RADIO & ELECTRONICS CONSTRUCTOR

DECEMBER 1978
Volume 32 No. 4

Published Monthly
(3rd of preceding Month)
First Published 1947

Incorporating The Radio Amateur

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141
Telegrams Databux, London

Annual Subscription: £7.00, Overseas £8.00 (U.S.A. and Canada $15.00) including postage. Remittances should be made payable to "Data Publications Ltd". Overseas readers, please pay by cheque or International Money Order.

Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that queries cannot be answered over the telephone, they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

Correspondence should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers as appropriate.

Opinions expressed by contributors are not necessarily those of the Editor or proprietors.

Production.—Web Offset.

Published in Great Britain by the Proprietors and Publishers, Data Publications Ltd, 57 Maida Vale, London W9 1SN

The *Radio & Electronics Constructor* is printed by Swale Press Ltd.

THE JANUARY ISSUE WILL BE PUBLISHED ON 4th DECEMBER

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zener	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25

SOCKETS/BRIDGES

8-pin	pcb	.20	ww	.35
14-pin	pcb	.20	ww	.40
16-pin	pcb	.20	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.35	ww	.95
24-pin	pcb	.35	ww	.95
28-pin	pcb	.45	ww	1.25
40-pin	pcb	.50	ww	1.25

Molex pins .01 To-3 Sockets .25
2 Amp Bridge 100-prv .95
25 Amp Bridge 200-prv 1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN (2N2222 Plastic .10)	.15
2N2907	PNP	.15
2N3906	PNP (Plastic - Unmarked)	.10
2N3904	NPN (Plastic - Unmarked)	.10
2N3054	NPN	.35
2N3055	NPN 15A 60v	.50
T1P125	PNP Darlington	
LED Green, Red, Clear, Yellow		.15
D.L.747	7 seg 5/8" High com-anode	1.95
MAN72	7 seg com-anode (Red)	1.25
MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74A	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

C MOS

4000	.15
4001	.15
4002	.20
4004	3.95
4006	.95
4007	.20
4008	.75
4009	.35
4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
4021	.75
4022	.75
4023	.20
4024	.75
4025	.20
4026	1.95
4027	.35
4028	.75
4030	.35
4033	1.50
4034	2.45
4035	.75
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
MC 14419	4.85
4511	.95
74C151	1.90

– T T L –

7400	.10
7401	.15
7402	.15
7403	.15
7404	.10
7405	.25
7406	.25
7407	.55
7408	.15
7409	.15
7410	.15
7411	.25
7412	.25
7413	.25
7414	.75
7416	.25
7417	.40
7420	.15
7426	.25
7427	.25
7430	.15
7432	.20
7437	.20
7438	.20
7440	.20
7441	1.15
7442	.45
7443	.45
7444	.45
7445	.65
7446	.70
7447	.70
7448	.50
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.40

7473	.25
7474	.30
7475	.35
7476	.40
7480	.55
7481	.75
7483	.75
7485	.55
7486	.25
7489	1.05
7490	.45
7491	.70
7492	.45
7493	.35
7494	.75
7495	.60
7496	.80
74100	1.15
74107	.25
74121	.35
74122	.55
74123	.35
74125	.45
74126	.35
74132	.75
74141	.90
74150	.85
74151	.65
74153	.75
74154	.95
74156	.70
74157	.65
74161	.55
74163	.85
74164	.60
74165	1.10
74166	1.25
74175	.80

74176	.85
74180	.55
74181	2.25
74182	.75
74190	1.25
74191	.95
74192	.75
74193	.85
74194	.95
74195	.95
74196	.95
74197	.95
74198	1.45
74221	1.00
74367	.75
75108A	.35
75491	.50
75492	.50
74H00	.15
74H01	.20
74H04	.20
74H05	.20
74H08	.35
74H10	.35
74H11	.25
74H15	.45
74H20	.25
74H21	.25
74H22	.40
74H30	.20
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.20

74H72	.35
74H101	.75
74H103	.55
74H106	.95
74L00	.25
74L02	.20
74L03	.25
74L04	.30
74L10	.20
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.85
74S00	.35
74S02	.35
74S03	.25
74S04	.25
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.25
74S40	.20
74S50	.20
74S51	.25
74S64	.15
74S74	.35
74S112	.60
74S114	.65

74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.20
74LS01	.20
74LS02	.20
74LS04	.20
74LS05	.25
74LS08	.25
74LS09	.25
74LS10	.25
74LS11	.25
74LS20	.20
74LS21	.25
74LS22	.25
74LS32	.25
74LS37	.25
74LS38	.35
74LS40	.30
74LS42	.65
74LS51	.35
74LS74	.35
74LS86	.35
74LS90	.55
74LS93	.55
74LS107	.40
74LS123	1.00
74LS151	.75
74LS153	.75
74LS157	.75
74LS164	1.00
74LS193	.95
74LS367	.75
74LS368	.65

LINEARS, REGULATORS, etc.

MCT2	.95
8038	3.95
LM201	.75
LM301	.45
LM308 (Mini)	.95
LM309H	.65
LM309K (340K-5)	.85
LM310	.85
LM311D (Mini)	.75
LM318 (Mini)	1.75
LM320K5(7905)	1.65
LM320K12	1.65

LM320T5	1.65
LM320T12	1.65
LM320T15	1.65
LM324N	1.25
LM339	.75
7805 (340T5)	.95
LM340T12	.95
LM340T15	.95
LM340T18	.95
LM340T24	.95
LM340K12	1.25

LM340K15	1.25
LM340K18	1.25
LM340K24	1.25
78L05	.75
78L12	.75
78L15	.75
78M05	.75
LM373	2.95
LM380 (8-14 PIN)	.95
LM709 (8,14 PIN)	.25
LM711	.45

LM723	.40
LM725N	2.50
LM739	1.50
LM741 (8-14)	.25
LM747	1.10
LM1307	1.25
LM1458	.65
LM3900	.50
LM75451	.65
NE555	.35
NE556	.85
NE565	.95
NE566	1.25
NE567	.95

9000 SERIES

9301	.85	95H03	1.10
9309	.35	9601	.20
9322	.65	9602	.45

MICRO'S, RAMS, CPU'S, E-PROMS

74S188	3.00	8214	8.95
1702A	4.50	8224	3.25
MM5314	3.00	8228	6.00
MM5316	3.50	8251	8.50
2102-1	1.45	8255	9.50
2102L-1	1.75	8T13	1.50
2114	9.50	8T23	1.50
TR1602B	3.95	8T24	2.00
TMS 4044-	9.95	8T97	1.00
		2107B-4	4.95
8080	8.95	2708	9.50
8212	2.95	Z80 PIO	8.50

INTEGRATED CIRCUITS UNLIMITED

7889 Clairemont Mesa Blvd., San Diego, CA 92111 U.S.A.

No Minimum

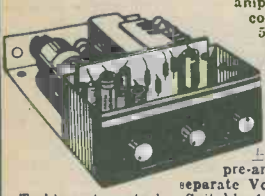
All prices in U.S. dollars. Please add postage to cover method of shipping. Orders over $100 (U.S.) will be shipped air no charge. Payment should be submitted with order in U.S. dollars. All IC's Prime/Guaranteed. All orders shipped same day received.

SPECIAL DISCOUNTS

Total Order	Deduct
$35 - $99	10%
$100 - $300	15%
$301 - $1000	20%

Phone (714) 278-4394 BarclayCard / Access / American Express / BankAmericard / Visa / MasterCharge

SUPERSOUND 13 HI-FI MONO AMPLIFIER



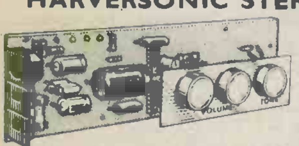
A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £15.00. P. & P. £1.20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mv into 47k. Input 2, 15mv into 47k. (suitable for use with mic. or guitar etc.) Input 3 200mv into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx. 12½"w. x 5" h. x 7½" d.

Special introductory price £28.00 + £2.50 carr & pkg.

HARVERSONIC STEREO 44



A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9¼" × 2¾" × 1" max. depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically), at only £9·00 plus 50p P. & P. Mains transformer with an output of 17V a/c at 500 m/a can be supplied at £1·50 plus 40p P. & P. if required. Full connection details supplied.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £3.20 P. & P. £1.20.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1.80 P. & P. 65p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. £2.00 P. & P. 65p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2.70 P. & P. 90p.
Pri. 200/240v. Sec. 23v. at 1·5 amp, 6v at ·6 amp, 8v. at 50 mA. £2.25 + 65p P. & P.

MAINS TRANSFORMER. Pri, 0,110 and 240 Sec. 28V at 1.8 amps. Also tapped at 12V .3 amp. Size 2¾in hx 3¼in w x 2¾ in d. £2.50 + £1 P. & P.

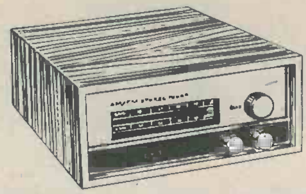
ALL PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2¾". Ready built and tested. Price £6.75. P. & P. 95p

STEREO-DECODER SIZE 2"×3"×½"

Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6.00 plus 20p P. & P.
Stereo beacon light if required 40p extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide × 3in deep × 6in high. Ready built and tested. PRICE £7·00. P. & P. £1.25
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £8·00. P. & P. £1.30.

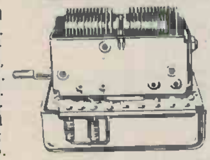
MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



200/240V Mains operated Solid State A/M F/M Stereo Tuner. Covering M.W. A.M. 540-1605 KHZ, VHF/FM 88-108 MHZ. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built-in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600 m/v RMS into 20K. Simulated teak finish cabinet. Will match almost any amplifier. Size 8½" w. - 4" h. × 9½" d. approx. LIMITED NUMBER ONLY at £28.00 + £1.50 P. & P.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2¼" × 1¼" × ¾" 7·6V + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25 + P. & P. 20p.



Pye VHF/FM Tuner Head covering 88-108M/Hz. 10·7M/Hz IF output 7·8V + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM Gang and 323 Pf + 323 Pf AM Tuning Gang only £3·15+P. & P. 35p.

PRECISION MADE Push Button Switch bank. 8 Buttons giving 16 S/P C/O Interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons 2 for £1.80 + 20p, P. & P.

SPECIAL OFFER
Limited Number Only!

New but very slightly store-soiled transistor radios by well known manufacturer. Very smart and attractive, vinyl covered with carrying handle.
Two models available:
Battery operated with twin speaker covering VHF/FM, MW and LW bands
£8.50 + £1.30 p&p
AC mains or battery operated and covering VHF/FM and MW bands **£11.00 + £1.30 p&p**
Size. (either model), 7in H x 9½in W x 4in D approx. Both types have telescopic aerials for VHF/FM reception and internal ferrite aerials for AM bands, also earphone socket for personal listening. Either model uses four HP11 or SP11 batteries, (not supplied).

LOUDSPEAKER BARGAINS
5in. 3 ohm £2.20, P. & P. 35p. 7 x 4in. 3 ohm £2.80. P. & P. 48p. 10 x 6in. 3 or 15 ohm £3.85, P. & P. 75p. 8 x 5in. 3 ohm with high flux magnet £3.60, P. & P 60p. Tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, £2.20, 30p P. & P.

2" PLASTIC CONE HF TWEETER 4 ohm, £3·50 per matched pair + 50p P. & P.

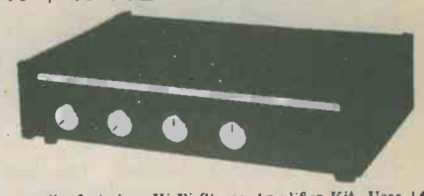
HIGH POWER HI-FI 8 ohm Dome Tweeter. 1" voice coil. Magnet size 3" dia. Suitable for use in up to 50 watt systems. £4·50 each + 60p P. & P.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £2.00 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER Size 11¾" × 14¾" × 1¼" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, etc. and used with or without baffle. Send S.A.E. for details. Only £8·40 each. P. & P. 90p for one, £1.10 for two.
Now available in either 8" round version or 4½" x 8½" rectangular. 10 watts R.M.S. 60Hz-20KHz £5.25 + P. & P. (one 65p, two 75p).

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE, T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2.50 P. & P. 20p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3.00. P. & P. 20p.
LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £2.00 P. & P. 20p
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £2.00 P. & P. 20p
STEREO MAGNETIC PRE-AMP sens. 3mVin for 100m Vout 15 to 35V neg earth. Equ. ± 1db. From 20 Hz to 20 KHz. Input impedance 47k. Size 1⅛in x 2¾in x 5⅛H. £2.60 + 20p P. & P.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



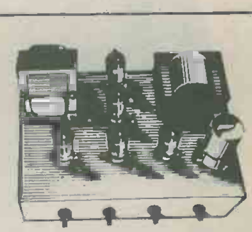
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ± 3dB 12–15,000 Hz. Bass, boost approx. to ± 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£13·50	P. & P. 80p
(Magnetic input components 33p extra)		
POWER PACK KIT	£5·50	P. & P. 95p
CABINET	£5·50	P. & P. 95p

Special offer—only £23.75 if all 3 units ordered at one time plus £1.25 P. & P.
Full after sales service
Also available ready built and tested £31·25. P. & P. £1.50.

3-VALVE AUDIO AMPLIFIER HA34 MK II. Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4¾"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £8.50. P. & P. £1.40.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £8.00. P. & P. £1.40.



10/14 WATT HI-FI AMPLIFIER KIT A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY £14.50. P. & P. £1.40. Also available ready built and tested £19.00. P. & P. £1.40.

SPECIAL LINES OFFERED SUBJECT TO STOCK AVAILABILITY

Limited number of British Manufacturer's Surplus professional 100 watt RMS Slave amplifiers. Special features: 2 separate power modules, 1 for Bass response, and 1 for mid. range/tweeter. 5 stage LED display for power o/p indication. A/c mains i/p switchable for 110 or 240V. Can easily be converted to stereo.
AVAILABLE TO PERSONAL CALLERS ONLY—PLEASE PHONE TO CONFIRM AVAILABILITY.
Brand new and tested only £33·75.

OUR PRICES INCLUDE VAT AT CURRENT RATES

Open 9.30-5.30 Monday to Friday. 9.30-5 Saturday Closed Wednesday.
Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. REC) 170 MERTON HIGH ST., MERTON, LONDON, SW.19. Tel: 01-540 3985.
A few minutes from South Wimbledon Tube Station
SEND SAE WITH ALL ENQUIRIES. FOR PERSONAL CALLERS ONLY: WE CAN NOW OFFER A FULL REPAIR SERVICE ON ALL HI-FI EQUIPMENT. DISCO. CASSETTES. CAR RADIO. ETC.

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

T.T.L. I.C.s

7400	13p	7410	16p	7437	33p	7454	18p	7492	42p
7401	16p	7412	20p	7438	33p	7460	18p	7493	40p
7402	16p	7413	30p	7441A	74p	7470	30p	74121	30p
7403	16p	7416	30p	7442	64p	7472	28p	74123	55p
7404	16p	7417	30p	7445	99p	7473	33p	74141	56p
7405	20p	7420	18p	7447	75p	7474	30p	74145	95p
7406	40p	7426	36p	7448	75p	7475	40p	74154	£1.00p
7407	38p	7427	34p	7450	18p	7476	36p	74190	£1.15p
7408	18p	7430	18p	7451	18p	7486	34p		
7409	18p	7432	30p	7453	18p	7490	33p		

LINEAR I.C.s

741 OP AMP 25p
555 TIMER 30p

I.C. SOCKETS D.I.L.

8 PIN	12p	24 PIN	28p
14 PIN	14p	28 PIN	35p
16 PIN	16p	40 PIN	50p

DIODES

OA90	10p	IN4001	5p	IN5401	15p
OA91	10p	IN4002	5p	IN5402	15p
OA95	10p	IN4003	6p	IN5403	15p
OA202	10p	IN4004	6p	IN5404	20p
IN4148	4p	IN4005	6p	IN5405	20p
BY127	12p	IN4006	7p	IN5406	20p
OA47	10p	IN4007	7p	IN5407	20p

TRANSISTORS

BC107	11p	BC170B	13p	BC186	20p	BCY72	17p
BC108	11p	BC171	13p	BC187	24p	BFY50	21p
BC109	11p	BC172C	13p	BC212	11p	BFY51	21p
BC147	10p	BC182	13p	BC213L	12p	BFY52	21p
BC148	10p	BC183	13p	BC214L	13p		
BC149	10p	BC184	13p	BCY70	18p		
BC161	34p			BCY71	17p		

ZENER DIODES 400mw BZY 88 series 2.7 — 33 volt 10p each

MOTOROLA POSITIVE FIXED VOLTAGE REGULATORS 1 amp

MC 7805	95p
MC 7806	95p
MC 7808	95p
MC 7812	95p
MC 7815	95p
MC 7818	95p
MC 7824	95p

THYRISTORS C106D 400 plv 4amp (very low trigger current) 55p
C106M 600 plv 4amp (very low trigger current) 65p

SPECIAL OFFER 10 of each colour 40 £5.00

L.E.D.s 5mm

RED	10	£1.00p
GREEN	10	£1.60p
YELLOW	10	£1.60p
CLEAR (red light)	10	£1.30p

4 DIGET 15mm 7 SEG L.E.D. CLOCK DISPLAY COM/CATHODE FEATURING AM/PM/ALARM INDICATION, DECIMAL POINT/ SECOND INDICATION. SUPERIOR QUALITY. **£4.50p**

0.6inch/15mm single digit 7 seg display red l.e.d. com/anode **£1.60**
0.6inch/15mm single digit 7seg display red l.e.d. com/cathode **£1.60p**

ELECTRONIC KITS

0-35 volt, 3 amp variable power supply, s/c protected P.C.B. & all parts ex transformer **£6.50p** suitable transformer **£6.50p p.p. £1.10p.**
0-45 volt, 3.5 amp variable power supply, S.C.R. S/C protected P.C.B. and all parts ex transformer **£7.50p.**
32 L.E.D. V.U. type display (stereo) P.C.B. and ALL PARTS, needs 12-18v 500ma power supply. Kit **£9.50p,** suitable power supply **£3.50p, p.p. 50p**, suitable box **£2.40p**, all together **£15.00p** post free.
FLUORESCENT INVERTER KIT WILL RUN 4w-40w tube £2.50p.

TRANSFORMERS

ALL 240 volts primary			POST/PACKAGE
6 — 0 — 6	100ma	£1.00p	£0.30p
9 — 0 — 9	1 amp	£2.50p	£0.78p
12 — 0 — 12	1 amp	£3.00p	£0.78p
15 — 0 — 15	2 amp	£4.50p	£0.78p
25 — 0 — 25	2 amp	£6.50p	£1.14p

PRINTED CIRCUIT MATERIALS

FERRIC CHLORIDE In 2lb quantities, packed in plastic dish suitable for etching the P.C.B. boards in. **£1.10p p.p. £0.70p**

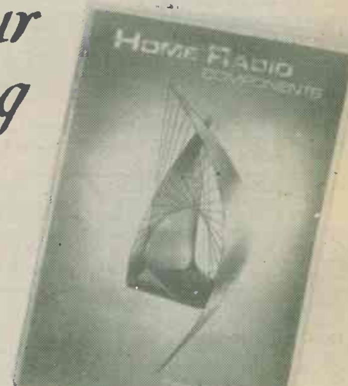
FIBRE GLASS P.C.B. BOARD
1/16 x 7 x 5 inches single sided **£0.85p**
1/16 x 9 x 7 inches single sided **£1.50p**
VEROBOARD 0.1 3¾ x 5 inches **£0.70p**, 0.15, 3¾ x 5 inches **£0.70p** copper clad.
DELO ETCH RESIST PEN £0.85p

TERMS
ALL PRICES INCLUDE V.A.T. C.W.O., P.O. & CHEQUES MADE PAYABLE TO FURAMA ELECTRONICS POST/PACKAGE 25p UNLESS OTHERWISE STATED. CALLERS VERY WELCOME.

FURAMA electronics

32/34 SCOTT LANE, DONCASTER, YORKSHIRE.
Tel.: Doncaster (0302) 65234

THIS is the Catalogue you need to solve your component buying problems !



Many people have called it "the finest components catalogue yet published." Others call it "the electronic constructor's Bible." Whatever you call it, at £1.25 including packing and postage, the Home Radio Components catalogue is a wonderful bargain. Just look at these features . . .

Please write your Name and Address in block capitals

NAME ....

ADDRESS ....

....

....

HOME RADIO (Components) LTD., Dept. RC
234-240 London Road, Mitcham, Surrey CR4 3HD
Regd. No. 912966, London

POST THIS COUPON WITH CHEQUE OR P.O. FOR £1·25

- About 2,500 items clearly listed and indexed
- Profusely illustrated
- 128 A-4 size pages, bound in full-colour cover
- Bargain List of unrepeatable offers included free
- Catalogue contains details of simple Credit Scheme

Send the coupon today with cheque or P.O. for £1.25

HOME RADIO (Components) LTD. Dept. RC, 234-240 London Road, Mitcham, CR4 3HD. Phone: 01-648 8422

BOOKS AND COMPONENTS

BOOKS BY BABANI

Purchase books to the value of £5.00 from the list below and choose any 60p pak from this page *FREE*.

BP2	Handbook of Radio, TV & Industrial & Transmitting Tube & Valve Equivalents	60p†
BP6	Engineers and Machinists Reference Tables	40p†
BP7	Radio & Electronic Colour Codes and Data	15p†
BP10	Modern Crystal and Transistor Set Circuits for beginners	35p†
BP15	Constructors Manual of Electronic Circuits for the Home	50p†
BP18	Boys and Beginners Book of Practical Radio and Electronics	60p†
BP22	79 Electronic Novelty Circuits	75p†
BP23	First book of Practical Electronic Projects	75p†
BP24	52 Projects Using IC741 (or equivalents)	75p†
BP26	Radio Antenna Handbook for Long Distance Reception and Transmission	85p†
BP27	Giant Chart of Radio Electronic Semiconductor and Logic Symbols	60p†
BP29	Major Solid State Audio Hi-Fi Construction Projects	85p†
BP32	How to Build Your Own Metal & Treasure Locators	85p†
BP34	Practical Repair & Renovation of Colour TVs	95p†
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	95p†
BP36	50 Circuits Using Germanium, Silicon & Zener Diodes	75p†
BP37	50 Projects Using Relays, SCR's and TRIACS	£1.10†
BP39	50 (FET) Field Effect Transistor Projects	£1.25†
BP43	How to make Walkie-Talkies	£1.25†
BP44	I.C.555 Projects	£1.45†
BP47	Mobile Discoteque Handbook	£1.35†
BP129	Universal Gram-motor Speed Indicator	8p†
BP160	Coil Design and Construction Manual	75p†
BP196	AF-RF Reactance—Frequency Chart for Constructors	15p†
BP202	Handbook of Integrated Circuits (ICs) Equivalents and Substitutes	75p†
BP205	First Book of Hi-Fi Loudspeaker Enclosures	75p†
BP213	Electronic Circuits for Model Railways	85p†
BP214	Audio Enthusiasts Handbook	85p†
BP216	Electronic Gadgets and Games	85p†
BP217	Solid State Power Supply Handbook	85p†
BP219	Solid State Novelty Projects	85p†
BP220	Build Your Own Solid State Hi-Fi and Audio Accessories	85p†
BP222	Solid State Short Wave Receivers for Beginners	95p†
BP223	50 Projects Using IC CA3130	95p†
BP224	50 CMOS IC Projects	95p†
BP225	A Practical Introduction to Digital IC's	95p†
BP226	How to Build Advanced Short Wave Receivers	£1.20†
RCC	Resistor Colour Code Disc Calculator	10p†

BOOKS BY NEWNES

No. 229 Beginners Guide to Electronics	Price £2.25†
No. 230 Beginners Guide to Television	Price £2.25†
No. 231 Beginners Guide to Transistors	Price £2.25†
No. 233 Beginners Guide to Radio	Price £2.75†
No. 234 Beginners Guide to Colour Television	Price £2.25†
No. 235 Electronic Diagrams	Price £1.80†
No. 236 Electronic Components	Price £1.80†
No. 237 Printed Circuit Assembly	Price £1.80†
No. 238 Transistor Pocket Book	Price £3.90†
No. 225 110 Thyristor Projects Using SCRs & Triacs	Price £2.50†
No. 227 110 COS/MOS Digital IC Projects For the Home Constructor	Price £2.75†
No. 226 110 Operational Amplifier Projects for the Home Constructor	Price £2.50†
No. 242 Electronics Pocket Book	Price £3.90†
No. 239 30 Photoelectric Circuits & Systems	Price £1.80†

NUTS AND BOLTS

BA BOLTS – packs of BA threaded cadmium plated screws slotted cheese head.
Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in 0BA	839	£1.20	½in 4BA	846	£0.32
½in 0BA	840	£0.75	¼in 4BA	847	£0.25
1in 2BA	842	£0.65	1in 6BA	848	£0.40
½in 2BA	843	£0.45	½in 6BA	849	£0.21
¼in 2BA	844	£0.52	½in 6BA	850	£0.25
1in 4BA	845	£0.44			

BA NUTS – packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	855	£0.72	4BA	857	£0.30
2BA	856	£0.48	6BA	858	£0.24

BA WASHERS – flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	859	£0.14	4BA	861	£0.12
2BA	860	£0.12	6BA	862	£0.12

SOLDER TAGS – hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	851	£0.40	4BA	853	£0.22
2BA	852	£0.28	6BA	854	£0.22

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.11*
DPDT standard slide	1974	£0.14*
Toggle switch SPST 1½ amp 250V a.c.	1975	£0.33*
Toggle switch DPDT 1 amp 250V a.c.	1976	£0.42*
Rotary on-off mains switch	1977	£0.50*
Push switch – Push to make	1978	£0.13*
Push switch – Push to break	1979	£0.18*

ROCKER SWITCH
A range of rocker switches SPST – moulded in high insulation. Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	£0.30*
BLACK	1981	£0.30*
WHITE	1982	£0.30*
BLUE	1983	£0.30*
YELLOW	1984	£0.30*
LUMINOUS	1985	£0.30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0.50*
Miniature SPST toggle, 2 amp 250V a.c.	1959	£0.55*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0.70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0.85*
Push button SPST, 2 amp 250V a.c.	1962	£0.78*
Push button SPST, 2 amp 250V a.c.	1963	£0.83*
Push button DPDT, 2 amp 250V a.c.	1964	£0.98*

MIDGET WAFER SWITCHES
Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactive loads make-before-break contacts. These switches have a spindle 0.25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0.48*
2 pole 6 way	1966	£0.48*
3 pole 4 way	1967	£0.48*
4 pole 3 way	1968	£0.48*

MICRO SWITCHES	Order No.	Price
Plastic button gives simple 1 pole change over action. Rating 10 amp 250V a.c.	1970	£0.25

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0.07*
1¼in x ¼in chassis mounting	507	£0.12*
1¼in car inline type	508	£0.15*
Panel mounting 20mm	509	£0.20*
Panel mounting 1¼in	510	£0.30*

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	6p	1A	615	5p	3A	619	5p
250mA	612	5p	1.5A	616	6p	4A	620	6p
550mA	613	5p	2A	617	5p	5A	621	5p
800mA	614	7p	2.5A	618	6p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3.15A	629
500mA	624	1.6A	627	5A	630

All 7p each

QUICK BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

CASES AND BOXES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5¼in	2in	£1.52
156	11in	6in	3in	£2.12
157	6in	4¾in	1¾in	£1.30
158	9in	5¼in	2½in	£1.76

ALUMINIUM BOXES. Made from bright ali., folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	62p
160	4in	4in	1½in	62p
161	4in	2¼in	1½in	62p
162	5¼in	4in	1½in	74p
163	4in	2½in	2in	64p
164	3in	2in	1in	44p
165	7in	5in	2½in	£1.04
166	8in	6in	3in	£1.32
167	6in	4in	2in	86p

P.C.B. BOARDS

C26 4 pieces 8" x 3¼" (approx.) Single-sided fibreglass 80p

C27 3 pieces 7" x 3¼" (approx.) Double-sided fibreglass 80p

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	95p*

MINIATURE MAINS Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	£1.50*
2025	MT150-0-12V, 0-12V RMS	£1.50*

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2.50*	P. & P. 45p
2027	9V-0-9V 1 amp	£2.00*	P. & P. 45p
2028	12V-0-12V 1 amp	£2.60*	P. & P. 55p
2029	15V-0-15V 1 amp	£2.75*	P. & P. 66p
2030	30V-0-30V 1 amp	£3.45*	P. & P. 86p

STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V.
Voltages available by use of taps:
4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

No.	Rating	Price	
2031	½ amp	£5.50*	P. & P. 86p
2032	1 amp	£6.60*	P. & P. 86p
2033	2 amp	£8.40*	P. & P. £1.10

AUDIO LEADS

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

VISIT US AT BREADBOARD

SEYMOUR HALL, LONDON W1
NOVEMBER 21st-25th
10 am to 7pm
STANDS E2·E3·F2·F3·E10·E11

BI-PAK CATALOGUE

NEW EDITION NOW AVAILABLE

Send for your copy of our revised catalogue and price list NOW! It contains 127 pages packed with literally hundreds of semiconductors, components and our famous range of BI-KITS audio modules.

ONLY 65p POST FREE

ORDERING Do not forget to state order number and your name and address.

V.A.T. Add 12½% to prices marked*, 8% to those unmarked. Items marked are zero rated.

P&P. 35p unless otherwise shown.

BI-PAK

DEPT. R.C.12 P.O. Box 6, Ware, Herts

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

the MIGHTY MIDGETS

S-R-B

Please quote your number when ordering

MINIATURE

SOLDERING IRONS AND ACCESSORIES

	RETAIL PRICE each inc v.a.t.	POSTAGE extra.
18 WATT IRON inc. No. 20 BIT	£3·78	22p
SPARE BITS	44p	—
STANDS	£3·25	65p
SOLDER: SAVBIT 20'	52p	9p
" 10'	26p	4p
LOWMELT 10'	65p	9p
I.C. DESOLDERING BIT	88p	9p

BIT SIZES: No.19 (1·5 mm) No: 21 (4·5 mm) No. 20 (3 mm) No. 22 (6 mm)

From your Local Dealer or Direct from Manufacturers

S. & R. BREWSTER LTD.

86-88 Union St · Plymouth PL1 3HG

Tel: 0752·65011 TRADE ENQUIRIES WELCOME

DORAM

SEE THE DORA CHIME KITS IN THE NEW DORAM HOBBIES CATALOGUE.

Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Please send my FREE Hobbies Catalogue.

I enclose 25p contribution to p. & p.

Name..

Address..

.... REC 8

DORAM Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Overseas customers (except for N. Ireland)–60p including despatch by Air (or all-up post).

SHOP WHERE THE BEST... "COSTS LESS"

SIGTRONIC ★★★ ★★★ ELECTRONICS

"SIMPLY THE BEST CHOICE"

FULL SPEC/TESTED TRANSISTORS

BC107/BC108/BC109/BC170/BC172/2N2926G/2G371B
All only **7p** each, inc. VAT
Bf199/BF240/BF241
All only **11p** each, Inc. VAT
ME6002/SE3646
Only **10p** each, inc. VAT
2n3819/BFY51
Only **22p** — while stocks last Inc. VAT

SUPER QUALITY, BIG VALUE, ACADEMY, HIGH OUTPUT — LOW NOISE C90, FERRIC OXIDE CASSETTE TAPES

Complete with FREE library case and index etc. 5 for **£3.45**, 10 for **£5.95**
Or try a Sample Tape for **72p**
VAT inc. in price, p&p 12p

STICKY PROBLEMS SOLVED EASILY *with*

AVDEL the WONDER BOND cynoacrylite adhesive (p&p this item) 10p
OUR PRICE only 75p (inc. VAT)
(Bonds: Ceramics, Plastics, Rubber, Wood etc.)
SUPER FAST SUPER STRONG
Just one small drop fixes any of the above permanently.

UNTESTED, BUT GUARANTEED BARGAINS

Germainium Diodes, similar to OA91 **10 for 23p**
Transistors, mixed NPN/PNP, some Silicon, some Germainium, many are brnaded. *Super snip at* **15 fpr 30p**
OUR OWN TESTS on the above yeilded 60% GOOD

BIG SAVINGS ON CERAMIC CAPACITORS

22pf/27pf/33/39pf/47pf/68pf/82pf/100pf/120pf/150pf/180pf/270pf/330pf/390/& 470pf/560pf/680pf/820pf/1,000pf/1,500pf/2,200pf 3,300pf/4,700pf/6,800pf/.01uf/.015uf/.022uf/.033uf/.047uf/
Small low voltage printed circuit types only **4p** each inc. VAT

METAL FOIL CAPACITORS

Similar to Mullard C280 series in values . . . 47uf/.068uf/.22uf/.015uf/0.01uf/0.1uf/, 160-220 volts, WKG
ALL ONLY 5p EACH VAT Inc.

SPECIAL OFFER *'MUST CLEAR'*

(End of Stock Line) ATZ High Quality Low Noise — High Output C60 Chromium Dioxide Cassette Tapes complete with Index and FREE Library Case
***A REAL SNIP AT* £1.10 each**
Plus 12p p&p — (inc. VAT)

FREE THIS MONTH, A GIFT OF A HANOSOME FLOWER PAPERWEIGHT

Worth 75p with every order taken worth £3.50 or more

VEROBOARD .1" Matrix and .15" Matrix in 4" x 3" size pieces. **30p** each inc VAT

NOT THE CHEAPEST — THE BEST QUALITY

Low noise — High output, C60, Ferric Oxide, CASSETTE TAPES, complete Index and Library Case etc. **£2.87** for 5. 10 for **£4.95**
Or try a **Sample Tape** for **62p**
VAT inc. in price, p&p 12p

SUPER VALUE ELECTROLITIC CAPACITORS

in values 47mfd to 10mfd and from 10mfd to 100mfd and 100mfd up to 68mfd. 10 to 250 volts wkg
All only **7p** each inc. VAT

ALL OUR PRICES ARE INCLUSIVE OF VAT, ADD 30p for p&p to your total order value, except where different. We accept: Cheques/Giro Cheques/Postal Orders etc. **(MONEY BACK ASSURANCE ON ALL ORDERS PLACED). Phone orders taken after 6 p.m. for your convenience.**

SIGTRONIC ELECTRONICS, 27 Malvern Street, Stapenhill, Burton-on-Trent, Staffordshire DE15 9DY
Telephone: (0283) 46868, after 6 pm Special Orders

TRADE COMPONENTS

NO LISTS: TOO MANY ITEMS. PAY A VISIT — THOUSANDS MORE ITEMS BELOW WHOLESALE PRICE. CALLERS PAY LESS AS PRICES INCLUDE POSTAGE AND VAT AND ADDITIONAL DISCOUNT IN LIEU OF GUARANTEE. GOODS SENT AT CUSTOMERS RISKS UNLESS SUFFICIENT ADDED FOR REGISTRATION OR COMPENSATION FEE POST.

OFFERS CORRECT AT 12-10-78 APPLICABLE TO ORDERS RECEIVED DURING OCTOBER

VALVE BASES

Printed circuit B7G	7p
Chassis B7-B7G	11p
Shrouded Chassis B7G-B8A	13p
B12A tube. Chassis B9A	13p

Speaker 6" x 4" 5 ohm ideal for car radio	£1.55
4¾" diam. 30 Ω	£1.75
2½" diam. 32 or 8Ω	£1.07

TAG STRIP—6 way 4p, 9 way 6p Single 1½p

5 x 50pF or 1000 x 300pF trimmers 35p

Car type panel lock and key 65p

Transformer 9V 4A £3.78

Aluminium Knobs for ¼" shaft. Approx. ⅝" x ⅞" with indicator Pack of 5 **95p**

BOXES — Grey polystyrene 61 x 112 x 31mm, top secured by 4 self tapping screws **57p** clear perspex sliding lid, 46 x 39 x 24 mm **15p**.

ABS, ribbed inside 5mm centres for P.C.B., brass corner inserts, screw down lid, 50 x 100 x 25mm orange **65p**; 80 x 150 x 50mm black **97p**; 109 x 185 x 60mm black **£1.52.**

DIECAST ALI superior heavy gauge with sealing gasket, approx 6½" x 2⅝" x 1⅜" **£1.50;** 3¾" x 2⅝" x 1⅜" **£1.25.**

VARIABLE CAMM PROGRAMMER 10, 12 or 15 pole 2 way, 50VAC motor — series with 1mfd, or 3k 10W or 15W pygmy bulb for mains operation. Ex equipment **£4.32**

SWITCHES

Pole	Way	Type	
1	2	Slide	15p
6	2	Slide	24p
2	1	Rotary Mains	28p
2	Alternating	Micro with roller	30p
2	3	Miniature Slide	20p
2	1	Toggle	32p
1	2	Sub-Min Toggle	75p
2	Alternating	2A Mains Push (⅜" hole)	43p

S.P.S.T. 10 amp 240v. white rocker switch with neon. 1" square flush panel fitting **38p**; Sidleen/AFA Very High Security barrel Key Switch, 2 tubular keys ... **£2.95**

Standard thumb-wheel switch 0-9 in 1248N or B or Comp. 1242 also 2p co........ **£1.20**

Standard Lever Key Switch D.P.D.T. locking plus D.P.D.T. and S.P.S.T. Heavy Duty non latching ... 82p

AUDIO LEADS

3 pin din to open end, 1½yd, twin screened	45p
3 pole jack both ends 4ft	£1
3 pole jack plug to tag ends, 4ft	45p

COMPUTER & AUDIO BOARDS/ASSEMBLIES VARYING CONTENTS INCLUDE ZENER, GOLD BOND, SILICON, GERMANIUM, LOW AND HIGH POWER TRANSISTORS AND DIODES, HI STAB RESISTORS, CAPACITORS, ELECTROLYTICS, TRIMPOTS, POT CORES, CHOKES ETC.

3lb for **£2** 7lb for **£3.70**

1k horizontal preset with knob 10 for **40p**

3" Tape Spools	5p
1" Terry Clips	5p
12 Volt Solenoid	40p

ENM Ltd. cased 7-digit counter 2¼ x 1¾ x 1¼" approx. 12V d.c. (48 a.c.) or mains **£1.10**

Auto charger for 12v Nicads, ex-new equipment ... **£5.19**

RESISTORS

⅛-¼-½ watt	1½p
1 watt	3p
Up to 15w w/wound	10p
1 or 2% 5 times price	

Cinch 8 way std 0.15 pitch edge connector 25p

RELAYS

P.O. 3000 type, 1,000 OHM coil, 4 pole c/o 75p
12v d.p.c.o. heavy duty octal ... £1
700 ohm 11-31 volt miniature sealed d.p.c.o. ... £1
185 ohm 6/12V miniature sealed 4 p.c.o. ... £1.45

POTS

Wirewound 38p. Log. or Lin., carbon rotary or slide. Single 30p With switch 40p Dual 45p Dual switch 65p 1.5m Edgetype 10 for 40p

Skeleton Presets
Slider, horizontal or vertical standard or submin 8p

THERMISTORS and V.D.R's

CZ1/2/6/11/14, KR22, KT150, VA1005/6/8/1010/1033/4/7/8/9 1040/1053/5 /1066/7/1074/6/7 / 1082/6/1091/6/7/8 / 1100/3/8/8602. Rod with spot blue/fawn/green. E299DDP120 / 218 / 224 / 338 / 340 / 350 / 352 · VF020 · E220ZZ002 · KR150 ... All 22p
E23 glass bead 85p
YG150-S534 bead, KB13, E299 DHP230, 116-121 401 (TH7, VA1104, OD10) 35p

Miniature 0 to 5mA d.c. meter approx ⅞" diameter ... **£1.25**
RS Yellow Wander Plug Box of 12 ... **40p**
18 SWG multicore solder ... **3½p foot**

SAPHIRE STYLII. 15 different; dual and single point, current and hard to get types. My mix **£2.**

JAP 4 gang min. sealed tuning condensers 40p

ELECTROLYTICS Many others in stock

Up to MFD	10V	25V	50V	63–75V	100V	200–250V	300–350 V	450–500V
10	6p	7p	7p	10p	13p	15p	26p	32p
25	6p	7p	7p	10p	13p	18p	32p	37p
50	6p	7p	7p	12p	16p	23p	32p	37p
100	7p	8p	13p	15p	24p	26p	—	—
250	12p	13p	15p	22p	36p	—	£1.10	£1.30
500	13p	15p	22p	30p	55p	—	—	£1.60
1000	16p	27p	50p	60p	—	£1.05	—	—
2000	28p	47p	55p	93p	—	—	—	—

As total values are too numerous to list, use this price guide to work out your actual requirements 8/20, 10/20, 12/20, 22/50, 47/25. Tub. Tant **24p** each 16-32/275V, 100/150V 100-100/275V **40p** 50-50/385V, 2+2/200V non polar, 32-32-50/300V 20-20-20/350V 0.1+0.1/500V AC **80p** 700mfd/200V, 100-200-60/300V **£1.30** 100-300-100-16/300V **£1.85**

RS 100-0-100 micro amp null indicator Approx. 2" x ¾" x ¾"....................................£1.85

INDICATORS

Bulgin D676 red, takes M.E.S. bulb..................38p
12 volt, or Mains neon, red pushfit....................23p
R.S. Scale Print, pressure transfer sheet...........12p

CAPACITOR GUIDE — maximum 500V

Up to .01 ceramic **4½p.** Up to .01 poly **6p** .013 up to .1 poly etc. **7p.** .12 up to .68 poly etc. **8p.** Silver mica up to 360pF **10p,** then to 2,200pF **13p**; then to .01 mfd **21p.** .1/750 **13p.** .01/1000, 8/20, .1/900, .22/900, 4/16, 25/250 AC (600v/DC). **15p.** 5/150, 10/150, 40/150 **50p.**
Many others and high voltage in stock.

SONNENSCHEIN/POWERSONIC DR-IFIT RECHARGEABLE SEALED GEL (Lead Antimony) BATTERY, 6 Volt 1 Amp. Hr. (3⅞" x 2" x ⅞") £3.70
6 amp Hour (4½" x 2" x 3") **£7.60.**
Ex-equipment, little used.

CONNECTOR STRIP
Belling Lee L1469, 4 way polythene. **9p each**

1¼ glass fuses 250 m/a or 3 amp (box of 12) 20p
Bulgin 5mm Jack plug and switched socket (pair) 40p

Reed Switch 28mm, body length 11p

Aluminium circuit tape, ⅛ x 36 yards—self adhesive. For window alarms, circuits, etc. **95p**

TV MAINS DROPPERS
5 assorted multiple units for..................................75p

100pF air-spaced tuning capacitor..................£1.30
5¼" x 2¼" Speaker, ex-equipment 3 ohm 65p
2 Amp Suppression Choke..................................10p
3 x 2½ x 1/16" } PAXOLINE 5 for 35p
4⅝ x ½ x ⅛" } 10 for 15p
PVC or metal clip on MES bulb Holder 5 for 30p
VALVE RETAINER CLIP, adjustable 5 for 15p

Sub-miniature Transistor Transformer 35p
Valve type output transformer 90p

POT CORES with adjuster
LA2508-LA2519 **43p per pair**

16 Watt Power Amp. Module
35v 1A power required, giving 16 watt RMS into 8 Ω **£3.45**

GRUNDIG REGULATED TAPE MOTOR
6V nominal approx. 3 x 1½". Incl. shock absorbing carrier £1.05

3.5mm metal stereo plug 30p

Ferric Chloride, Anhydrous mil spec 1lb bag **97p**
RS neg. volt regulator 103, 306-099 (equiv. MPC900) 10A, 100 watt 4-30 volt. Adjustable short circuit protection. Normally £12.50+. **£6.65**

Digital count unit. Counts in steps of 1, 2, 5 or 10 with total limit switch (2 x D.I.L. BCD), reed relay remote output. Mains power supply, relay and delay unit. UNUSED. Displays on 2 Minitron. 7 segments sold separately. £5.40

Crouzet 30-minute timer-programmer, multi-variable contacts £7.56

ACOS DUST JOCKEY Automatic record cleaner £1.30

Mail Order Over £50 deduct 10% Over £100 deduct 20%

Burglar alarm, cord-powered for windows, doors, luggage and personal attack. Battery powered 86p

McMurdo 4 or 8 way plug and socket ex-equipment 50p

DEAC rechargeable NICAD 450K. Capacity 6V 450 m.a.h. at 10 hour rate. Ex-new equipment £4.11

"Makaswitch" 1p 10-way wafer 15p Wood cased 8-12V buzzer £2.50

2.5A r.f. thermo-couple and meter 2¼" square £3.80

BRIAN J. REED

161 ST. JOHNS HILL, BATTERSEA, LONDON SW11 1TQ
Open 10 a.m. till 7 p.m. Tuesday to Saturday. VAT receipts on request.
Terms: Payment with order Telephone: 01-223 5016

Lamp control panels with 5A mains triac, heat sink, 2 Multi-turn trimpots, cermet pot. 4 x 1A diodes, 9 x 1N914 neon indicator, 11 popular transistors, Hi-stab resistors, capacitors, etc. £1.60

C90 Cassette Tape 62p

Mullard 12-0-12V, 1.4A stabilized, regulated, power supply. Approx. 8½" x 4¾" x 3½" with handbook £14.50

27V 5A Double section bobbin transformer £4.32

Greenpar 50 ohm BNC line plug, round or flanged chassis socket or t.n.c. plug, all 60p each

250 Ω 50 watt + Resistor 40p

UK & EIRE — Postal Orders for same day service. Cheques require 8 days from a Tuesday banking to ensure clearance: export — banker's draft (sterling) same day service. Foreign currency money orders etc. can lose value and take 4-6 weeks to clear.

SEMICONDUCTORS Full spec. by Mullard etc. Many others in stock

AC128/176	17p
ACY29	22p
AD161/2 match pr.	85p
AF116	20p
AF124/6/7	28p
AF139	23p
AF178/80/81	35p
AF239	35p
ASY27/73	35p
AU110/113	£2.50
BC107/8/9 + A/B/C	8p
BC147/8/9 + A/B/C	8p
BC157/8/9 + A/B/C	8p
BC17BA/B 179B	14p
BC184C/LC	11p
BC186/7	23p
BC213L/214B	13p*
BC261B	10p
BC327/8 337/8	10p
BC547/8+A/B/C	13p
BC556/7/78/8/9	11p
BCX32/36	15p
BCY31	90p
BCY70/1/2	14p
BCZ11	32p
BD113	57p
BD115	35p
BD116(BRC116T)	£1.15
BD130Y	£1.50
BD131/2/3	40p
BD135/6/7/8/9	35p
BD137/138 match pr	82p
BD140/142	35p
BD201/2/3/4	92p
BD232/3/4/5/8	55p
BDX77	£1.15
BD437	58p
BF/115/167/173	18p
BF178/9	23p
BF180/1/2/3/4/5	18p
BF194/5/6/7	8p
BF194A, 195C	8p
BF200 258 324	23p
BF262/3	35p
BF336	31p
BFS28 Dual Mosfet	£1.15
BFW10/11 F.E.T	46p
BFW30	£1.15
BFW57/58	21p
BFX12/29/30	23p
BFX84/88.89	20p
BFY51/52	16p
BFY90	57p
BR101	34p
BRY39/56	29p
BSV64	36p
BSV79/80 F.E.T.s	90p
BSV81 Mosfet	£1.00
BSX20/21	16p
BSY40	30p
BSY95A	14p
BU204+Mount Kit	£1.85
BU208	£2.26
CV7042 (OC41/44 ASY63)	12p
GET111	45p
OC45(ME2)	13p
ON222	23p
R2008B/2010B	£2.30
TIP30	50p
TIS43	39p
TIS88A F.E.T.	28p
uA7805	£1.85
ZT1486	£1.15
ZTX300/341	9p
2G371(OC71)	18p
2N393 (MA393)	36p
2N456A	57p
2N706A	18p
2N929	16p
2N987	45p
2N1484	£1.15
2N1507/2219	18p
2N2401	35p
2N2412	80p
2N2483	28p
2N2904/5/6/7/7A	18p
2N3053	16p
2N3055 R.C.A.	60p
2N3133	24p
2N3553	56p
2N4037	39p
2N5484 FET	39p
2SA141/2/360	36p
2SB135/6/457	24p
40250(2N3054)	35p

NEW B. V.A. VALVES

EB91	49p
ECL80	67p
PCC84	59p
6SN7/6K7	89p
6AT6	89p
EZ81	59p

TRANSFORMER

Ferromag C core. Screen 95-105-115-125-200-220-240v Input output 17v ½A x 2 24-0-24v 1.04 + 20v 1mA. These current ratings can be safely exceeded by 50%. £4.90

Cassette Dynamic Microphone with switch and twin plug £1.80

Telephone Pickup, sucker with lead and 3.5 plug. 70p.

OTHER DIODES

1N916	8p
1N4009	9p
1N4148	4p
BA145	17p
Centercel	29p
BZY61/BA148/OA81	12p
BB103/110 Varicap	24p
BB113 Triple Varicap	43p
BA182	15p
OA5/7/10	17p
BZY88 up to 43 volt	10p
BZX61 11 volt	17p
AA133	10p
BZY96C 10V	34p
BZY95C 33V	34p

RS *Irravin* high temperature wire, 19/0.16, minus 55° to 105°C, 600V 3A, white, black or red. Half trade price at 54p 10M coil.

PVC QUALITY TAPE

Lasso 10m x 15mm grey 38p

33m x 33mm green £1.13p

Trimmer: Post stamp type 3-30pF 16p

10-80pF 19p

30-140pF 23p

GARRARD

GCS23T Crystal Stereo Cartridge £1.20

Mono (Stereo compatible) Ceramic or crystal £1

BRIDGE RECTIFIERS

Amp	Volt		
1	1,600	BYX10	34p
1	140	OSH01-200	30p
5	100	Ex Equip	73p
0.6	110	EC433	20p
5	400	Texas	£1.10
2½	100	I.R.	48p
3½	100	B40C 3200	58p

RECTIFIERS

	Amp	Volt	
M1	½	68	5p
1N4005/6	1	6/800	6p
1N4007/BYX94	1	1250	8p
BY103	1	1,500	21p
SR100	1.5	100	9p
SR400	1.5	400	10p
REC53A	1.5	1,250	16p
LT102	2	30	15p
BYX22-200	1½	300	25p
BYX38-300R	2.5	300	48p
BYX38-600	2.5	600	52p
BYX38-900	2.5	900	60p
BYX38-1200	2.5	1,200	65p
BYX49-300R	3	300	35p
BYX49-600	3	600	42p
BYX49-900	3	900	47p
BYX49-1200	3	1,200	60p
BYX48-300R	6	300	47p
BYX48-600	6	600	60p
BYX48-900	6	900	70p
BYX48-1200R	6	1,200	92p
BYX72-150R	10	150	42p
BYX72-300R	10	300	52p
BYX72-500R	10	500	65p
BYX42-300	10	300	36p
1N5401	3	100	16p
1N5402	3	200	18p
MR856	3	600	24p
BYX42-900	10	900	92p
BYX42-1200	10	1,200	£1.07
BYX46-300R*	15	300	£1.19
BYX46-400R*	15	400	£1.75
BYX46-500R*	15	500	£2.00
BYX46-600*	15	600	£2.30
BYX20-200	25	200	72p
BYX52-300	40	300	£2.05
BYX52-1200	40	1,200	£2.90
RAS310AF*	1.25	1,250	48p

**Avalanche type*

TRIACS

Amp	Volt		
8	400	Plastic RCA	£1.40
25	900	BTX94-900	£4.50
25	1200	BTX49-1200	£6.75

RS 2mm Terminals Blue & Black . . . . . 5 for 50p

Chrome Car Radio facia 28p

Rubber Car Radio gasket 10p

DLI Pal Delayline 90p

Relay Socket miniature 2PCO . . . 20p

28 pin d.l.l. socket low profile . . . 38p

Colour EHT Tray 3000/3500 . . £5.50

Nylon self-locking, 3½" tie clips . . . 3p

750uh choke 12p

0-30, or 0-15, black pvc, 360° dial, silver digits, self adhesive 4½" dia. 13p

Mullard Semiconductor, Valve & Component Data Book 1976-78 . 50p

OPTO ELECTRONICS

Diodes		Photo transistor	
TIL209 Red	14p	BPX29 . . .	92p
BPX40 . . .	57p	OCP71 . . .	75p
BPX42 . . .	92p		
BPY10 . . .	92p		
(VOLTIAC)			
BPY68			
BPY69 . . .	92p		
BPY77			

BIG L.E.D. 0.2" 2v 50m/A max.

RED 16p

Wire end neons 9p

PHOTO SILICON CONTROLLED SWITCH

BPX66 PNPN 10 amp £1.15

THYRISTORS

Amp	Volt		
1	240	BTX18-200	35p
1	400	BTX18-300	41p
1	240	BTX30-200	35p
15	500	BT107	£1.14
6.5	500	BT101-500R	£1.05
6.5	500	BT109-500R/SCR957/BRC4444	£1.14
20	600	BTW92-600RM	£3.40
15	800	BTX95-800R Pulse Modulated	£8.75

3" red 7 segment L.E.D. 14 D.I.L. 0-9 + D.P. display 1.9v 19m/a segment, common anode 95p

RS 0.6in. green £2.25

Minitron 0.3in 3015F filament £1.25

CQY11B L.E.D. Infra red transmitter . . £1.15

One fifth of trade Plastic Transistor or Diode Holder 1½p

Transistor or Diode Pad . 1½p

Holders or pads 65p per 100

PAPER BLOCK CONDENSER

0.25MFD	800 volt	87p
1MFD	250 volt	54p
1MFD	400 volt	65p

TV KNOB

Dark grey plastic for recessed shaft (quarter inch) with free shaft extension 8p

CHASSIS SOCKETS

Car Aerial 11p, Coax 8p, 5 pin 180° 11p, 5 or 6 pin 240° din 8p, speaker din switched 13p, 3.5 mm switched 7p, stereo ¼" jack enclosed 20p.

INTEGRATED CIRCUITS

TBA920	£2.20
TAA700	£2.40
TBA800	£1.24
741 dil. op amp	28p
uA702 op amp	53p
(72) 709	52p
SN76013N/ND	£1.40
SN76228N	£2.03
SN76131N	£1.55
SN74107N	38p
TAD100 AMRF	£1.22
CA3001 R.F. Amp	58p
CA3132	£2.22
CD4013 CMOS	41p
CD4069	24p
TAA300 1 wt Amp	£1.15
TAA550 Y or G	26p
TAA263 Amp	75p
TAA320	£1.15
7400/7401	16p
7402/4/10/20/30	16p
7414	64p
7438/74	27p
7414	64p
7483	79p
7493	41p
LM300 2/20V reg	£1.15
LM1303N	£1.15
74154	£1.02
TBA550Q	£1.80
ZN414 Radio Chip	£1.40

McMurdo PP108 8 way edge plug 12p

Multicore Solder ½kg. 16 or 18 or 20 s.w.g. 60/40 . . . . £5.00

3 inch 8 Ω speaker £1.15

New unmarked, or marked ample lead ex new equipment

ACY17-20	10p	TIC44	28p
ASZ20	10p	2G240	£1.17
ASZ21	35p	2G302	6p
		2G401	6p
BC186	13p	2N711	28p
BCY30-34	24p	2N2926	6p
BCY70/1/2	10p	2N598/9	8p
BY126/7	5p	2N1091	10p
HG1005	12p	2N1302	10p
HG5009	4p	1N1907	£1.17
HG5079	4p	Germ. diode	2p
L78/9	4p	2N3055	
M3	12p	Motorola	36p
OA81	4p	GET120 (AC128 in 1" sq. heat sink	22p
OA47	4p		
OA200-2	4p		
OC23	27p	GET872	15p
OC200-5	24p	2S3230	34p

MINIATURE EDGE METERS

100uA f.s.d., scaled 0.5. 12V Illuminated blue perspex front, 35mm x 14mm £3.45

200uA level meter, clear front. 10 x 18mm £1.20

SPECIAL OFFERS

2500 mfd. 40v 56p

0.1 mfd. 350/500v 10 for 50p

10000 mfd. 15v 3 for £1.16

6800 mfd. 10v 3 for 90p

32+32/275v 3 for 90p

16+32/350v 3 for 90p

8+8 mfd. 375v4 for 90p

1 mfd. non-polar 350v 10 for £1.19

25000 mfd. 25v 65p

12000/12v 3 for £1.16

G.E.C. 5% Hi-stab capacitors 013, 061, 066, 069, 075, 08, 10 for 65p

Philips Head Cleaner Tape 32p

BC548B 500 for £28.50

BC556 500 for £28.50

BCY71 500 for £43.50

BD437 50 for £13.75

BD133 100 for £16.60

2N2906 500 for £43.50

TBA920 10 for £11.50

Vero card handle 10 for 65p

62 Ω ½W Resistor 2,000 for £6.75

ON222 (superior matched BF181) 10 for £1.20

HANDLES

Rigid light blue nylon 6¼" with secret fitting screws 11p

Belling Lee white plastic surface coax outlet box 40p

Miniature Axial Lead Ferrite Choke formers 5 for 13p

RS 10 Turn pot 1% 250 500 Ω 1K, 50K £1.70

Copper coated board 10" x 9" approx. 60p

Geared Knob 8-1 ratio. 1¼" diam., black 93p

KLIPPON 25A 440v TERMINAL BLOCKS Professional leaf spring clamp, twin with clip-over cover 11p

Strip of 4, 40A 440V 16p

VAT & POST PAID

MINIMUM ORDER £3 OTHERWISE ADD 50% FOR SMALL ORDER HANDLING COSTS (UNDER £1.00 TOTAL ALSO INCLUDE 9p S.A.E.)

NO MORE TO ADD — Prices INCLUDE UK VAT and Post/Packing

ALL ENQUIRIES, ETC., MUST BE ACCOMPANIED BY A STAMPED ADDRESSED ENVELOPE

FAST AND EASY FAST AND EASY FAST AND EASY FAST AND EASY

Complete the Circuit at Breadboard '78

Lektrokit have made sure that, no matter how often you go'round the exhibits at Breadboard '78, you'll keep coming back to Stands D8 and D9. "Completing the circuit" every time.

Because Lektrokit—as only Lektrokit could—have combined their vast array of components with those of AP Products Inc to bring you the most comprehensive range of breadboarding and testing devices on earth.

Nowhere else at Breadboard '78 will you see everything you're likely to need all in one place, all in one go, and at the right price.

If you can't get to Breadboard '78 contact us for more details and the name of your nearest Lektrokit dealer and take a look at how much you can get for how little.

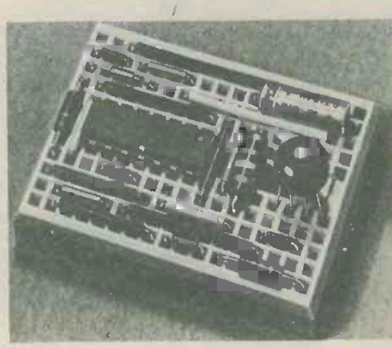
Lektrokit Breadboards

FROM £3.25, inc p & p and VAT

Hole for hole, top value! Lektrokit Breadboards are modular, so they can be linked together to form any size. With a pitch of 0.1", even the smallest breadboard—217L—can accept 8, 14, 16 or 18 pin Dil devices. You just take a component, choose a hole, and push it in.

Model No.	Contacts	Price, each
217L	170	£3.25
234L	340	£5.75
248L	480	£6.65
264R	512	£6.65
264L	640	£8.32

(All prices include packing, postage and VAT)



Lektrokit IC Test Clips

FROM £3.08 inc p & p and VAT

Eleven models, from TC-8 to TC-40 to fit all DIP sizes. Prices from £3.08 for the TC-14, £3.25 for the TC-16, etc.

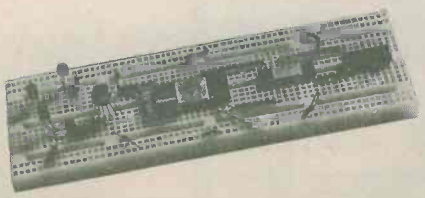
Test clip grips IC's without slipping or shorting between pins—makes testing IC's on boards easier, aids removing and inserting DIP's without damage. Each IC pin can be brought up to a convenient contact post for test leads or probe connections.

Lektrokit Super Strip SS2

ONLY £11.05 inc p & p and VAT

Super Strip accepts ALL DIP's— as many as nine 14-pin at a time— and/or TO-5's and discrete components. With interconnections of any solid wire up to 20 AWG.

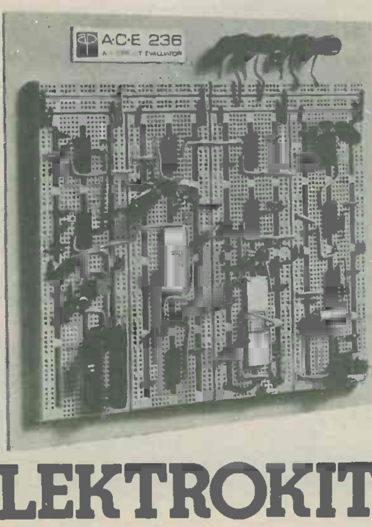
Super Strip has 840 contact points, combining a power/signal distribution system with a matrix of 640 contacts in groups of 5. Distribution system has eight bus-bars, each with 25 contact points.



Lektrokit All-Circuit Evaluator FROM £12.53 inc p & p and VAT

"ACE" in the hole for home constructors and project builders who do things faster and easier! No laying out circuit diagrams, printed circuit boards, soldering everything together, trouble-shooting, making mods, then chucking it and starting the whole time-consuming business all over again!

With ACE, you just plug in components and make connections with ordinary 22-gauge solid wire. No soldering. You can build any working project *complete*, as fast as you could lay out a circuit diagram before.



Seven ACE models altogether—with from 728 to 3,648 contacts. IC capacity (all 14-pin DIP's) from 9 to 36. Buses from 2 to 36. Posts from 2 to 4. Prices from £12.53 including packing and postage and VAT.

Lektrokit's policy is the right product, whatever the project, at the right price. And it's backed by a nationwide network of retailers.

Send for the name of the dealer nearest you—plus a FREE full-colour catalogue.

And, if you can, see and try out the great Lektrokit range at Breadboard '78—from Nov. 21 to Nov. 25 at Seymour Hall, Seymour Place, London.

To Lektrokit Limited, London Road, Reading, Berks, RG6 1AZ. Tel. Reading (0734) 669116/7.
Please send me the name of my nearest Lektrokit dealer—plus FREE catalogue.
Please supply the following (list items required)

. . . .

. . . . I enclose P.O./cheque for £ . . . .

(Allow 28 days for delivery. All prices above include packing, postage and VAT).

Name . . . .

Address . . . .

. . . .

SEE LEKTROKIT ON STANDS D8 AND D9 AT BREADBOARD '78!

LEKTROKIT COMPLETES THE CIRCUIT

REC 2

LOW COST COMPONENTS — OUR GUARANTEE IS YOUR SATISFACTION

POT'S ROTARY

1ohm Lin (26mm) new	11p
680ohm Lin (21mm) new	12p
2K7 Lin (21mm) new	12p
4K Lin (22mm) new	13p
10K Lin (22mm) new	13p
250K Log (22mm) new	13p
50K Lin (19mm) new	13p
50K Lin (27mm) new	14p
100K Lin (27mm) new	12p
2.5K Lin (27mm) new	13p
200K Lin (27mm) new	14p
500K Lin (27mm) new	12p
Switched 2K2 (16mm) min type new at	18p
Double ganged 100K Lin type new at	22p
Double ganged 500K Lin type new at	18p
50ohm Wirewound new	20p

SLIDERS POT'S

1K (88mm long) new	14p
1K8 Lin (60mm) new	16p
5K (74mm long) new	18p

TOROIDAL CORES

21mm round new at	10p
25mm round new at	12p
27mm round new at	13p
29mm round new at	14p
33mm round new at	16p
34mm round new at	17p
39mm round new at	21p
48mm round new at	28p
52mm round new at	33p
58mm round new at	38p
68mm round new at	54p
78mm round new at	52p
86mm round new at	60p

Project Boxes black plastic with screw on lids,

'A' 77 x 56 x 37 at	59p
'B' 95 x 71 x 35 at	69p
'C' 115 x 95 x 37 at	79p

AUDIO TRANSFORMERS

Output types for transistor circuits

11mm x 15mm at	14p
14mm x 16mm at	15p
15mm x 17mm at	17p
18mm x 22mm at	18p
19mm x 24mm at'2	22p

Transistor interstage types,

15mm x 20mm at	18p

all types are new.

New button type nickel cadmium rechargeable cells

16mm x 5mm rated 1.2v 50ma at	32p
25mm x 5mm rated 1.2v 250ma at	55p

LED'S

We have obtained new supplies which cost a bit more but they are still reasonable

0.2" red at	8p
1.2" yellow at	10p
0.2" green at	12p
0.2" orange at	12p

DISPLAYS

0.3" seven segment led, common anode, left hand decimal point,

Red at	65p
Yellow at	70p
Green at	75p

all are 14-pin dil type packages.

2 watt new zener diodes 15/15v, metal cased at **6p**

PAKS

Ten mixed marked values electrolytics at 16p or. 40 at **50p**

Eighteen mixed small resistors at 12p

Fifteen assorted capacitors could be mylar, ceramic polyester etc. at 12p

Twenty mixed audio transistors at **35p**

Ten mixed wirewound resistors at **24p**

Eighteen mixed values ceramic capacitors at **12p** or 100 for **75p**

Ten mixed 400mw zener diodes **18p**

Ten mixed 2w zener diodes at **24p**

Six mixed value pots rotary at **65p**

Three mixed sizes of toroidal cores at **40p**

Three mixed sizes of transistor audio output transformers **35p**

Twelve 7400 series IC's unmarked/untested at **24p**

Twenty silicon diodes mixed signal and power types at **10p** or 60 for **25p** or 200 for **65p**

Six mixed FETs at **60p**

Six mixed photo type transistors at **65p**

Twenty mixed BC107/8/9 transistors at **70p**

Regulated and smoothed transistor power units rated 6v 100ma **£2.60**, 9v 100ma **£2.60**, 10v 100ma **£2.60**.

Car Battery Charger Unit 200/240v AC in-12v (13½v pk) dc out, at 2A/H, metal boxed, all new components, ready assembled with battery clips, sized approx. 6" x 4" x 3" at **£4.00** plus p/p 30p.

TRANSISTORS

BC107 at	4p
BC108 at	5p
BC109 at	5p
AC128 at	6p
FETs general purpose P-channel at	12p
Photo transistors gen. purpose	16p
Photo darlingtons gen. purpose	17p
BD187 plastic power 4amp	32p
OC71 equiv – (NKT214) at	14p
MP8512 medium power at	20p
MP8112 medium power at	20p
2N3055 new ex-equip. at	28p
BFY56 new ex-equip. at	16p
BCY32 new ex-equip. at	8p
BC177 at	6p
BC178 at	6p
2N2905 at	8p
2N706 at	8p
BFY50 at	8p
BFY51 at	8p

ZENER DIODES

3V7, 4V6, 5V6, 6V, 6V8, 7V2, 8V6, 9V4, 10V, 10V7, 12V, 16V, 20V, 24V, 33V all 400mw types at **4p**

Neon Indicators 150mm leads, fixed in 6.4mm hole by nut, 240v in red **24p**, amber **25p**, opal **26p**, clear **25p**.

Aluminium boxes 128 x 44 x 38mm, at **36p** each

NEW RANGE TRANSISTORISED INVERTER UNITS

Designed to operate reliably in continuous or intermittent use, low standing current drain, proportional current consumption with regard to the connected load, assembled in vinyl covered instrument cases with grade one silicon power transistors — Guaranteed 2 years — DC input fused.

12 volt dc inputs — 200/240V AC outputs regulated at 50HZ square wave or optional smoothed and filtered wave form circuitry for sensitive equipment:

22/25 watts, cased 4 in x 3 in x 2 in **£6.80** postage **85p** extra; **38/40 watts**, cased 4 in x 3 in x 2 in **£9.40** postage **85p** extra; **120/140 watts**, cased 8 in x 7 in x 3 in **£18.70** postage **£1.40** extra; **180/200 watts**, cased 8 in x 7 in x 3 in **£24.60** postage **£1.40** extra; **240/250 watts**, cased 9 in x 8 in x 3 in **£28.80** postage **£1.80** extra; **350/360 watts**, cased 10 in x 8 in x 3½ in **£34.50** postage **£2.00** extra; **420/440 watts**, cased 10 in x 8 in x 3½ in **£40.00** postage **£2.00** extra; **480/500 watts**, cased 10 in x 8 in x 3½ in **£48.20** postage **£2.00** extra.

OPTIONAL EXTRAS

Smoothed and filtered waveform circuitry **£2.50**; Additional 13 amp mains output socket fitted **£1.20**; Panel fuse/holder 20mm for mains protection fitted **£1.00**. All inverters are ready assembled, DC input via heavy duty cables with attached battery clips, AC mains output via a 13 amp socket.

DO NOT ADD ANY EXTRAS UNLESS INDICATED

Some of the advertised components are offered below normal prices due to their being unmarked but identified and tested new and workable by ourselves, any unsatisfied customer may return goods purchased within 8 days for full refund as long as the goods are undamaged.

ORDER DETAILS

It is helpful if you send a S.A.E. with all orders or enquiries, lists free on request.

ELECTROVANCE

Tel: 01-736 0685

MAIL ORDER ONLY

125 HAZLEBURY ROAD, LONDON SW6 2LX

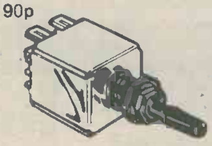
STEVENSON
Electronic Components

SWITCHES

Subminiature toggle. Rated at 3A 250V.

SPDT 65p SPDT centre off 70p
DPDT 75p DPDT centre off 90p

Standard Toggle.
SPST 34p DPDT 48p



Wavechange switches.
1P12W, 2P6W, 3P4W or 4P3W
all 37p each.

Miniature switches (non-locking)
Push to make 15p Push to break 20p

POTENTIOMETERS

5K–2M2 single 26p ea.
5K–2M2 stereo (dual) 75p ea.
5K–2M2 DP switched 60p ea.
100Ω–2M2 horizontal or vertical preset 6p ea.

KNOBS

Ideal for use on mixers, etc. Push on type with coloured cap in red, black, green, blue, yellow and grey.
Position line marked 14p each.

MICROPROCESSORS

6800	670p	6820	350p	21L02	110p
8080A	525p	6850	360p	2112	175p
6810	300p	AY5-1013	380p	2114	700p

REGULATORS

78L05	30p	79L05	70p	LM309K	110p
78L12	30p	79L12	70p	LM317	220p
78L15	30p	79L15	70p	LM323K	530p
7805	60p	7905	80p	LM723	35p
7812	60p	7912	80p		
7815	60p	7915	80p		

THYRISTORS AND TRIACS

Plastic cased Thyristors. Texas.

	4A	8A	12A
100V	36p	45p	62p
200V	42p	53p	68p
400V	51p	66p	86p

Plastic cased Triacs. Texas.
All rated at 400V

4A	70p	12A	90p	20A	185p
8A	80p	16A	95p	25A	215p

We now have an express telephone order service. We guarantee that all orders received before 5pm. are shipped first class on that day. Contact our Sales Office now! Telephone: 01-464 2951/5770.

ORDERS DESPATCHED BY RETURN POST

Quantity discounts on any mix TTL, CMOS, 74LS and Linear circuits: 25+ 10%. 100+ 15%. Prices VAT inc. Please add 30p for carriage. All prices valid to 30th April 1979. Official orders welcome.

BARCLAYCARD AND ACCESS WELCOME.

TRANSISTORS

AC127	17p	BCY71	14p	ZTX109	14p
AC128	16p	BCY72	14p	ZTX300	16p
AC176	18p	BD131	35p	2N697	12p
AD161	38p	BD132	35p	3N1302	38p
AD162	38p	BD135	38p	2N2905	22p
BC107	8p	BD139	35p	2N2907	22p
BC108	8p	BD140	35p	2N3053	18p
BC109	8p	BF244B	36p	2N3055	50p
BC147	7p	BFY50	15p	2N3442	135p
BC148	7p	BFY51	15p	2N3702	8p
BC149	8p	BFY52	15p	2N3704	8p
BC158	9p	MJ2955	98p	2N3705	9p
BC177	14p	MPSA06	20p	2N3706	9p
BC178	14p	MPSA56	20p	2N3707	9p
BC179	14p	TIP29C	60p	2N3708	8p
BC182	10p	TIP30C	70p	2N3819	22p
BC182L	10p	TIP31C	65p	2N3904	8p
BC184	10p	TIP32C	80p	2N3905	8p
BC184L	10p	ZTX107	14p	2N3906	8p
BC212	10p	ZTX108	14p	2N4058	12p
BC212L	10p			2N5457	32p
BC214	10p			2N5458	30p
BC214	10p			2N5459	32p
BC477	19p			2N5777	50p
BC478	19p				
BC479	19p				
BC548	10p				
BCY70	14p				

DIODES

1N914	4p	1N4148	3p
1N4001	4p	1N5401	13p
1N4002	4p	1N5402	15p
1N4004	5p	1N5404	16p
1N4006	6p	1N5406	18p

BZY88 series 2V7 to 33V 8p each.

74LS

LS00	16p	LS95	65p
LS01	16p	LS123	56p
LS02	16p	LS125	40p
LS03	16p	LS126	40p
LS04	16p	LS132	60p
LS08	16p	LS136	36p
LS10	16p	LS138	54p
LS13	30p	LS139	50p
LS14	70p	LS151	50p
LS20	16p	LS153	50p
LS30	16p	LS155	80p
LS32	24p	LS156	80p
LS37	26p	LS157	45p
LS40	22p	LS164	90p
LS42	53p	LS174	60p
LS47	70p	LS175	60p
LS48	48p	LS190	80p
LS54	16p	LS192	70p
LS73	29p	LS193	70p
LS74	29p	LS196	80p
LS75	44p	LS261	60p
LS76	35p	LS257	55p
LS78	35p	LS258	55p
LS83	60p	LS266	40p
LS85	70p	LS283	60p
LS86	33p	LS290	55p
LS90	45p	LS365	45p
LS93	45p	LS366	45p
		LS367	45p
		LS368	45p
		LS386	35p
		LS670	180p

LINEAR

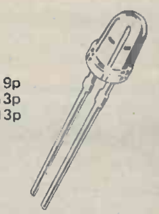
A SELECTION ONLY! DETAILS IN CATALOGUE.

709	25p	LM324	50p	NE556	60p
741	22p	LM339	50p	NE565	120p
747	50p	LM380	75p	NE567	170p
748	30p	LM382	120p	SN76003	200p
CA3046	55p	LM1830	150p	SN76013	140p
CA3080	70p	LM3900	50p	SN76023	140p
CA3130	90p	LM3909	60p	SN76033	200p
CA3140	70p	MC1496	60p	TBA800	70p
LM301AN	28p	MC1458	35p	TDA1022	650p
LM318N	125p	NE555	25p	ZN414	75p

TTL

7400	12p	7493	34p
7401	12p	7494	52p
7402	12p	7495	52p
7404	12p	7496	50p
7408	14p	74121	25p
7410	12p	74122	33p
7413	25p	74123	40p
7414	48p	74125	35p
7420	12p	74126	35p
7427	24p	74132	50p
7430	12p	74141	56p
7442	43p	74148	90p
7447	55p	74150	70p
7448	58p	74151	50p
7454	14p	74156	52p
7473	25p	74157	52p
7474	25p	74164	70p
7475	32p	74165	70p
7476	28p	74170	125p
7485	70p	74174	68p
7489	145p	74177	58p
7490	32p	74190	72p
7492	35p	74191	72p
		74192	64p
		74193	64p
		74196	55p
		74197	55p

OPTO



LEDs	0.125in.	0.2in.	
Red	TIL209	TIL220	9p
Green	TIL211	TIL221	13p
Yellow	TIL213	TIL223	13p
Clips	3p	3p	

DISPLAYS

DL704	0.3 in CC	130p
DL707	0.3 in CA	130p
FND500	0.5 in CC	100p

CMOS

FULL DETAILS IN CATALOGUE

4001	15p	4029	60p
4002	15p	4040	68p
4007	15p	4042	54p
4011	15p	4046	100p
4013	35p	4049	28p
4015	60p	4050	28p
4016	35p	4066	40p
4017	55p	4068	20p
4018	65p	4069	16p
4023	15p	4071	16p
4024	45p	4075	16p
4026	95p	4093	48p
4027	35p	4510	70p
4028	52p	4511	70p
		4518	70p
		4520	65p

RESISTORS

Carbon film resistors. High stability, low noise 5%.

E12 series. 4.7ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res.)
0.5W £7.50. 0.25W £5.70

CAPACITORS

HERE ARE JUST A FEW OF THE CAPACITORS STOCKED

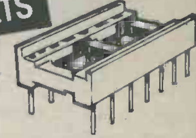
TANTALUM BEAD each
0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V 9p
4.7, 6.8, 10uF @ 25V 13p
22 @ 16V, 47 @ 6V, 100 @ 3V 16p

MYLAR FILM
0.001, 0.01, 0.022, 0.033, 0.047 3p
0.068, 0.1 4p

RADIAL LEAD ELECTROLYTIC

63V	0.47, 1.0, 2.2, 4.7, 10	5p
	22, 33, 47	7p
	100	13p
	220	20p
25V	10, 22, 33, 47	5p
	100	8p
	220	10p
	470	15p
	1000	23p
10V	220	5p
	470	9p
	1000	13p
	2200	23p

SKTS



Low profile by Texas

8 pin	10p	24 pin	24p
14 pin	12p	28 pin	28p
16 pin	13p	40 pin	40p

Soldercon pins: 100: 50p
1000: 370p

AT LAST! OUR NEW 40 PAGE CATALOGUE OF COMPONENTS IS AVAILABLE. SEND S.A.E.

Mail orders to: STEVENSON (Dept RE)

236 High St, Bromley, Kent, BR1 1PQ, England

THE MODERN BOOK CO

UNDERSTANDING DIGITAL ELECTRONICS
by Texas Instruments — PRICE £3.95

WORLD RADIO T.V. H/B
by J. M. Frost PRICE: £8.00

BEGINNERS GUIDE TO MICRO PROCESSORS
by M. Gilmore PRICE £4.85

BUILDING & DESIGNING TRANSISTOR RADIOS A BEGINNER'S GUIDE
by R. H. Warring PRICE £3.30

FOUNDATIONS OF WIRELESS & ELECTRONICS
by M. G. Scroggie PRICE: £4.25

TRANSISTOR POCKET BOOK
by R. G. Hibberd PRICE: £4.20

BEGINNER'S GUIDE TO INTEGRATED CIRCUITS
by I. R. Sinclair PRICE: £3.00

BEGINNER'S GUIDE TO T.V.
by G. J. King PRICE: £2.50

ILLUST. TEACH YOURSELF RADIO
by D. Gibson PRICE: £1.80

RADIO TECHNICIAN'S BENCH MANUAL
by H. W. Hellyer PRICE: £4.00

SOLID STATE COLOUR T.V. CIRCUITS
by G. R. Wilding PRICE: £6.00

SERVICING WITH THE OSCILLOSCOPE
by G. J. King PRICE: £5.30

THE RADIO AMATEUR'S H/B 1978
by A. R. R. L. PRICE: £7.60

TRANSISTOR ELECTRONIC ORGANS FOR THE AMATEUR
by A. Douglas PRICE: £4.80

RAPID SERVICING OF TRANSISTOR EQUIP.
by G. J. King PRICE: £2.80

RADIO CIRCUITS EXPLAINED
by G. J. King PRICE: £6.00

ELECTRONICS POCKET BOOK
by P. J. McGoldrick PRICE: £4.25

BEGINNER'S GUIDE TO ELECTRONICS
by T. L. Squire PRICE: £2.50

BEGINNER'S GUIDE TO COLOUR T.V.
by G. J. King PRICE: £2.50

T.V. TECHNICIAN'S BENCH MANUAL
by G. R. Wilding PRICE: £5.00

ELECTRONICS & RADIO AN INTRO.
by M. Nelkon PRICE: £3.10

T.V. SERVICING H/B
by G. J. King PRICE: £5.60

TELECOMMUNICATION SYSTEMS TEC LEVEL I
by P. H. Smale PRICE: £2.80

MINI-PROCESSORS FROM CALCULATORS TO COMPUTERS
by D. L. Heiserman PRICE £4.85

TRANSISTORISED RADIO CONTROL FOR MODELS
by D. W.Aldridge PRICE: £3.30

PRINCIPLES & SYSTEMS FOR RADIO & T.V. MECHANICS
by K. F. Ibrahim PRICE: £2.25

INTEGRATED CIRCUIT POCKET BOOK
by R. G. Hibberd PRICE: £4.20

BEGINNER'S GUIDE TO AUDIO
by I. R. Wilding PRICE: £3.60

BEGINNER'S GUIDE TO ELECTRIC WIRING
by F. Guillou PRICE; £2.50

BEGINNER'S GUIDE TO RADIO
by G. J. King PRICE: £3.00

AUDIO TECHNICIAN'S BENCH MANUAL
by J. Earl PRICE: £3.50

COLOUR T.V. WITH PART. REF. TO THE PAL SYSTEM
by G. N. Patchett PRICE: £6.00

THE OSCILLOSCOPE IN USE
by I. R. Sinclair PRICE: £2.80

ELECTRONICS TEC LEVEL II
by D. C. Green PRICE: £3.80

PRICES INCLUDE POSTAGE

We have the Finest Selection of English and American Radio Books in the Country

19-21 PRAED STREET (Dept RC) LONDON W2 INP

Telephone 01-723 4185

A CAREER IN RADIO

Start training *today* and make sure you are qualified to take advantage of the many opportunities open to the trained person. ICS can further your technical knowledge and provide the specialist training so essential to success.

ICS, the world's most experienced home study college, has helped thousands of ambitious men to move up into higher paid jobs — they can do the same for *you*.

Fill in the coupon below and find out how!

There is a wide range of courses to choose from, including:

CITY & GUILDS CERTIFICATES
- Telecommunications Technicians'
- Radio TV Electronics Technicians'
- Electrical Installations Technicians'
- Electrical Installation Work
- Radio Amateurs'
- MPT Radio Communications Cert.

EXAMINATION STUDENTS — GUARANTEED COACHING UNTIL SUCCESSFUL

TECHNICAL TRAINING

ICS offer a wide choice of non-exam courses designed to equip you for a better job in your particular branch of electronics, including:
- Electronic Engineering & Maintenance
- Computer Engineering/Programming
- Radio, TV & Audio Engineering & Servicing
- Electrical Engineering, Installations & Contracting

COLOUR TV SERVICING

Technicians trained in TV Servicing are in constant demand. Learn all the techniques you need to service Colour and Mono TV sets through new home study course approved by leading manufacturer.

POST THIS COUPON OR TELEPHONE FOR FREE PROSPECTUS

I am interested in ....

Name .... Age ....

Address ....

.... Occupation ....

ICS — *Accredited by CACC Member of ABCC*

To International Correspondence Schools
Dept B278 Intertext House, LONDON
SW8 4UJ or phone 01-622 9911 (anytime)

Wilmslow Audio

THE firm for speakers!

SEND 15p FOR THE WORLDS BEST CATALOGUE OF SPEAKERS, DRIVE UNITS KITS, CROSSOVERS ETC. AND DISCOUNT PRICE LIST

ATC • AUDAX • BAKER • BOWERS & WILKINS • CASTLE • CELESTION • CHARTWELL • COLES • DALESFORD • DECCA • EMI • EAGLE • ELAC • FANE • GAUS • GOODMANS • HELME • I.M.F. • ISOPON • JR • JORDAN WATTS • KEF • LEAK • LOWTHER • MCKENZIE • MONITOR AUDIO • PEERLESS • RADFORD • RAM • RICHARD ALLAN • SEAS • TANNOY • VIDEOTONE • WHARFEDALE

WILMSLOW AUDIO DEPT REC

SWAN WORKS, BANK SQUARE, WILMSLOW CHESHIRE SK9 1HF

Discount HiFi Etc. at 5 Swan Street and 10 Swan Street

Tel: Wilmslow 29599 for Speakers Wilmslow 26213 for HiFi

OSTS now from ambit international ®

"One Stop Technology Shopping"

Ambit stoppress....news on items available.....KV1210: triple AM tuning diode with 2-9v bias only £2.75.....DTI200 Digital frequency readout module ...... 911223 ultra low THD/IMD mpx decoder module £9.95.......944378 'Hyperfi' mpx decoder with post decoder muting and pilot cancel £19.95...... VMOS

COUNTER ATTRACTIONS:

New this month from Intersil, the ICM 7216. This is probably the most significant new IC for frequency counter/timer applications ever devised. It drives a full 8 digit display (LED) and operates on inputs of up to 10MHz minimum. The single 28 pin DIL also has:- *Leading zero blanking *Frequency ratio *Period *Unit counter *Time Interval *overrange The IC cost is £19.82, and the 10MHz HC18U Xtal £2.50 (for timebase functions). The circuit data is free with the IC, or £1 purchased separately. Input preamp board £7.00.

New from Ambit is the MC3357. 6v, 2mA standby NBFM IF, detector and squelch with 10.7 - 455 kHz balanced mixer, onboard oscillator device, and 5uV sensitivity. It is ideally suited to our CFM and LFY filter series, and costs £3.12 with full data. Xtal £2.50.

*Please note that OSTS prices exclude VAT at 8% throughout this side of the page. Most ambit items are at 12½% except those marked *. Please keep orders separately totalled, although a single combined payment, and 25p postage charge, will be sufficient.*

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	400p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

Micromarket PRICES SLASHED

6800 series					
6800P	6.50	8216	1.95	2114	£10
6820P	£6	8224	3.50	2708	£10.55
6850P	2.75	8228	4.78	**Development**	
6810P	£4	8251	6.25	MEK6800	£220
6852	3.65	8255	5.40	TK80	£306
8080 series		**MEMORIES**		AMI, Signetics, TI, Intersil, Harris etc. OA	
8080	6.30	2102	£1.70		
8212	2.30	2112	£3.40		
		2513	£7.54		
		4027	£5.78		

Voltage Regs

NEW LOW PRICES

7800 series UC TO220 package 1A	all 95p
7900 series UC TO220 package 1A	all £1
78MUC series TO220 package ½A	all 90p
78LCP series TO92 100mA	all 35p
L200 up to 3A/adjustable V&A	195p
78MGT2C ½amp adjustable volts	175p
79MGT2C ½amp adjustable volts	175p
723C precision controller	65p

MAINS FILTERS FOR NOISE/RFI etc

1 amp in IEC connector	£4.83
5 amp in 'wire in' case	£3.87
NE550A	73p

LINEARS non-consumer

BIMOS		LM324N	71p
CA3130E	84p	LM339N	66p
CA3130T	90p	LM348N	186p
CA3140E	35p	LM3900N	60p
CA3140T	72p	709HC to5	64p
CA3160E	90p	709PC dil	36p
CA3160T	99p	710HC to5	65p
Op amps		710PC dil	59p
LM301AH	67p	723CN	65p
LM301AN	30p	741CH to5	66p
LM308H	121p	741CN 8dil	27p
LM308N	97p	747CN	70p
LM318H	279p	748CN	36p
LM318N	224p	NE531T	120p
		NE531N	105p

OPTO 7 seg displays

0.43" High Efficiency HP:

5082- 7650	red CA	233p
5082- 7653	red CC	
5082- 7660	yellow CA	
5082- 7663	yellow CC	
5082- 7670	green CA	
5082- 7673	green CC	

0.3" Standard HP

5082- 7730	red CA	147p
5082- 7740	red CC	

0.5" Fairchild

FND500	red CC	150p
FND507	red CA	150p

TTL: Standard AND LP Schottky

All prices listed in pence *

	'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'N'	'LSN'
7400	13	20	7455	35	24	74126	57	44	74185	134	
7401	13	20	7460	17		74128	74		74188	275	
7402	14	20	7463			74132	73	78	74190	115	92
7403	14	20	7470	28		74133		29	74191		
7404	14	24	7472	28		74136		40	74192	105	180
7405	18	26	7473	32		74138		60	74193	105	180
7406	38		7474	27	38	74139		60	74194	105	187
7407	38		7475	38	40	74141	56		74195	95	137
7408	17	24	7476	37		74142	265		74196	99	110
7409	17	24	7478			74143	312		74197	85	110
7410	15	24	7480	48		74144	312		74198	150	
7411	20	24	7481	86		74145	65		74199	160	
7412	17	24	7482	69		74147	175		74248		90
7413	30	52	7483A			74148	109		74251		90
7414	51	130	7484	97		74150	99		74253		105
7415		24	7485	104	99	74151	64	84	74257		108
7415	30		7486		40	74153	64	54	74279		52
7417	30		7489	205		74154	96		74283		120
7420	16	24	7490	33	90	74156	54	110	74290		90
7421	29	24	7491	76	110	74156	80	110	74295		120
7422	24	24	7492	38	78	74157	67	55	74298		100
7423	27		7493	32	99	74158		60	74258		110
7425	27		7494	78		74159	210		74260		26
7426	36	27	7495A	65	99	74160	82	130	74365		49
7427	27	29	7496	58	120	74161	92	78	74366		49
7428	35	32	7497	185		74162	92	130	74367		43
7430	17	24	74100	119		74163	92	78	74368		49
7432	25	24	74104	63		74164	104		74375		60
7433	40	32	74105	62		74165	105		74379		130
7437	40	24	74107	32	38	74166			74399		150
7438	33	24	74109	63	38	74167	20		74445		92
7440	17	24	74110	54		74168			74447		90
7441	74		74111	68		74169		200	74490		140
7442	70	99	74112	88		74170	230	200	74668		110
7443	115		74113		38	74172	625				
7444	112		74114		38	74173	170				
7445	94		74116	198		74174	87	120			
7446	94		74118	83		74175	87	110			
7447	82		74119	119		74176	75				
7448	56	99	74120	115		74177	78				
7449		99	74121	25		74180	85				
7450	17		74122	46		74181	165	350			
7451	17	24	74123	48		74182	160				
7453	17		74124			74183		210			
7454	17	24	74125	38	44	74184	135				

ICM7217 - count & display £9.50
ICM7207 - clock pulse IC £4.95
ICM7208 - count & display £14.95
ICL7106CP - LCD DVM IC £9.55
KIT .. £24.80
LED DVM with ICL7107 £20.65

Ambit overspill

the remainder of the column is not DSTS

Varicap diodes
VAT 12.5%...........

BA102	30p
BA121	32p
ITT210	30p
BB105B	40p
BB104B	45p
5xBB104B	200p
MVAM2	148p
MVAM115	105p
MVAM125	105p
matching to a max of 6 diodes per diode (1%)	25p
KV1210	275p

PIN & switching
VAT 12.5%...........

BA479 pin	35p
tda1061 pi-network attenuator	95p
BA182 bandswitch diode	21p
10 for	150p

Requests for the next issue of the catalogue now being "booked" for despatch immediately it is ready (about November). Please send 45p to reserve a copy.

MISCELLENY

NE555	30p
NE556	78p
NE558	180p
LM3909	72p
11C90DC	1400p
8629 divide by 100 to 150MHz	4.20p
95H90DC 320MHz divide by ten	7.80p

From the World's leading radio innovation source:

Apart from the MC3357, mentioned alongside, Ambit has the first easy-to-use low noise, low cost UHF dual gate MOSFET - the BF960 from Siemens. With a gain of 18dB, and a noise figure of only 2,8dB at 800MHz, you will see what we mean. At 200 MHz, the gain is 23dB, and NF only 1.6dB. Combine these figures with the famous ease of use of a dual gate MOSFET, and you have the easiest and most effective front end device yet. £1.60 each

Moving Coil Meters

Ambit offers a very wide range of low cost meters, together with the unique 'Meter Made' scale system for professional grade scale customizing:

Series	Scale Area	illumination	cost*
900	14x31mm	internal 12v	250p
920	30x50mm	from behind	275p
930	36x63mm	internal 12v	375p
940 twin	35x45mm	from behind	350p
950	55x45mm	from behind	300p

Stock movement 200uA/750Ω. The 930 series is 5% linear, others are 77uA at 50% FSD. These and many others available in quantity for OEMs
SAE for full scale details please. (Not in cat.)

Radio; Audio; Comms ICs:

Only the very best quality - and only types we have used in our own laboratory tests

Radio frequency + mixers + oscillator(s)		
TDA1062	DC to VHF front end system	1.95
TDA1083/ULN2204	am/fm/audio in one IC	1.95
TDA1090/ULN2242	am/fm hifi tuner system	3.35
HA1197	LF/30MHz am receiver system	1.40
CA3123E/uA720	LF/30MHz linear system	1.40
TBA651	LF/30MHz linear system	1.81
SD6000	DMOS RF/Mixer pair	3.75
IF amplifiers		
CA3089E/KB4402	famous FM IF system	1.94
HA1137W/K	4420 as 3089 + deviation mute	2.20
CA3189E	update with deviation mute	2.75
TBA120a/SN76660N	FM if and detector	0.75
TBA120S	hi gain version TBA120	1.00
MC1350P	agc IF amp	1.20
MC1330P	synch AM demodulator	1.35
MC1495L	precision 4 quad multiplier	6.86*
MC1496P	popular double balanced mixer	1.25
Communications circuits		
KB4406	differential amplifier	0.50
KB4412	2 bal.mixers/agc/gain/doub. conv	2.55
KB4413	am/fm/ssb det. AGC, ANL, mute	2.75
KB4417	3mV mic processor preamp	2.55
KB4423	FM noise blanker system	2.55
Audio preamps		
LM381	stereo high gain/low THD	1.81
LM1303	stereo audio optimized OA	0.99
TDA1054	high quality with alc option	1.95
KB4417	see above	
Audio Power amps		
TBA810AS	7W RMS overload protected	1.09
TDA2002	8W/2Ω in pentawatt package	1.95
TDA2020	15W RMS hifi power dc coupled	2.99
TCA940	10W higher voltage 810	1.80
ULN2283	1W 2,5 to 12 v supply capability	1.00
LM380N8	1W power	1.00
LM380N14	2.5W power	1.00
HA1370	HiFi 15w in easy heatsink pack	2.99
Stereo Decoder Devices		
MC1310/KB4400	original pll decoder	2.20
CA3090AQ	RCA's pll decoder	3.25
uA758	Buffered version of 1310	2.20
LM1307/uA707	non pll type	1.55
HA1196	advanced adj.sep pll low thd	3.95
HA11223	newpilot cancel low thd/imd	4.35

All ambit decoders are supplied with the LED beacon of your choice. Please state colour.

Discrete semiconductors

Some of the biggest stocks of specialist MOS and FET transistors for radio in the UK.

BF900	80p*	40673	55p*	40822	43p*
40823	51p*	MEM680	75p*	BF256S	34p*

Most types for most RF circuitry, inc. new UHF T package types etc. See price list.....

Hitachi VMOS 100W power devices:

Hitachi 2SK134 /2SJ48 100W comp. VMOS. Data and circuit info £1, and the devices themselves for £14.00 a pair *

DISCRETE LEDs from Telefunken, square sided and round, AMBIT has the best value......

LED size (mm)	2.5x5	5 dia	2.5dia
RED	17p	14p	14p
Yellow	20p	15p	15p
Green	20p	16p	16p
Orange	24p /he	29p/heL	17p

he= high efficiency L= lens end

10% disc for 10
25% per 100 mix

Switch Systems: Check our combinations !

A very wide selection of BDTH Alps SUB series units, (Schadow/AB/Dreor compatible) & the miniature Dialistat units. Available in DIY systems for maximum flexibility and low cost.

And Finally

Further details of these, and many more of the wonders of the world of wireless in the new Ambit catalogue - with magazine supplement. 45p inc pp etc.
Phone (0277) 216029/227050 9am-7pm, callers welcome anytime

Coils & Filters by TOKO

After a period of relative price stability, please note that some prices are increased- as a direct result of the failure of £ versus stronger trading currencies. (Mainly Yen)

7 & 10mm IFTs for AM/FM - 1000s es		
455/470kHz	most types of appcns	30p
10.7MHz		33p
Short Wave Coils sets		
Now two ranges of impedance/coupling		ea 33p
TV video and sound IFs/detectors		
Another new range in 10mm		33p
6MHz ceramic IF sound filter		80p
Molded VHF coils full catalogue 15p		
Ultra stable coils for 30 - 200MHz	from	20p
Chokes - biggest range/biggest stocks		
Most E12 values ex stock, any to order		
7BA series	1uH to 1mH	16p
8RB series	100uH to 33mH	19p
10RB series	33mH to 120mH	33p
FM IF FILTERS ceramic and linear phase		
CFSE/SFE10.7	stereo ceramic IF 10.7MHz filters in 5 groups	50p
CFSB10.7	mono/roofing IF filter	50p
BBR3125N	4pole linear pahe 10.7MHz	150p
BBR3132A	6pole linear phase 10.7MHz	250p
MPX pilot tone filters for 19 & 38kHz		
BLR3107N	Stereo 4k7 impedance	215p
BLR2007	Stereo 3k3 impedance	220p
BLR3152	Mono 4k7 impedance	100p
BLR3157	Mono 4k7.3k0 imp	100p
AM/FM/SSB IF FILTERS		
MFL series	2.4kHz ssb /455kHz carrier	1195p
MFH series	4/5/7kHz BW on 455kHz	195p
MFK series	7/9kHz BW on 455kHz	165p
LFY455D	12kHz 4 ele ladder on 455kHz	125p
CFM2455	6kHz micro mechanical ..	65p
SFD455/470kHz	murata IF filter	85p
CFT455B/C	6/8kHz min + 2IFTs	60p
CFU470C	6kHz on 470kHz	65p
Ratio Detectors for FM/NBFM		
1A651/7	455kHz ratio det	135p
KAN1508/9	10.7MHz ratio detector	66p
94ACS15106/7	10.7MHz ratio detector	66p
Quadrature detectors for CA3089E etc		
KACSK586HM	single	33p
KACS34342/3	double	66p
Polyvaricon tuning capacitors + trimmers		
2A20ST7	2x266pF AM	95p
CY22217Z	2x335p AM 2x20pF FM	175p
CY23217PX	2x335pF AM 3x20pF FM (2 trimmers)	245p

Tuner Modules

From the biggest and best range................

TUNERHEADS for 88-108MHz band 2 (varicap)		
EF5803	6 cct, 3 MOSFETs, amp. osc.	19.75
EF5801	6 cct, 2 MOSFETs, osc op	17.45
EF5600	5cct, MOSFET RF, by TOKO	14.95
EF5400	4cct balanced mixer/pin agc	9.75
EC3302	3cct FET input miniature	8.25
TUNERSETS by LARSHOLT (head+IF)		
7252	Dual MOS head/low dist IF	26.50
7253	FET head, mpx decoder inc	26.50
IF AMPLIFIERS all with deviation mute, agc, afc, meter drives etc		
7020	HiGain dual ceramic filter	6.95
7030	Mos preamp, linear phase filter	10.95
7130	2 mos preamps, 3 lpfilters	16.25
NBFM1	455/470kHz NBFM module	9.95
MPX decoders, all with pilot tone filters and buffer amplifiers for min 300mV RMS		
92310	1310 based system	6.95
93090	3090AQ based system	8.85
91196	HA1196 based + birdy filter	1299
91196B	HA1196 based + birdy filter + 2 x LM380 audio monitor amps	16.45
911223	HA11223 based system	12.50
AM RADIO -		
91197	The original MW/LW varicap tuner with electronic switch	11.85
9122	The uniband tuner module	13.22
AM FM RADIO UNITS		
71083	Using TDA1083, provides a complete MW/LW/FM portable radio chassis for clock radio etc	12.95
71083D	Drive/dial system for 71083	1.75

SPECIALS: TUNERHEADs in the range 40-200MHz to special order
The EF5803 and EF5400 are available to cover bands in the region described. The costs depend on quantity and actual mods required to cover the desired band. Max coverage approx. 20% of centre frequency selected. Also, please allow 3-5 weeks delivery for these items.

2 Gresham Road, Brentwood, Essex.

"EASI-BUILD" 100kHz CALIBRATOR

By M. V. Hastings

Simple low-cost design takes advantage of BBC transmitter frequency accuracy

While not absolutely essential, an accurately calibrated tuning dial is a desirable asset for a communications receiver, and it can make the set easier to use by saving a lot of wasted time in searching for a particular band or station. In order to provide a home-constructed receiver with an accurate tuning dial it is necessary to have some form of calibration oscillator. The same is true if a set which is already calibrated undergoes realignment, and it is also possible for a receiver's calibration to become inaccurate due to mechanical or electrical drift.

The highest quality calibration oscillators are crystal controlled, have outputs at several fundamental frequencies and their harmonics, together with an a.f. modulating oscillator which can be switched in or out to make the signal more readily identifiable. The main problem with such a unit is that it is rather complex and expensive.

More than adequate results can be obtained from a very simple calibration oscillator, although it will be inevitably less accurate than a more sophisticated unit and will also be less easy to use. Nevertheless, a calibrator incorporating an LC oscillator instead of a crystal controlled oscillator can provide very accurate results if it is carefully set up, and there are few communications receivers, especially of the general coverage type, which can really make full use of the accuracy provided by a sophisticated crystal controlled unit.

HARMONIC CALIBRATION

The calibrator described in this article provides a 100kHz signal which is rich in harmonics, these being available at good strength up to frequencies above 30MHz. It is therefore suitable for use over the entire medium and short wave bands. It is inexpensive and easy to construct, and is a practical accessory for even a very simple receiver.

For those unfamiliar with this type of equipment, it should perhaps be explained that it consists of an oscillator running at a basic frequency of 100kHz. Harmonics of this fundamental frequency are produced, these simply being signals at multiples of the fundamental frequency. Thus, a 100kHz calibrator will have outputs at 200kHz, 300kHz, 400kHz and so on. The circuit must be designed so that the harmonic output extends at good strength throughout the required wavebands, as it is the harmonics which provide the calibration signals.

Obviously, the lower the fundamental frequency the greater will be the number of calibration points which will be produced. With a large number of calibration points it becomes more difficult to determine which is which, particularly at the higher short wave frequencies. More sophisticated calibrators may have two fundamental frequencies, one considerably higher than the other. For example, calibration points at 2MHz intervals may be provided, and these will be so far apart on the receiver dial that it is obvious which harmonic is being picked up. The 2MHz points can be marked on the dial, or noted, after which intervening points can be located by switching over to a lower fundamental frequency, say at 100kHz. Identification of these harmonics is then quite straightforward. Successive 100kHz harmonics above 6MHz, for instance, will be 6.1MHz, 6.2MHz, 6.3MHz, etc.

When using a single fundamental frequency, as here, it is necessary to choose one which is a good compromise between an adequate number of calibration points and ease of identification. 100kHz is probably the best compromise. There may be some problem with identifying the harmonics, especially at high frequencies, but stations of known or approximately known frequency can be helpful in this respect, as will be explained more fully later on.

The case specified has a compartment which accommodates a PP3 battery

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 4.7k Ω
R2 560k Ω
R3 1k Ω

Capacitors
C1 0.33μF ceramic plate
C2 0.0047μF polystyrene
C3 390pF polystyrene or silvered mica
C4 0.0068μF ceramic plate
C5 3.3pF ceramic plate or silvered mica

Inductor
L1 7mH variable inductor type CAN1980 (Toko)

Semiconductors
TR1 2N3819
TR2 BC108

Switch
S1 s.p.s.t. toggle, rotary

Sockets
SK1 wander plug socket, red
SK2 Wander plug socket, black

Miscellaneous
Verobox type 65-2036H
Veroboard, 0.15 in. matrix
Control knob
9 volt battery type PP3 (Ever Ready)
Battery connector
Wire, solder etc.

THE CIRCUIT

The circuit of the calibrator unit is given in Fig. 1, and it consists of a basic LC oscillator stage around TR1 followed by a buffer amplifier and harmonic generator, TR2.

TR1 is connected in the common drain Colpitts configuration, with R1 as the source load resistor. Gate biasing is provided by the d.c. circuit through L1, and this coil also forms a 100kHz tuned circuit in conjunction with C3. L1 is an adjustable inductance and this enables the tuned circuit to be set up to the correct operating frequency. The source of TR1 is in phase with the gate and the necessary positive feedback for oscillation is provided from a tap in the coil via C2. The voltage gain from TR1 gate to its source is slightly less than unity; coupling the source to the tap in the coil causes L1 to provide sufficient voltage step-up to produce oscillation.

The output from TR1 is virtually a sine wave and is not sufficiently rich in harmonics for the present application. Also, although the impedance at TR1 source is fairly low since the transistor is used in the common drain mode, variations in output loading at this circuit point can still produce small but significant changes in the frequency of oscillation. Both of these problems are overcome by

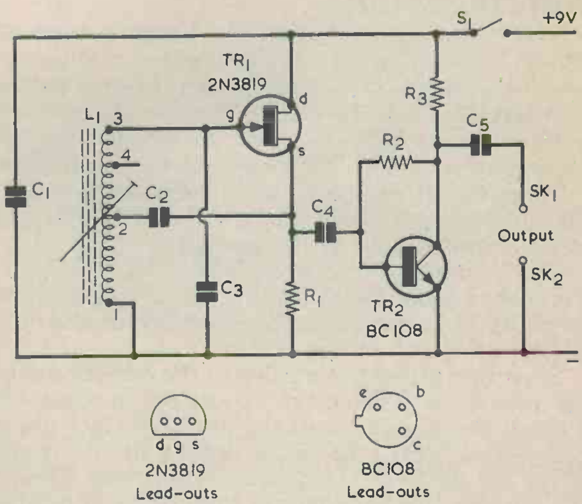
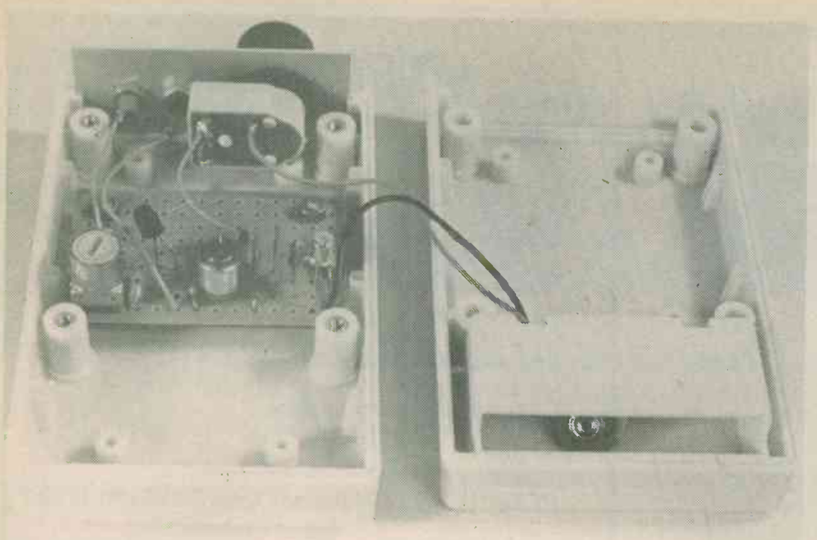


Fig. 1. The 100kHz calibrator has a very simple circuit. TR1 is a sine wave oscillator whilst TR2 functions as a buffer amplifier and harmonic generator



Internal layout of the calibrator unit

interposing a conventional common emitter amplifier, TR2 between TR1 source and the calibrator output.

TR2 produces a strong harmonic content and virtually eliminates any output loading effects. It also causes the mark-space ratio of the 100kHz fundamental it produces to be far removed from a one-to-one ratio. This is beneficial, as the even harmonics, at 200kHz, 400kHz and 600kHz, etc., would otherwise be very much weaker than the odd harmonics at 300kHz, 500kHz, 700kHz, and so on. Apart from the gradual falling off in strength of the higher frequency harmonics, there is still some difference in strength between even and odd harmonics, but this is of a comparatively minor nature and is of no real consequence.

C5 provides d.c. blocking at the output and C1 is a supply bypass capacitor. S1 is the on-off switch, and the current consumption from the 9 volt supply is approximately 3mA only.

CONSTRUCTION

The prototype is built in a Verobox type 65-2036H, which has outside dimensions of about 110 by 68 by 33mm. This box has an integral battery compartment which will accommodate a 9 volt battery type PP3. As can be seen from the photographs, the on-off switch is mounted at the front panel in company with the output sockets, SK2 being nearer the switch. The PP3 battery fits in its compartment at the rear.

The remaining components are assembled on a Veroboard panel of 0.15in. matrix having 9 copper strips by 14 holes. The component layout and other details are given in Fig. 2.

Start by cutting out a panel of the correct size using a hacksaw. Then clean up any rough edges with a small flat file and drill the two 6BA clear mounting holes. Next, the three breaks in the copper strips are made at the appropriate points. Finally, the various components are soldered into position on the board. This procedure is quite straightforward except in the case of L1.

L1 is a ready-wound component which can be obtained from Ambit International. Its five pins will fit straight into the component panel with pin 1 at hole A3, pin 2 at hole B3 and pin 3 at hole C3. The two mounting lugs of its can do not, however, fit so readily. The lug corresponding to hole C2 is simply bent at right angles out of the way, or is removed with a pair of wire cutters. The other lug passes through hole A2, which is enlarged for it by being drilled with a bit of about 1.5mm diameter. The lug is soldered to the strip at hole A2, thereby connecting the screening can to the negative supply rail.

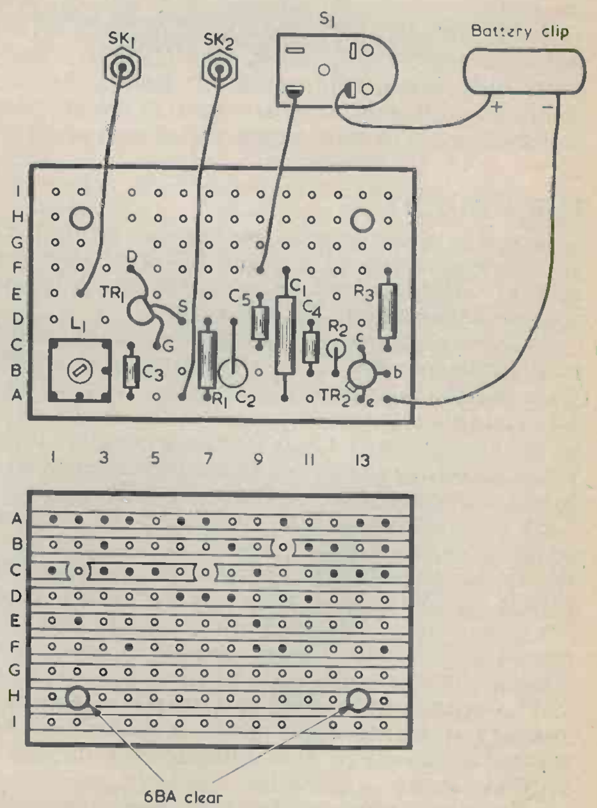
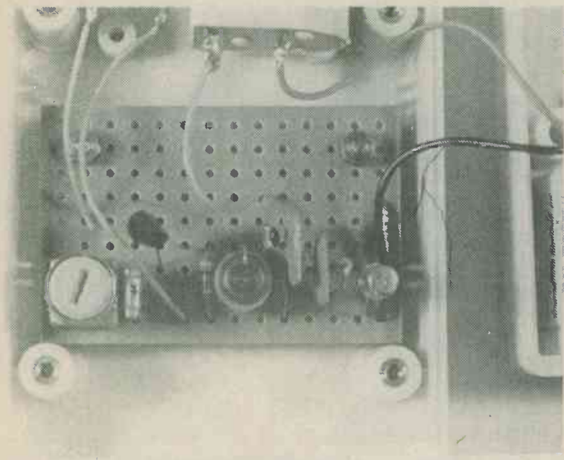


Fig. 2. The calibrator components may be conveniently assembled on a small Veroboard panel

The component panel is mounted in the bottom of the case, in the position shown in the photographs, by means of two 6BA bolts and nuts. Spacing washers on the bolts provide clearance between the Veroboard underside and the case. The board is not finally fitted in position until the connections to the output sockets, the on-off switch and the battery clip have been made.



A Veroboard module takes the components which make up the calibrator circuit

ADJUSTMENT AND USE

Before the calibrator is ready for use it is necessary to adjust the core of L1 to bring the output frequency to 100kHz. This is achieved by beating the second harmonic with the BBC long wave transmission on 200kHz (1,500 metres). An ordinary transistor radio is tuned to this transmission and a short lead from socket SK1 is placed close to it. This may produce an audible beat note from the receiver as soon as the calibrator is switched on; if not, the core of L1 should be adjusted until the beat note is heard.

A black insulated socket is used for the earthy output connection and a red insulated socket for the harmonic output

L1 is then carefully adjusted for the lowest beat note frequency possible, and there should be no problem in obtaining a beat as low as a few Hertz or even less. The calibrator oscillator will then be accurately set up to 100kHz.

The circuit does not have the same long term stability as is given by a crystal controlled oscillator, and it is therefore advisable to initially set up the unit in this way each time it is used. For easy adjustment, a hole can be drilled in the lid of the case above L1, allowing access to its core without having to remove the lid.

When calibrating a receiver it will not normally be necessary to connect the output of the calibrator direct to the aerial input of the receiver. One short insulated lead may be connected to output socket SK1 and another to the receiver aerial terminal, whereupon satisfactory signal transfer should be obtained by placing the two leads close together. At high frequencies it may be necessary to twist the two leads together or even make a direct connection between SK1 and the receiver aerial input. The degree of coupling required depends on receiver sensitivity at these frequencies. It is advisable not to have a level of signal injection which is any higher than is necessary to produce a moderately strong signal at the receiver. Most receivers have spurious responses and an excessively strong signal from the calibrator could therefore produce confusing results. There should be sufficient signal transfer to make the calibration signal stand out from any other signals which may be picked up. The aerial must, of course, be disconnected from the receiver to minimise such signals. If there is any doubt as to whether or not a received signal is generated by the calibrator, the matter can be settled by switching the calibrator off and then on again. In many instances there will be no need to make any connection to the earthy output socket, SK2. If, however, this socket is connected to earth or to the chassis of the receiver being calibrated it will be found that the coupling to the receiver aerial input is of a more consistent nature.

As was pointed out earlier, it can sometimes be difficult to determine which harmonic is being received. One way around this problem is to locate a broadcast station of known frequency. Should the station be operating on, for example, 6.25MHz, the harmonics above this will be 6.3MHz, 6.4MHz, 6.5MHz, and so on. Those below it will be 6.2MHz, 6.1MHz, 6.0MHz, etc.

The amateur bands can also be helpful in this respect. Under reasonably good conditions these are normally crammed from end to end with stations and so the approximate band limits are quite well defined. The calibrator can then be used to indicate the precise band limits and calibration points within the band. Once these calibration frequencies have been identified, the frequencies of the calibration points adjacent to them become obvious. ■

NEWS . . . AND

THE PET — A COMPUTER THAT CAN TEACH

G. R. Electronics add Video Board and Pocket Terminal to Commodore's KIM1 Microprocessor, using a domestic TV as visual display unit

Now available from Commodore is a new tutorial program introducing the newcomer to the Basic Computer Language. The program,which has been written by two experienced college professors, is one of a number of new software cassette releases by Commodore Systems designed to be used in conjunction with their £695 PET computer. "BASIC BASIC" is thoroughly interactive and enables the PET computer to teach you how to operate it. The newcomer to computing can now actually learn BASIC in several hours and then begin his own programming. The topics include line numbers, variables, strings, arrays and the use of the various commands such as LIST, RUN, and SAVE. Also basic keywords will be explained and used such as PRINT, READ/DATA, INPUT, IF/THEN, GOTO, and FOR/NEXT. fifteen chatpers, six sample programs ... and homework assignments.

The price of the cassette is £9.00 and will undoubtedly further increase the enormous appeal of the PET Personal Computer within the educational field and to the newcomer to computing.

This is the first example of the considerable potential for teaching where a student interacts with a computer. The student is able to proceed just as fast or slowly as his own ability allows, while the computer becomes effectively a textbook in which information is displayed on the screen — an exercise book and pen where information is written in via the keyboard and finally the intelligence of the computer enables it to ask questions of and talk to the user. Although used to teach in this first instance about computers, the technique can be potentially expanded to many areas of education. It is considered to be a very powerful method of maximising an individual's learning capacity.

Around 21% of Commodore's overall sales of PET computers in the UK have been in educational establishments, colleges and universities, and a big expansion is expected with the start of the new academic year.

COMING SHORTLY – PROGRAMMABLE CALCULATORS

Exclusive New Series

A WATCH FOR THE ACTIVE

Casio's new F-100 digital wristwatch is designed primarily to appeal to active people — sportsmen and youngsters particularly.

Listed at a recommended retail price (including VAT) of only £29.95, it features a super lightweight construction, coupled with dramatic and rugged styling in keeping with its intended environment.

In standard mode, Casio F-100 continuously displays accurate time in hours, minutes and running seconds, together with a clear indication of am/pm. Press a button to show date, month and day of week. Another button converts it from an ordinary watch into a one-hundredth of a second stopwatch able to record lap times as well as normal start/stop. The same button restores the watch to standard time-keeping mode, and a third button provides backlighting of the display for use in the dark.

Casing is an extremely tough, durable non-metallic black material. Figures in the display are large, clear and easy to read and the buttons are colour coded to make for simple operation. A lightweight sports strap completes the outfit.

For those who like the technical specification of F-100 but prefer a stainless finish case and bracelet, Casio offer the same watch with a stylish stainless steel outer case and bracelet at £44.95.

Prices quoted above are "recommended", and should be interpreted as the maximum anyone should expect to pay.

. . . COMMENT

TECHNOLOGY EQUALS REDUNDANCY?

There is much concern being expressed that the rapid advances being made in technology are going to lead to massive unemployment. As people who are interested in electronics we must be aware of the wider implications of our interest.

At a press conference to mark the 50th anniversary of Motorola Inc., founded as Galvin Manufacturing Corporation in 1928, the President, Mr. William J. Weisz, in the course of his address had these reassuring words to say:

"Throughout history there has always been fear that technology is eliminating jobs. This is a misguided notion. **Technology is changing the complexion of work.** It is eliminating the routine and mundane in favour of the more economically productive and socially satisfying. As an example, the development of the microprocessor has spawned all types of new businesses making new products that were impossible before. This both improves life quality and provides new jobs. Electronics is permitting us to respond in innumerable ways to people's needs to communicate, to measure, to control and to compute. By so doing, we are free to find more meaningful work and more productive uses of human time, talent and energy."

BBC WAVELENGTH CHANGES

We have, dating back to our February issues, given information and background to the changes which will have been operating for some days by the time these notes are read. In next month's issue we will be publishing an article — RADIO 4 CONVERTER, which converts 1,500 metres to medium waves. The converter radiates a local signal which is picked up inductively by the receiver on its own ferrite aerial.

It is of interest that, by mid-November coinciding with the new wavelengths, Marconi Communications Systems will have supplied eleven, out of a total of 24, of their new B6034 50kW transmitters, plus change-over units, diplexers and triplexers.

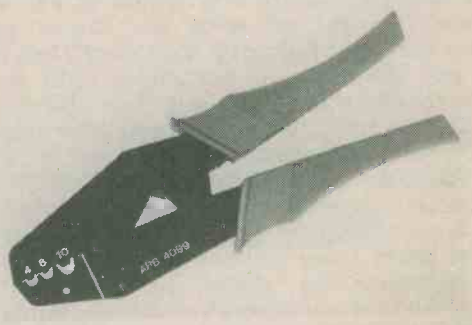
The transmitters are being used to update existing BBC transmitting stations, some of which were installed by Marconi in the early 1930s, and when the re-equipment programme is complete the BBC's medium frequency UK network will be capable of fully automatic and unattended operation.

The new B6034 is one of the world's most compact, efficient and reliable 50kW broadcast transmitters, Measuring 12ft x 5ft x 6ft 9in, the B6034 is less than half the size of its immediate 50kW predecessor — the Marconi type B6031. The advanced solid-state design incorporates only four vacuum tubes for the high power stages. It also employs an improved version of the Doherty type modulation system. Suitable for both local and remote operation, the equipment's operating frequency range is 525kHz to 1605kHz.

TOOLS TO SPEED ELECTRICAL INSTALLATION REPAIRS

One of the problems associated with the maintenance and repair of electrical installation lies in making a secure connection from the wire to a replacement terminal. Now AB Engineering Company has introduced a new range of neat, lightweight crimping tools to provide a solution to cramped spaces and difficult access situations.

The new AB Crimpex range of crimping tools includes five different models for insulation and tube terminals or splices. All feature a fixed and moveable jaw, with a step-down rate leverage system between the jaw and handle which starts low — so the handle can be moved freely, then "accelerates" towards the end of the crimping process when the handles are close together and the operations natural grip can be used to complete a perfect crimp.



The models available offer twin and triple aperture jaws for 0.75-6mm² (SWG 18-10) terminals and splices with symmetrical crimping nests — terminals can be inserted from either side for right hand or left handed operation, and the handles are brightly coloured in red, blue, yellow and green for instant recognition of the model required.

Full details of the Crimpex range may be obtained from AB Engineering Company, Apem Works, St. Albans Road, Watford, Herts. WD2 4AN.

LEKTROKIT LAUNCH NEW CONSTRUCTOR KITS

Lektrokit are taking the opportunity at Breadboard 78 to launch a major new range of products for retailers of hobbyist and home constructor kits.

The company are showing a comprehensive selection of new simple-to-use solderless breadboards, terminal and distribution strips, connectors, pins, sockets, jumpers, i.e. test clips, heat sinks, cabling etc. All these will be available for sale off the stand as individual items or in kits.

Their freely-available illustrated catalogue, entitled "The Faster and Easier Book", lists full details of their new product range, examples of which will be shown in circuit configurations ranging from single-chip simplicity to multiple-chip complexity.

DOUBLE DECCERS

A SPECIAL NEW SERIES FEATURING S-DeCs

CUNNING LIGHT ALARM

By Ian Sinclair

This circuit sounds an alarm when light first falls on a photocell and is then taken away.

This is the second project in the 10-part series of "Double Deccers", which may be assembled on two S-DECs positioned side by side. It is for a light-operated alarm, but with the rather unusual feature that light falling on the sensor arms the circuit, and the alarm is not raised until the light *ceases* to strike the photocell. The alarm is then switched on until it can be reset, after which the circuit remains dormant until armed by another light flash. An action of this sort is a useful feature of a burlgar alarm, since an intruder is lulled into a false sense of security when no alarm is sounded by a light beam being switched on. For the sake of demonstration, the "alarm" here is a light bulb, but methods of sounding a full-scale alarm are discussed later.

CIRCUIT ACTION

The light detector is a photoconductive cell, or light dependent resistor, type ORP12. This is wired in series with the 10kΩ variable resistor VR1, which controls the sensitivity of the circuit, so that light falling on the cell, either continually or in the form of a flash, causes the voltage at point 27 in the circuit to go sufficiently positive to switch on TR1. TR1 and TR2 are connected as a Schmitt trigger circuit, with R2 ensuring that TR2 conducts when point 27 is at a low voltage, which is when the photoconductive cell is in darkness. With TR2 conducting, the current in R3 keeps point 15 at a low voltage (less than a volt), and the same current flowing in R4 takes the emitter voltage of TR1 at

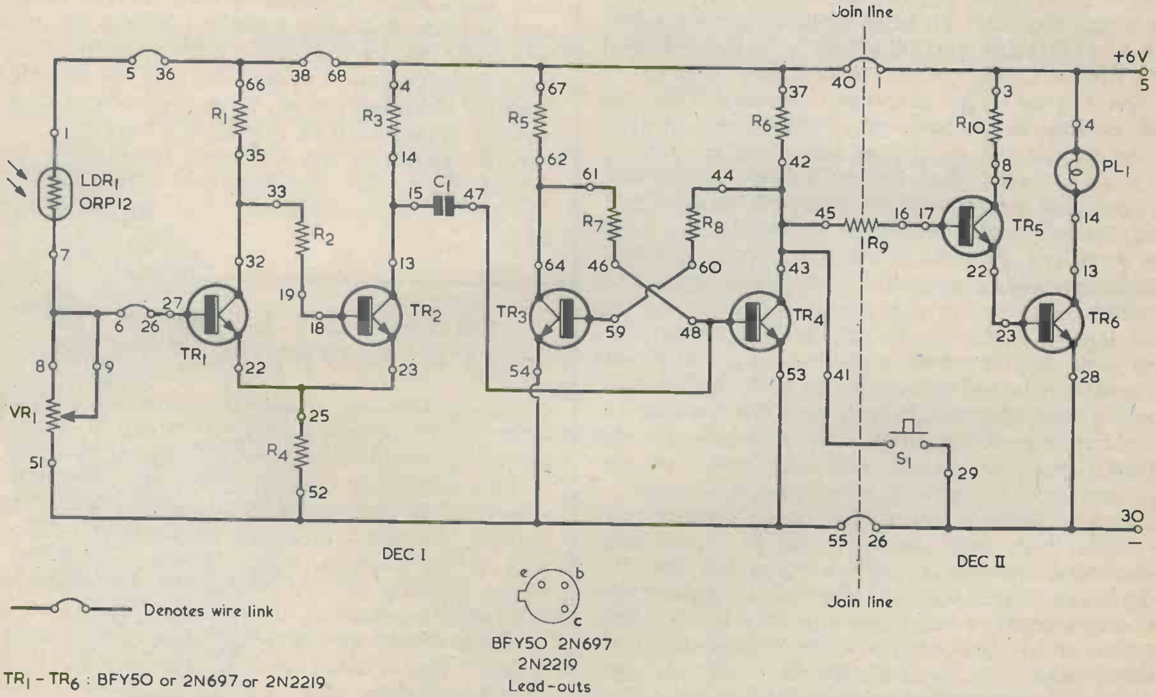
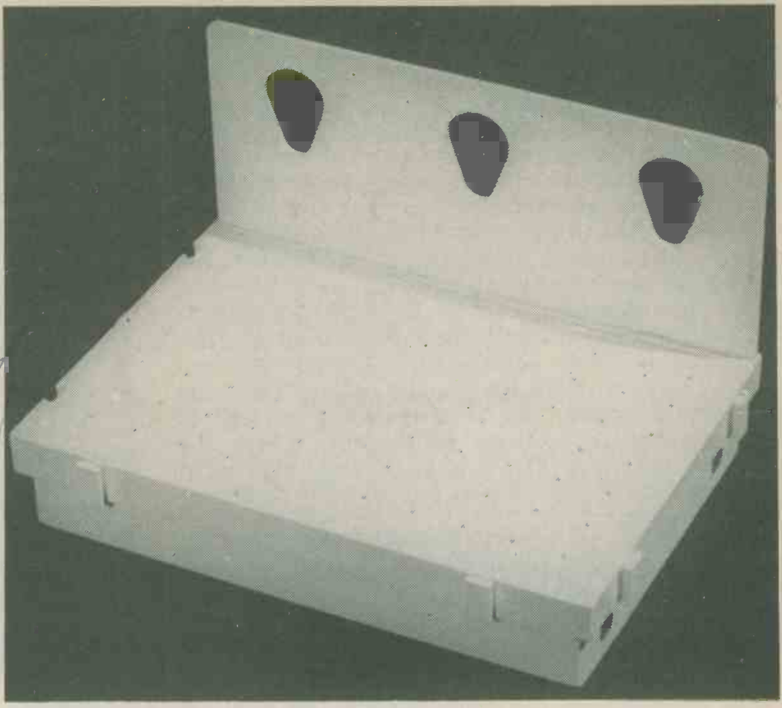


Fig. 1. Circuit of the alarm. This is armed when light falls on the photoconductive cell, the alarm being triggered when the light is taken away



A single S-DeC. Two of these, mounted side by side to form a single long DeC, can be used for all the projects in this series

point 22 high enough to keep TR1 switched off even when there is about one volt at point 27.

The second stage of the circuit is the bistable formed by TR3 and TR4. The effect of pressing the reset switch S1 is to make the collector voltage of TR4 equal to zero, so that no bias current can flow in R8, and TR3 is turned off. With no current flowing in TR3, the current through R5 flows through R7 into the base of TR4, keeping this transistor switched on and ensuring that the collector voltage of TR4 is low when the reset switch is released.

With a low voltage at the collector of TR4 no current flows through R9, so that TR5 is turned off. When no current flows in TR5 there is, in turn, no bias current into the base of TR6, so that PL1 is not lit. In our project, the alarm is indicated by PL1 lighting.

When the cell, LDR1, is illuminated, its resistance drops so that the voltage at point 27 rises. If the rise in voltage is sufficient, as set by VR1, then TR1 will turn on, and its collector current flowing in R1 will cause the voltage at point 32 to drop to a low value. There will now be no current flowing through R2, so that TR2 switches off, allowing the voltage at point 15 to rise to nearly 6 volts positive.

The capacitor C1 now comes into action. When the voltage at point 15 rises, the voltage at the other plate of the capacitor, connected to point 47, will also rise, and the rise in voltage causes current to flow between the base and emitter of TR4. C1 therefore charges, so that the final state is that point 15 is at about 6 volts positive with point 47 at about 0.6 volt positive, limited by the voltage across the base-emitter junction of TR4. The charging current flowing into the base of TR4 does not cause any change in the bistable, because TR4 is already conducting.

COMPONENTS

Resistors
(All fixed values $\frac{1}{4}$ watt 5%)
R1 1.8kΩ
R2 22kΩ
R3 1.8kΩ
R4 150Ω
R5 1.8kΩ
R6 1.8kΩ
R7 22kΩ
R8 22kΩ
R9 56kΩ
R10 1.8kΩ
VR1 10kΩ potentiometer, linear

Capacitor
C1 0.1μF polyester

Semiconductors
TR1-TR6 BFY50 or 2N697 or 2N2219
D1 1N4001 (see text)

Photoconductive Cell
LDR1 0RP12

Switch
S1 push-button, press to make

Lamp
PL1 6V, 60mA, m.e.s.

Miscellaneous
2-off S-DEC
6V battery
Lampholder, m.e.s.
Relay (see text)
Control knob

When the light ceases to strike the photocell its resistance increases, so that the voltage at the base of TR1 decreases again. The Schmitt trigger switches over to its previous state, with TR2 conducting. The point of using a Schmitt trigger circuit is that these changeovers of voltage are rapid, much more rapid than the changes of voltage at point 27. This time round, the effect is that the collector voltage of TR2 drops suddenly.

The voltage drop at point 15 causes an equal voltage drop at point 47, due to the coupling action of the capacitor. This voltage drop, at point 48, is large enough to switch off the base current of TR4, so that its collector voltage rises. Current through R6 now flows through R8 into the base of TR3, turning this transistor on. The collector current of TR3, flowing in its load resistor R5, keeps the collector voltage of TR3 low, so that the current in R7 ceases and TR4 remains cut off after capacitor C1 recharges.

Since TR4 is not now conducting, current through R6 flows through R9 into the base of TR5, causing this transistor to conduct and turn on TR6. R9 and R10 act to prevent excessive dissipation in TR5. PL1 will now shine until the reset switch is pressed or the whole circuit is switched off.

For more serious purposes, the light PL1 can be replaced with a 6 volt relay whose coil is wired between points 4 and 14, as shown in Fig. 2. It can have an operating current between 12 and 70mA, and a good choice would be the "6 volt Open Relay" with 410Ω coil which is available from Maplin Electronic Supplies. A diode, such as the 1N4001, must be connected across the relay coil so that point 14 cannot be taken to a voltage much above 6 volts. This protects TR6 against excessive collector voltages when it turns off, because a sudden cessation of current through the coil of the relay causes a large pulse voltage to be generated. The contacts of the relay should be rated for whatever voltages and currents will be present, and can be used to switch sirens, bells, buzzers or any other form of alarm.

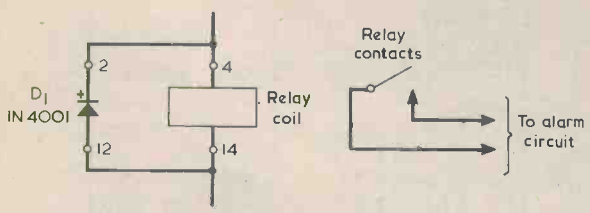


Fig. 2. For serious applications, PL1 is replaced by the coil of a relay, the contacts of which complete the alarm circuit. The latter is powered by a separate battery

S-DEC CONSTRUCTION

For construction as a Double-Deccer, join two S-DeCs end-on to form one long DeC. The dashed line in the circuit diagram shows how much of the circuit is built on each of the DeCs.

Start by inserting the wire links, five in all, which connect sections of the DeCs together. Insert also the resistor R9 which links the signal from one DeC to the other. The transistors can now be plugged in place, following the pinout diagram for the silicon n.p.n. transistors used for all these Double Deccer projects. The reset switch, the sensitivity control VR1, and the lamp PL1 can be mounted on the panels of the DeCs. The light detecting cell can be plugged directly into the DeC for testing, or used remotely if need be. Remember that stranded wire should not be plugged into the DeCs, so that if stranded wire is used for remotely located components the ends should be tinned lightly and smoothly to prevent the strands from separating before being plugged into the DeC holes.

Place C1 into holes 15 and 47 of DeC 1, and then insert the leads from VR1 into the appropriate points. Since the control is mounted on one of the panels it should be connected to the S-DeC by single strand insulated wires. Finally insert the remaining resistors and the leads for the battery and the circuit is ready for testing.

TESTING

Check all the connections, place the unit in a dimly lit room with its light turned off and set VR1 to its minimum resistance setting, i.e. with the slider at the end of the track which connects to point 51. Press and release S1 so that the circuit is reset. If PL1 lit up when the battery was connected it should now be extinguished. Now switch the room light on and off again — this should cause no change with VR1 at its least sensitive setting. Advance the setting of VR1 until switching the room light on and off again causes PL1 to light up when the room light turns off. This is now the correct setting of VR1 in the conditions of room lighting being used. If VR1 is too far advanced, the dim light of the room may arm the circuit and there will not be a sufficient drop in light intensity to trigger the alarm.

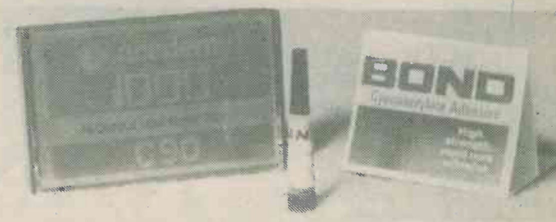
An important point is that VR1 should not be set to its minimum resistance point if LDR1 is in very strong light, such as strong sunlight. The photocell may then have a low enough resistance to cause excessive current to flow both in itself and in the potentiometer. This precaution does not apply when VR1 has been set up as just described under artificial light conditions.

The current drawn from the 6 volt supply is approximately 7mA when the circuit is not triggered to the alarm condition. When the circuit is so triggered the current increases by the amount taken by the bulb or relay coil, as applicable. ■

With regard to the first article in the series, published last month, Blob Board type ZB-6-D was shown as an alternative to using S-DeCs. We are given to understand that the boards are not at present being manufactured. If readers wish to continue with these alternative boards they should check the supply position with their component supplier before ordering.

Trade News . . .

SIGTRONIC ELECTRONICS ADD TO THEIR RANGE



Amongst the products available from Sigtronic Electronics, 27 Malvern Street, Stapenhill, Burton-on-Trent, Staffordshire DE15 9DY, are two new items namely, AVDEL BOND, cyanoacrylate, adhesive, which is a high strength, rapid cure adhesive, and although this product comes in a small 2GM/phial, it packs a mighty punch, in securing plastics, rubbers, transistors, components, etc. as it bonds quickly and permanently.

Another good feature of the adhesive is that only a small drop is needed to make a high strength bond, which exhibits a good resistance to stress, and it is also 'non toxic', and will if used sparingly and carefully make it a valuable addition to the 'constructor's tool box', at 75p plus 10p p&p, per phial.

The second product is a range of 'High Quality' British made, ferric oxide CASSETTE TAPES, which are made under the name of ACADEMY, by a well known manufacturer and exhibit low noise and high output at high quality. All of which helps to produce excellent recordings, from the classics to pop, and are available in C60-C90 sizes at 62p and 72p (VAT included) plus 12p p&p, and are guaranteed for six months.

DIGITAL THERMOMETERS WITH AUDIBLE ALARMS

The latest addition to Jenway's 8000 Series of digital thermometers is fitted with an audible alarm to warn of deviation from a given temperature.

A feature of the instruments is the use of solid state modular circuitry in their design, which provides the 8000 Series with its characteristic accuracy, reliability and economy of use. Fitted with HP9 dry cells as standard they provide up to 10 hours of continuous use, while the manganese alkaline MN 1500 cells offered as an option provide as much as 35 continuous or 80 hours intermittent use.

The unique feature of the 8000 Series, however, is the ability to detect and warn of deviations in the monitored temperature. When this facility is in use, implying relatively long-term continuous monitoring of a given temperature, the instrument's LED display can be switched off to further improve battery power conservation. The temperature level about which deviations are to be noted, is set by means of a precision, multi-turn potentiometer conveniently located in the instrument's case. The control is adjusted while the display is observed, to obtain the desired setting. When the relevant temperature is reached or exceeded, the audible alarm is activated.

Jenway are the designers and manufactuers of what has become one of the widest ranges of hand-held temperature and pH measurement instruments available in the U.K.

Pye Electro-Devices franchise for Sasco

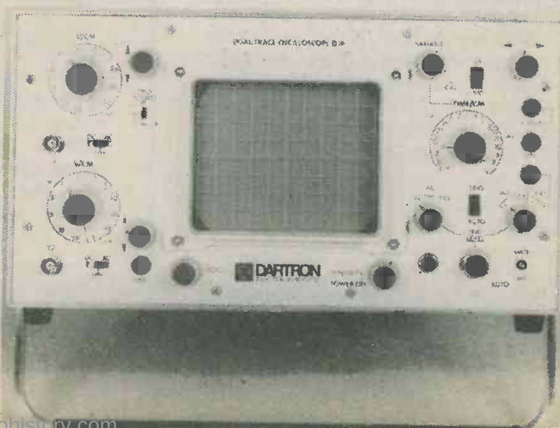
SASCO, the Crawley-based distributor of electronic components, has been appointed as a franchised distributor for the Controls Division of Pye Electro-Devices Ltd. Products initially stocked by SASCO include a wide range of relays. Pye Electro-Devices, formed in 1977 as the result of a merger between Pye TMC Components Ltd. and Magnetic Devices Ltd., has experienced in electromechanical components dating back more than 60 years, and manufactures components at six plants in East Anglia and Kent.

Products from the Pye Electro-Devices range handled by SASCO include the Series 120 (a.c.) and 125 (d.c.) compact, general purpose 2-pole changeover relays, the Series 130 and 135 3-pole versions.

DARTRON D10 DUAL TRACE OSCILLOSCOPE

Dartron Instruments Ltd., of 280-282 Wood Street, London E17, makers of precision oscilloscopes and electronic instruments, have recently announced their latest oscilloscope model, the D10 Dual Trace Oscilloscope.

This latest model has an excellent specification and will be priced at under £200. Details may be obtained from the company at the address above.



SUGGESTED CIRCUIT

DISCRETE NAND GATES

By G. A. French

From the home constructor's point of view, CMOS logic has several advantages over the older t.t.l. technology. CMOS devices do not require a stabilized supply, and their current consumption is frequently negligibly low. So far as interfacing with external discrete components is concerned, CMOS gates will directly drive individual light-emitting diodes and 7-segment displays with reasonable brightness. However, an external transistor is required if it is desired to have a CMOS gate energise a relay, and this article describes means by which external transistor circuits can enhance the logic capability of CMOS and relay combinations.

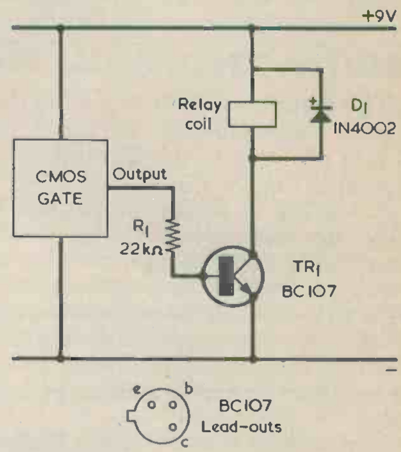


Fig. 1. Employing an external transistor to enable a CMOS gate output to drive a relay

RELAY DRIVE

Fig. 1 shows one method by means of which a CMOS output, when high (i.e. at or near the potential of the positive rail), can cause a relay to be energised. The high output allows base current to pass via R1 into TR1, which thereby turns on and operates the relay. When the CMOS output is low (at or near the negative rail) the transistor is turned off and the relay is de-energised. The circuit is suitable for supply rail voltages of the order of 9 volts when the relay coil has a resistance of 400Ω or more and a suitable operating voltage. The voltage dropped across the transistor when it is turned on is, in practice, around 0.15 volt. R1 may be a ¼ watt 10% resistor.

The output of the CMOS gate is not affected to any significant degree by the added resistor and transistor. It was found, for instance that when the output of a CD4011 NAND gate was connected to the resistor and transistor of Fig. 1, its high output voltage was only 0.1 volt negative of the positive rail. In consequence the gate output can be connected to other gate inputs as well as to the transistor circuit.

Since it is necessary in any case to use a discrete transitor between the CMOS gate and the relay coil, the inevitable question arises whether simple transistor circuitry can be employed to augment logic performance in CMOS gate and relay applications. The answer to that question is that transistors can quite definitely augment the performance, and that they may be used to replace one or more CMOS gates.

Fig. 2 shows a transistor NOR

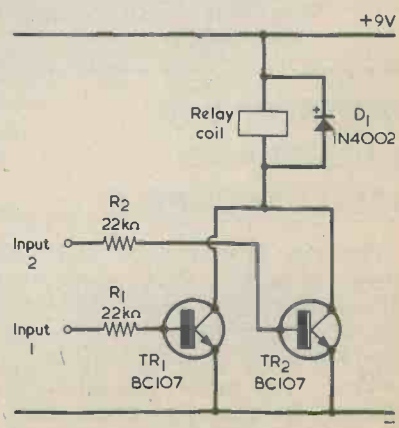


Fig. 2. A very simple NOR gate incorporating two transistors. The two inputs connect to the outputs of CMOS gates sharing the same power supply rails, and the number of transistors and inputs can be extended, if desired

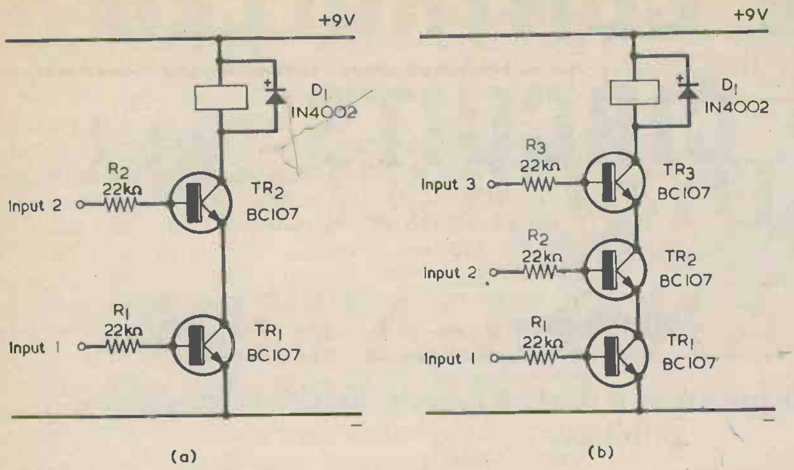


Fig. 3(a). A 2-input NAND gate. The relay energises only when both inputs are high
(b). With this circuit, all three inputs have to be high if the relay is to operate

gate. Its operation is virtually obvious at first sight, and we do not need to stay long with this particular configuration. The two transistor inputs are connected to CMOS gate outputs, and the relay energises when either input, or both, is high. The relay is de-energised only when both inputs are low. If three NOR inputs are required a further transistor and series base resistor can be added, the transistor emitter being connected to the negative rail and the collector to the lower terminal of the relay coil. The system can be extended to any number, within reason, of transistors.

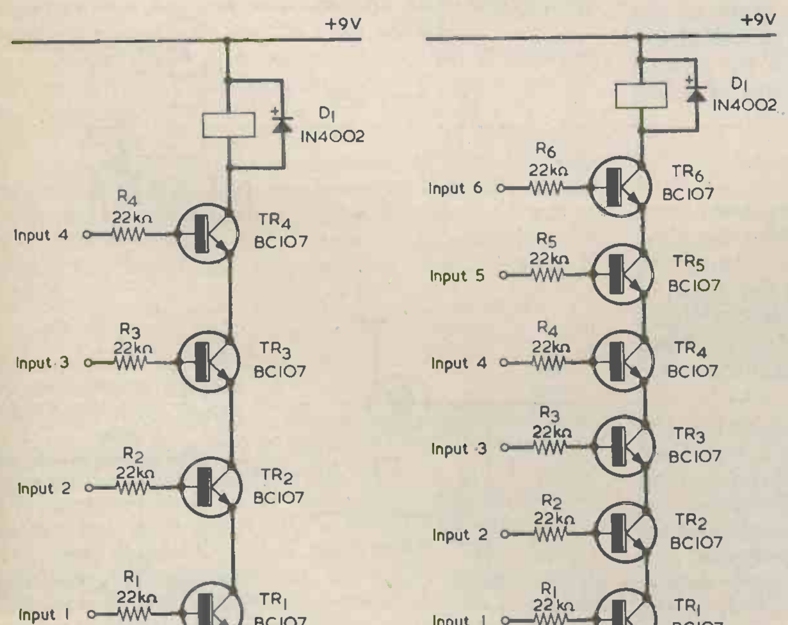


Fig. 4(a). A 4-input NAND gate employing bipolar transistors
(b). Transistor 6-input NAND gate. It is possible to add even more transistors and inputs to the basic NAND configuration

NAND GATES

The provision of transistor NAND gates is not so apparent, but here we can borrow a trick from internal CMOS circuitry itself, where NAND operation is accomplished partly by field-effect transistors connected in series. It is possible to similarly connect bipolar transistors in series.

A 2-input NAND gate appears in Fig. 3(a). When both Input 1 and Input 2 are low, both transistors are off and the relay is de-energised. If Input 1 is taken high TR2 remains turned off, and no collector current can flow in TR1. Similarly, if only Input 2 is taken high, the turned off TR1 prevents emitter current flowing in TR2. The two transistors can only be made conductive, and thereby operate the relay, when both inputs are high. The voltage dropped across the two transistors in series in then approximately 0.3 volt.

Fig. 3(b) shows a 3-input NAND gate incorporating discrete bipolar transistors. Again, the three inputs are connected to CMOS gate outputs All three transistors have to be turned on if the relay is to energise, and this can only happen when all the three inputs are high.

As with the NOR gates, the system can be expanded to take in more transistors and more inputs, but a limiting factor here is the voltage dropped across the transistors when they are turned on. Fig. 4(a) shows a practical circuit with four transistors and four inputs. All the inputs have to be high to energise the relay, and the voltage dropped across the series-connected transistors is then 0.6 volt. The 6-input NAND gate of Fig. 4(b) is also quite practical. Here, when all the inputs are high and all the transistors are conducting, the voltage dropped across them is of the order of 0.9 volt.

The author has checked out all the circuits accompanying this article, the relay he employed being the "Open Relay" with 410 Ω coil resistance which is available from Maplin Electronic Supplies. This particular relay is well suited to circuits of this nature since its minimum coil operating voltage is only 4.8 volts. It could, in consequence, be used in a transistor NAND gate array having even more transistors and inputs than appear in the 6-input gate of Fig. 4(b). In all the circuits it is assumed that the CMOS gates providing the inputs share the same power supply as that used for the relay coil and bipolar transistors. ■

SILICON CONTROLLED SWITCH CIRCUITS Part 1

By

John Baker

Working projects incorporating a device which deserves far more publicity

Although the silicon controlled switch has been available to the amateur for some time now, it has not really been featured to any great extent in the amateur electronics magazines. In fact, the author was unable to find a single constructional project employing one of these devices after an extensive search!

These devices, which are often given the abbreviated name 's.c.s.', are very versatile and are quite inexpensive, and so the reason for their lack of use is presumably merely that there are better known alternatives for the applications in which they can be employed. Thus they have often been ignored, even though they can have distinct advantages over alternative devices.

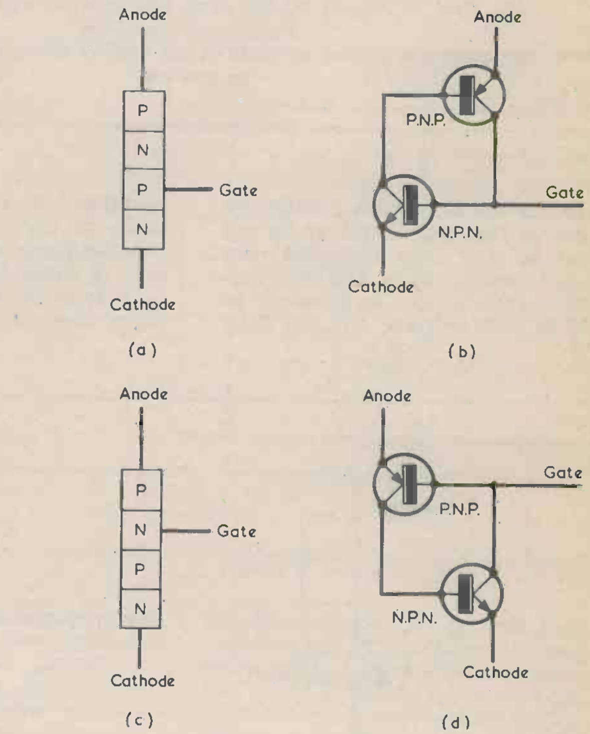
The purpose of this 2-part series is to outline the way in which an s.c.s. operates and some of the ways in which it can be used. Some practical examples of the type of circuit in which the device can be utilised will be given in the form of a few simple working projects.

WHAT IS AN S.C.S.?

A silicon controlled switch is a development from two semiconductor devices which will be familiar to many readers. and it can be made to emulate either of these. The two devices are the thyristor, or silicon controlled rectifier (s.c.r.) as it is sometimes known, and the programmable unijunction transistor. It will be helpful to briefly discuss these two devices before considering the s.c.s.

A thyristor is a four layer device which has the basic semiconductor structure shown in Fig. 1(a). It is analogous to two transistors of different polarity connected as shown in Fig. 1(b). A thyristor is normally used to control a load in its anode circuit, the load connecting to the positive supply rail and the thyristor cathode to the negative supply rail. A control voltage is applied, when required, to the gate terminal.

With no gate voltage applied the device will be turned off since neither transistor has any significant base current. If the gate is taken about 0.6 volt positive of the cathode the lower n.p.n. transistor will begin to turn on and, in doing so, its collector will draw a base current from the upper p.n.p. transistor. In turn the collector of the p.n.p. transistor will apply a base current to the n.p.n. transistor,



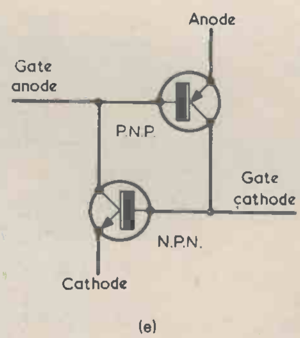


Fig. 1(a). The basic structure of a thyristor or silicon controlled rectifier
(b). The thyristor may be looked upon as two transistors connected together in the manner shown here
(c). The programmable unijunction transistor has its gate at the layer next to the anode
(d). Transistor equivalent of the programmable unijunction transistor
(e). The silicon controlled switch is a four layer device with gate terminals at both of its internal layers

causing it to conduct more heavily. There is an overall regenerative action which continues until both transistors are turned fully on. It should be noted that the transition in the thyristor from being turned off to being turned on is very rapid, and that it can be initiated, if desired, by a very short positive pulse at the gate.

Once a thyristor has been switched on it cannot be turned off again by reducing the gate voltage, and it can only be turned off by momentarily reducing the current through the device below a certain threshold level which is usually in the region of 20mA. The current only needs to be reduced below this level for a few tens of microseconds in order to switch the device off. Of course, the load current flowing through the device, once it has been switched on, should be above this threshold level in order to obtain correct operation. A thyristor is essentially a power device, and so this would normally be the case. A gate current of about 20mA is needed in order to switch a thyristor on. This may seem to be rather insensitive, but again it must be remembered that the device is normally used to control currents of 1 amp or more.

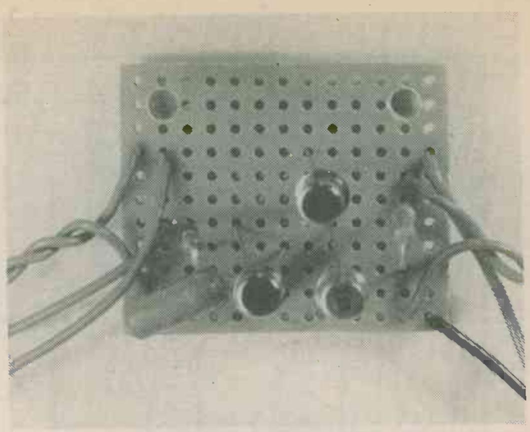
A programmable unijunction transitor does not really have much in common with an ordinary unijunction transistor apart from the fact that both may be used in fairly similar relaxation oscillator circuits. On the other hand, the p.u.t. is very similar to the thyristor and it is a four-layer device having the basic semiconductor structure shown in Fig. 1(c). The gate now connects to the n. section nearest the anode rather than to the p. section nearest the cathode. It operates in a similar manner to the thyristor, but the gate must now be taken negative of the anode to cause it to be turned on. The negative-going gate causes base current to flow in the upper p.n.p. transistor and initiates the regenerative action between the two transistors which turns on the device as a whole.

A silicon controlled switch is another four-layer device with one gate terminal connected to the p. layer nearest the cathode and a second gate terminal connected to the n. layer nearest the anode. If represented as two transistors, it has the configuration of Fig. 1(e). By ignoring the gate anode terminal it is obviously possible to obtain a form of thyristor operation and, similarly, by ignoring the gate cathode terminal it is possible to obtain a p.u.t. action.

TOUCH SWITCH

An s.c.s. can be used as a direct replacement for a p.u.t., but it is not suitable for use in place of a thyristor in most cases. An s.c.s. is not a power device and the BRY39 s.c.s. employed in the circuits to be described has a maximum dissipation figure of 275mW and a maximum "on" current rating of 175mA. However, the whole point of using the device in the thyristor mode is that it can be employed in low and medium power applications where a thyristor would not operate properly.

For example, the touch plate switching circuit shown in Fig. 2 would not function successfully if a thyristor were to be substituted for the s.c.s. Here, the relay is energised when the "on" touch plates are bridged by the skin resistance of the operator's finger. Obviously, only a very small current will flow into the gate cathode of the s.c.s., this being nowhere near the 20mA gate current which would



The Veroboard assembly for the touch plate switch

COMPONENTS

TOUCH SWITCH

Resistors
R1 100kΩ ¼ watt 5%
R2 2.7kΩ ¼ watt 5%

Capacitor
C1 0.1μF type C280 (Mullard)

Semiconductors
S.C.S. BRY39
TR1 BC108
TR2 BC179
D1 1N4148 (if required)

Relay
See text

Miscellaneous
Veroboard, 0.1in. matrix
Materials for touch plates

LOW POWER PILOT LIGHT

Resistors
(All ¼ watt 5%)
R1 120kΩ
R2 390Ω
R3 56kΩ
R4 56kΩ

Capacitors
C1 10μF electrolytic, 16v. Wkg.
C2 10μF electrolytic, 16V. Wkg.

Semiconductors
S.C.S. BRY39
D1 TIL209 or similar

Miscellaneous
L.E.D. panel holder
Veroboard, 0.1in. matrix

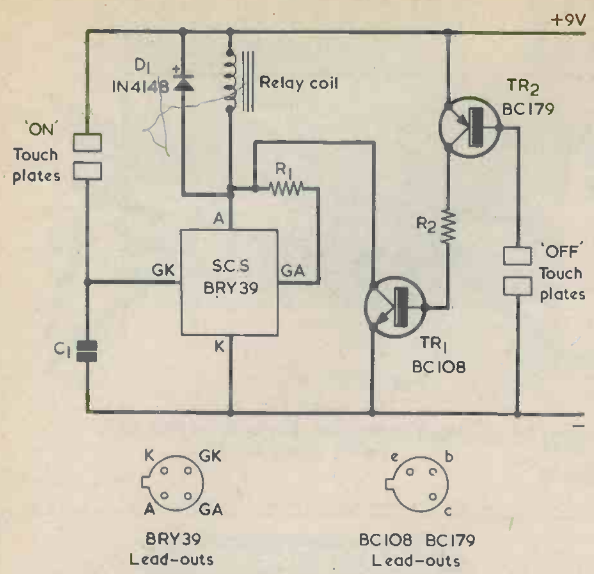


Fig. 2. A touch plate switching circuit incorporating a silicon controlled switch

be required by a thyristor. Less than 1μA gate current is required by the s.c.s. to turn on and the circuit has more than adequate sensitivity in this respect. In fact, spurious triggering to the "on" state can be more of a problem than lack of sensitivity, and R1 and C1 are included to improve reliability by preventing self-triggering.

After it has been turned on, the s.c.s. is turned off by bridging a finger across the "off" touch plates. The consequent small base current in TR2 causes a much larger base current to flow in TR1, R2 limiting this to a safe value. When the s.c.s. is turned on, the voltage drop between its anode and cathode is typically a little under 1 volt. When TR1 is turned on, by touching the "off" plates, the voltage between its collector and emitter is much lower, being only a few tens of millivolts. As a result the load current which flowed through the s.c.s. is diverted through TR1, and the s.c.s. becomes turned off. When the finger is taken away from the "off" plates the load is switched off as TR1 ceases to conduct, and it will only be switched on again when the "on" plates are touched.

The relay with its protective diode are only required if it is desired to control the circuit in which there is a high voltage or current, or where there is an a.c. supply. Control is then exerted by way of the relay contacts. Small d.c. loads such as transistor radios can be operated direct from the circuit and are simply connected in place of the relay coil and D1. The small voltage drop across the s.c.s. should not cause any problems here. A load current of only a few hundred microamps is sufficient to hold the s.c.s. in the "on" state.

If a relay is used in the circuit it can be any type having a coil resistance of about 200Ω or more and which is capable of energising at a nominal 6 volts. The prototype was tested using an "Open Relay" having a 6 volt 410Ω coil, this relay being available from Maplin Electronic Supplies.

CONSTRUCTION

The touch switch is assembled on a 0.1in. pitch Verboard having 13 holes by 11 copper strips, and details of the component layout are shown in Fig. 3. There are no breaks in the copper strips. D1 is mounted on the relay when these two components are used, its cathode (indicated by the plus sign in Fig. 2) connecting to the wire from hole D2.

Touch contacts can be made from copper laminate board using printed circuit techniques, or pieces of stripboard can be employed. There are other possibilities, and it is a matter of using one's initiative here. In the interests of good sensitivity the two touch plates should not be too small in area, and they must be kept free from excessive grease, dirt and corrosion.

The prototype touch switch is very sensitive and can be readily triggered from one state to the other, although the "off" function is a little less sensitive than the "on" function. A small improvement here could be obtained if desired, by fitting a high gain BC108C in the TR1 position.

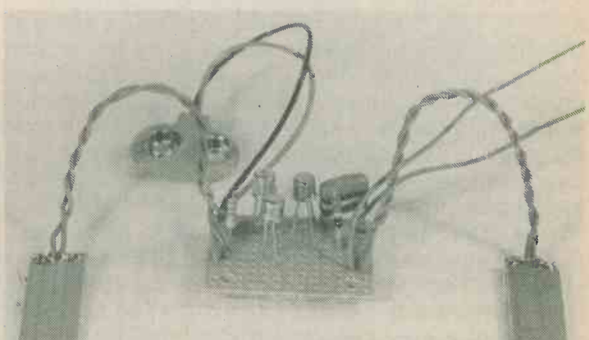
When the switch is in the "off" state it consumes no significant power as only minute leakage currents flow in the circuit. In the "on" state with the 410Ω relay it consumes about 20mA. The only current which flows in the "on" condition is, of course, that taken by the s.c.s. anode load.

USE AS A P.U.T

A programmable unijunction transistor is not usually employed to switch a load but, like an ordinary unijunction transistor, is used in a relaxation oscillator circuit. Although there are superficial similarities between p.u.t. and u.j.t. relaxation oscillators, the devices themselves are completely different, as will already be apparent to readers who are familiar with u.j.t. operation.

A relaxation oscillator is one in which a capacitor is charged via a resistor until the potential across the capacitor reaches a certain threshold level. The capacitor is then rapidly discharged or partially discharged, whereupon the capacitor charges up until the threshold voltage is developed across it once again. It then discharges or partially discharges once again, and the circuit continuously oscillates in this fashion.

The circuit diagram of a conventional p.u.t. relaxation oscillator using an s.c.s. in the p.u.t.



The complete touch plate switch unit. In this version the touch plates consist of pieces of stripboard

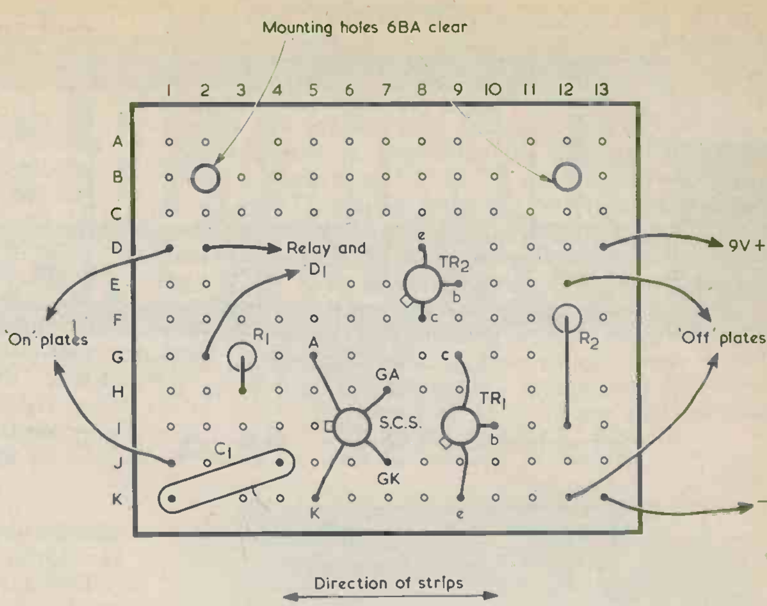


Fig. 3. Veroboard assembly for the touch plate switch

mode is given in Fig. 4. The gate anode terminal is held at approximately half the supply rail potential by the potential divider formed by R3 and R4. The cathode terminal is connected to the negative supply rail by way of R2, and this component must have a fairly low value.

When the supply is initially connected, C2 will have no charge and the anode terminal of the s.c.s. will be at the negative supply rail potential. With the gate anode held at half the supply rail potential the device is obviously strongly reverse biased and will not conduct between anode and cathode terminals. C2 is therefore free to charge up via R1.

When the voltage across C2 is about 0.6 volts positive of that at the gate anode, the s.c.s. is switched on and will continue to conduct until the current flowing through it falls below the holding level. Thus C2 is rapidly discharged through the s.c.s. and R2 until the voltage across it is too low to maintain the holding current, and the s.c.s. turns off. C2 then begins to charge again, and the whole cycle of events is repeated for as long as the supply voltage is present.

R1 must be low enough in value to provide sufficient current to turn the s.c.s. on, but it must not be so low as to hold the device on continuously. R2 must not be too high in value as it would then introduce negative feedback to the s.c.s. cathode circuit; this would hinder its regenerative action and prevent it triggering properly.

The circuit produces two output waveforms: a high impedance non-linear sawtooth across C2 and a low impedance pulse across R2 as C2 is discharged. The frequency of oscillation is set by the values of R1 and C2, and is largely independent of variations in supply voltage.

In a relaxation oscillator employing an ordinary unijunction transistor the voltage at which the timing capacitor discharges is set by the characteristics of the device used, and for practical u.j.t.'s is subject to quite wide variations between individual devices of the same type number. For example, with the 2N2646 the voltage can be anything from 0.56 to 0.75 of the supply voltage. This makes it impossible to obtain highly predictable results with regard to operating frequency even if the timing components have close tolerances.

With a programmable unijunction transistor, or an s.c.s. acting as a programmable unijunction transistor, the capacitor discharge level is set by an external potential divider (R3 and R4 in Fig. 4.) and, if necessary, highly predictable results can be obtained by using close tolerance components here and in the timing network.

Fig. 4 shows a conventional form of programmable unijunction transistor relaxation oscillator, but when an s.c.s. is employed as a p.u.t. it can be

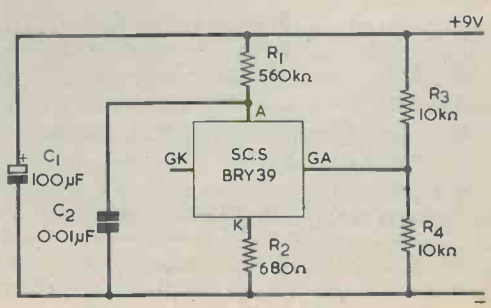


Fig. 4. Using a silicon controlled switch in a conventional programmable unijunction oscillator circuit

used in the alternative configuration shown in Fig. 5. This is very much the same as Fig. 4, but the anode and cathode functions have been transposed and the reference voltage connects to the gate cathode instead of to the gate anode. The circuit works in basically the same way as that of Fig. 4, with C2 charging via R2 until the cathode is about 0.6 volt negative of the gate cathode. The s.c.s. is then turned on and discharges C2. The output signals are negative-going now, of course, whereas they were positive-going in Fig. 4.

At first sight neither circuit has any advantage over the other, but in practice the configuration of Fig. 5 seems to be considerably less critical with regard to component values than is that of Fig. 4, and for this reason is to be preferred.

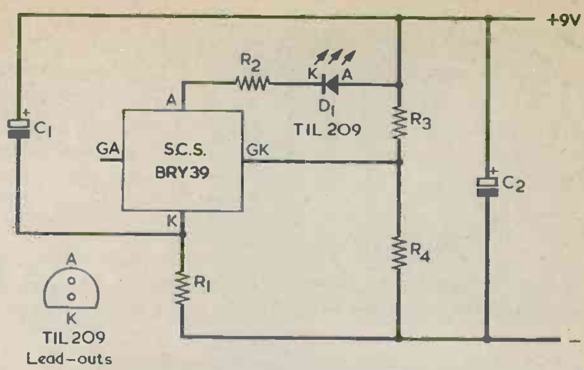


Fig. 6. Employing the p.u.t. style oscillator in a flashing pilot lamp circuit. Current consumption from the 9 volt supply is very low

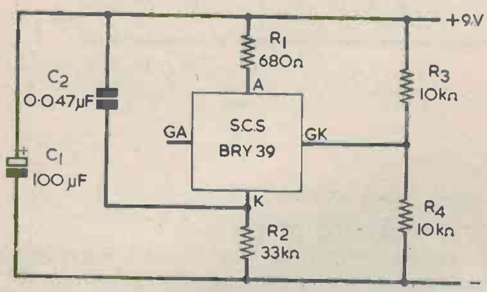


Fig. 5. An alternative form of the p.u.t. oscillator circuit which offers advantages in practice

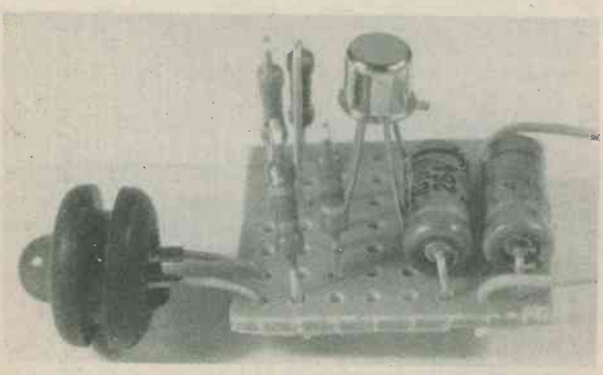
FLASHING PILOT LIGHT

A very simple practical project using an s.c.s. as a p.u.t. is shown in Fig. 6, and this gives the circuit of a low power pilot light. The idea behind this project is that it causes an l.e.d. to flash briefly at intervals of about 1 second, whereupon a very noticeable pilot light having a very low current consumption is given. Such a unit is particularly useful with small battery powered equipment where other types of pilot light would be unsuitable due to excessive current consumption and consequent reduction of battery life.

The circuit of Fig. 6 is simply that of an s.c.s. relaxation oscillator operating in the p.u.t. mode, with an l.e.d. included in the anode circuit so that it is pulsed on by the discharge current of the timing capacitor. The values of C1 and R1 have been chosen to produce a frequency of oscillation which is slightly greater than 1Hz.

Ordinary unijunction transistors can be, and are, used in flashing pilot light circuits of this type, but they have the disadvantage of drawing a standing current of about 1 to 2mA apart from the capacitor charge current, which makes them rather inefficient. In Fig. 6 the values of R3 and R4 have been made fairly high so that only a fairly small standing current flows in addition to the charge current. The standing current is approximately 85μA, and the total current consumption of the circuit is only about 130μA.

A suitable component layout for the unit is shown in Fig. 7, and this is based on a 0.1in. matrix Veroboard panel having 8 holes by 7 copper strips. There are no breaks in the strips. The panel is very small and light. If the l.e.d. is mounted in a panel holder, an adequate mounting for the Veroboard will be provided as well. Due to its small size it should be possible to find space for the pilot light unit in nearly all items of battery operated equipment.



The flashing pilot light project. The Veroboard assembly is very small and may be secured by way of the l.e.d. panel mounting

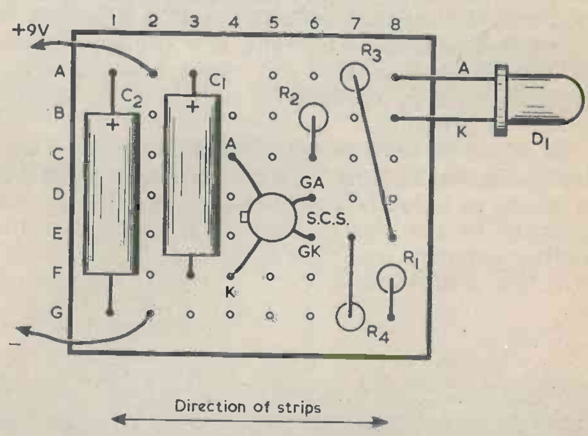


Fig. 7. Constructional details for the low power flashing pilot light

NEXT MONTH

In next month's issue we shall examine further circuits incorporating the silicon controlled switch including, in particular, a versatile metronome.

(To be concluded)

RADIO & ELECTRONICS CONSTRUCTOR

IN OUR NEXT ISSUE —

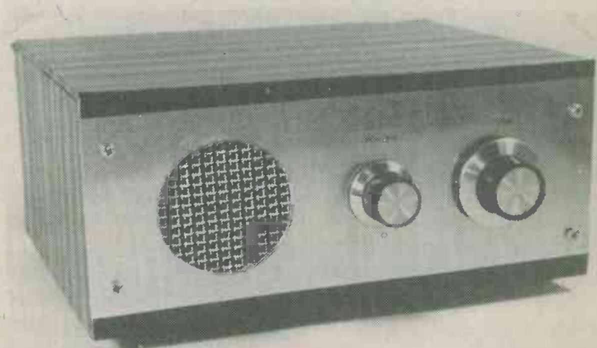
PHASE LOCKED A.M. RECEIVER

Part 1 (2 parts)

Can a phase locked loop be used for a.m. detection?

It can, and very successfully with this practical medium wave superhet receiver.

This fairly simple receiver employs the NE567 phase locked loop i.c. to provide the second i.f. amplifier and detector functions. The receiver is powered from a PP6 9 volt battery and provides a good quality audio output of a few hundred milliwatts to an internal loudspeaker.



CMOS RESISTANCE EVALUATOR

The Unit described is suitable for evaluating resistance values from less than 5 Ω to 10MΩ with eleven overlapping ranges.

The circuit is designed around 2 CMOS operational amplifiers, resulting in a low component count and ease of intitial setting up without the drawback of a dual power supply.

9 VOLT ELIMINATOR SPEAKER UNIT

Stabilized 9 volt output
Current limit at 100mA

Originally designed and built for use with the "3 Band Short Wave Superhet" it can be employed with other short wave receivers requiring a 9 volt supply and an external speaker.

RADIO 4 CONVERTER

This article describes a simple and inexpensive converter, which is particularly appropriate now that Radio 4 has been moved to the long wave band on 1,500 metres (200kHz) and many a.m. sound receivers, both home constructed and commercially manufactured, do not have a long wave band.

There is no need to make a direct connection between the converter and the medium wave radio as the converter radiates a local signal which is picked up inductively by the receiver on its own ferrite aerial.

MANY OTHER ARTICLES

ON SALE 4th DECEMBER **Avoid disappointment. ORDER NOW**

BACK NUMBERS

For the benefit of new readers we would draw attention to our back number service.

We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old. The cost is 58p, inclusive of postage and packing.

Before undertaking any constructional project described in a back issue, it must be borne in mind that components readily available at the time of publication may no longer be so.

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies* = kHz

From my early days in radio, I have never ceased to enter the shack without a sense of wonder at this world of the short waves and a hope — often forlorn — that this time conditions will really be good, the QRM absent and the Dx rolling in. This constant hope, coupled with my own optimistic nature, are the spurs which jolt me awake at the most unearthly hours — and have done so for almost fifty years now! Just now and then my efforts are rewarded but that of course applies to all of us long-suffering Dxers. Someone, I've forgotten just who, once remarked that when the bug of short wave listening bites, it bites deep. I am covered with bites!

● **SRI LANKA**
Colombo on **11800** at 0055, YL with songs in the Hindi programme of the All Asia Service.

● **NETHERLANDS ANTILLES**
Bonaire (Trans World Radio) on **11925** at 0105, OM with a newscast in the English programme to the Far East, scheduled from 0035 to 0135.

● **PAKISTAN**
Azad Kashmir (Free Kashmir) on **3860** at 1750, OM with song, local music, sign-off at 1816. The schedule is from 0045 to 0200 and from 1200 to 1816, the power is 10kW and the transmitter is located at Trarkhel.

● **SURINAM**
SRS Paramaribo on **4850** at 0323, programme of pops on records, OM announcer in Dutch. The schedule is from 0815 to 0330 and the power is 10kW.

● **BRAZIL**
Radio Itatiata, Belo Horizonte, on **4805** at 0225, OM with sports commentary in Portuguese. The schedule is around the clock and the power is 25kW.

● **AUSTRALIA**
Radio Australia on **15240** at 0525, OM with a talk in English about prison life in Australia.

Radio Australia on **17795** at 0340, YL with a talk in English about local affairs. Also logged in parallel on **17870**.

● **U.S.S.R.**
Radio Moscow on **7390** at 1725, piano music in the Russian 5th Programme "Atlantica" for seamen in the Atlantic, scheduled here from 1630 to 1730 and in parallel on **7340, 9685, 11705, 11790, 11810, 11830, 11870** and on **15455.**

Radio Moscow on **12000** at 1735, OM with the Hausa programme to Africa, scheduled from 1730 to1800.

Radio Moscow on **12055** at 1740, OM with the Zulu programme to Africa, scheduled from 1730 to 1800.

Radio Moscow on **11830** at 0610, YL with the English programme to Africa, scheduled from 0600 to 0700. Also logged in parallel on **11965.**

Radio Moscow on **11705** at 0732, OM with a talk in Russian in the programme "International Observers at the Round Table" — a rebroadcast of the Domestic Service 5th Programme — scheduled here on Sundays only from 0730 to 0800.

Radio Moscow on **11805** at 0738, piano music in a relay of the Domestic Service 2nd Progamme "Mayak".

● **WEST GERMANY**
"Deutsche Welle — the Voice of Germany", Cologne, on **11765** at 0625, OM with the English programme directed to West Africa, scheduled from 0600 to 0630. Also logged in parallel on **11905.**

● **SPAIN**
Madrid on **11920** at 1807, OM with a newscast in the Spanish programme for Europe, scheduled here from 1300 to 1900. For those interested, the English programme to Europe is currently radiated from 2030 to 2230 on **6100, 7155** and on **9505.**

● **INDIA**
AIR (All India Radio) Delhi on **11620** at 1835, local songs and music in the English programme (General Overseas Service) to East Africa, the U.K. and Western Europe, scheduled from 1745 to 1945.

● **VATICAN**
Vatican City on **11715** at 0615, Latin Mass to Europe, scheduled from 0715 to 0820. Also logged in parallel on **11740.**

● **EGYPT**
Cairo (one of my old stamping grounds!) on **11785** at 0705, OM with a newscast in Arabic in the Domestic Service General Programme, scheduled here from 0700 to 1300.,

● **SWITZERLAND**
Berne on **11780** at 0720, OM with a talk about the Red Cross and war prisoners in the English programme directed to Australasia, the Far East South and South-East Asia and Europe, scheduled from 0700 to 0730.

● **ECUADOR**
HCJB Quito on **11835** at 0800, OM with station identification, time-check then a religious programme in the English transmission to Europe and the Pacific, scheduled from 0700 to 0830 here and in parallel on **9525, 9665** and on **11900.**

● **FINLAND**
Helsinki on **11755** at 1445, OM's with a discussion about the Finnish Constitution in the English programme for Europe and North America, scheduled from 1325 to 1455 (Sundays only).

● **ALBANIA**
Tirana on **11985** at 1454, OM with the Indonesian programme to South-East Asia, scheduled from 1430 to 1500.

● **ROMANIA**
Bucharest on **11940** at 1500, OM with the opening of the English programme for Asia, scheduled from 1500 to 1530, followed by YL with a news bulletin.

● **ITALY**
Rome on **11800** at 1948, YL with comment on current affairs in the English programme intended for the U.K., scheduled from 1935 to 1955.

● **CUBA**
Havana on **11930** at 0120, YL and OM alternate with news comment in the English programme for the Americas, scheduled from 0100 to 0450.

● **CANADA**
Montreal on **11940** at 0124, OM with a talk about French separatism in the English programme for the Americas, scheduled from 0100 to 0130.

● **CZECHOSLAVAKIA**
Prague on **11990** at 1440, OM with a talk about the atom bomb in the English programme directed to Africa, South Asia, the Far East and and the Pacific, scheduled from 1430 to 1500.

● **CHINA**
PLA Fukien Front on **3200** at 1850, YL in Chinese until sign-off at 1859. This is the Network 2 programme in Amoy and Standard Chinese to Taiwan and other Offshore Islands, scheduled here from 1000 to 1900.

Radio Peking on **7503.5** measured at 2025, Chinese songs by YL in the Domestic Service 1, scheduled here from 2000 to 1735.

Radio Peking on **11000** at 0007, YL with songs in Tibetan in the Domestic Service for Minority Groups to Tibet, YL in Tibetan, the programme being scheduled here from 2330 to 0025.

Radio Peking on **11290** at 0019, YL with songs in Chinese in the Domestic Service 1 programme, scheduled here from 2000 to 1735.

Radio Peking on **15510** at 0030, military music, YL and OM alternate with the Uigher programme in the Domestic Service for Minority Groups, scheduled here from 0030 to 0125.

Urumchi, Sinkiang, on **5060** at 1900, 'East is Red' theme on chimes, identification "Govorit Peking", YL with the programme in Russian to U.S.S.R., scheduled from 1800 to 2100.

Radio Peking on **11650** at 1535, OM with news comment in the English programme for South Asia, scheduled here from 1500 to 1600.

Radio Peking on **9080** at 2013, OM and YL in Chinese, local-type music in the Domestic Service 1, scheduled from 2000 to 2300, 2303 to 1400 and from 1503 to 1735.

Radio Peking on **9940** at 1745, OM with the Cantonese programme to South East Africa and South East Asia, scheduled from 1700 to 1800.

Radio Peking on **9880** at 1750, YL and OM in the Standard Chinese programme for Europe, North Africa and West Asia, scheduled from 1730 to 1830.

● **COLOMBIA**
Radio Bucaramanga on **4845** at 0402, OM with station identification followed by sign-off with the National Anthem. The schedule is from 1000 to 0400 and the power is 1kW.

● **GUINEA**
Conakry on **4910** at 0405, OM with a talk in French about local affairs. The schedule of this one is from 1230 to 0730 and the power is 18kW.

● **NIGERIA**
Lagos on **4990** at 0408, OM with a newscast in English followed by U.K. pop records at 0411. This is the National Programme which is in English and vernaculars and is scheduled here from 0430 to 1000 and from 1700 to 2305, the power being 20kW.

● **ANGOLA**
Radio Nacional, Luanda, on **3375** at 2001, OM with a newscast in Portuguese followed by identification and a musical programme at 2003. This is the 'A' Programme in Portuguese from 0400 (Sundays from 0430) to 0800, from 1530 to 2400. Programmes in Kikongo, a local language, are inserted in the above schedule from 2100 to 2130. The power is 10kW.

● **NOW HEAR THIS**
Clandestine "Radio Freedom from South Yemen" on **9960** at 1415, Arabic songs and music, readings from the Holy Qur'an, political harangue, rousing music and male chorus and off at 1430. This is an anti-South Yemen Communist Government programme, calling on the armed forces to rebel against the Moscow-backed regime.

LIGHT CHANGE ALARM UNIT

— will not cause false alarms

by P. R. Arthur

AN UNUSUAL AND INEXPENSIVE APPROACH TO PROPERTY SURVEILLANCE

* *During daylight will detect someone moving around a room*

* *After dark can be triggered off by just a torchlight*

* *Will not cause false alarms by responding to natural changes in ambient light level*

A large number of light sensitive electronic designs of various types have been published in the past, and most of these come under the broad heading of light level detectors. In other words, they activate some piece of ancillary equipment when the amount of light received by the photosensitive device passes through a certain threshold level. Common examples of this type of project are automatic parking lights and automatic porch lights.

There is an alternative type of light activated switch which is better suited to certain applications, and this is a circuit that responds to fairly rapid changes in light level rather than to the detection of a particular light level. Probably the most obvious application for a device of this nature is a burglar alarm system.

If such a unit has adequate sensitivity it is quite capable of detecting a person moving around a room during the hours of daylight. It will be particularly effective if the photocell is placed on the opposite side of the room to a window. Anyone moving around the room will, of course, produce shadows, but the light coming in through the window will almost certainly be well diffused and a large number of shadows will be produced. The walls and ceiling will further tend to diffuse the light and increase the number of shadows. As shadows cross the photocell they will produce small changes in light level which will trigger the unit.

After dark the system will probably not function in this manner due to a lack of ambient light, but it will still be triggered by an intruder switching on the room lights, or even by indirect light from an intruder's torch.

Natural changes in the ambient light level will occur relatively slowly, and the unit must be designed not to respond to these so that false alarms are not produced.

Light detector circuits of this type are not quite as effective as other forms of movement detectors, such as those employing microwave techniques or ultrasonic sound doppler shift techniques, but they are very much less complicated and comparatively inexpensive.

The unit which forms the subject of this article is a sensitive light change detector which is based on an operational amplifier i.c. and a silicon controlled switch (a form of highly sensitive thyristor). In the untriggered state the circuit consumes typically less than 1mA from a 9 volt supply and can therefore be battery powered if necessary.

OPERATING PRINCIPLE

Fig. 1 shows the basic arrangement of the alarm unit in block diagram form. A photocell circuit produces a voltage which varies with light intensity in conventional manner, and the output from this is fed to a ground referenced CA3130 operational amplifier circuit via a coupling capacitor. The latter blocks the d.c. component in the output from the photocell circuit, and its value is chosen so that in conjunction with the input impedance of the amplifier it forms a high pass filter which also blocks any slow voltage changes. Reasonably fast changes in potential are, however coupled through to the amplifier.

The ground referenced amplifier is much the same as an ordinary operational amplifier, but it has a single positive supply rather than the normal dual balanced positive and negative supplies. The fact that the negative supply is absent means that negative-going output half-cycles must also be absent, whereupon the amplifier output is effectively half-wave rectified. This is not of importance as only positive-going signals are needed in order to trigger the following thyristor stage. Also, the CA3130 operational amplifier has a low current consumption of a few hundred microamps only when used in this manner.

The thyristor is driven from the output of the amplifier, the quiescent output voltage of which will be little more than zero. Under normal conditions the thyristor is therefore switched off. If the photocell circuit is activated, the output of the amplifier will momentarily swing positive and switch on the thyristor. Once the thyristor has been triggered it latches in the on state, and continues turned on until it is reset. The thyristor is used to operate a relay whose coil forms its load, and the relay contacts can either be connected into an alarm system or can directly control an audible alarm generator of some kind.

The thyristor employed in this circuit is a silicon controlled switch (s.c.s.) which is connected to act as a highly sensitive thyristor. The performance of the circuit would not be as good if an ordinary thyristor, or silicon controlled rectifier, were to be used, as the output current from the amplifier is only just sufficient to trigger many of these. The s.c.s. places little loading on the amplifier output and will trigger when the amplifier output goes more than about 0.5 volt positive.

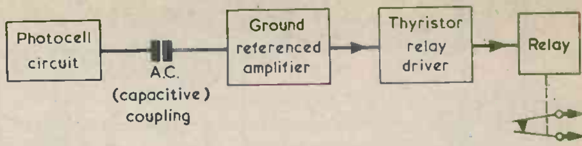


Fig. 1. Block diagram illustrating the operation of the light change alarm. This detects fast changes in illumination of the photocell, as could be caused by the movements of an intruder

The front panel of the light change alarm carries the Set-Reset switch and jack sockets for connection to the photoconductive cell and the external alarm circuitry

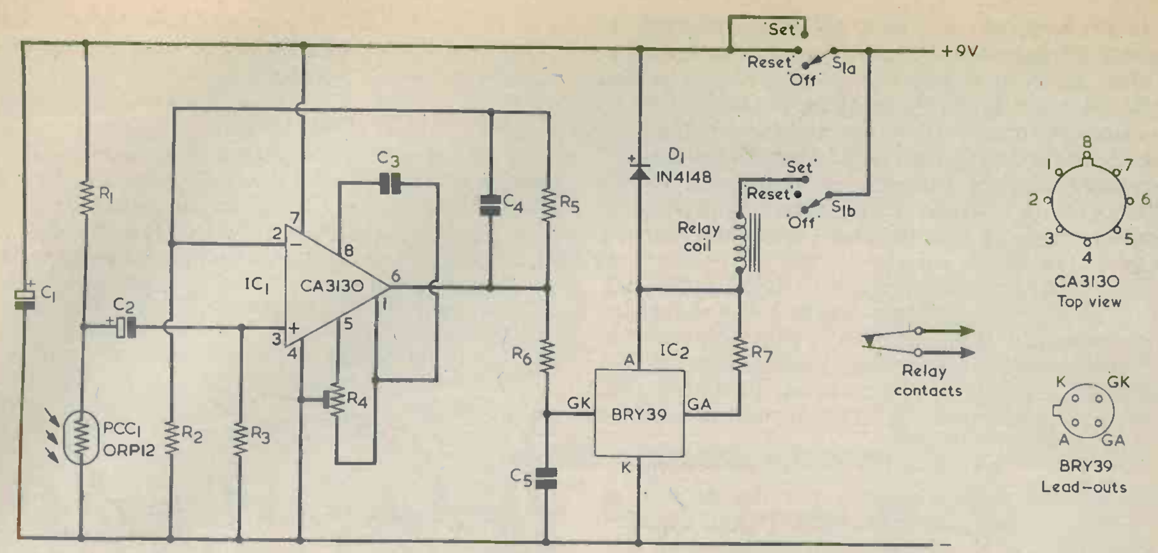


Fig. 2. The circuit of the alarm unit. The relay contacts may alternatively be normally open if it is intended to couple the unit to a simple warning circuit, such as a battery and bell in series

THE CIRCUIT

The complete circuit diagram of the light change alarm appears in Fig. 2. The photocell is an ORP12 cadmium sulphide cell, which is inexpensive but gives excellent sensitivity. R1 is its load resistor and the optimum value for this component depends upon the ambient light level. It is therefore given a value which gives a good compromise over a wide range of light levels, and which also incurs a reasonably small current consumption.

IC1 is used in the non-inverting mode and the output from the photocell circuit is coupled to the non-inverting input by way of C2. R3 is the bias resistor for this input and, in conjunction with C2, it also forms the high pass filter.

The voltage gain of the amplifier is set by the ratio of R5 to R2 at approximately 1,000 times, and this high level of gain gives the circuit excellent sensitivity. C4 rolls off the high frequency response and aids the stability of the circuit whilst C3 provides compensation for the i.c.

Although the quiescent output voltage of the i.c. is theoretically zero, practical operational amplifiers have an offset voltage between the inputs. This voltage will be small, but when amplified by the voltage gain of the i.c. it could easily become quite large, producing a quiescent output voltage of several volts. It is also possible that leakage current through C2 could result in a very small quiescent voltage appearing at the non-inverting input of the amplifier; after amplification, this could also produce quite a high quiescent output voltage which would prevent the unit from functioning. Offset null correction is therefore included in the circuit, and R4 can be adjusted to produce zero quiescent output voltage.

The output from IC1 is fed to the input terminal of the s.c.s. (IC2) via R6. An s.c.s. is a very sensitive device and C5 and R7 are needed to prevent spurious triggering of this component.

S1 is the on-off and reset switch. In the "Off" position of this switch the power is disconnected and the unit is switched off. In the next "Reset" position power is applied to the main circuit, but not to the relay coil. This is necessary because when power is initially applied a voltage spike is produced by the photocell circuit and C2, and the spike could trigger the s.c.s. and cause it to latch in the on state. The triggering voltage is, indeed, passed to the s.c.s. but, without a load supply, it cannot latch on. Thus, if S1 is taken from "Off" to "Reset" and left in the second position momentarily, sufficient time is allowed for the circuit to settle down and become ready for normal operation. The switch is then put to "Set". The relay will not be actuated as the initial spike voltage from C2 will have decayed.

Once triggered by a change in light level, the circuit can be reset by momentarily putting S1 to the "Reset" position. The current flowing through IC2 then falls to zero and it turns off. Diode D1 ensures that there is no risk of high back-e.m.f. voltages from the relay coil being applied to the output of IC2.

Some remarks need to be made concerning components. C2 is specified in the Components List as having a working voltage of 10 volts but it will be quite in order to employ a capacitor having a

The alarm unit is housed in a small plastic case which can be easily concealed. The photocell then couples to the input jack socket via screened cable higher working voltage; as high, even, as 60 to 70 volts. S1 is a miniature 2-pole 3-way rotary switch, and that used in the prototype is a 3-pole 4-way switch with an adjustable end stop set to give 3-way operation. No connections are made to one of the poles. The relay is a "Sub-Miniature Relay" with 2 changeover contact sets and a 185Ω coil, and is available from Maplin Electronic Supplies. It draws a current of around 45mA when the alarm is triggered. The recommended battery is made up of six HP7 cells fitted in a suitable battery holder. This will have contacts which take a battery connector of the PP3 type.

CONSTRUCTION

Most of the components are assembled on a Veroboard panel of 0.1in matrix having 19 copper strips by 29 holes. Details of this panel are given in Fig. 3, which also shows the wiring to S1. The relay is secured to the board by means of two bare tinned

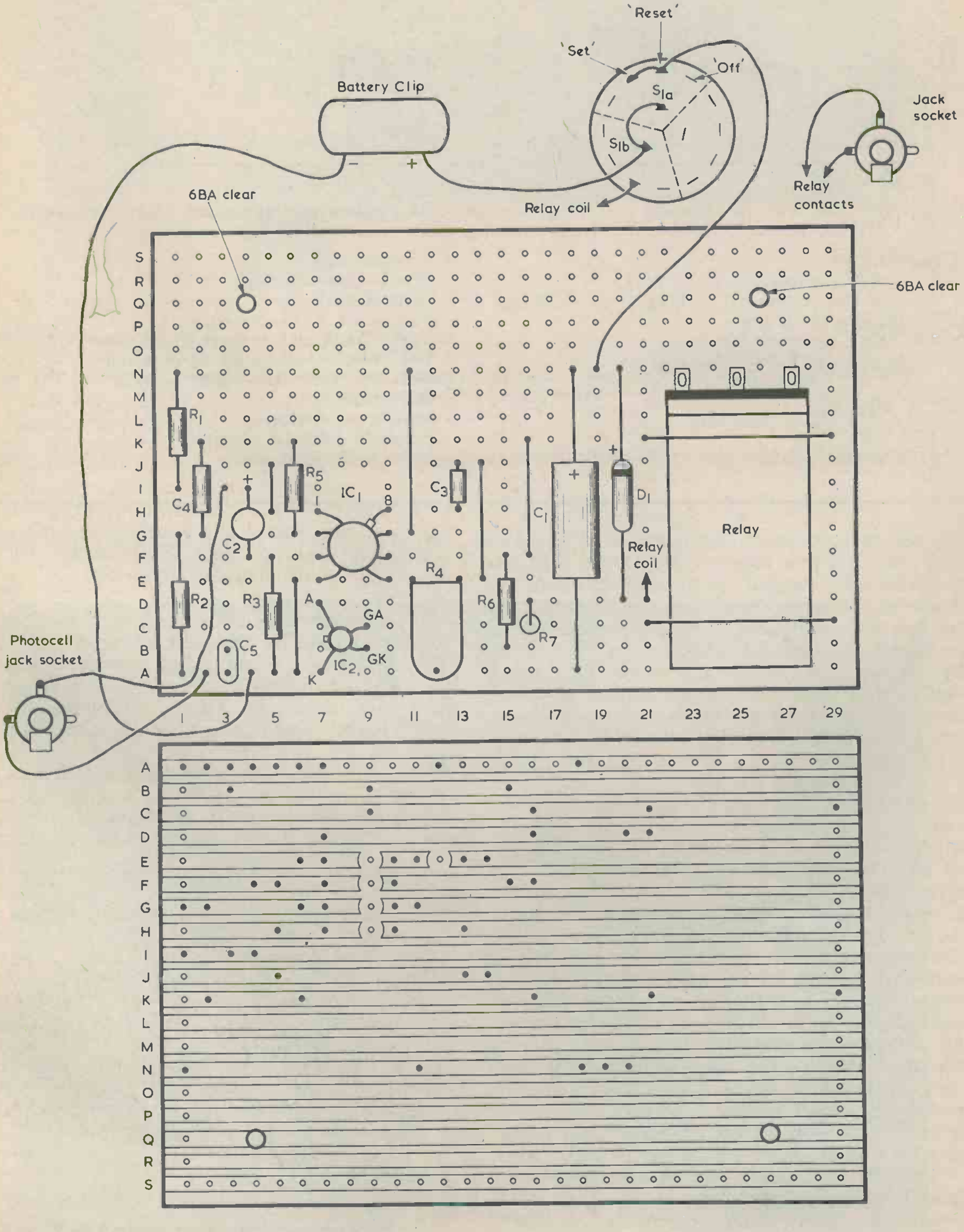


Fig. 3. Details of the component assembly on the Vero stripboard. The relay is held in position by two tinned copper wires soldered to the strips at the points indicated

copper wires passed over its body and soldered to the Veroboard strips, as illustrated. The relay will be held quite firmly if each of the wires is pulled tight on the copper side of the board when the second joint to the copper strip is made. The excess wire on the copper side can then be cut off. If desired, additional stability will be given by first applying adhesive between the relay body and the board. The relay has its coil tags nearest the board.

Since IC1 is a CMOS device it is advisable to

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 10kΩ
R2 100Ω
R3 100kΩ
R4 100kΩ pre-set potentiometer, 0.1 watt, horizontal
R5 100kΩ
R6 1kΩ
R7 100kΩ

Capacitors
C1 100μF electrolytic, 10 V. Wkg.
C2 1μF electrolytic, 10 V. Wkg.
C3 82pF ceramic plate
C4 220pF ceramic plate
C5 0.1μF type C280 (Mullard)

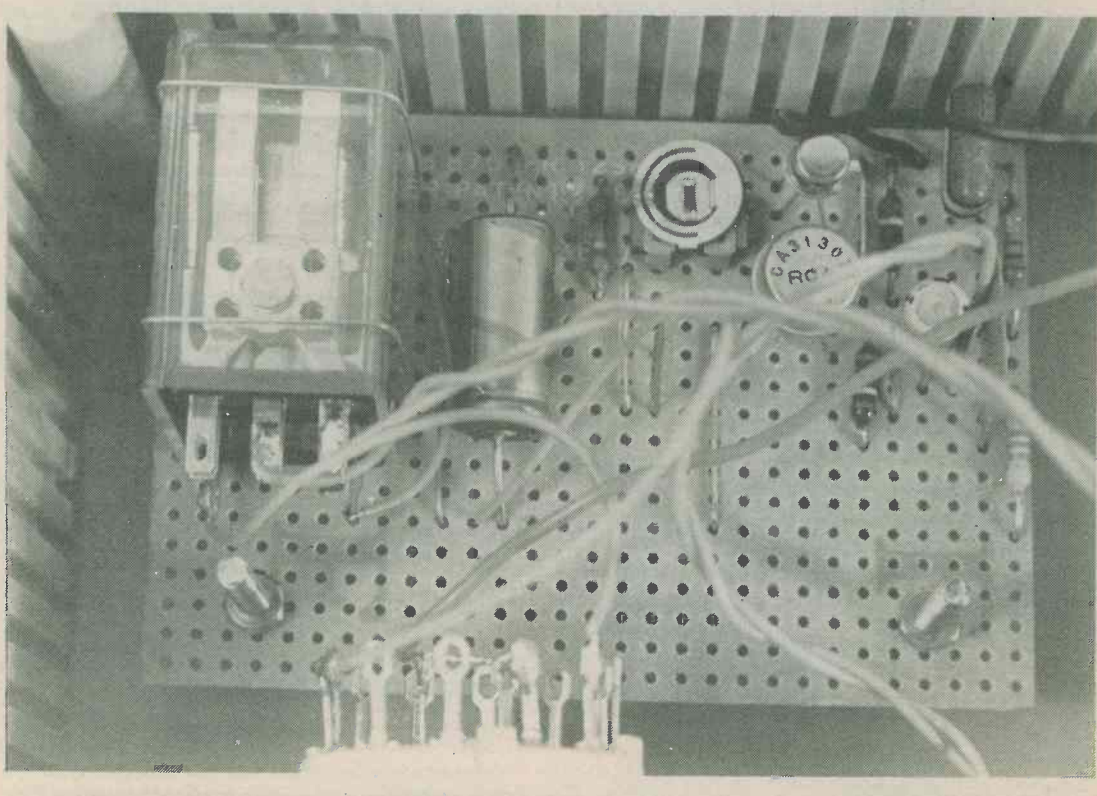
Semiconductors
IC1 CA3130T or CA3130S
IC2 BRY39
D1 1N4148

Photocell
PCC1 ORP12

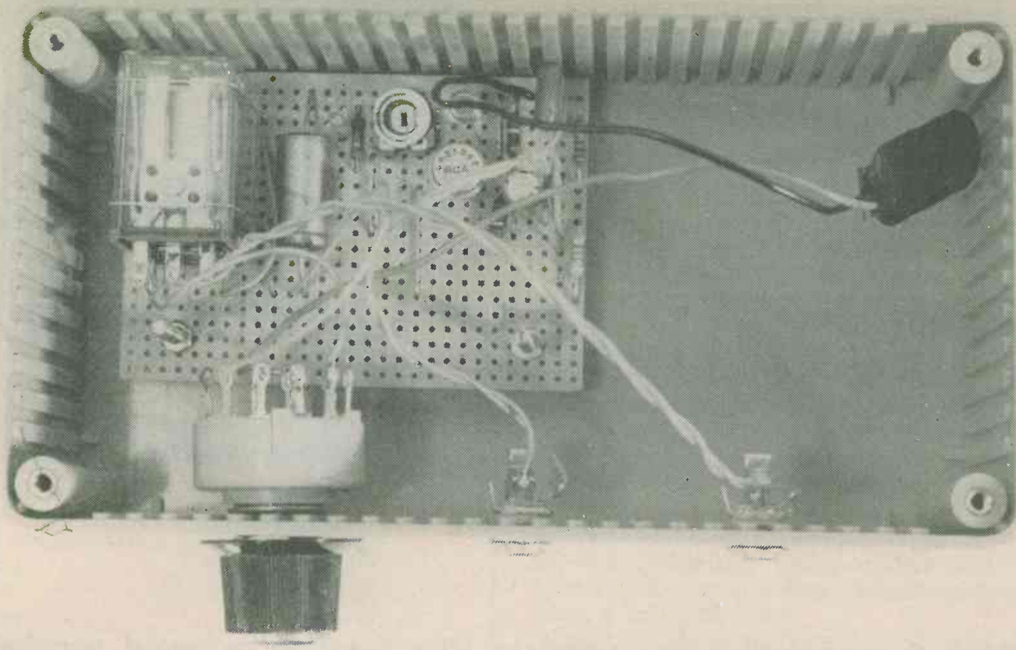
Relay
185Ω relay (see text)

Switch
S1 2-pole 3-way miniature rotary (see text)

Miscellaneous
Plastic case (see text)
Control knob
Veroboard, 0.1in. matrix
2-off 3.5mm jack sockets (if required)
2-off 3.5mm jack plugs (if required)
6-off cells type HP7 (Ever Ready)
Battery holder
Battery connector
Screened cable (if required)
Nuts, bolts, wire, etc.



A Veroboard panel provides a neat and readily assembled basis for the main wiring of the alarm unit



The Veroboard assembly is bolted to the bottom of the case behind the rotary switch. Adequate space remains for the battery holder

make this component the last to be soldered to the board. A soldering iron with a reliably earthed bit must be used.

The method of coupling the photocell to the unit depends upon the requirements for the particular installation in which the unit is to be used. The cell could be mounted on the case which houses the main circuitry but better security will be given in most instances if it is positioned remotely, whereupon it can be connected to the unit by way of up to 2 metres of screened cable terminated in a 3.5mm jack plug. The centre conductor of the cable carries one connection to the cell and the braiding provides the other connection. The braiding should be common with the negative supply rail and this will be achieved if it connects to the "sleeve" contact of the plug.

The manner in which the relay contacts conect to the external alarm or audible warning system can also vary according to individual requirements, but a good plan here is to connect the contacts to a second 3.5mm jack socket into which a plug connecting to the external circuit can be inserted. The prototype employed jack sockets in both the photocell and relay contact circuits, and these are shown in Fig. 3. Only one of the two relay contact sets is used and, for most alarm systems, the connection will be to a pair of normally closed contacts rather than to a pair of normally open contacts.

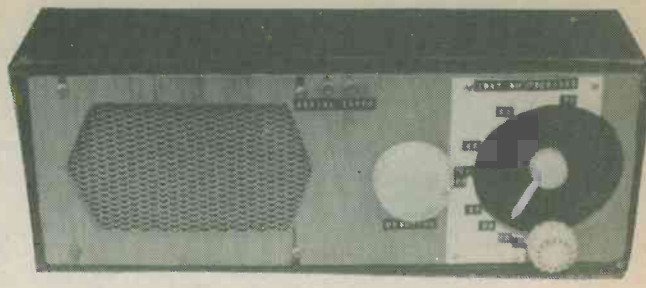
The unit can be assembled in any plastic case capable of taking the components and the battery holder, and the prototype is housed in a box measuring approximately 150 by 80 by 50mm. One of the 150 by 50mm sides forms a front panel and has S1 mounted towards its left hand side. The socket for the photocell is mounted in the centre and that for the relay contacts to the right, following the symmetrical layout shown in the photographs. The Veroboard assembly is mounted inside the case behind S1, and there is space for the battery holder in the remaining part of the case. The Veroboard panel is secured by means of two 6BA bolts and nuts, spacing washers keeping the soldered connections under the board clear of the case bottom and thereby preventing strain on the board.

ADJUSTMENT

After completion it is necessary to set up the offset null potentiometer R4. This requires a multimeter switched to a 10 volt range, or to a range which allows a clear reading of 9 volts. The meter is connected to the negative rail and to pin 6 of IC1, a suitable connection point for the latter being at the link wire between points K16 and F16 of the Veroboard. The photocell should be positioned where it will not be subjected to any rapid changes in light intensity, and the slider of R4 turned almost fully in the clockwise direction. S1 is switched to "Reset", whereupon the meter should give an indication of approximately 9 volts. R4 should then be adjusted in an anti-clockwise direction just far enough to reduce the voltage reading to zero. After switching off and removing the multimeter the unit is then ready for use.

It will be found that the alarm unit exhibits excellent sensitivity. Indeed, it may be considered excessively sensitive by some constructors. If considered necessary the sensitivity can be lowered somewhat by reducing the value of R5. ■

The "6S3T"



SHORT WAVE RECEIVER

by Sir Douglas Hall, Bt, K.C.M.G.

Only 3 transistors are used in this 6-stage reflexed receiver covering 19 to 75 metres.

The simple receiver to be described is a modernised version of a very successful design of the writer's which was published in the August 1964 issue of this magazine. Described as a "6-Stage 3-Transistor Short Wave Reflex Receiver", the first two reflexed stages employed p.n.p. silicon transistors which were amongst the first to appear on the home-constructor market. The receiver was built in large numbers and one reader stated that "in his opinion no circuit has been published anywhere which is comparable".

The receiver now to be described employs a similar circuit to that earlier set, and uses current silicon transistors. It will be found sensitive and selective, with a modest current requirement of only 12mA from a new 9 volt battery. The prototype tunes from just below the 19 metre band to just above the 75 metre band.

RECEIVER CIRCUIT

As can be seen from the circuit diagram of Fig. 1 the aerial signal is applied via C1 to the emitter of TR1, which acts as a common base r.f. amplifier. The amplified signal at the collector is applied to L2, the primary of an r.f. transformer, and is coupled thence to the tuned secondary winding, L1, the tuning capacitor being VC1. It passes next to the base of TR2 which, acting as an emitter follower, provides current amplification. Diode D1 gives signal rectification, or detection, whereupon TR2, functioning as a common base audio amplifier, gives a.f. amplification.

Since the output at TR2 collector is at high impedance and the collector current is only about 600uA, the collector load consists of the large winding of an audio frequency transformer. This provides a high impedance without the loss of direct voltage which would occur if a high value resistor were used. The audio signal is passed via C3 to the base of TR1, which acts as an emitter follower at a.f., the base offering a high input impedance which does not damp the incoming signal. The output from TR1 passes through the r.f. stopper R2 to the base of TR3, a high gain output transistor.

It will be seen that the positive end of R5 is taken

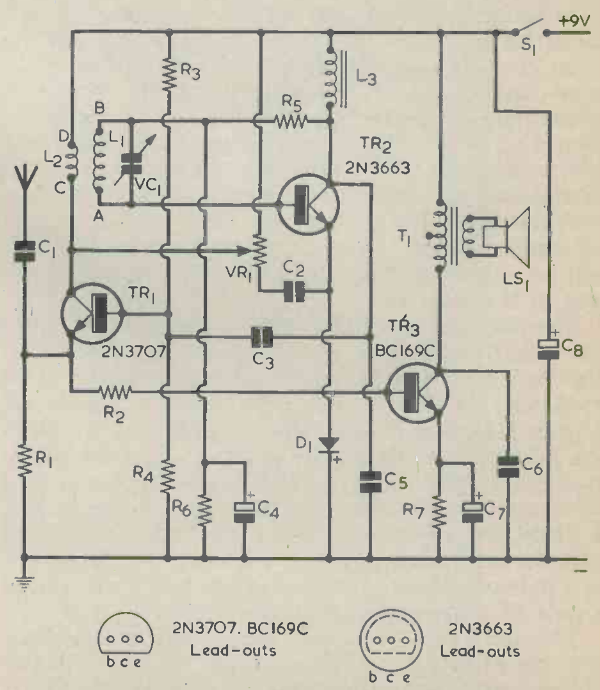


Fig. 1. The circuit of the short wave receiver. The stages are reflexed, with TR1 and TR2 both functioning as r.f. and as a.f. amplifiers

to the collector of TR2. When connected in this manner (in the earlier circuit it was returned to the positive rail) the resistor offers negative feedback of direct current for TR2. A further advantage is that R5 provides a small amount of damping across L3 and thereby removes the possibility of threshold howl at critical reaction settings.

Reaction is controlled by VR1, which is in an r.f. positive feedback path from the emitter to the base of TR2. Reaction feedback increases as the slider of VR1 approaches the end of the track connecting to C2. When the slider is close to the track end connecting to the positive rail it partially or fully short-circuits L2. VR1 therefore functions also as a true volume control.

COMPONENTS

Resistors
(All fixed values ¼watt 10%)
- R1 2.2kΩ
- R2 470Ω
- R3 470kΩ
- R4 220kΩ
- R5 47kΩ
- R6 see text
- R7 100Ω
- VR1 5kΩ potentiometer, linear, with switch S1

Capacitors
- C1 33pF silvered mica or ceramic
- C2 0.01μF polyester
- C3 0.047μF polyester
- C4 47μF electrolytic, 3V. Wkg.
- C5 1,000pF silvered mica or ceramic
- C6 0.1μF polyester
- C7 47μF electrolytic, 3V. Wkg.
- VC1 500pF air spaced variable

Inductors
- L1,L2 see text
- L3 see text
- T1 LT700, LT712 or LT730 (see text)

Semiconductors
- TR1 2N3707
- TR2 2N3663
- TR3 BC169C
- D1 OA81

Switch
- S1 s.p.s.t. toggle, part of VR1

Speaker
- LS1 3Ω or 8Ω, 6 x 4in. or 7 x 4in. (see text)

Miscellaneous
- Control knob
- Tuning drive (see text)
- 2 terminals
- 9-volt battery
- 10-way tagstrip (see text)
- Plywood
- Screws, wire, etc.

COMPONENTS

VC1, a 500pF tuning capacitor, is available from Home Radio Components in Jackson type E1. This was a popular value with valve radios and many older readers may have the component already on hand. A 365pF variable capacitor can alternatively be used, but it will not then be possible to receive the 60 and 75 metre bands. Whilst on the subject of component availability, the 2N3663 specified for TR2 can be obtained from Electrovalue and the OA81 diode from Bi-Pak Semiconductors.

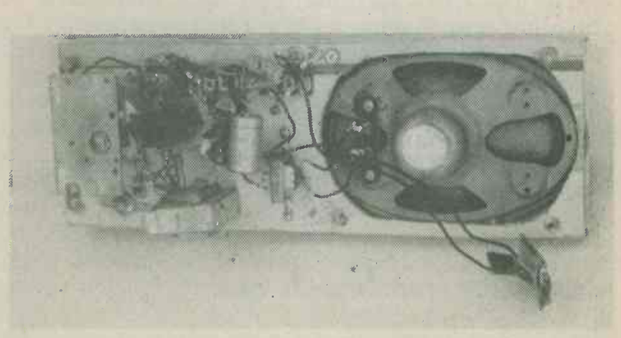
An excellent choice for L3 is the secondary winding of an R.S. Components intervalve transformer. This can be the midget or standard size with a 1:3 or 1:5 ratio. These transformers have not been produced for some years but the author mentions them in case a reader may still find one on dealers' shelves or in his spares box. Another good choice is the primary of an LT44 transformer made by Rex, a common component some 10 or more years ago. It is distinguished by a high primary winding resistance of 2kΩ and a green plastic covering. With either the intervalve transformer or the Rex transformer, R6 should have a value of 10kΩ.

Very nearly as good results, but with some loss of bass, will be given by the primary of a standard Eagle LT44 transformer. With this transformer, R6 should be 7.5kΩ. Whatever transformer winding is employed for L3, no connections are made to the unused winding.

If a 3Ω speaker is used, the Eagle LT700 is suitable for T1. If an 8Ω speaker is employed, the transformer can be an Eagle LT712. Another alternative is the Eagle LT730, which has a tapped secondary and may be used with either 3Ω or 8Ω speakers. These last two transformers are not quite as common as the ubiquitous LT700, but they are stocked by Maplin Electronic Supplies, amongst others. No connection is made to the primary centre-tap of any of these transformers.

CONSTRUCTION

The components, including the speaker, are assembled on a ¼in. plywood panel. This should have dimensions of about 4 by 12 or 13in., the final size being that which accommodates the parts comfortably. Measure the speaker first before cutting out the panel; it may be over 4in. wide! Components are arranged as shown in Fig. 2. The mounting of L3 and T1 depends on the particular transformers employed. If these have printed circuit mounting lugs, the latter may be bent out at



The rear of the front panel, as viewed from the tuning capacitor end

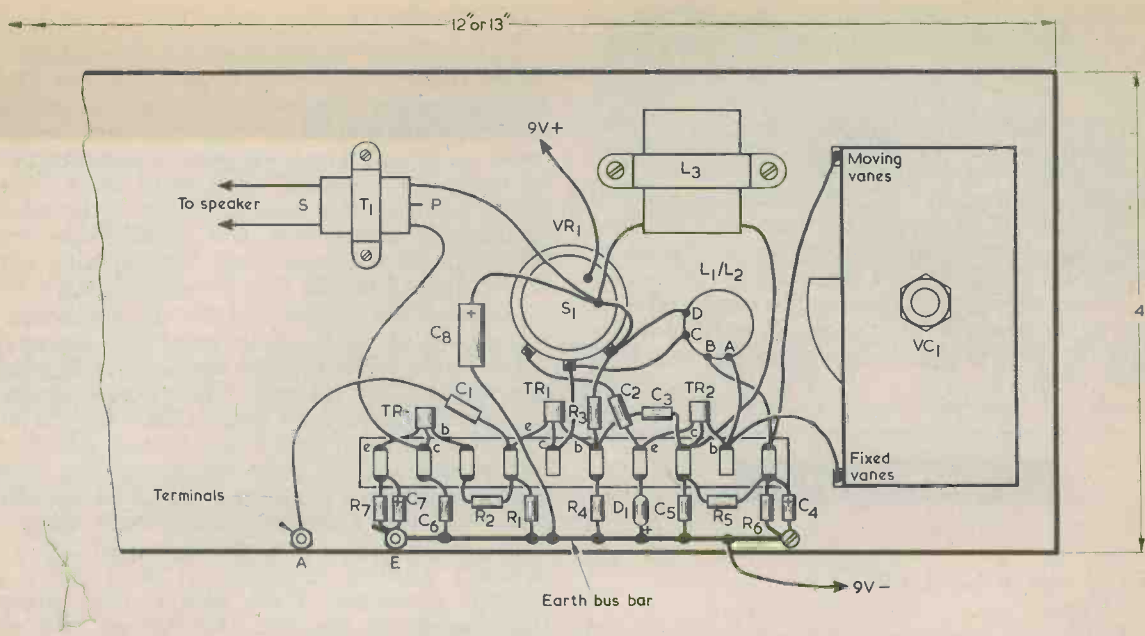


Fig. 2. Layout of components and wiring behind the front panel

right angles and have small tags soldered to them. Short woodscrews then pass through the holes in the tags. A 10-way tagstrip is required and this can be cut out from a "Standard" 18-way group panel retailed by Doram Electronics. It is secured to the plywood by small woodscrews passing through the holes in the centres of the two end tags. Any other 10-way tagstrip having a length of about 3½in. will be suitable.

The coil, consisting of L1 and L2, is home-made, and is wound on a ⅜in. diameter former. The points marked "B" and "D" in Fig. 1 are the earthy ends of the windings. L1 has 12 turns of 24 s.w.g. enamelled wire, close-wound. The winding is covered by a layer or two of Sellotape and L2 is wound immediately over the earthy end of L1. It consists of 5 turns of 32 s.w.g. enamelled wire, also close-wound and covered with Sellotape. It is essential that L2 be wound over L1 and not alongside it. Points "A" and "C" are now the live ends of the windings and should be physically their top ends. No reaction will be given if either winding is connected into circuit out of phase.

Small components are arranged as shown in Fig. 2. Note that a heavy gauge tinned copper bus wire runs parallel to the tagstrip. It is secured at one end to the earth terminal and by a woodscrew at the other end. A slow-motion drive is necessary for VC1 and this can consist of a manufactured item suitable for panel mounting. However, a perfectly sound drive may be made easily and inexpensively in the following manner. Obtain an ordinary small knob of the slightly tapered variety fitted with a grub screw. Cut a piece of s.r.b.p. to make a disc 3in. in diameter. Cut a hole at the centre of the disc which is marginally smaller in diameter than the base of the knob. A fret saw is the tool for this. First apply adhesive around the base of the knob then drive the knob into this hole so that the base is tight in the s.r.b.p. disc. Take an inch or so of ¼in. rod (which could be, say, the excess cut off from a potentiometer spindle) and push a tight fitting grommet over it. Fit a ¼in. bush to the panel such that, when the knob with the disc is passed over VC1 spindle and the rod with the grommet is passed into the bush, the edge of the disc marries into the groove in the grommet. The idea is shown in Fig. 3 and the result is a smooth drive offering a ratio of about 7 to 1.

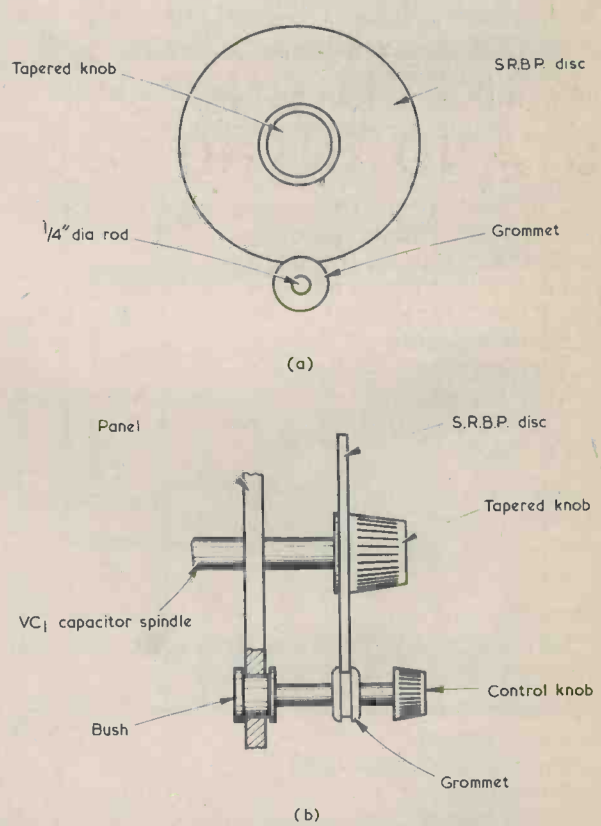
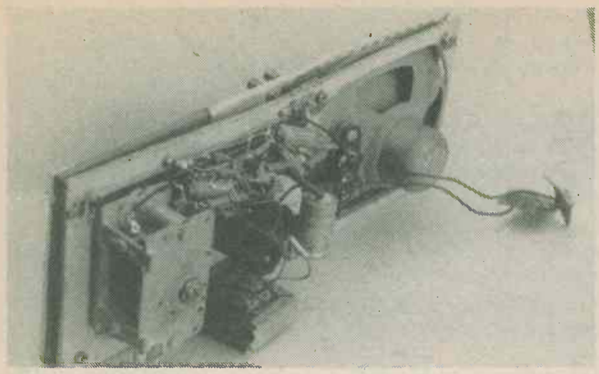
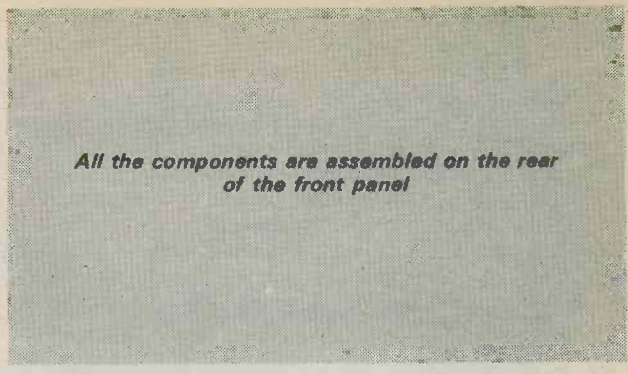


Fig. 3(a). Front view of a home-constructed slow-motion tuning drive. The control knob is removed
(b) Side view of the tuning drive





All the components are assembled on the rear of the front panel

USING THE SET

There are no setting up operations and the receiver is ready for use as soon as it has been completed. A few yards of wire slung across the ceiling will be needed for an aerial. If a long outside wire aerial is employed it may be necessary to reduce the value of C1 fairly drastically to preserve selectivity. Alternatively, a lower value capacitor could be inserted in series externally between the long aerial and the aerial terminal of the set. An earth is not essential, but a connection to the earth line of a mains socket may be tried.

Connect up a 9 volt battery, such as a PP7, switch on and advance VR1 until a hiss denotes the onset of oscillation. Adjust VC1 until a station is heard. For amplitude modulation, keep VR1 backed down just below the oscillation point. The receiver should be oscillating gently for reception of c.w. or s.s.b. signals.

Constructors will want to tidy up the exposed front, possibly by adding a second panel. If this is to be done, bear it in mind before cutting down either of the control spindles. If the home-made tuning drive of Fig. 3 is used the s.r.b.p. disc may have an arrow marked on it, and the panel can be fitted with a scale showing the various bands. A suitable case for the receiver can be made very simply. ■

New Product

PRINTED CIRCUIT DRILL STAND INTRODUCED

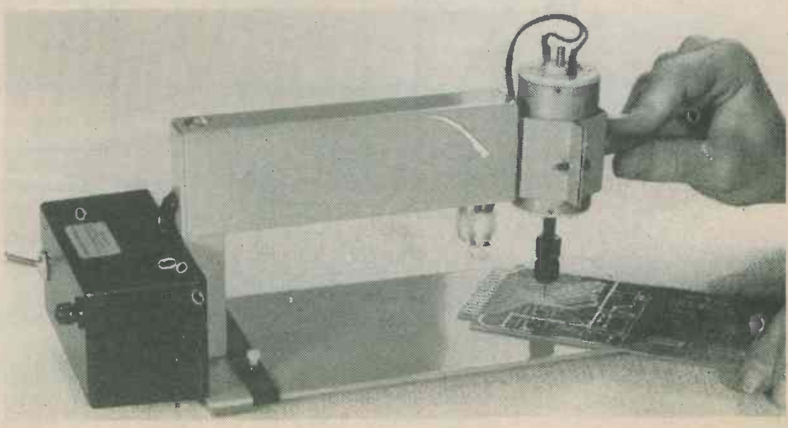
A printed circuit drill stand, specially designed for drilling small quantities of P.C. Boards, prototypes, one-off production specials, missed production holes and modifications, is now available from Technomark, Church Road, Maidstone, Kent.

The motor body is supported on a cantilever spring system which, when depressed, switches the motor on, and off, when released. If the drill motor body is adjusted so that the motor switches on with the drill just touching the board surface, drill wander can be eliminated to enable accurate drilling of plain copper surfaces.

The 315mm long x 115 wide x 150 high 2.5kg drill stand has an integral 12V D.C. power supply, fused and switched, a motor clamp for drill height adjustment, a large throat depth (168mm), low voltage lighting and a reliable high speed motor attached to the unique parallel spring suspension.

Full operative's instructions are supplied with each unit which comes complete with chuck, collets, light and x-y locating jigs.

Recommended retail price of the Technomark P.C. Drill Stand is £61 plus VAT.



Accurate PCB drilling is assured with the new Technomark combination drill stand and positioning jig

GAS & SMOKE DETECTOR

Part 2

By R. A. Penfold

Concluding details of this sensitive and easily constructed unit

In last month's issue we described the manner in which the gas and smoke detector functions, then proceeded to constructional details of the main component panel and the fitting of components to the case. We deal next with the mains power supply section.

MAINS POWER SUPPLY

The wiring of the mains power supply is shown in Fig. 5. T1 is mounted on the case bottom behind the loudspeaker and a solder tag is fixed under one of its

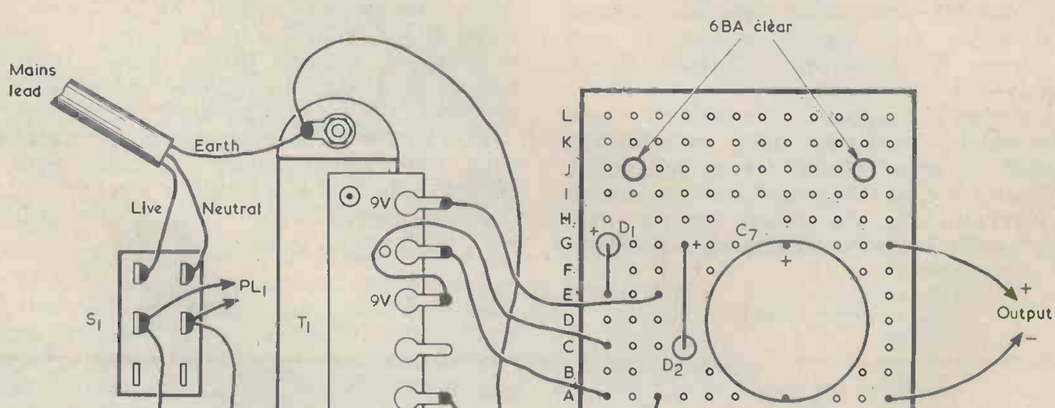


Fig. 5. The wiring of the power supply section. The transformer tag layout is that for the particular component employed in the prototype; other transformers may have their tags positioned differently. There are no breaks in the Veroboard copper strips

mounting nuts. The mains earth lead connects to this and thus earths the metal case. When the unit is powered from the mains it is essential that the case be properly earthed in this way for reasons of safety.

D1, D2 and C7 are wired up on a 0.1in. matrix Veroboard panel which has 12 copper strips by 12 holes. The component layout of this panel is provided in Fig. 5. There are no breaks in any of the copper strips. The completed panel is wired to the rest of the unit before it is finally secured on the base of the cabinet to the rear of S1. It is mounted using a couple of 6BA bolts and nuts in the same way as the main component panel, and spacers are used to hold the panel underside clear of the metal of the case.

It is important to remember that the live and neutral mains connections are accessible at the tags of both T1 and S1 when the case lid is removed, whereupon all precautions against accidental shock must be observed. If there is any risk of the transformer primary tags making contact with the inside of the lid a piece of thin s.r.b.p. should be glued to the lid underside at the appropriate position, employing a powerful adhesive such as an epoxy resin.

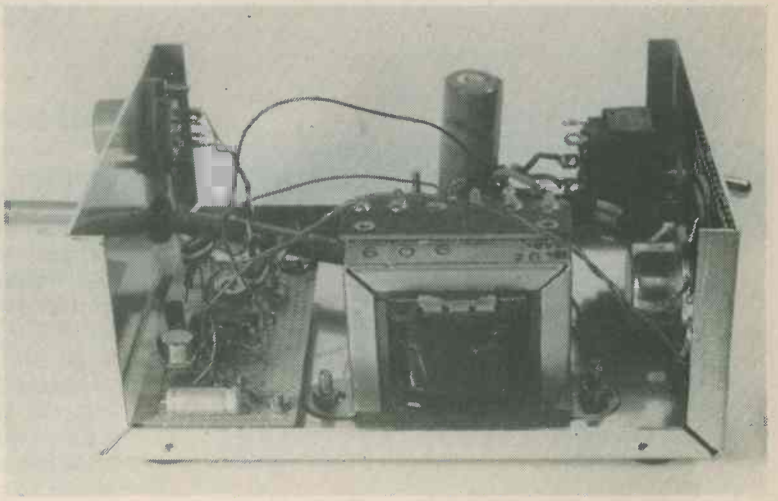
Any outstanding point-to-point wiring is next completed, after which the unit is ready for testing.

then returning to a fairly high level again. The effect is particularly pronounced after the gas sensor has been in storage for a long period.

Give the sensor several minutes after switch-on to achieve a stable operating condition and then adjust R3 in an anti-clockwise direction. At some point the alarm will sound again, and R3 should be backed off slightly from this point. The closer R3 is taken to the threshold of oscillation the more sensitive the circuit becomes. However, it is not desirable to set R3 for the highest possible sensitivity as the unit will then become oversensitive, and a small amount of tobacco smoke or even just breathing near the sensor will be sufficient to set off the alarm! The result is likely to be false alarms in a practical situation, and it is advisable to back off R3 about 30 degrees from the alarm threshold setting. The sensitivity of the unit will still be more than adequate when this is done.

It should be pointed out that the 812 gas sensor is a symmetrical device and can be plugged into its holder either way round. The sensor will not work indefinitely and will become slow to operate and insensitive after about two years of continuous use. It must then be replaced, a process which simply entails unplugging the old sensor and inserting a new one. It is advisable to

Side view of the interior of the gas and smoke detector. The main component panel is to the left of the mains transformer and the speaker is to the right



ADJUSTMENT

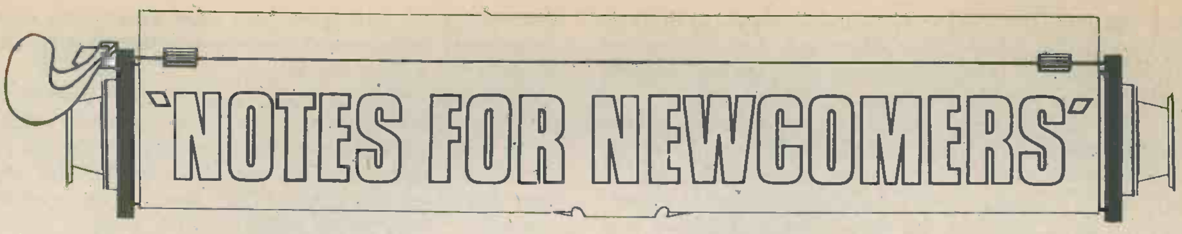
Before switching on for the first time, adjust R3 fully clockwise. The alarm should sound almost immediately after switching on; if it does not, switch off and recheck the wiring for errors.

After a short while the alarm will turn off. This triggering at switch-on is caused by the resistance of the gas sensor starting at a high level, falling as it warms up and

periodically check that the unit is functioning properly by purposely releasing some gas or smoke near the sensor. This will ensure that the sensor is replaced before it becomes too ineffective.

(Concluded)

Copies of the November issue of Radio & Electronics Constructor featuring Part 1 of this attractive project are available from Data Publications Ltd., 57 Maida Vale, London W9 1SN. Price 58p inclusive of postage.



TRANSFORMER RATIO MATCHING

By D. Snaith

We examine a mildly puzzling transformer property

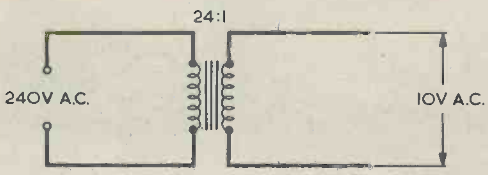


Fig. 1. A common application for an iron-cored transformer. Here, the transformer steps down the a.c. mains voltage to a secondary voltage of 10 volts

Iron-cored transformers are, basically, pretty simple components. If as in Fig. 1 we want to obtain an r.m.s. alternating voltage of 10 volts from the 240 volt a.c. mains supply we use an iron-cored transformer having a step-down ratio, from primary to secondary, of 24:1. In other words the primary has 24 times more turns than the secondary. If the current drawn from the secondary is 1 amp, the current flowing in the primary is one twenty-fourth of an amp. This is because the same power (voltage times current) must theoretically pass into the primary as is drawn from the secondary.

(In practice the current flowing in the primary will be a little higher than one twenty-fourth of an amp because the transformer is not a "perfect" component: it possesses "losses" due to resistance in the windings and other effects which result in the primary power being slightly higher than the secondary power. The small extra power which is lost is then dissipated in the transformer as heat. However, it is not impossible to design an iron-cored transformer so that it has very small "losses" and is thereby nearly "perfect", and we shall assume from now on that the transformers we are discussing are, indeed, of a "perfect" nature.)

IMPEDANCE MATCHING

The use of transformers for changing alternating voltages and currents is easy to understand, and the voltage and current changes are directly related to the turns ratio of the transformer. We employ transformers also for impedance matching. For example, we may have a transistor audio output stage which will give of its best when coupled to an 800Ω load. We can't get 800Ω speakers but we can get 8Ω ones, and so we use a step-down transformer, as in Fig. 2, between the transistor output stage and the speaker. This process is known as matching the speaker to the output stage.

What step-down ratio does the transformer require to present what is effectively an 800Ω load to the transistor output stage? The answer is not 100:1, as it would have been with our voltage and current examples, but is 10:1 instead. The impedance change provided by the transformer is equal to the *square* of its turns ratio. The square of 10 is, of course, 100, and the 10:1 transformer presents an 800Ω impedance at its primary when the secondary connects to an 8Ω load. The same applies with any other impedance changing circuit using a transformer: the impedance change is proportional to the *square* of the transformer turns ratio.

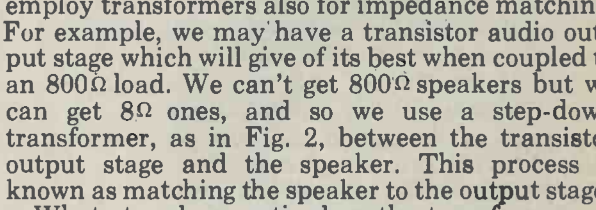


Fig. 2. Here, a transformer matches an 8Ω speaker to a transistor a.f. output stage for which the optimum load is 800Ω

To see how this, at first sight, peculiar relationship holds true, let us look at a simple example in which the secondary load is a 5Ω resistor, as illustrated in Fig. 3. The transformer has a 2:1 ratio and, when the circuit is set up to operate, causes a voltage of 10 volts to appear across the 5Ω resistor. The current flowing in the resistor, is, in consequence, 2 amps. The voltage at the primary must be 20 volts, and the current in the primary must be 1 amp. Now resistance in ohms is equal to volts divided by amps, and so the primary winding is behaving like a resistor whose value, in ohms, is equal to 20 divided by 1, or 20Ω. Our 2:1 transformer has, therefore, provided an effective resistance transformation of 2 squared or 4 times.

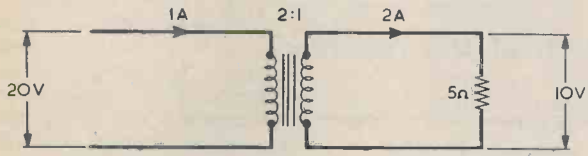


Fig. 3. As is explained in the text, this circuit causes the transformer primary to present an effective resistance of 20Ω

ANY LOAD

Repeat the exercise of Fig. 3 with any numbers and you will find that the effective resistance transformation is always equal to the turns ratio squared. Let's try it with a resistor connected across the secondary whose value is called Rs and say that the effective resistance at the primary is Rp. The transformer has a ratio of n:1, n being any number. As voltage and current come into the picture, we'll say that the secondary voltage and current are Vs and Is, and that the primary voltage and current are Vp and Ip. Fig. 4 shows these values.

Let us now list some facts. First, Rs is equal to Vs divided by Is. Second, Vp is equal to Vs multiplied by n and, third, Ip is equal to Is divided by n. and, fourth,

$$Rp = \frac{Vp}{Ip}$$

Since Vp is equal to Vs multiplied by n,

$$Rp = \frac{Vs.n}{Ip}$$

And, as Ip is equal to Is divided by n,

$$Rp = \frac{Vs.n.n}{Is}$$

$$= \frac{Vs.n^2}{Is}$$

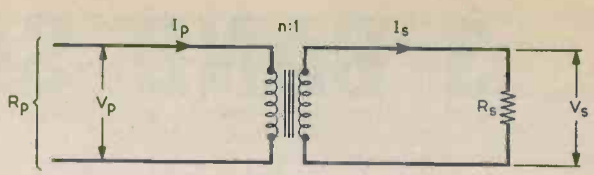


Fig. 4. A general case of transformer matching. Rp is the effective resistance presented by the transformer primary

In the last step but one, note how the second n nips smartly *above* the fraction bar (as it has to do because Is is below the bar).

Now, Vs divided by Is is Rs, so Rp is Rs multiplied by n squared.

We have been using resistances in this simple calculation but the same reasoning applies with impedances. However, it is only necessary to remember the basic calculation with resistances to understand how the turns ratio has to be squared when employing a transformer for impedance matching. ■

3 BAND SHORT WAVE SUPERHET Part 4

By R. A. Penfold

Alignment and operation of the receiver

In last month's issue we completed the construction of this short wave superhet receiver. We now carry on to a description of the manner in which it is aligned, together with notes on its operation.

"S" METER ADJUSTMENT

Before making any tuned circuit alignment it is necessary to adjust the "S" meter circuit for correct operation. The "S" meter may then be used, during alignment, as a signal strength indicator.

VR4 is adjusted as far as possible in an anti-clockwise direction before any significant deflection of the meter needle takes place. If, later, the "S" meter should seem to be a little over-sensitive, this effect can be corrected by shunting a resistor of a few kilohms across the meter, the required value being found by trial and error. On the other hand, should the "S" meter appear to lack sensitivity, then a reduction in the value of R15 should help. Again, the required value is found by trial and error.

VR4 may require re-adjustment from time to time due to variations in the supply voltage caused by the battery aging.

The alignment of the receiver will next be described. It will be helpful here to initially disable the Q multiplier by turning VR3 fully anti-clockwise and breaking the connection between C33 and Tr1 drain.

R. F. ALIGNMENT

Although in the various parts of the circuit there are some thirteen cores to be adjusted, the alignment procedure is not too complicated and can be carried out satisfactorily even if no test equipment is available.

As supplied, the Denco dual-purpose coils have their cores screwed right in for packing purposes. Initially these are adjusted so that about 10mm of metal thread is visible at the top of each coil. With the set switched on and connected to an aerial and a speaker or headphones, it should be possible to receive a number of stations on each tuning range, except perhaps on Range 5, where propagation conditions can often result in there being few strong signals. If a calibrated r.f. signal generator is available it can be used to assist in obtaining the correct adjustment of the oscillator coil cores. These are set up to provide the following frequency ranges, either exactly or as near as possible: Range 3, 1.6 to 4.6MHz; Range 4, 4.5 to 12 MHz; Range 5, 10 to 25 MHz.

If a suitable signal generator is not available, then the cores of the oscillator coils are simply left with 10mm protrusion of thread. The frequency coverage will then be approximately correct, and no significant gaps in the coverage will occur.

The aerial coil cores are given any setting which enables the aerial trimmer control to peak signals at all positions of the tuning control. One way of achieving the correct settings is to tune the set to a signal at about the centre of one tuning range. With VC1 set at about half maximum capacitance the core of the appropriate aerial coil is adjusted to peak the signal. The "S" meter makes a useful tuning indicator. This procedure is then repeated for the other two tuning ranges.

I. F. ALIGNMENT

The i.f. stages are aligned by first tuning to a reasonably strong station of consistent strength on Range 3 or Range 4 and then adjusting the cores of IFT2, IFT1, the i.f. transformer associated with the mechanical filter, and then the mechanical filter itself, in that order. All cores are adjusted for maximum "S" meter reading, and S2 is set up for "A.M." reception. Use a proper trimming tool, such as the Denco TT5, for IFT2 and IFT1, as a miniature screwdriver or a similar implement can damage the cores. The mechanical filter and its matching i.f. transformer have a different construction, and their cores can be adjusted with a screwdriver provided adequate care is taken.

B.F.O. ADJUSTMENT

First tune as accurately as possible to an a.m. station and then switch S2 to the upper sideband mode. This should cause a beat note between the carrier of the a.m. station and the b.f.o. signal. The core of L3 is adjusted to zero-beat the b.f.o. with the carrier signal. The set is then switched to the lower sideband mode, and this should again produce an audio beat note. Adjust the core of L3 to reduce the pitch of this note slightly.

There should then be an audio beat note with the set switched to either the upper or lower sideband mode. Ideally the core of L3 should be adjusted by trial and error so that almost precisely the same note is produced at each position of S2 but in practice good results will be obtained provided the two notes are not greatly different.

Due to the positioning of the b.f.o. coil it may be necessary to use a cut-down trimming tool to adjust its core. As with all the Denco transformers the trimming tool should be of a type which engages correctly with the core. An alternative approach is to remove the Q multiplier panel from the front panel when the b.f.o. is adjusted.

Q MULTIPLIER ADJUSTMENT

The Q multiplier may now be brought into circuit, with the link between C33 and TR1 drain being re-connected. Adjustments are still carried out with the same a.m. signal which was used for alignment of the i.f. and b.f.o. stages. S2 is set to the "A.M." position.

VR3 is now slowly advanced. As it approaches the point at which oscillation occurs the selectivity of the receiver will noticeably increase, but because IFT3 is not yet properly aligned with the i.f. amplifier the Q multiplier will have a similar effect to very slightly altering the tuning control.

The cores of IFT3 are adjusted to peak the received signal at the correct tuning control position, employing the "S" meter as a tuning indicator. VR3 should be kept just below the point at which oscillation occurs while these adjustments are made, and since the positions of the cores of IFT3 affect the feedback level, this control will need constant re-adjustment.

With both cores correctly adjusted and VR3 set to just below the threshold of oscillation it should be found that most of the modulation on the a.m. signal is outside the receiver's passband, and that only the very low notes are reproduced by the speaker or headphones.

Alignment of the Q multiplier may be very difficult if IFT3 is initially well out of alignment. Should this prove to be the case it will be necessary to remove IFT3 from its component panel and connect each winding, in turn, between TR1 drain and chassis via a 0.047μF d.c. blocking capacitor in series with the connection to TR1 drain. It is then possible to approximately align each winding by adjusting its core to peak the test signal. After both windings have been roughly aligned in this manner it should be a simple matter to set them up in the Q multiplier when the i.f. transformer has been reconnected into circuit.

As with the b.f.o. core, there is limited access to the lower core of IFT3. Again, a cut-down trimming tool may be used. Or, the product detector and b.f.o. panel may be temporarily removed from the front panel when the Q multiplier is being adjusted.

NOTES ON USE

The receiver is intended for use with an ordinary long wire antenna, and an earth connection is also very helpful on the lower frequency bands. Most of the controls are quite conventional. VC1 is the aerial trimmer control and this is adjusted to peak received signals. At high frequencies it will probably be found that there are two peaks with this control. The lower frequency one (VC1 vanes more fully meshed) is the correct one, and the other setting is for the image signal.

For s.s.b. reception on the low frequency amateur bands S2 is set to the l.s.b. mode as this is the s.s.b. mode usually employed (160, 80, and 40 metres). For s.s.b. reception on the high frequency amateur bands (20 and 15 metres) S2 is set to the u.s.b. mode. It is usually fairly obvious if this switch is in the wrong position since the signal disappears as the tuning control is adjusted towards the correct point.

For the reception of a.m. signals the i.f. bandwidth provided by the mechanical filter is just about the optimum, and the selectivity control, VR3, can be fully backed off. It is beneficial if it is advanced somewhat for s.s.b. reception, but do not advance it too far. This will result in the signal being increased in strength in comparison with any background signals, but the rather peaky i.f. response that results provides a very poor audio frequency response, and in consequence a loss of intelligibility. For c.w. reception the selectivity control is advanced to just below the threshold of oscillation.

Although the use of a product detector provides the set with quite a wide dynamic range on s.s.b. and c.w. reception, it is still possible for strong signals to cause an overload. Obviously the set does not have an infinite dynamic range on a.m. either, and very strong signals could conceivably overload the detector. If this should occur then VR1 should be backed off as necessary to provide satisfactory results. It can sometimes be beneficial to back off this control to some degree in order to reduce cross-modulation noise, particularly on the low frequency bands when a long aerial is used.

The Jackson dial has provision for three tuning scales, and so one of these can be marked for each range covered using legends from "Panel Signs" Set No. 4. The dial can either be calibrated with a proper frequency scale or a simple alternative is to merely mark the positions of the amateur and broadcast bands.

IMPROVED A.G.C.

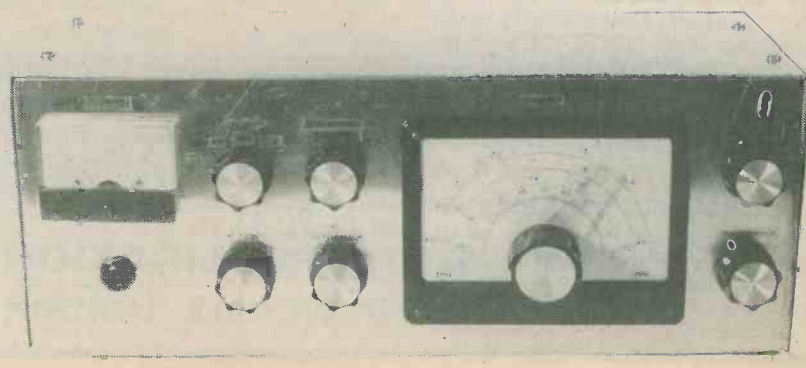
It was pointed out in the first article in this series that the a.g.c. system, although satisfactory with a.m. signals, is less than 100% efficient with s.s.b. and c.w. signals.

The reason for this is that the a.g.c. system has a fast attack time and also a fast decay time. Thus on a strong s.s.b. or c.w. signal the a.g.c. circuit provides the necessary reduction in gain in the presence of the signal, but s.s.b. and c.w. signals are both of an intermittent nature and the gain of the set returns to maximum during the inevitable breaks in these signals. This often results in quite a high background noise level on even the strongest signals.

The "S" meter circuit also has a fast attack and decay time since it is operated from the a.g.c. voltage. This results in the meter being rather difficult to read on s.s.b. and c.w. signals since the meter's needle is constantly moving, and usually moving very quickly.

Ideally both the a.g.c. and "S" meter circuits should have fast attack and slow decay times. With a decay time of about 2 seconds the a.g.c. voltage would be maintained during short breaks in the signal, and as a result there would be a lower background noise level on strong signals, and "S" meter readings would be very much

A general look at the front panel of the superhet demonstrates the large number of control functions which are available



steadier.

A simple way of modifying the a.g.c. circuit to provide a slow decay time in the u.s.b. and l.s.b. modes is shown in Fig. 13. S2(d) is the previously unused section of S2, and it shunts a 1,000μF electrolytic capacitor across R9 and R10 when "U.S.B." and "L.S.B." are selected. Because of the high value of the added capacitor, the charge that develops across it in the presence of a signal takes an appreciable time to leak away through R9 and R10 when the signal is absent. This provides the required slow decay time.

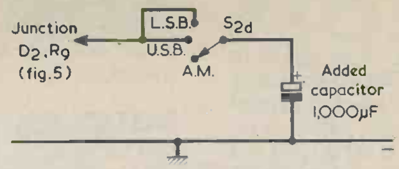


Fig. 13. A modification which reduces a.g.c. decay time when receiving s.s.b. and c.w. signals

Unfortunately, the high value of the capacitor also increases the attack time, but the increase here is considerably less than the increase in decay time. Although theoretically less than perfect, the arrangement works quite well in practice.

The working voltage of the additional capacitor is not important since the voltage across it is only a fraction of a volt. In fact, a reverse polarity can be developed across it with strong signals. This reverse voltage, which is only about 250mV at most, does not cause any practical problems. It is not, of course, feasible to use a non-electrolytic capacitor because of the high value of capacitance that is required.

The additional capacitor can conveniently be wired between the appropriate tag of S2 and the chassis solder tag on the product detector panel. A wire then connects the requisite contacts of S2 to the junction of D2 and R9.

MAINS UNIT

The short wave superhet has now been fully described and it may be employed as a working unit in its own right. The author has, also however, developed two optional extras which may be added to the receiver. The first of these is a mains supply unit complete with speaker; this provides a 9 volt supply and thereby reduces the running costs since the 9 volt battery is not then required. It also offers a convenient housing for a speaker coupling to the receiver output. This item will be described in next month's issue. The following issue will give details of another optional extra, this being a fully tuned preselector which may be inserted between the aerial and the aerial input of the receiver.

(Concluded)

In Fig. 4 of part 2 of this article, published in the October 1978 issue, the centre of switch S1 should be 18mm. from the left hand edge of the coilpack metal bracket, and not 18mm. from the right hand edge.

MINIMISING A.M. INTERFERENCE

By Ivor N. Nathan

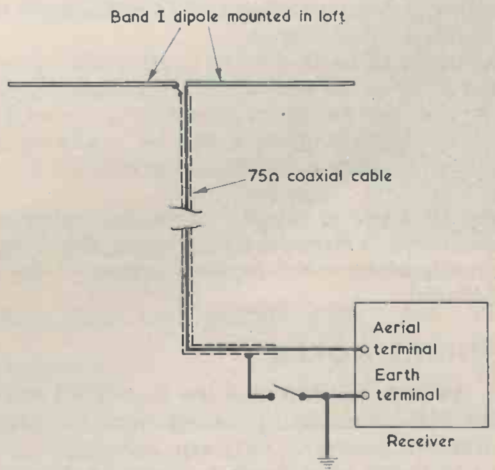
A neat aerial dodge for a.m. Dx listeners

Much is written and spoken about interference to television reception but little regard is given to radio reception. Mainly with television reception in mind, manufacturers of electrical equipment do all that is economically possible to ensure that their products are fitted with interference suppressors, and amateur radio operators go to great lengths to make certain that their transmitters do not spoil pleasure of people who may be watching television while they themselves are enjoying their hobby. It seems rather ironic, therefore, that during peak television viewing time some radio enthusiasts have their pleasure denied them because of interference the caused by radiation, from domestic television receivers, of various harmonics which fall within the medium and long wave bands of a.m. radio receivers. The Post Office is obliged only to ensure that reception of U.K. radio stations is free of interference, and it could well be argued that v.h.f. reception is available to the majority of listeners so there is no great need for a.m. to be used in any case.

HIGH QUALITY AUDIO

For high quality audio reception and negligible interference (assuming that an efficient antenna is included in the installation) v.h.f. is the unchallenged answer. It also provides the option of stereo radio reception for those who prefer it. However, there are quite a few people who still require the alternative of a.m. reception because they do not want to be restricted to the local station reception which v.h.f. provides. Some are music enthusiasts who are not content to listen to the programmes being transmitted at any given moment and prefer to listen to Continental stations such as Hilversum, Brussels, and various German and French stations. Others are foreign language students or people of foreign origin who prefer to listen at times to non-English programmes for reasons of language or cultural background. A third group consists of those who are interested in Dx (long distance) radio reception on long, medium and short waves primarily from a technical point of view.

For the more serious a.m. listener, whose receiver incorporates aerial and earth terminals, a useful and efficient method of keeping interference to a minimum is to take use of screened coaxial cable as a down lead from a long wire antenna, with the screening connected to the receiver chassis and earth. The author was unable to easily install an outside long wire antenna so use was made of a disused 405 line (Band 1) television aerial fitted in the loft space. The antenna, consisting of a centre-fed 75 Ω dipole, approximately 10 ft. 6 in. from end to end and without a reflector or directors, was firstly remounted in the horizontal plane. Its coaxial cable feeder was re-routed to the radio receiver and a switch was connected in series with the screening at the receiver end of the feeder so that the screening could be either connected to the radio chassis and earth or not. The switch was mounted on the receiver cabinet. The accompanying diagram shows the details.



Dual-operation a.m. antenna. When the switch is open the coaxial cable screening couples capacitively to the inner conductor, giving effectively a long wire antenna. Closing the switch gives a screened down lead and freedom from interference by adjacent television receivers.

If the receiver is an old mains model with a live chassis connected to one side of the mains a direct connection to its chassis must on no account be made. Should such a receiver be fitted with an earth terminal, that terminal will be connected to the receiver chassis via an internal isolating capacitor but, even so, the earth terminal must also connect to a reliable earth such as the mains earth. These precautions are essential to reduce the risk of accidental shock.

During non-peak television viewing time (mostly during the day) the switch can be in the open position so that the cable screening is not connected to earth; in this mode the inner conductor adds to the length of the antenna and the entire system functions as an efficient all-wave a.m. antenna. When adjacent television receivers come into use in the evening, as will be evidenced by interfering harmonics on medium and long waves, the switch can be closed so that the down lead becomes screened and only the dipole section of the antenna is being effectively used. The result is reduced but interference-free reception on long waves, less reduced and still interference-free reception on medium waves, and nearly normal reception on short waves.

With the switch in the open position and using the system as a long wire antenna, the author, living in the Southgate area of North London, obtained daytime reception of Radio Orwell, which is the Ipswich radio station on 257 metres. The antenna system also provides very strong interference-free signals from BBC Radio Medway on 290 metres and BBC Radio Solent on 301 metres. ■

IBA DEVELOPMENTS

SURROUND SOUND

An advanced system of 'surround sound' broadcasting — believed by IBA engineers to be superior to any system previously broadcast in Europe — is to be field tested on Independent Local Radio shortly. This system, based on the "Ambisonic' technology of the National Research Development Corporation, uses information transmitted in a third channel to improve the limited surround sound quality obtainable with two channel systems.

First over-air tests are expected to be broadcast in the London area on Capital Radio (93.8 MHz VHF/FM). The programme material will be specially recorded by IBA engineers working in collaboration with Capital Radio and using a new surround mobile recording unit of IBA design.

These tests are the first in a series due to be transmitted during late 1978 and early 1979 from a number of ILR stations in various parts of the country.

Dates and times of the first broadcasts will be announced on Capital Radio. The radio trade will be kept informed of all broadcasts on "IBA Engineering Announcements" (Tuesdays at 9.10 a.m. on all ITV stations).

Listeners will be invited to participate by reporting the degree of stereo and monophonic compatibility on the receivers currently in general use. A reply-paid questionnaire will be available from the IBA Engineering Information Service (01-584 7011).

These tests are in support of studies being made by the European Broadcasting Union. The IBA are also investigating other current proposals for surround sound.

TECHNICAL NOTES

The system uses information in a third channel together with an encoding matrix chosen to achieve optimum compromise between surround sound, stereo and mono reproduction. Because the system encodes all the significant information required for correct surround sound decoding in a fully recoverable way, the inherent advantages of linear decoding can be realised. For this reason, IBA engineers are convinced that three-channel radio receivers incorporating such linear decoders, as well as providing superior results, could be manufactured for the consumer market more cheaply than two-channel receivers using the complex variable matrix decoders commonly required for many of the alternative surround sound systems that have been proposed. The third channel is bandwidth restricted and quadrature modulated on to the 38 KHz sub-carrier already present for stereo transmission. Because of the restriction of the third channel bandwidth this form of transmission is often called "2½-channel" transmission.

The domestic decoder needed for 2½-channel surround sound reception (together with the necessary audio amplifiers and loudspeakers) would also be capable of correctly decoding suitable encoded disc and tape recordings. The IBA is planning further studies in these fields because of their importance in the daily programming of the ILR stations.

For listeners interested in surround sound reception, a technical leaflet is being prepared which will give full information on the form of decoder required. Full technical information and the leaflet will be made available to the public and technical press shortly.

"IBA ENGINEERING PROGRESS"

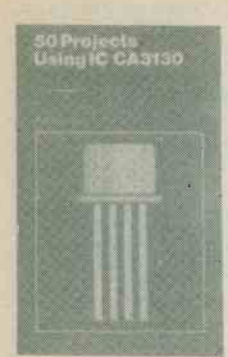
Recent developments in the engineering of the transmitter networks for Independent Television and Independent Local Radio are described and illustrated in a new 20-page brochure "IBA Engineering Progress".

This shows how technical developments are helping to improve coverage with many local relay stations now filling in the gaps left by the network of 51 main high-power stations.

A major development has been the bringing into operational use of the first of four Regional Operations Centres from which the entire network will be supervised. The first ROC at Croydon now serves almost 20 million viewers in an area extending from The Wash to Dorset.

In an introduction, Mr. Tom Robson, IBA's Director of Engineering, points out that during the decade 1968-78 the number of IBA transmitting installations has increased from 40 to over 400.

The booklet is available on request to engineers, technicians and students from the Independent Broadcasting Authority, 70 Brompton Road, London SW3 1EY.

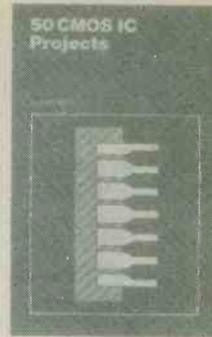


DIRECT READER SERVICE

RADIO & ELECTRONICS BOOKS

1. **50 PROJECTS USING RELAYS, SCR's & TRIACS** by F. G. Rayer — £1.25
2. **FUN & GAMES WITH YOUR ELECTRONIC CALCULATOR** by J. Vine — 90p
3. **50 (FET) FIELD EFFECT TRANSISTOR PROJECTS** by F. G. Rayer — £1.40
4. **DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS** by Adrian Michaels — £2.70
5. **50 SIMPLE L.E.D. CIRCUITS** by R. N. Soar — 90p
7. **THE COMPLETE CAR RADIO MANUAL** by F. C. Palmer — 90p
8. **SOLID STATE NOVELTY PROJECTS** by M. H. Babani — £1.00
9. **28 TESTED TRANSISTOR PROJECTS** by R. Torrens — £1.10
10. **SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS** by R. A. Penfold — £1.10
11. **50 PROJECTS USING IC CA3130** by R. A. Penfold — £1.10
12. **50 CMOS IC PROJECTS** by R. A. Penfold — £1.10
13. **HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS** by R. A. Penfold — £1.35
14. **BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS** by R. A. Penfold — £1.40
15. **50 CIRCUITS USING GERMANIUM SILICON & ZENER DIODES** by R. N. Soar — 90p
16. **LINEAR I.C. EQUIVALENTS AND PIN CONNECTIONS** by Adrian Michaels — £3.00

all prices include postage & packing



To: Data Publications Ltd., 57 Maida Vale, London W9 1SN

Please send me within 21 days .... copy/copies of

....

....No. ....

I enclose Postal Order/Cheque for £..........

Name ....

Address ....

(Block Letters Please)

(We regret this offer is only available to readers in the U.K.)

In your work-shop

COMPUTER SUBTRACTION

Ones Complement Calculations

"Computers, computers," sighed Dick, "everything seems to be computers these days!"

"That's the result," said Smithy cheerfully, "of what is known as the exponential growth of technology."

"The trouble is," wailed Dick, "that everything electronic is getting so complicated."

"True, true," agreed Smithy consolingly. "An electronics engineer is nowadays the same as the Red Queen. He has to keep running all the time just to stay in the same place."

Dick looked at the Workshop clock morosely. He and Smithy had cleared up the last job for the day some five minutes earlier but there was still half an hour to go before their working day officially came to and end. After some desultory conversation with Smithy, Dick had now embarked on a subject which was plainly troubling him.

COMPUTER SUBTRACTION

"I picked up a book about computers the other day," he went on aggrievedly, "and I just had to put it down again."

"Why was that?"

"It happened when I got to the chapter which dealt with computer calculations. I'll admit that the addition part in the chapter was easy enough to understand. A computer adds up in binary notation in just the same way that we add up in decimal notation. And, of course, there are only two figures in binary, these being 0 and 1."

"Fair enough," stated Smithy. "Each 0 or 1 is a binary digit, or a bit for short. You can't have a number in binary higher than 1, so that if you add binary 1 and 1 together the answer comes to binary 10."

"That's right," said Dick. "Even I can follow that. But then the chapter went on to computer subtraction. And, blow me, the computer doesn't subtract one binary number from another like a human being does, it flaming well *adds* them!"

Smithy chuckled.

"What the computer does basically," he said, "is to carry out a subtraction by means of the 'ones complement' system. This allows the same circuit which does addition to do subtraction as well."

"It all sounda crazy to me," complained Dick. "Is this complement thing something special that you can only do with binary numbers?"

"Oh no," replied Smithy. "You can do it with decimal numbers, too. But with decimal numbers you use a nines complement instead of a ones complement."

Dick frowned.

"Perhaps," he said slowly, "if I understood how the system worked with decimals I could understand it more easily with binary."

This time it was Smithy who looked up at the clock. He paused thoughtfully for a moment, and then came to a decision.

"Very well then," he said briskly. "There's still quite a bit of time to go before we pack up for the day, so if you come over here I'll do my best to gen you up on this number complement business."

Dick, delighted at this turn of events, moved with commendable alacrity and it was a matter of moments only before he was perched on his stool alongside the Serviceman. He waited expectantly.

"We'll start with some decimal subtractions first," said Smithy, pulling out a ball-point pen, "so I'll need my note-pad."

He drew the pad towards him.

"Now, the word 'complement'," he continued, "means something which makes up a whole. From this it follows that the nines complement of any single number in decimal notation is the number which has to be added to it to make 9. So, the nines complement of 6 is 3, and the nines complement of 2 is 7. Got it?"

"I think so," said Dick slowly. "Let's try a few other figures. Would the nines complement of 8 be 1?"

"It would."

"Blimey, this is easier than I thought! Let's go through the remaining numbers. The nines complement of 7 will be 2 and the nines complement of 5 will be 4. Figure 4 will have a nines complement of 5, figure 3 one of 6 and figure 1 a complement of 8."

"You've got the idea," commended Smithy, "but you've left out two numbers."

"Have I? Which ones are those?"

"9 and 0," replied Smithy. "The nines complement of 9 is 0, and the nines complement of 0 is 9."

"Oh yes, of course. Where do we go from here, Smithy?"

COMPLEMENT CALCULATION

"We get down to doing an actual nines complement subtraction," said Smithy. "And we'll choose a very simple one to begin with. We'll subtract decimal 3 from decimal 7. In the normal way of doing things, we would carry out the subtraction by putting the 3 under the 7 and then writing down the answer underneath. Which is, of course, 4."

Smithy jotted down the calculation. (Fig. 1(a).)

(a)	(b)	(c)
7	7	7
−3	+6	+6
—	—	—
4	13	13
		+1
		—
		4

Fig. 1(a). A simple decimal subtraction carried out in conventional manner. 3 is subtracted from 7
(b). Here, the nines complement of 3 is added to the 7
(c). The 1 in the most significant position is next carried to the least significant position and added to the 3 to give 4

"How do we do it the nines complement way?"

"We write down the figure 7, and then *add* to it the nines complement of 3, which is 6. This gives us the figure 13." (Fig. 1(b).)

"But," protested Dick, "that's nowhere near 4."

"There's another step to take yet," said Smithy. "We next take the 1 off the left hand end of the 13, put it under the 3 and add these together. This gives us the correct answer, 4, and as you can see it's all done by addition." (Fig. 1(c).)

Dick looked down unhappily at Smithy's note-pad.

"I just can't fathom this," he stated, scratching his head. "I'll agree that what you've just done gives the right answer, though."

"Try one yourself."

"All right. I'll try subtracting — let me see now — 4 from 9. I'll put the 9 at the top and I'll put the nines complement of 4, which is 5, below it. Next I'll add them together. This gives me 14. What comes next?" (Fig. 2(a).)

"You do the same as I did," said Smithy. "A figure 1 has once again popped up at the left hand side of the sum number. You take this away from the left and add it to the right. The process, incidentally, is called 'end-around carry'. What you're doing is making a carry from the most significant position of the sum number, which is any digit apart from 0 at the extreme left hand end, to the least significant position. which is at the extreme right."

"I'll take your word for it," grinned Dick. "Okay then, I'll carry the 1 over and add it. Which gives me 5." (Fig. 2(b).)

"Satisfied?"

"I'm satisfied that the system works," said Dick. "But I'm blowed if I know *why* it works!"

"Think about it. With the calculations we've carried out up to now, adding the nines complement of the number we're supposed to be subtracting means that the answer is always too high by 9. If, for instance, we want to subtract 1 from 9, we first add to 9 the nines complement of 1, which is 8. The answer at this stage *must* be too large by 9, because we're adding 8 instead of subtracting 1. The same applies with any other single digit decimal calculations, where a smaller number is subtracted from a larger number."

"If," said Dick thoughtfully, "you subtracted 0 from any number, you'd actually add 9, which is the nines complement of 0, to that number. So far, what you say seems to make sense."

"Good," responded Smithy. "So, after arriving at an answer which is too great by 9, we next take 10 from it by removing the left hand 1, and add 1 to it at the right hand end. The final result is the correct solution."

An idea suddenly occurred to Dick.

"What happens," he asked quickly, "if we subtract the same number from itself. Say, for instance, we subtract 7 from 7."

"The system," conceded Smithy, "begins to creak a bit then. We'd

(a)	(b)
9	9
+5	+5
—	—
14	14
	+1
	—
	5

Fig. 2(a). First step in subtracting 4 from 9. The nines complement, 5, is added to 9
(b). An end-around carry then takes the 1 under the 4, the resultant addition giving 5

add the nines complement of 7 to 7, giving us 9, but there'd be no extra 1 coming up at the left. But if we then add 1 to the 9 we'd get 10, whereupon the correct answer of 0 is given when we lop off the 1 at the left."

"Humph," grunted Dick. "It looks as though I've uncovered a weakness here."

"Not entirely," replied Smithy. "Assume that you've got a register in a computer which can only store a single number in decimal. I admit it would be a pretty funny thing to have such a register in a practical computer, but just assume it for a moment. If we did any of our nines complement calculations we would carry out our complement addition and then add 1. The 1 which appears at the left would simply slip out of the single digit register, and it just wouldn't see the light of day. This would happen even when you use the system to subtract the same number from itself."

LARGER NUMBERS

"All right," said Dick. "Can we use this nines complement business with larger numbers?"

"Oh yes," stated Smithy, taking up his pen again. "We could for instance subtract 5,723 from 8,457. Now the nines complement of 5,723 is 4,276, and you arrive at this by writing down the nines complement of each digit in turn. We next add the numbers as before whereupon, once again, a 1 sprouts up at the left hand end. We do an end-around carry by taking this 1 to the least significant position and add 1, giving us an answer of 2,734." (Fig. 3(a).)

"You said just now," commented Dick, "that the answer given by the first addition of single decimal numbers gives the answer which is too great by 9. What will it be in this case?"

"Too great by 9,999," replied Smithy promptly. "Here, give me two more figures."

(a)	(b)
8457 – 5723	10000 – 99
8457	10000
+4276	+99900
12733	109900
+1	+1
2734	9901

Fig. 3(a). Subtractions of larger decimal numbers may also be carried out with the nines complement system (b). Another nines complement calculation

"All right," responded Dick. "Subtract 99 from 10,000."

"Fair enough," said Smithy. "In this case we have to carry out an important initial step. This consists of filling out the 99 so that it has the same number of digits as the 10,000. It is done by simply putting noughts to the left of the 99, giving us 00,099. The nines complement of this is 99,900 and that's what I'll add to the 10,000. The result works out as 109,900. We do the end-around carry, and the final answer comes out as 9,901." (Fig. 3(b).)

"Gosh," said Dick, impressed. "It's easier doing the subtraction this way than by the ordinary method!"

Smithy chuckled.

"I'm glad you've noticed that with some numbers it can be easier. Well now, that's enough messing around with decimal numbers, so let's get down to binary numbers."

Dick groaned.

"Dear, oh dear," he complained. "No sooner do I get myself clued up on one thing than you start pressing on to the next!"

"Don't get too upset about it," said Smithy comfortingly. "Once you've grasped the complement principle with decimal numbers, you'll find that it's a piece of cake with binary numbers. Now, the highest single digit in decimal notation is nine, and so we subtract by working with the nines complement. The highest single digit in binary is one, and so with binary we work to the ones complement."

"This, commented Dick, "needs a little bit of thought. For starters, there are only two numbers in binary, these being 0 and 1."

"So?"

"So," continued Dick slowly, "I suppose that the ones complement of 0 must be 1, and the ones complement of 1 must be 0. Is that right?"

"It is," confirmed Smithy. "And this is where the advantages of ones complement working shows up. You can change any binary number to it ones complement simply by changing all the 0's to 1's and all the 1's to 0's. Beautiful, isn't it?"

"Gosh," breathed Dick, as the simplicity of the scheme gradually dawned on him, "I'll say it is. Let's try a binary subtraction, Smithy."

BINARY SUBTRACTION

"Okeydoke," said Smithy equably. "I'll subtract binary 4 from binary 8. The figure 8 in binary is 1000 and the figure 4 is 100. I have to write this down as 0100, by adding a nought at the left, to give it the same number of digits as the 1000. Its ones complement then becomes 1011. Here we go!"

Smithy quickly carried out the calculation. (Fig. 4.)

"As you will observe," he said, "an extra 1 popped up again at the left hand end, just as with the

Fig. 4. For binary subtractions, the ones complement is used

```
1000(8) –
 100(4)
 1000
+1011
-----
10011
   +1
-----
 0100(4)
```

decimal figures, and we end-around carry this to the least significant position. The answer, of course, is 0100, or 4."

"Try some other numbers."

"All right," said Smithy. "I'll subtract 9 from 25, using binary notation and following the same rules as before."

He busied himself with the calculation.

"Ah," he remarked with satisfaction, "this comes out quite tidily. The solution is the binary equivalent of 16." (Fig. 5.)

"One must say," said Dick enthusiastically, "that this ones complement business has turned out to be a lot easier than one would have thought."

"And our little gen-sesh," remarked Smithy cheerfully, glancing up again at the clock, "has also had the advantage of taking us painlessly up to knocking-off time."

"Right," said Dick, taking off his overall jacket. "One must now make one's preparations for one's journey home."

Smithy's eyebrows rose.

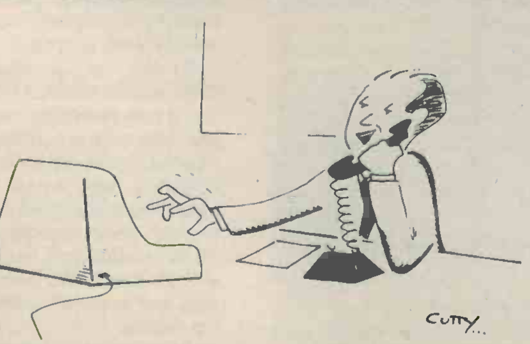
"Here," he said, "you're talking very posh all of a sudden, aren't you?"

"One does it," grinned Dick, "in order that one can present one's compliments to you, one's old mate!"

And so, our ears resounding to the latest of Dick's appalling gags, we take our leave of the pair as they walk serenely out into the wintry evening air.

Fig. 5. Another binary subtraction. The ones complement of a binary number is given by simply changing the 0's to 1's and the 1's to 0's

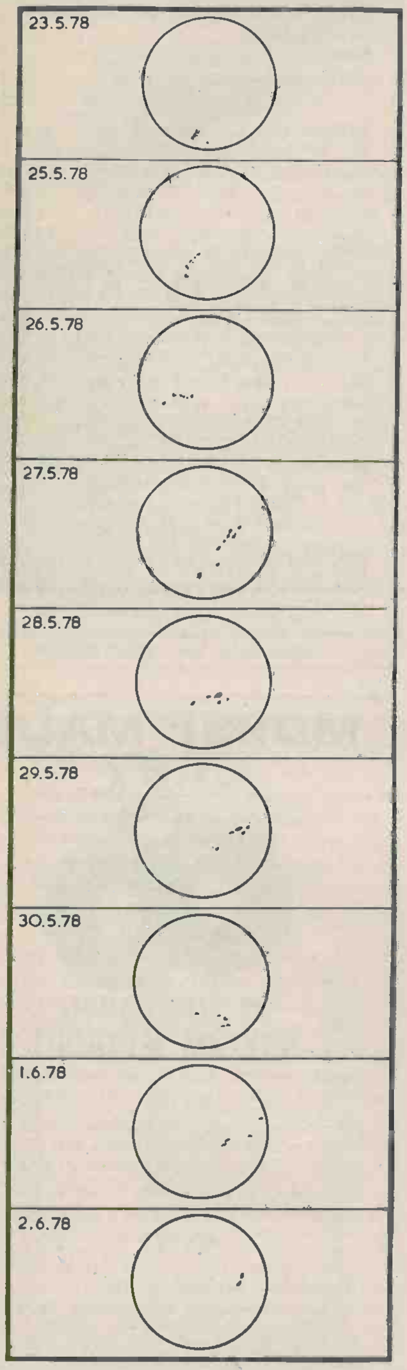
```
11001(25) –
 1001(9)
 11001
+10110
------
101111
    +1
------
 10000
  (16)
```



"Let me see now, if my memory serves me correctly. . ."

SUNSPOTS

By Arthur C. Gee



Sunspot observations drawn by the author between 23rd May and the 2nd June showing the passage of a group of sunspots across the face of the sun. The 10 metre band was "wide-open" around the 27th May, when the group was facing the earth

MUCH interest is being shown in sunspots in general and the sunspot cycle in particular by the amateur radio fraternity, because we are in a transition period between one sunspot cycle and the next. As the intensity of sunspot activity determines radio conditions, there is much speculation, albeit scientific speculation, as, as to what the next sunspot cycle is going to be like and how intense its activity may be.

Sunspot cycles average more or less eleven years in duration, but considerable variation can, and does, take place. Periods as short as nine years or as long as thirteen years have been recorded. And their intensity varies greatly too. In the late 1950's, the cycle in progress then peaked to over two hundred on the Zurich Sunspot Number Scale. Around 1907, one of the lowest peak activities was recorded of only sixty. Great variation in activity takes place within the general trend. The last minimum of the sun's cycle was in mid-1976 and the increase in sunspot and other solar activity since then has been rather more rapid than expected. The frequency of these solar events has been greater than at any time since the end of 1970. There appears to be a correlation between the rate of increase in solar activity and the final level of the ensuing sunspot maximum. If this is so, the forthcoming cycle — number 21 — should be an intense one.

A very interesting report entitled "Sunspot Cycle 21 — The Peak, How Much and When", was recently circulated as a "Special Report" for "H.R. Report", Greenville, New Hampshire, U.S.A., by O. Okleshen, W9RX, Propagation Editor, H.R. Report. He writes:-

"Of the many methods and authors of the 'how much and when' of a solar cycle maximum, the most recent and likely the most accurate method has been devised by A. I. Ohl, a Soviet scientist whose first publication was reported in 'Solnechnaya Dannyye'. H. H. Sargent, of the Space Environment Services Centre, Boulder, Colorado, modified the Ohl theory, thus enhancing the accuracy of the basic method developed by Ohl. The theory is based on the Regression of recurrent Geomagnetic activity recorded from the previous cycle to predict the sunspot maximum of the following cycle.

Mr. Sargent modified the Ohl theory by taking into account finer time resolution and more accurate data than was available to Ohl. The Ohl theory, as modified, provided accuracies of maximum sunspot cycle peaks when tested against observed data, within an accuracy of 1% in some cases. Whilst not so in every case, accuracies within 5% of maximum sunspot level predictions appear to be common. Compared to previously known methods, the Ohl/Sargent method would be, by far, a major breakthrough in the prediction of sunspot cycle maximum levels, when accuracy and other advantages are considered. The data used to establish and test the original Ohl theory was extracted from the last 110 years. The data before 1848 is dubious because of the information and techniques available. For that reason, some of the other theories used at that time to predict sunspot maximum levels may be erroneous.

Many other methods have been used to achieve individual and combined success to determine maximum sunspot peak levels. The IGY peak of 1957 led to anticipation of a peak level, certainly of a magnitude that would stimulate IGY research. One often used method is a 'slope' technique that observes the rate upward change at the beginning of a new cycle. This observed rate of change is then projected to a peak value. The Ohl method has two most important advantages over all other theories and methods of establishing the sunspot peak level. First, it appears to be superbly accurate, and second and probably most important, the Ohl method gives a year's earlier lead time. It is only necessary to use data from the prior decaying cycle.

The exact mechanism between the prior cycle recurrent geomagnetic behaviour and the succeeding cycle sunspot maximum is not clear. However, it is likely that one is directly related to the other in solar physics whereby it is even possible that a new definition of a solar cycle may have to be established. Conjecture may place some possible validity in the theory that coronal holes that relate to recurrent geomagnetic disturbances, may be the birthplaces for the succeeding cycle sunspot regions. This aspect of course, would have to be studied and proved.

There is no doubt that the Ohl/Sargent method has great potential, as those needing accurate sunspot predictions are and have always been confronted with widely ranging opinions. We know that cycle 21 predicted maximums of 50 to 60 have already been exceeded; the February 1978 smoothed sunspot level has already reached at least 90. with the cycle peak approximately two years into the future!

As for specific figures of what may be in store for amateur radio, the following highlights and numbers have been extracted from the work of Mr. Sargent:

What will Sunspot Cycle No. 21 be like?

Monthly Smoothed Predicted sunspot numbers using the modified Ohl method for Cycle 21

Predicted Smooth Sunspot Maximum for Cycle 21 .... 153.6

Approximate arrival date of Maximum....................... early 1980

Jan 78	58.6	Jan 79	110.8	Jan 80	151.5	Jan 81	139.0
Feb 78	64.4	Feb 79	114.6	Feb 80	153.4	Feb 81	135.8
Mar 78	69.6	Mar 79	116.8	Mar 80	151.4	Mar 81	133.7
Apr 78	75.0	Apr 79	120.3	Apr 80	152.0	Apr 81	134.8
May 78	80.6	May 79	124.5	May 80	153.6	May 81	127.8
Jun 78	85.1	Jun 79	127.8	Jun 80	152.2	Jun 81	126.2
Jul 78	89.5	Jul 79	131.1	Jul 80	150.9	Jul 81	126.2
Aug 78	93.6	Aug 79	136.1	Aug 80	149.8	Aug 81	125.6
Sep 78	97.6	Sep 79	138.2	Sep 80	146.2	Sep 81	123.4
Oct 78	99.7	Oct 79	140.8	Oct 80	145.4	Oct 81	122.3
Nov 78	103.3	Nov 79	145.0	Nov 80	143.7	Nov 81	121.2
Dec 78	107.1	Dec 79	148.1	Dec 80	141.2	Dec 81	120.6

It is clear that if the predictions hold true, Cycle 21 will be a whopper and will likely parallel Cycle 18 and have an impact almost as severe as Cycle 19. During periods of high solar activity, many services will be detrimentally affected. Satellite damage from solar radiation is one example. Communications and power supplies will be interrupted. VLF Omega navigation alert used on overseas aircraft would likely be affected rendering the service at times, next to useless. Worse may be the impossibility of warning users that the system is failing. Space travel and related health hazards will become a significant factor to take into account. Magnetometer survey work for natural resources will be affected to such an extent that at times, the investigations would have to be curtailed with a severe cost impact on such resources even before production. CB radio on HF will likely be sheer havoc with skip interference. And now there is new evidence to support the fact that the weather is directly affected by solar sunspot behaviour and geomagnetic occurrences previously thought to be unrelated."

Solar radiation effects radio propagation primarily in two ways, viz, by untraviolet radiation and by streams of charged particles discharged in the direction of the earth, which effect the ionosphere. Ultraviolet light travels at 300,000,000 metres per second, so effects from this source happen eight minutes or so after observed effects on the sun. Particle radiation takes longer to reach the earth; it may take up to 36 hours or longer. The effects produced include the production of aurora, and high absorption of radio waves.

The author's equipment

The sun takes approximately 27 days to complete a full rotation, so if sunspots are sufficiently intense to persist for a longer period than this, they will reappear as they come round on to the earth-facing 'face' of the sun again. They may persist for periods of four to five solar rotations. In these circumstances, periodic propagation changes will be noted every 27 days.

One of the easiest ways of assessing what's happening on the sun, and thus forecasting to some degree, possible ionospheric conditions, is to observe the sunspots on the sun. This can be done with quite a small telescope. Here we must repeat the oft'-repeated warning ***that one NEVER looks through a telescope directly at the sun. This would simply burn one's eyes out!*** What is done, is to project the sun's image on to a white screen, suitably placed at a distance from the eye-piece. With suitable equipment, a circular image of the sun, about 3 inches diameter, can be projected on to the projection screen, when sunspots can be clearly seen, if present. The equipment used by the author is shown in the accompanying photo. By tracing the size and position of the observed sunspots on a sheet of paper placed on the projection screen, records can be kept of the movement and change in size of the spots. A set of such charts drawn by the author is shown at the beginning of this article. ■

Radio Topics

By Recorder

★★★★★★★★★

I wonder what arguments will be indulged in by the high fidelity enthusiasts at the turn of the century.

The outsider, on surveying the present hi-fi scene, could well be excused for wondering what on earth the hi-fi squabbles are all about. High fidelity amplifiers have become virtually distortionless so far as laboratory tests are concerned, and yet some equipment reviewers will slam one amplifier and praise another to the skies. Objective measurements are put to one side, and amplifiers seem to be judged by subjective listening tests.

MUSICALITY

To my mind, the current furore is to some extent inevitable, because *true* electrical reproduction of musical performances is impossible! An orchestra speaks with many voices, each consisting of, say, the vibration of a reed or the resonance of a string coupled to a sound-box, and these are all spaced out over a relatively wide area. To reproduce them electrically by means of a mechanically driven loudspeaker cone or cones can result in an excellent *copy* of the original, but it can never be *exactly* the same as the original. If you want to hear the actual sound in the concert hall then you have to go to the concert hall itself.

The dividing line between the experiences of hearing music live and music reproduced is tenuous, and many sensible people are perfectly happy to virtually ignore its existence and enjoy the rightful pleasure of listening contentedly and in comfort to a good high fidelity system. In some instances the dividing line can very nearly disappear altogether. Imagine, for instance, the reproduction of a pop group whose instruments are all electronic and whose sounds are themselves generated by loudspeakers.

But the dividing line cannot, with existing audio techniques, be completely eradicated. Between the live sound and the reproduced sound is the high fidelity system (including where applicable the recording or broadcasting process) and the high fidelity system therefore becomes a musical instrument in itself, with the result that subjective assessments of its performance become inevitable. Indeed, references are made to the "musicality" of a system. Since no two persons' subjective evaluations can entirely coincide there must always be some disagreement over the performance of different makes and designs of hi-fi equipment, and such disagreement will continue so long as the existing methods of audio reproduction remain in being.

My opening rhetorical question concerned the possibilities of hi-fi arguments continuing at the turn of the century. There are more than twenty years to go yet, but twenty years is a long time so far as high fidelity development is concerned. New audio techniques and quite startling advances are more than possible, but I would be very surprised indeed if these did not give rise to just as many arguments about performance as are currently the fashion.

WONDERBOARD

I have just received a sample of "Wonderboard", a new circuit board originating from Orcus International of U.S.A. The board, which is about 0.15in. thick, is perforated with 6 rows of 31 holes having a spacing of 0.1in. along the row. Spacing between rows across the board is 0.3in., 0.1in., 0.3in. and 0.3in. The board can therefore take all d.i.l. integrated circuits from 4 to 60 pins.

What makes "Wonderboard" special is that each hole is filled with a conductive elastomer which, after polymerisation, has a rubber-like consistency but is electrically conductive. Wires, component leads and i.c. pins are simply inserted in the holes, whereupon electrical contact at each hole is provided by the elastomer. No soldering is required and there are no contact springs. The elastic conductive material forms a seal around the wire or pin passing through it, and the contact resistance between two conductors at any hole is typically of the order of 10 milliohms. The wires or pins are also held securely by the elastomer; about 3 kilograms of extraction force is required to remove a 14 pin d.i.l. package.

It is intended that components and i.c.'s be mounted on one side of the board and interconnecting wires on the other side. A typical circuit array can be seen in the photograph. Each of the holes is good for about 150 insertions and extractions, and the holes are identified on both sides of the board by letters for the rows, and numbers for the holes in the rows. For best results it is recommended that wires with a diameter of 0.25 to 0.5mm. (33 s.w.g. to 25 s.w.g.) be used, the 0.5mm. wire being easiest to insert. Wire ends and component leads should be cut at an angle so as to produce a point, thereby easing their insertion in a hole. I.C. pins do not need to be cut, but they should be vertical with respect to the contact holes.

The U.K. representative for Orcus is Charcroft Electronics, Charcroft House, Sturmer (Haverhill), Suffolk.

PURE METAL TAPE

Development in recording tape continues unabated and a further step from chromium dioxide tape is now upon us. Pure metal, or iron metallic particle, tape offers even better tape performance, and permits further slowing of cassette tape speeds for longer playing time.

Tandbergs Radiofabrikk A/S, the Norwegian-based electronics group, state that they are already prepared to produce equipment capable of accommodating the new tape technology. In revealing their closely guarded monitoring of this substantially new tape technology over the past two years, Tandberg announce their own new systems breakthrough, referred to as "Actilinear".

It is claimed that the introduction of the new Tandberg Actilinear Recording System (for which world patents are pending) makes Tandberg the first electronics manufacturer able to exploit fully the capabilities of iron metallic particle tapes. Tandberg's new Actilinear system replaces their well established Cross-Field Recording System, and the first two products to be equipped with Actilinear, a 10½in. reel-to-reel deck type TD 20A, and the TCD 340A stereo cassette deck, were both demonstrated earlier this year. A wider new product range incorporating Actilinear and its full iron metallic particle tape capability will be marketed when the tapes are available to the general public.

Tandberg Actilinear is a completely new recording system and employs a transconductance converter. This reduces amplifier slew rate effect and thus improves transient signal handling. Additionally, it reduces intermodulation interference from the bias oscillator and results in a dramatic 20dB improvement in signal handling capacity compared with conventional recording systems. Signal-to-noise ratio is improved because Actilinear gives stronger recording at the same or less distortion level than do previous systems.

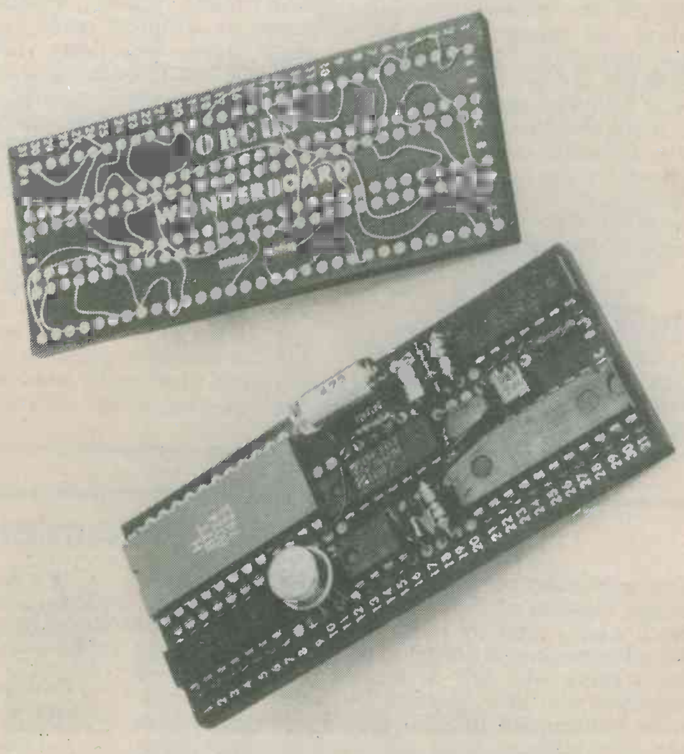
The new metallic tapes give a possible 5 to 10dB improvement in maximum output level, a highly significant development which will also enable tape speeds to be reduced without loss of sound quality. This prospect is only feasible if the tape recording and replay system has been designed specifically to take these tapes. The Tandberg Actilinear recording system is stated to be the first to do so, and its introduction has wide implications for all recording, whether the application be educational, scientific, professional or entertainment. One of the limiting factors (especially with cassette recorders) has been the inability to achieve good sound quality and sustain this while slowing down tape speed, to allow for long duration recordings. The combination of Tandberg Actilinear and the development of pure metal tapes will enable recording speeds to be reduced without loss of audio quality.

INTERFERENCE RECEIVER

I see that Eddystone Radio are now in the process of meeting a major contract to manufacture and supply the Post Office with receivers for use by its Radio Interference Service. The contract, won incidentally in the face of fierce competition, calls for the production of over 200 receivers Type 40A.

The Type 40A is a portable single conversion superhet receiver covering the frequency range of 130kHz to 32MHz. It can be operated from either mains or battery supplies. Special design features which have been incorporated enable the receiver to measure impulsive and quasi-impulsive noise in accordance with the provision of British Standard 727. It is therefore suitable for measurements in connection with E.E.C. directives relating to radio interference.

With the introduction of new regulatory powers governing the acceptable level of radio frequency



A circuit built on Orcus "Wonderboard". Each hole in the board is filled with a conductive elastomer incorporating a silicone sealant, so that interconnections are automatically provided at each hole without soldering interference which may be generated by all electrical appliances, the receiver Type 40A will provide the Post Office Radio Interference Service with a specialist equipment to trace and measure man-made electrical noise.

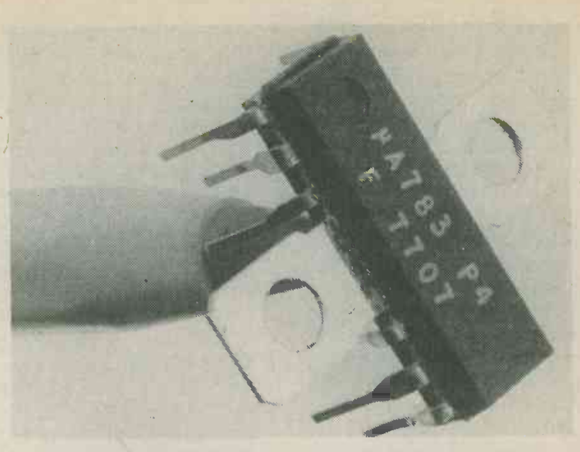
It is pleasant for the more venerable amongst us to see the revered name "Eddystone" still featuring in the news releases. Eddystone Radio Ltd. is nowadays a member company of Marconi Communications Systems.

9 WATT CHIP

New from Fairchild is the introduction of an audio power amplifier i.c. intended for high voltage applications driving 8Ω and 16Ω loads. This, the μA783, is encapsulated in the standard 12 pin power package and is designed for use as a low frequency Class B power amplifier. It can typically provide 9 watts into an 8Ω load. The i.c. can operate from a wide supply voltage range, with a maximum rating of 30 volts. Repetitive output current capability is 2.5 amps.

There is an integral thermal limiting circuit which offers the designer two advantages: an overload on the output, even if permanent, or an above-limit ambient temperature can be easily handled; second, the heatsink employed can have a smaller factor of safety compared with that for a conventional circuit. If junction temperature is too high the power output, power dissipation and supply current all decrease, thereby giving automatic protection for the device.

Typical applications include TV audio circuits and inexpensive radio receivers. A further indirect advantage offered by the i.c. amplifier is that the use of a high operating voltage simplifies power supply filtering requirements.



New Fairchild audio power amplifier i.c. intended for high supply voltage applications. It is capable of providing output currents and powers of 2.5 amps and 9 watts respectively, and has built-in thermal limiting

PAINTING

One of the more aesthetic pleasures of radio construction is the designing and subsequent building of any electronic project in which one is engaged. An enormous amount of satisfaction can be obtained from merely surveying the completed work and observing the neatness of wiring, the logical positioning of components and the excellence of the solder joints. Indeed, very often the whole thing looks so darned good that it seems a shame to have to put it in a box!

But into a box the project has to go if it is not to collect dust or have the more fragile parts damaged. There are many very presentable ready-made plastic, plastic and metal or all-metal cases available these days. Sometimes, however, the case has to be home-made and this is where, until recently, I have been falling short of optimum so far as final appearance is concerned.

If the home-made housing uses aluminium sheet, or wood and aluminium sheet, it has to be painted. And painting is not one of my strong points. First of all I'm too impatient to get the job finished, whereupon the paint gets applied too thickly in places; and secondly I'm too impatient again to wait for the paint to set really hard before I start messing around with the case, with the result that I get fingermarks and scratches all over it.

The solution to the problem is so obvious that I could kick myself for not having thought of it before. The answer is quick drying car touch-up paint. You can get this in small aerosols from places like Halfords, and the range of colours available is exceptionally wide. Since the aerosols are intended to match particular car make colours you can always be certain of getting exactly the same shade again if an aerosol runs out on you in the middle of a job.

It is important to faithfully follow the instructions on the aerosol can, particularly with regard to shaking before use, and my favourite approach is to lay the case to be painted out on the garden path with some sheets of newspaper under it. As with all human endeavour there are penalties and risks. Working in the garden requires a fine day, which in the U.K. is a problem in itself. And it is necessary to be careful with the spray from the aerosol; otherwise you may end up with battleship-grey chrysanthemums or an apple-green pussy-cat. ■

Mail Order Protection Scheme

The publishers of this magazine have given to the Director General of Fair Trading an undertaking to refund money sent by readers in response to mail order advertisements placed in this magazine by mail order traders who fail to supply goods or refund money and who have become the subject of liquidation or bankruptcy proceedings. These refunds are made voluntarily and are subject to proof that payment was made to the advertiser for goods ordered through an advertisement in this magazine. The arrangement does not apply to any failure to supply goods advertised in a catalogue or direct mail solicitation.

If a mail order trader fails, readers are advised to lodge a claim with the Advertisement Manager of this magazine within 3 months of the appearance of the advertisement.

For the purpose of this scheme mail order advertising is defined as:

"Direct response advertisements, display or postal bargains where cash has to be sent in advance of goods being delivered."

Classified and catalogue mail order advertising are excluded.

SMALL ADVERTISEMENTS

Use this form for your small advertisement

To: The Advertisement Manager, Data Publications Ltd., 57 Maida Vale, London W9 1SN

Please insert the following advertisement in the ....issue of RADIO & ELECTRONICS CONSTRUCTOR

15 words at 10p = £1.50

ALL WORDING IN BLOCK LETTERS PLEASE

I enclose remittance of .... being payment at 10p a word. MINIMUM £1.50

Box Number, if required, 25p extra

NAME..

ADDRESS ....

....

Copy to be received four weeks prior to publication. Published on the 1st of every month.

BREAD BOARD 1978

The kits & bits show for the home electronics enthusiast

Seymour Hall Seymour Place London W1

21–25 November 1978

Seventy stands packed with the gear that the home electronics constructor needs. From kits for keen youngsters just starting – to components for the dedicated enthusiast intent on building his own computer, it can all be seen and bought on the spot in the Seymour Hall this November. Browse through the range of instrumentation, test gear, components and circuit boards. Kits for making everything from an electric grandfather clock to an electronic organ. Build your own microprocessor, construct your own television games and choose hi-fi audio modules for the ultimate in sound!

Watch the Demonstrations in adjoining halls – electronic projects brought to life by the experts – and a chance for you to try for yourself the latest ideas from manufacturers and journals.

Competitions – Win a microprocessor kit – a frequency counter – a 'starter' kit for the kids – and many other daily prizes throughout the show.

Open 10 a.m. – 7 p.m. daily.
Entrance £1.00 adults, 70p students.

Organised by Trident Conferences and Exhibitions Limited, Abbey Mead House, 23a Plymouth Road, Tavistock, Devon. PL19 8AU.
Tel: 0822 4671 Telex: 45412 TRITAV.

SMALL ADVERTISEMENTS

Rate: 10p per word. Minimum charge £1.50

Box No. 25p extra

Advertisements must be prepaid and all copy must be received by the 4th of the month for insertion in the following month's issue. The Publishers cannot be held liable in any way for printing errors or omissions, nor can they accept responsibility for the ***bona fides*** of Advertisers. (Replies to Box Numbers should be addressed to: Box No. — ***Radio and Electronics Constructor,*** 57 Maida Vale, London, W9 1SN.

VINTAGE VALVES, RADIOS, components, literature, service sheets, etc., 1920-1955. S.A.E. please with enquiries and for sample Antique Wireless Newsheet. Tudor Rees, 64 Broad Street, Staple Hill, Bristol. Telephone: 0272-565472.

WANTED: Clean, new semiconductors, i.c.'s etc. Good prices paid. Hewitts, 52 Barkby Road, Syston, Leicester.

ELECTRONIC KITS. S.A.E. for new catalogue, and clearance list of obsolete kits. AMTRON UK, 7 Hughenden Road, Hastings, Sussex.

FIFTEEN CMOS PROJECTS — Mystery Maze; 70 mph. Alarm; AF/RF Signal Generator; Fifteen detailed circuits plus 14-pin socket and kits Voucher. Send £1 to David Ian Designs, 47 Hampton Court Parade, East Molesey, Surrey.

I.C's ITT 7273 9099 JK Flip Flops 10p each. Mullard 7306, Mullard 7241, Signetics S7425, LU320k. 10p each. All brand new. Add 15p post. All i.c's offered at 11 for £1. Jack Simpson, 35 Cattlemarket Street, Norwich, Norfolk.

FOR SALE: Inverter, 12V d.c. to 240V a.c. Suitable running electric shaver, camping, boating, etc. £5.50. Box No. G355.

WANTED: Large and small quantities of transistors, I.C.'s displays, etc., etc. Call any Saturday to: 306 St. Paul's Road, London N.1. Telephone: 01359 4224.

TREASURE HUNTERS: Construct, for £5, transistorised Metal Detector giving £50 performance. For simple illustrated plans, send £1.00. (Dept. R. & EC), John Lucas, 2 College Road, Grays, Essex.

TV REPAIRS SIMPLIFIED. Full repair instructions individual British sets £4.50; request free circuit diagram. Stamp brings details of unique TV publications. Auserec, 76 Churches, Larkhall, Lanarkshire.

ATTENTION SWL'S & DXERS. A long wire aerial presents different impedances at various frequencies, it rarely matches the receiver impedance at more than one frequency. NOW you can make sure! The AT2 Aerial Tuner Unit from Amtest has been designed to match long wires to your receiver. Features air core coil with 11 tapping positions tuned by 2 precision coils in PI network. Size only 8 x 5½ x 2½ ins. Only £14.80 inc. Preselector still available. Mail order only. S.A.E. for details of all above. AMTEST, 55 Vauxhall Street, Worcester, WR3 8PA.

TURN YOUR SURPLUS Capacitors, transistors, etc., into Cash. Contact COLES-HARDING & CO. 103 South Brink, Wisbech, Cambs. Telephone: 0945-4188. Immediate settlement. We also welcome the opportunity to quote for complete factory clearance.

FOR SALE: Ex-A.M. rotary motor generator, 12V d.c. at 3.8 amps to 480V at 0.04 amps. £2.00 plus carriage. Box No. G356.

CRYSTAL SET KITS. No soldering. Experience unnecessary. £2.25 inclusive. P. Faherty, 4 Angus Drive, South Ruislip, Middlesex.

WANTED: Codar R.Q.10 (or 10X) Q. Multiplier/Filter. Telephone: Maidstone 77331.

(Continued on page 261)

ELECTROVALUE

All the many types of components we supply are BRAND NEW and guaranteed and only from manufacturers direct or approved suppliers. *No surplus, no seconds*

I.C.s — TTL 7400 series

7400	14p	7414	60p	7454	14p	7485	74p	74107	27p
7401	140	7420	14p	7460	14p	7486	27p	74121	27p
7402	14p	7430	14p	7470	24p	7490	40p	74123	51p
7403	14p	7440	14p	7472	24p	7491	71p	74141	54p
7404	18p	7442	54p	7473	23p	7492	46p	74151	60p
7405	14p	7443	60p	7474	23p	7493	40p	74154	£1.60
7407	22p	7444	60p	7475	45p	7494	66p	74190	94p
7408	18p	7447	70p	7476	32p	7495	57p	74191	74p
7409	18p	7450	14p	7480	41p	7496	63p	74192	94p
7410	14p	7451	14p	7482	61p	74100	73p	74193	94p
7413	22p	7453	14p	7483	58p	74104	4p		

OUR COMPUTER TAKES GOOD CARE OF YOUR ORDERS!

SIEMENS CAPACITORS*
World-famous for quality and dependability.
PC8 TYPES
— 7.5mm PCM 0.001 to 0.015 6p each: 0.022 to 0.047 7p each. 5mm PCM 0.068-8p, 0.1-9p, 0.22-12p.
CERAMIC
2.5mm PCM 0.01-4p, 0.022, 0.033, 0.047 5p each, 0.068-6p. 5mm PCM 0.1-7p.
ELECTROLYTICS
— 1/100, 10/25, 10/63, 100/25, etc. For full range see our current lists.

RESISTORS
⅓, ½, ¾, watts — 2p each* metal film, metal oxide and 1 watt carbon 5p each* — *good quantity discounts.* Magnetic field dependant from £1.50. Hall Effect from £1.23.

SIEMENS TRANSISITORS
Silicon npn and pnp from 8p each: LEDs, rec 19p: yellow or green from 23p (3 or 5mm): Photo transistors from 76p.

DISCOUNTS
5% If list value of order over £10: 10% if list value of order over £25 — where cash (P.O. or cheque) is sent with order.

V.A.T. Add 8% to value of order or 12½%, with items marked* (No V.A.T. on overseas orders). Good sent post free on C.W.O. orders in U.K. over £5 list value. If under, add 27p oer order.

MONTHLY BARGAIN LISTS
S.A.E. brings monthly list of bargains. Also current quick reference price list of all ranges.

KEEN PRICES — GOOD SERVICE — WIDE RANGES

Cash with order (P.O. or cheque payable to Electrovalue Ltd) or your Access or Barclaycard number. TRADE AND INDUSTRIAL ENQUIRIES INVITED

For all round satisfaction — Be safe — buy it from ELECTROVALUE

ELECTROVALUE LTD

Dept RC12, 28 St Judes Rd, Englefield Green, Egham, Surrey TW20 0HB. Phone Egham 3603. Telex 264475.
Northern Branch (Personal shoppers only) 680 Burnage Lane, Burnage, Manchester M19 1NA Phone (061) 432 4945.

CHESTER ELECTRONICS

CONVERGENCE POTS: 20Ω, 22Ω, 30Ω, 33Ω, 60Ω, 120Ω, 250Ω. All at 5p each or 100 mixed for £3.

AC128	16p	BC125	10p	BRY39	26p	1S44	4p
AC187K	25p	BC147B	7p	BU208	£2.00	1N914	2p
AD161	35p	BC184C	7p	BFY50	15p	1N4148	3p
AD162	35p	BD131	34p	BFY52	15p	OA47	10p
AD149	50p	BD132	34p	BFY53	15p	OA200	6p
AU110	£1.00	M/Pair	82p	TIP32C	50p	1N4001	4p
BC107	8p	BD238	45p	2N3055	35p	1N4004	5p
BC108	8p	BF262	30p	OC45	25p	1N4006	6p
BC109	8p	BFX89	20p	OC72	30p	1N4007	7p

Belling Lee Flush mounted 2-Gang Coaxial Outlets (Complete with screws) (Type L1481/R) SPECIAL CLEARANCE PRICE, 50p each

Belling Lee Flush Mounting Diplexer (UHF & VHF) (Complete with screws) (Type L1893) SPECIAL CLEARANCE PRICE, 75p each

Belling Lee Flush Mounting Twin Coaxial Outputs, Type L1704 (complete with screws) SPECIAL CLEARANCE PRICE 75p each

Zener Diodes 400mW: 4V7, 5V1, 11V, 13V5, 24V, 30V
8p each, 50 for £3.50, 100 for £5.00

				Tantalum Bea Capacitors	1+	100+
Axial 25μ 24V	4p	Axial 200μ 6V	5p			
Axial 1.0μ 63V	5p	Axial 220μ 80V	15p			
Axial 15μ 450V	20p	Axial 640μ 25V	20p	0.1μ 35V	10p	8p
Axial 47μ 160V	10p	Tag 4700μ 16V	30p	0.22μ 35V	10p	8p
Axial 100μ 80V	10p	Tag 3500μ 30V	25p	0.47μ 35V	10p	8p
Radial 100μ 10V	5p	Tag 10000μ 25V	40p	68μ 3V	10p	8p

SMITH small clock motors. Mains50Ω 2W (Brand new and unused) £1.00 each

Metal Rotary Pots 10 for £1.00 (Advise us of value preferred and we will send it or the nearest available)

SPECIAL OFFER: BFY50, BFY51, BFY52. (All new, full spec. marked etc) 10 for £1.45, 50 for £7.00, 100 for £12.50

WHITE IN LINE, CAR RADIO TYPE, FUSEHOLDERS. 5p each, 100 for £4.00
4 core Curly leads (unscreened) stretch from 3' to 8'. 30p each

SPECIAL OFFER: 741 8 pinDIL, Brand New, marked, full spec, etc) 1-18p, 50 for £8.00, 100 for £15.00

Hunts Capacitor, Axial 0.0015μ 400V only 5p each

Tubular Ceramic Capacitors, 100 for £1.00 (Our mix but all low of values)

Do not add any VAT to the above prices. Only add 15p P&P to your total order. No callers please as we have no retail facilities.

Send your orders to:

DEPT. DP9 CHESTER ELECTRONICS
6 HUNTER STREET, CHESTER, CH1 2AU

SMALL ADVERTISEMENTS

(Continued from page 259)

TRADE CMOS cookbook for books 1, 3, 9 and 12 on page 494 April issue *Radio & Electronics Constructor*. Box No. G362.

JOIN THE INTERNATIONAL S.W. LEAGUE. Free services to members including Q.S.L. Bureau, Amateur and Broadcast Translation, Technical and Identification Dept. — both Broadcast and Fixed Stations, DX Certificates, contests and activities for the SWL and transmitting members. Monthly magazine, *Monitor*, containing articles of general interest to Broadcast and Amateur SWLs, Transmitter Section and League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership including monthly magazines, etc., £3.75 per annum. (U.K. and British Commonwealth), overseas $10.00 or £4.00. Secretary ISWL, 1 Grove Road, Lydney, Glos., GL15 5JE.

RESISTORS: Carbon film, ¼W, 5%. Various values being sold off cheaply. S.A.E. for detailed list to Box No. G363.

SOLDERING IRONS. 240V, 40W, £2.10 plus 25p post. Transistors 100 for 98p, postage 15p. W. Higgins Electrical, 35 Cattle Market Street, Norwich, Norfolk.

THE RADIO AMATEUR INVALID & BEDFAST CLUB is a well established Society providing facilities for the physically handicapped to enjoy the hobby of Amateur Radio. Please become a supporter of this worthy cause. Details from the Hon. Secretary, Mr. H. R. Boutle, 14 Queens Drive, Bedford.

FOR SALE: Solar cells, produce up to 1mA from light. 10 — £2.50. Sample free. Box No. G364.

FOR SALE: Tins of switch cleaner 50p. Please add postage. Box No. G365.

ELECTRIC SHOCK MACHINES. Harmless. £1.95 inclusive. P. Faherty, 4 Angus Drive, South Ruislip, Middlesex.

FOR SALE: *Fundamentals of Radio Servicing* by B. W. Hicks, published by Hutchinsons Educational, £2.20 post paid. *Handbook of Satellites and Space Vehicles* by R. P. Haviland, £3.50 post paid. *FM and Repeaters for the Radio Amateur*, published by ARRL, £1.25 post paid. Box No. G366.

INTERESTED IN OSAR? Then join AMSAT-UK. Newsletters, OSCAR NEWS Journal, prediction charts, etc. Details of membership from: Ron Broadbent, G3AAj, 94 Herongate Road, Wanstead Park, London, E12 5EQ.

FOR SALE: Bound Volumes *Radio Constructor* Nos. 16-27 (1962 to 1974). £3.00 per volume ono. Box No. G367.

NOT THE CHEAPEST — THE BEST! Quality, low noise, high output Cassette Tapes, with free library case, index. C60, 5 for £2.87, 10 for £4.95. Sample tape 62p. C90, 5 for £3.45. 10 for £5.95. Sample tape 72p. VAT paid. Add 15% for postage. Money back guarantee. Sigtronic Electronics, 27 Malvern Street, Stapenhill, Burton-on-Trent, Staffs.

FOR SALE: Viscount X125 electronic organ, with separate Leslie speaker, 2-manual foot pedals, percussion, rhythm box. Matching stool, £450 o.n.o. T. F. Weatherley, 16 Bevereley Court, Carlton Colville, Lowestoft, Suffolk. Telephone: Lowestoft 63216.

FOR SALE: Avometer £7.00. Electro-magnetic counters 25p, postage 25p. Key chain radio, non-working, £1.50. Cassette recorder, non-working, £3.00. Box No. G368.

(Continued on page 262)

SMALL ADVERTISEMENTS

(Continued from page 261)

FOR SALE: Phillips VCR1700 £700.00 Sinclair microvision pocket television £200.00. Box No. G369.

POSTAL ADVERTISING? This is the Holborn Service. Mailing lists, addressing, enclosing, wrapping, facsimile letters, automatic typing, copy service, campaign planning, design and artwork, printing and stationery. Please ask for price list. — The Holborn Direct Mail Company Capacity House, 2-6 Rothsay Street, Tower Bridge Road, London, S.E.1. Telephone: 01-407 6444.

FOR SALE: 1000 mixed resistors £1.00. 100 high wattage resistors 50p. 25 2W zeners 50p. Stereo cassette mechanisms £10 and £15. J. Fulton, Derrynaseer, Dromore, Co. Tyrone, N. Ireland.

CLEARING BOOKSHELF. Bound Volumes *Radio Constructor* and recent books on electronics. S.A.E. for list. Box No. G370.

COMPONENTS: Bargains for Radio & Mechanical Engineers. Clearance lines, regular lists, from: SOUND SYSTEMS, 676 Foxhall Road, Ipswich, Suffolk.

FOR SALE: Approx. 10 lbs mixed capacitors £5.00. 10 lbs mixed components, etc. £5.00. Tins switch cleaner 50p. Postage 25p. 12in steel rules 50p. Level meter 50p. Box No. G371.

HOME REPAIR MEN. Send now for your bumper box of electrical spares and interesting items. New, but slightly shop soiled. They are valued at £12+. Just £5 plus £1 P. & P. ELECTRONIC CONSTRUCTORS. Send now for your bumper box of electronic spares, full of everything you will need to boost your stock. £5 plus £1 P. & P. Mail order only to: Bacca Electronics, 34 Keats Close, Wootton Bassett, Wiltshire. Terms C.W.O. please.

WANTED: FAX equipment, manuals, service sheets, etc. G2UK, 21 Romany Road, Oulton Broad, Lowestoft, Suffolk. NR32 3PJ.

110 INTEGRATED CIRCUIT PROJECTS for the home constructor. 128 pages. By R. M. Marston. £3.70. From Bacca Electronics, Box No. G372.

ATTENTION SWL'S & DXERS. PRS 1 RF Preselector employs silicon FET front end with silicon NPN broadband rf amp. High Q coils tuned by precision capacitor. Will substantially improve most receivers performance over 1.5-30MHz. Gives improved signal/noise ratio with an average gain of 30dbs. Also helps selectivity and image rejection. Size: 8 x 5½ x 2½ inches. 9V operation. We also manufacture items of interest to MW DXers. S.A.E. for details of all above please. AMTEST, 55 Vauxhall Street, Worcester, WR3 8PA.

CASSETTE TAPES, C60, six for £1.60. C90, four for £1.60. Case and index included. VAT Paid. Please add 10% postage. West, (A1), 56 Frankwell Drive, Coventry, CV2 2FB.

CLEARING LAB, EMI scope S/B £50. Marconi A.F. signal generator & voltmeter £35. Weston multimeter £10. 8mm camera, projector, dev/tank, striper, unex. films, £75 the lot. Tape/cassette mechs. & circuit boards, transistors, i.c.'s caps., etc. Also International Marine radio 54, 31 meg. to 15kHz, 10 bands, £25. Telephone: Southampton 447264.

FOR SALE: *Radio Constructor* from No. 1 (1947) to 1977. 30 volumes. Mostly bound. £90. Wilson, 54 Chepstow Villas, London W.11.

(Continued on page 263)

SMALL ADVERTISEMENTS

(Continued from page 262)

LEARN CODE THE EASY WAY. No. 1 Cassette fundamentals. No. 2 Practice 10-16 wpm. No. 3 Practice 18-20 wpm. C.90 cassettes. £3.75 each. P&P 30p. R. Eastland, 50 Heath Road East, Petersfield, Hants., GU3 14HN.

PERSONAL

JANE SCOTT FOR GENUINE FRIENDS. Introductions to opposite sex with sincerity and thoughtfulness. Details free. Stamp to: Jane Scott, 3/Con North St. Quadrant, Brighton, Sussex, BN1 3GJ.

IF YOU HAVE ENJOYED A HOLIDAY on the Norfolk Broads, why not help to preserve these beautiful waterways. Join the Broads Society and play your part in determining Broadlands future. Further details from: — The Hon. Membership Secretary, The Broads Society, "Icknield," Hilly Plantation, Thorpe St. Andrew, Norwich, NOR 85S.

SPONSORS required for exciting scientific project Norwich Astronomical Society are building a 30" telescope to be housed in a 20' dome of novel design. All labour being given by volunteers. Already supported by Industry and Commerce in Norfolk. Recreational. Educational. You can be involved. Write to: NAS, Secretary, 195 White Woman Lane, Old Catton, Norwich, Norfolk.

BROADLANDS RESIDENTIAL CLUB for elderly people. Are you recently retired and looking for a home? We have a delightful top floor room overlooking Oulton Broad, facing south. Write to: The Warden, Broadlands Residential Club, Borrow Road, Oulton Broad, Lowestoft, Suffolk.

BUILD YOUR OWN

P.A., GROUP & DISCO SPEAKERS by R. F. C. Stephens

Save money with this practical guide. Plans for 17 different designs, Line source, I.B., Horn and Reflex types, for 8"-18" drive units. £3.95 post free ($8 overseas).

THE DALESFORD SPEAKER BOOK by R. F. C. Stephens

This book is a must for the keen home constructor. Latest technology DIY designs. Plans for I.B., and Reflex designs for 10-100 watts. Also unusual centre-bass system. £2.20 post free ($5 overseas).

VAN KAREN PUBLISHING
5 Swan Street, Wilmslow, Cheshire

PRINTED CIRCUITS AND HARDWARE

Comprehensive range Constructors' hardware and accessories. Selected range of popular components. Printed circuit boards for individual designs. Drawing materials for printed circuits. Resist coated laminate, epoxy glass for the d.i.y. man. Full processing instructions, no unusual chemicals required.

Send 15p for catalogue

Ramar Constructor Services

Masons Road · Stratford-on-Avon · Warwks CV37 9NF

Self-Binder

for "Radio & Electronics Constructor"

The "CORDEX" Patent Self-Binding Case will keep your issues in mint condition. Copies can be inserted or removed with the greatest of ease. Rich maroon finish, gold lettering on spine.

Specially constructed Binding Cords are made from Super Linen of great strength, very hard twisted and twice doubled. They are attached to strong RUSTLESS Springs under tension, and the method adopted ensures PERMANENT RESILIENCE of the Cords. Any slack that may develop is immediately compensated for and the Cords will always remain taut and strong. It is impossible to overstretch the springs, as a safety check device is fitted to each.

PRICE £1.80 P.&P. 40p

including V.A.T.

Available only from:—

Data Publications Ltd.

57 Maida Vale London W9 1SN

RADIO & ELECTRONICS CONSTRUCTOR

Single Copies
Price **45p** each, p&p 13p
Issue(s) required ....

Annual Subscription
Price **£7.00 inland, £8.00 overseas**
post free, commence with .... issue

Bound Volumes:

Vol. 27. August 1973 to July 1974	Price **£2.80**, post & pkg 90p
Vol. 28. August 1974 to July 1975	Price **£3.20**, post & pkg 90p
Vol. 29. August 1975 to July 1976	Price **£3.50**, post & pkg 90p
Vol. 30. August 1976 to July 1977	Price **£3.70**, post & pkg 90p

CORDEX SELF-BINDERS *NEW FORMAT*

With title, 'RADIO & ELECTRONICS CONSTRUCTOR' on spine, maroon only	Price **£1.80**, post & pkg 40p
With no title on spine, maroon	Price **£1.70**, post & pkg 40p
With no title on spine, green	Price **£1.70**, post & pkg 40p

Prices include V.A.T.

DATA BOOK SERIES

DB5	**TV Fault Finding,** 132 pages	Price **£1.20**, P. & P. 20p
DB6	**Radio Amateur Operator's Handbook,** New edition in course of preparation	
DB17	**Understanding Television,** 504 pages	Price **£3.95**, P. & P. 70p
DB19	**Simple Short Wave Receivers** 140 pages	Price **80p**, P. & P. 20p

STRIP-FIX PLASTIC PANEL SIGNS

Set 3: Wording — White	— 6 sheets	Price **£1.00**, P. & P. 8p
Set 4: Wording — Black	— 6 sheets	Price **£1.00**, P. & P. 8p
Set 5: Dials	— 6 sheets	Price **£1.00**, P. & P. 8p

Prices include V.A.T. on Panel Signs

I enclose Postal Order/Cheque for .... in payment for ....

NAME ....

ADDRESS ....

.... (BLOCK LETTERS PLEASE)

Postal Orders should be crossed and made payable to Data Publications Ltd.

Overseas customers please pay by International Money Order.
All publications are obtainable through your local bookseller

Data Publications Ltd., 57 Maida Vale, London W9 1SN

PLEASE MENTION THIS MAGAZINE WHEN WRITING TO ADVERTISERS