", he is also looking for a v.h.f. receiver.

Eleven members of the Brighton and District Radio Society visited the *Practical Wireless* stand at the RSGB show at Alexandra Palace on May 6th. The mini-bus used for the journey was equipped with an IC240 and an Antec window-mount, ground plane aerial for contacting the exhibition talk-in station, GB2VHF, organised by the Grafton Radio Society.

Many reports exist that static-like radio interference is heard prior to an earthquake, any readers who have experienced this, please let we know because **Richard Hill** of Tunbridge Wells is making a special study of this.

Geoff Drewe, G4CAO, Weybridge, Surrey, is operational on c.w., 625-line TV, Slow Scan TV, and Facsimile. Geoff had a 2m FAX contact with G8ONE on April 17th using sync for the first time. The frequency is 144·700MHz and Geoff says "We can now transmit two-way FAX in fine detail in sync without too much stress". He also hopes that more amateurs will become active in this field.

Many thanks for all your interesting reports on such a wide range of subjects.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-
AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.
MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands **must** be kept separate.
VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

PW PERSONALITY VISITS WEST KENT ARS

Richard Leman, G8CDD, challenged fellow members of the West Kent Amateur Radio Society to make a crystal set, to look again at the first principles and provide a competitive activity for the Society.

The completed set had to receive the 200kHz BBC transmitter and any medium wave station, excluding the BBC World Service transmitter at Crowborough which pounds a signal into Tunbridge Wells. Bonus marks (10%) were awarded for not using new components, and (15%) for using wireless parts of the pre-1940 era.

Judging by G8CDD, for loudness, clarity, construction and originality (one competitor used a 30 amp antenna fuse), was carried out on top of a local multi-storey car park using a long wire aerial and a connection to the fire hose rising main for earth.

The prizes were presented on May 12th, at the fortnightly meeting of WKARS, by Ron Ham, our VHF Columnist, who was the visiting speaker seen here fourth from left.

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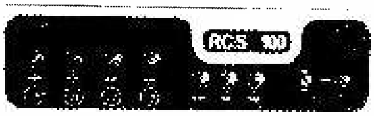
R.C.S. 100 watt MIXER/AMPLIFIER ALL VALVE



Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 5 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier. Send for details.

Chassis only **£94** carr. £5

R.C.S. MINI MODULE KIT

3-way Loudspeaker System comprising of Bass, Middle & Tweeter Units with 3-way Crossover & Ready Cut Baffle. Full assembly instructions supplied. Response=60 to 20 000 C.P.S. 12 watt RMS. 8 ohm. £10·95 per kit. Two kits £20. Postage 75p.

TEAK VENEER HI-FI SPEAKER CABINETS

MODEL "A". 20 × 13 × 12in. For 12in. dia. or 10in speaker. Illustrated. **14·50** Post £1·60

MODEL "B" BOOKSHELF For 13 × 8in. speaker or Mini Module Kit **£8·50** Post £1

MODEL "C" BOOKSHELF For 6½in and tweeter. **£5·95** post 75p

LOUDSPEAKER CABINET WADDING 18in. wide. 20p ft.

GOODMANS CONE TWEETER

3½in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3·25**
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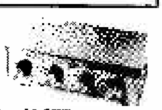
ELAC TWEETER 4 ohm 20 watt £2·50

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£6·75**



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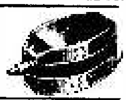
3 ohm. 7 × 4in. £1·50. 8 × 5in. £1·90. 6½in. £1·80. 8in. £2.
15 ohm 7 × 4in. £1·50. 6 × 4in. £1·50. 5in. £1·50. 5 × 3in. £1·50.

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER
Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/249V. Leaflet S.A.E. **£4·95** Post 50p



A.C. ELECTRIC MOTORS
2 Pole, 240V, ·2 Amp. Spindle – 1·43 × 0·212in. £1·75. 2 Pole, 240V, ·15 Amp. Double Spindle – 1·75 × 0·16in. Each £1·50. 2 Pole, 120V, ·5 Amp. Spindle – 0·75 × 0·2in. Two in series – 240V. 75p each. Brush Motor. From a Food Mixer 240V, ·3 Amp. High Speed and Powerful. Spindle – 0·5 × 0·25in. £2·95 each.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides. 6 × 4in. 95p; 8 × 6in. £1·40; 10 × 7in. £1·55; 14 × 9in. £1·90; 16 × 6in. £1·85; 12 × 3in. £1·20; 16 × 10in. £2·20; 12 × 8in. £1·70.
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ALUMINIUM BOXES, MANY SIZES IN STOCK.
4 × 2 × 2in. 36p; 3 × 2 × 1in. 60p; 6 × 4 × 2in. £1; 8 × 6 × 3in. £1·90; 12 × 5 × 3in. £2; 12 × 4 × 4in. £2·40.

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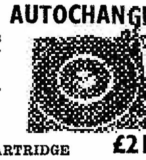

Plays 12in. 10in. or 7in. records Auto or Manual. A high quality unit backed by BSR reliability with 12 months guarantee. A.C. 200/250V. Size 13½ × 11¼in. Above motor board 3¼in. Below motor board 2½in. With MAGNETIC STEREO CARTRIDGE **£21·50**
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BSR MP60/P128 with Goldring G850 magnetic cartridge.	£24·50
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BSR. P163. Belt drive Turntable, less cartridge.	£27·50
Garrard 5300. Autochanger with ceramic cartridge.	£14·35
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BAKER MAJOR 12″ £16·88

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90-14,500 c/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/s rated 25 watts. NOTE: 4 or 8 or 16 ohms must be stated.

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30-17,000 c/s with tweeter, crossover, baffle 19 × 12½in. Please state 4 or 8 or 16 ohms. **£21·38** Post £1·60

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Useful response 30-13,000 cps.
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BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs 4 way mixing. Master treble, bass and volume controls. 3 speaker output sockets to suit various combinations of speakers. 4-8-16 ohm. Slave output. A/C mains. Guaranteed. Details S.A.E. **£79** Carr. £1·50

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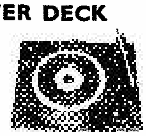

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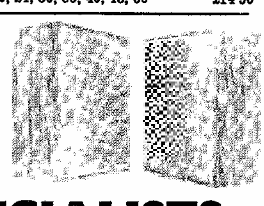

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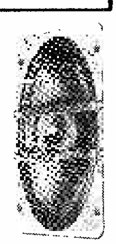

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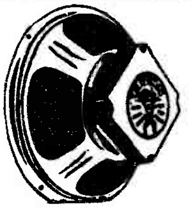

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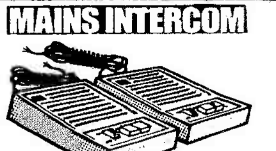

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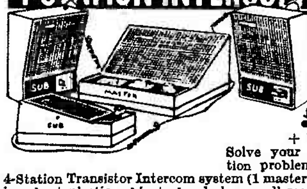

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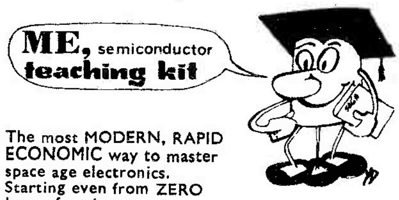

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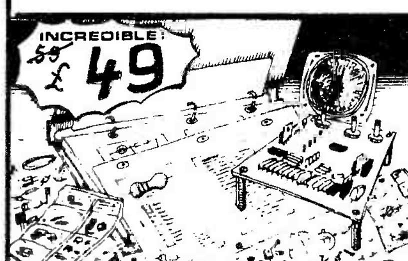

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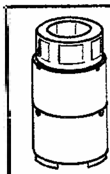

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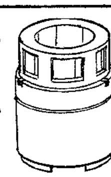

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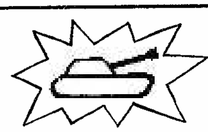

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Ref	Amps 12V	Amps 24V	£	P & P
111	0·5	0·25	2·20	0·45
213	1·0	0·5	2·64	0·78
71	2	1	3·51	0·78
18	4	2	4·03	0·96
70	6	3	5·35	0·96
108	8	4	6·98	1·14
72	10	5	7·67	1·14
116	12	6	8·99	1·32
17	16	8	10·39	1·32
115	20	10	13·18	2·08
187	30	15	17·05	2·08
226	60	30	26·82	OA

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Prim 220/240V Sec 0-20-25-33-40-50V 20V-0-20V or 25V-0-25V available by connection to appropriate taps.

Ref	Amps	£	P & P
102	0·5	3·41	0·78
103	1·0	4·57	0·96
104	2·0	6·98	1·14
105	3·0	8·45	1·32
106	4·0	10·70	1·50
107	6·0	14·62	1·64
118	8·0	17·05	2·08
119	10·0	21·70	OA

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PRIM 120/240 SEC 120/240 CT

Ref	VA (Watts)	£	P & P
*07	20	4·40	0·79
149	60	6·20	0·96
150	100	7·13	1·14
151	200	11·16	1·50
152	250	12·79	1·84
153	350	16·28	1·84
154	500	19·15	2·15
155	750	29·06	OA
156	1000	37·20	OA
157	1500	45·60	OA
158	2000	54·80	OA
159	3000	79·05	OA

*State Volts required 115V or 240V.

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Prim 200/220V or 400/440V Sec 100/120V or 200/240V

Va	Ref	£	P & P
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350	247	14·11	1·84
1000	250	41·76	OA
2000	252	54·25	OA

30 VOLT RANGE
Prim 220/240V Sec 0-12-15-20-24-30V 12V-0-12V or 15V-0-15V available by connection to appropriate taps.

Ref	Amps	£	P & P
112	0·5	2·64	0·78
79	1·0	3·57	0·96
3	2·0	5·27	0·96
20	3·0	6·20	1·14
21	4·0	7·44	1·14
51	5·0	8·37	1·32
117	6·0	9·92	1·45
88	8·0	11·73	1·64
89	10·0	13·33	1·84

60 VOLT RANGE
Prim 220/240V Sec 0-24-30-40-48-60V. 24V-0-24V or 30V-0-30V available by connection to appropriate taps.

Ref	Amps	£	P & P
124	0·5	3·88	0·96
126	1·0	5·58	0·96
127	2·0	7·60	1·14
125	3·0	10·54	1·32
123	4·0	12·23	1·84
40	5·0	13·95	1·64
120	6·0	15·66	1·84
121	8·0	20·15	OA
122	10·0	24·03	OA
189	12·0	27·13	OA

AUTO TRANSFORMERS

Ref	VA (Watts)	Volts	£	P & P
113	15	0-115-210-240	2·48	0·71
64	75	0-115-210-240	3·95	0·96
4	150	0-115-200-220-240	5·35	0·96
67	500	0-115-200-220-240	10·99	1·64
84	1000	0-115-200-220-240	18·76	2·08
93	1500	0-115-200-220-240	23·36	OA
95	2000	0-115-200-220-240	34·82	OA
73	3000	0-115-200-220-240	48·00	OA

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250	10·49	1·45	69W
500	15·73	1·64	67W
750	18·55	1·76	83W
1000	22·68	OA	84W
1500	26·02	OA	93W
2000	37·65	OA	95W

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Ref	mA	Volts	£	P&P
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212	1A, 1A	0-6, 0-6	2·85	0·78
13	100	9-0-9	2·14	0·38
235	330, 330	0-9, 0-9	1·99	0·38
207	500, 500	0-8-9-, 0-8-9	2·59	0·71
208	1A, 1A	0-8-9, 0-8-9	3·53	0·78
236	200, 200	0-15, 0-15	1·99	0·38
214	300, 300	0-20, 0-20	2·56	0·78
221	700 (DC)	20-12-0-12-20	3·41	0·78
206	1A, 1A	0-15-20-0-15-20	4·63	0·96
203	500, 500	0-15-27-0-15-27	3·99	0·96
204	1A, 1A	0-15-27-0-15-27	5·39	0·96
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U191	0·75	5Y3GT	0·65	6L6M	1·90	30F12	1·20
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UCF80	0·80	6AK8	0·40	6SL7GT	0·75	30PL14	1·10
UCH81	0·60	6AL5	0·40	6SN7GT	0·75	35L6GT	0·80
UCL82	0·75	6AL5D	0·65	6SQ7	0·75	35W4	0·60
UF41	0·80	6AM5	1·60	6V6GT	0·75	35Z4GT	0·70
UL41	0·75	6AM6	0·65	6X4	0·60	50C5	0·70
UL84	0·75	6AN8	0·85	6X5GT	0·55	50CD6G	1·20
UM80	0·60	6AQ5	1·30	6Y6G	0·95	75	1·00
UY82	0·55	6AQ5W	0·85	6Z4	0·65	75C1	0·80
UY85	0·50	6AS6	0·80	6-30L2	0·90	76	0·80
VR105/30	1·80	6AT6	0·75	7B7	0·80	78	0·75
VR150/30	1·25	6AU6	0·40	7V4	0·80	80	0·75
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X61M	1·50	6AX4GT	0·80	9D6	0·75	723A/B	9·00
Z800U	3·00	6AX5GT	1·00	11E2	11·00	803	6·00
Z801U	3·50	6B7	0·75	12A6	0·60	805	18·00
Z900T	1·50	6BA6	0·40	12AT6	0·45	807	1·00
1A3	0·60	6BE6	0·50	12AT7	0·55	813	10·50
1L4	0·30	6BG6G	1·00	12AU7	0·50	829B	5·50
1R5	0·55	6BJ6	1·10	12AV6	0·70	832A	4·50
1S4	0·40	6BQ7A	0·60	12AX7	0·50	866A	2·80
1S5	0·40	6BR7	2·30	12BA6	0·50	931A	6·00
1T4	0·40	6BW6	2·80	12BE6	0·60	954	0·50
1X2B	1·10	6BW7	1·00	12BM7	0·60	955	0·50
2D21	0·55	6C4	0·40	12C8	0·55	956	0·50
2K25	9·00	6C6	0·55	12E1	4·25	957	0·90
2X2	0·80	6CH6	3·00	12I5GT	0·40	1625	1·00
3A4	0·60	6CL6	0·75	12K7GT	0·60	1629	0·70
3D6	0·40	6D6	0·50	12K8GT	0·70	2051	1·00
3D21	20·00	6EA8	0·80	12Q7GT	0·50	5763	2·00
3E29	5·50	6F8G	0·75	12SC7	0·55	5842	6·50
3S4	0·50	6F12	0·65	12SH7	0·70	5933	3·00
3V4	0·85	6F17	1·00	12SJ7	0·55	6057	0·85
5B/254M	6·50	6F33	4·20	12SQ7	0·55	6060	0·85
		6M6	4·20	12Y4	0·40	6064	0·85
		6J4WA	1·75	14S7	1·00	6065	1·20
		6J5	0·75	19AQ5	0·75	6067	1·00
		6J5GT	0·55	19G3	10·00	6080	3·50
		6J6	0·50	19G6	6·00	6146	3·80
				19H5	17·00	6146B	4·20
				20P3	0·60	6360	2·00
				20P4	1·10	8020	5·50

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WD 8

WATFORD ELECTRONICS

(Continued from opposite side)

DIODES
AA119 15
AA129 25
AAY30 25
AAZ15 15
AEY11 60
BA100 10
BY100 24
BY126 14
BY127 14
OA9 75
OA47 12
OA70 12
OA79 12
OA81 15
OA85 12
OA90 6
OA91 6
OA95 8
OA200 9
OA202 8
IN914 4
IN916 5
IN4001/2* 5
IN4003* 6
IN4004/5* 6
IN4006/7* 7
IN4148 4
IS44 20
3A/100V* 15
3A/400V* 18
3A/600V* 27
3A/1000V* 30
6A/600V 65

SCR's* Thyristors
1A50V 38
1A100V 42
1A200V 47
1A400V 52
1A600V 70
3A50V 38
3A100V 43
3A200V 60
3A400V 110
3A600V 120
5A400V 120
7A400V 125
8A400V 150
BT106 150
C106D 55
TIC44 25
TIC45 45
2N4444 140

***BRIDGE RECTIFIERS** (plastic case)
1A/50V 20
1A/100V 22
1A/200V 25
1A/400V 29
1A/600V 34
2A/50V 35
2A/100V 44
2A/200V 46
2A/400V 53
2A/600V 65
4A/100V 72
4A/200V 75
4A/400V 79
4A/600V 105
4A/800V 120
6A/100V 73
6A/200V 78
6A/400V 85
BY164 56
VM18 DIL 40

ZENERS
Rng: 2V7-39V
400mW 9p
Rng: 3V3-33V
1·3W 17p

VARICAPS
MVAM115 105
BA102 25
BB104 40
BB105B 40
BB106 40

Noise Diode
Z5J 160

ALUM. BOXES with lid*
3x2x1" 45
2¾x5½x1½" 68
4x4x1½" 68
4x2¾x1½" 60
4x5¼x1½" 78
4x2½x2" 64
5x4x2" 82
6x4x2" 88
7x5x2½" 114
8x6x3" 148
10x7x3" 172
10x4½x3" 142
12x5x3" 165
12x8x3" 210

SPEAKERS
8Ω 0·3W
2"; 2¼" 65
2·5; 3" 58
40Ω 2·5" 65
64Ω 2·5" 65
8Ω 5W
7" x 4" 190
8Ω 3W
6" x 4" 160

TRIACS*
6A400V 88
6A500V 95
8A400V 99
8A500V 110
10A500V 140
15A400V 165
16A400V 185
16A500V 210
40430 125
40528 150
40669 95

DIAC*
ST2 25

OPTO ELECTRONICS*
LEDS + Clip
TIL209 Red 13
TIL211 Grn 23
TIL212 Yellow 27
0·2" Red 17
0·2" Yellow, Grn, Amber 21
ORP61 84
ORP12 63
2N5777 54

OPTO ISOLATORS
TIL111/2 105
TIL114 110
TIL117 164

7 Segment Displays
5-LT-01 Futaba 460
TIL312 ·3" C.An 125
TIL313 ·3" C.Cth 125
TIL321 ·5" C.An 140
TIL322 ·5" C.Cth 140
DL704 ·3" C.Cth 99
DL707 ·3" C.Anod 99
DL747 ·6" An 180
FND357 149
XAN351 ·3" Green 180
XAN625 ·6" Green 250
MINITRON 3015F 240
Liquid Crystal Display 3½ OR 4 digit 975p

VOLTAGE REGULATORS*
TO3 Can Type
1A +ve: 5V, 12V, 15V, 18V 145p each
LM309K 135
LM323K 625
MVR5 or 12 180
1A —ve: 5V, 12V 220

Plastic Case: +ve
0·1A (TO92) 5V, 6·2, 8·2V, 12V, 15V 30
1A (TO220) 5V, 12V, 15V, 18V, 24V 99

Plastic (TO220) case
—ve 0·5A: 5V, 6·2V, 8·2, 12, 15V 95
—ve 1A 5V, 12V 175
LM320-12 —ve 165
LM320-15 —ve 165
LM341-15 +ve 99
Variable Type
723 +2 to +37V 45
LM304H 0 to +40V 240
LM317H +1·2 —37 100
LM317K +1·2 to 37 350
LM325N ±15V 240
LM326N ±12V 240

SWITCHES*
TOGGLE 2A 250V
SPST 28
DPST 34
DPDT 38
4 pole on off 54

SUB-MIN TOGGLE
SP changeover 59
SPST on off 54
SPST biased 85
DPDT 6 tags 70
DPDT C/OFF 79
DPDT Biased 115

SLIDE 250V
1A DPDT 14
1A DPDT C/O 15
½A DPDT 13
4 pole 2-way 24

PUSH BUTTON
Spring loaded
Latching
SPST on off 60
SPDT C/over 65
DPDT 6 Tag 85

MINIATURE
Non Locking
Push to make 15
Push Break 25

ROCKER: (Black) on/off 10A 250V 23

VEROBOARD* Pitch

	0·1 (copper clad)	0·15 (copper clad)	0·1 (plain)	0·15 (plain)
2½ × 3¾"	41p	33p	28p	22p
2½" × 5"	49p	45p	—	28p
3¼ × 3¼"	49p	45p	—	—
3¼ × 5"	58p	60p	45p	38p
2½ × 17"	152p	121p	—	78p
3¾ × 17"	195p	163p	128p	107p
4¼ × 17"	252p	—		165p

Pkt of 36 pins 30p
Spot face cutter 78p
Pin insertion tool 99p

VERO WIRING PEN* + Spool 325p
Spare Wire (Spool) 80p; Combs 10p ea.

FERRIC CHLORIDE*
1lb bag Anhydrous 65p + 30p p. & p.

DALO ETCH RESIST PEN* 75p
(The extra spare line gained is to be used in No. 18)

COPPER CLAD BOARDS*

Fibre Glass	Single-sided	Double-sided	SRBP 8" x 10·5"
6" x 6"	75p	90p	75p
6" x 12"	130p	175p	

SOLDERCON PINS*
100 pins 50p: 1000 pins 350p

DIL SOCKETS*: Low Profile (TEXAS)
8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 20p; 20 pin 27p; 22 pin 30p; 24 pin 30p; 28 pin 42p; 40 pin 55p

ROCKER: (white) 5A 250V SP change-over centre off 30
ROCKER: (illuminated, red) Chrome Bezel 5A 250V SP 52
ROTARY: "Make-A-Switch" Make your own multiway Switch. Adjustable Stop Shafting Assembly, Accommodates up to 6 Wafers 69
Mains Switch DPST to fit 34
Break Before Make Wafers, 1 pole/12 way, 2p/6 way, 3p/4 way, 4p/3 way, 6p/2 way 47
Spacer and Screen 5
ROTARY: (Adjustable Stop)
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way 41
ROTARY: Mains 250V AC, 4 Amp 45

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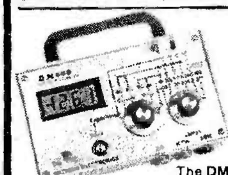

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5 AC & DC Current ranges; 4 Capacitance ranges
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