RADIO & ELECTRONICS CONSTRUCTOR

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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.

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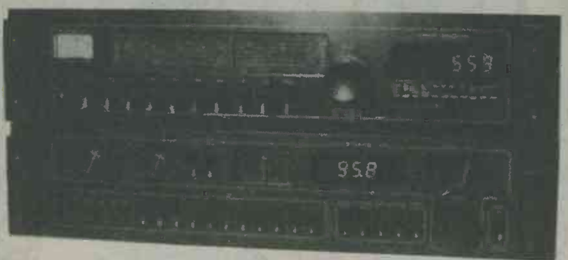
THE MAY ISSUE
WILL BE PUBLISHED
EARLY IN APRIL

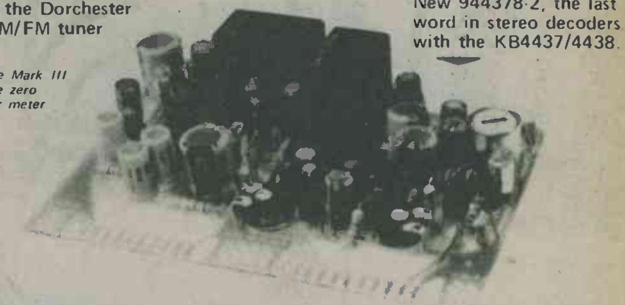
BEWARE! RADIO ACTIVITY



The new MK III FM tuner sitting under the Dorchester multiband AM/FM tuner

Revisions to the Mark III include a centre zero tuning indicator meter and silent preset switching

New 944378-2, the last word in stereo decoders with the KB4437/4438.



Choosing the products to advertise each month can be quite a task at AMBIT, since we tend to introduce at least one new line per week. So it is nearly impossible to say all we would like in this space - other than to bring you as far up to date as possible with current events. The major medium for finding out about what we have to offer is our unique catalogue system, and we ask that you invest in a copy of parts 1,2 & 3 since many questions we are asked can be readily answered by reference to these.
Each part costs 60p, or £1.60 for all three current editions.
We are also launching a new and greatly elongated version of our PRICE LIST, which now includes a large number of quantity listings, and many items not previously listed. The new style price list is a quick reference short form to our general catalogues - available FOC with a large (A4) SAE please.

As a result of the soaring price of oil - and the subsequent huge increases in the cost of wax for Mr Tom Jackson's famous moustache, the Post Office have increased their charges (Feb. 4th). Accordingly, our standard cover charge has been increased to 35p per order (CWO).

MODULE NEWS

We are at last able to quote for quantities of our modules, following a program of standardization and revision to speed manufacture and test. The following types are the results of the standardization program:

UM1181	5 varicap MOSFET input VHF band 2 tunerhead	£12.00 inc
911225 A	High Performance FM IF system, with switched BW	£23.95 inc
911225 B	Single BW filters, single tuned detector	£14.95 inc
91072 A	DC tuned and single pole switched MW LW tuner	£14.43 inc
91072 B	As type 'A' but with either SW1 or SW2 band	£15.90 inc
92242 A	Combined LW/MW tuner, with FM IF detector section	£29.00 inc
92242 B	As 92242A but with 5-10MHz SW section	£34.00 inc

All are supplied housed in screened metal cases 97x56x24mm, with all connections along a single edge, suitable for verticle or horizontal mounting.

Previously advertized units are still available - although there may have been some price changes in the latest edition of the Price List (Date Feb.80). A separate leaflet covering the new range of modules is available from April 80, with an A4 SAE please

COMPONENTS

DIGITAL FREQUENCY READOUTS / SYNTHESISER SYSTEMS

Ambit has the biggest range of digital frequency readout systems for various applications in Broadcast and Communications. Prices range from £18.50 for a complete AM/FM broadcast frequency display (kit of DFM2). Most are detailed in the latest catalogue.

TUNING SYNTHESIZERS are also heavily featured, and we offer our first complete system covering MW/LW/SW2 and FM based on Hitachi parts. The unit is retrofittable to voltage tuned radio systems - and will shortly be incorporated in a complete tuner project. Cost for the synthesiser will be circa £40
A versatile communications system based on the new Mullard 2 IC system is nearing completion, together with 16 station CMOS memory and optical shaft encoder system with fast tune facility. Synthesiser circa £70, memory £50.

Latest semiconductor news:

CMOS, TTL and LPSN TTL are in stock (ask for our OSTS price leaflet). Some of the very popular types are still "difficult" but we have things like 4011s, 4017s at the time of writing.

RADIO ICs - - -interesting developments here, we now have the Hitachi HA11225 and the HA12412 ultra high specification members of the CA3089E family. The PLESSEY SL1600 range now includes the SL6600 high performance PLL NBFM IF and detector.

CA3089E	2.11	HA1197	1.61	SD6000	4.31	SL1610	1.84	SL1626	2.80
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59	SL1611	1.84	SL1630	1.86
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38	SL1612	1.84	SL1640	2.17
HA11225	2.47	TBA651	2.53	MC1350P	1.38	SL1613	2.17	SL1641	2.17
HA12412	2.81	TDA1090	3.51	KE4412	2.24	SL1620	2.50	SL6600	4.31
KB4420	1.95	TDA1220	1.61	KB4413	2.24	SL1623	2.80	SL6640	3.16
TBA120S	1.15	TDA1083	2.24	KB4417	2.53	SL1624	3.77	SL6690	3.68
KB4406	0.80	TDA1062	2.24	MC3357P	3.16	SL1625	2.50	MC1496	1.44

TRANSISTORS : New lower prices, wider range, large stocks. Also the world's lowest noise audio devices (2SC2546E and 2SA1084E) first from AMBIT of course. Power MOSFETs & all sorts of other devices. Our 3SK51 MOSFET replaces the 408XX and 40673 families.

BC237-8-9	0.092	2SC1775	0.207	2SA1084E	0.368	BF256	0.437	BFY90	1.03
BC307-8-9	0.092	2SA872A	0.207	2SC2547E	0.391	2SK55	0.368	BF224	0.253
BC413-5	0.115	2SD666A	0.345	2SA1085E	0.391	2SK168	0.402	BF274	0.207
BD414-6	0.126	2SB646A	0.345	2SK133	6.32	3SK51	0.62	BFT95	1.138
BC546-556	0.138	2SD760	0.52	2SJ48	6.32	3SK60	0.667	VN66AF	1.092
BC550-560	0.138	2SB720	0.52	2SK135	7.29	BF960	1.426	2N4427	0.977
BC639-640	0.265	2SC2546E	0.368	2SJ50	7.29	3SK48	1.426	J176	0.747

RADIO CONTROL: A special section for all RC fans. New and exciting stuff:
KB4445/KB4446 : complete 4 channel RX/TX dig.prop IC pair RF&control in one 4.75pr
MSL9362/MSL9363 : logic section of a four channel dig.prop link, with switch opt. 3.75pr
NE5044 : Signetics versatile 7 channel encoder, suitable for mixing etc. £2.14 ea
NE544 Signetics famous servo driver IC £2.07 MC3357P as used in RCME design £3.16 ea
AMBIT RCRX4 - RCME FM system compatible, complete RX kit with box/connector and AMBIT design screened front end with 27MHz ceramic filter £16.10 (kit)
XTALS: FM pairs £3.74 (no splits) TX is fund. ½ op frequency, RX 3rd OT- 455kHz
AM pairs £3.57 (no splits. Both 3rd OT types, again RX IF at 455kHz

NEW LINE : ALPS switches and rotary potentiometers. With a general catalogue that's over 3 inches thick, we cannot begin to offer a comprehensive list of what we can offer - but we are already stocking the keyboard switches, keyswitches, pushbutton switches etc. In particular, the pushbutton switches really put all others in the shade (schadow?) when it comes to quality and price. A special new shortform is being prepared (and may be ready when you read this). All the potentiometers and switches you could ever need from a single source. Keypad switches cost as little as 15p ea (1 off), with a range of two part caps for easy ledgending. You must see the shortform catalogue (30p) and our new pricelist for full details of this huge range of components

AMBIT SHOP NOW OPEN

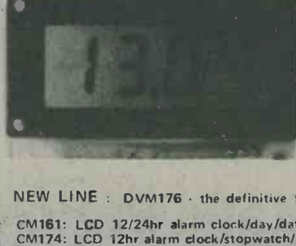
We are gradually getting our caller sales area sorted out, with displays of the products on offer and a browsers corner to sit and study data/catalogues. Call in next time you are in the area - parking outside the door.

COMPUTER CAPABILITIES

Ambit has been keeping a low profile on the subject of the MPU and its applications. Interestingly enough, the first project we offer with MPU content does rather more in the way of processing than simply playing a daft game, or looking like an enormous calculator. Our MPU facility and expertise is now for hire on a fully commercial basis. Z80, 6800, 6809, 2650 etc.

Keyboard switch
SCK41505
typ 6m ops
23p each (1-24)

NEW LINE : DC/DC+AC converters for fluorescent displays. TOKO CPS series 12v IN, −20 and 3v AC out at 65mA. Thick film design £2.34 ea Qty. prices OA



GENERAL INFORMATION

Ambit stocks the following ranges of components for ex-stock volume delivery: SIGNAL COILS, CERAMIC, MECHANICAL and CRYSTAL FILTERS, RADIO ICs for AM/FM/SSB, TOROID CORES FOR RADIO and EMI FILTER CIRCUITS, INDICATING AND PANEL METERS, AUDIO ICs, RF TRANSISTORS, FETS, MOSFETS, DIODES (PIN,VARICAP,SCHOTTKY), PASSIVE OBMs (like MD108 etc), IC SOCKETS, LEDS, TRIMMER CAPS, SWITCHES, KEYBOARD SWITCHES, TUNERHEADS, IF AMPS, AM RADIO MODULES, etc etc

NEW LINE : DVM176 - the definitive ICM7106 LCD DVM module. 3½ digit £22.37 ea.

CM161: LCD 12/24hr alarm clock/day/date/backlight (eq.RS308-499) 7mm digits £11.44 each
CM174: LCD 12hr alarm clock/stopwatch/backlight with 30mm height digits £14.32 each

CATALOGUES 60p ea . all three for £1.60
PRICES SHOWN HERE INCLUDE VAT
POST/PACKAGE CHARGE NOW 35p

ambit INTERNATIONAL

CWO PLEASE : Commercial MA terms on application
Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt

200 North Service Road, Brentwood, Essex

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

ALL PRICES INCLUDE V.A.T. AND P. & P.

SAME DAY SERVICE

QUALITY COMPONENTS

AXIAL CAPACITORS

1/25v	4p	150/25v	6p
2.2/63v	4p	160/25v	6p
3.3/50	4p	220/16v	8p
4.7/40v	4p	220/25v	8p
10/25v	4p	220/63v	9p
15/16v	5p	330/10v	9p
22/10v	5p	330/25v	9p
22/16v	5p	330/63v	12p
22/25v	5p	470/6.3v	9p
33/35v	5p	470/16v	12p
33/50v	5p	470/40v	15p
47/25v	5p	680/6.3v	12p
47/16v	5p	1000/6.3v	15p
47/50v	6p	1000/16v	20p
100/10v	5p	1500/25v	20p
100/16v	5p	2200/10v	20p
100/63v	8p	3300/16v	25p

RADIAL CAPACITORS

.47/50v	4p	220/50v	9p
1/50v	4p	220/63v	9p
2.2/25v	4p	330/10v	8p
10/40v	4p	330/25v	8p
10/50v	5p	330/50v	9p
15/16v	5p	330/63v	9p
22/25v	5p	470/6.3v	8p
22/50v	6p	470/16v	9p
33/63v	6p	470/25v	10p
47/16v	6p	1000/16v	20p
47/35v	6p	1000/25v	21p
100/35v	6p	2200/10v	23p
220/16v	8p	2200/10v	23p
220/40v	8p	3300/6.3v	24p

C280 POLYESTER CAPACITORS

.01uF	4p	.15uF	6p
.015uF	4p	.22uF	6p
.022uF	4p	.33uF	8p
.033uF	4p	.47uF	8p
.047uF	4p	.68uF	12p
.068uF	5p	.68 F 630v	10p
.1uF	5p	1.0uF	15p

AXIAL POLYESTER

.001uF	400v	3p	.047uF	160v	4p
.0015uF	400v	3p	.1uF	160v	5p
.0022uF	160v	3p	.1uF	400v	5p
.0022uF	400v	3p	.15uF	160v	6l
.0027uF	400v	3p	.18uF	160v	6p
.0068uF	400v	3p	.22uF	160v	6p
.01uF	160v	4p	.22uF	400v	6p
.022uF	160v	4p	.47uF	400v	8p
.033uF	400v	4p	1uF	160v	15p
.039uF	400v	4p			

CERAMIC DISC

.047 24v 9mm dia 3p
.1uF 30v 13mm dia 5p

CAN CAPACITORS

1250/50v	50p	10,000/1 0v	60p
2500/35v	70p	15,000/10v	60p

TANTALUM BEAD

.22/35v	8p	10/16v	11p
.33/35v	8p	15/16v	14p
.47/35v	8p	22/6.3v	14p
2.2/35v	8p	47/16v	16p
4.7/25v	11p	100/3v	16p
6.8/35v	11p		

HIGH VOLTAGE CAPS

Polystyrene .1uF10% 1000v 8p
Paper .1uF 10% 1000v 10p

DISPLAYS

TLR302 .3 inch Common Cathode	70p
TLR308 .6 inch Common Anode	£1.10
DL500 .5 inch Common Cathode	75p
FND507 .5 inch Common Anode	£1.20
Red L.E.D's .2 inch	8p
Green L.E.D's .2 inch	12p

DIODES

IN914	3p	IN4006	6p
IN4001	4p	IN4150	3p
IN4002	4p		
IN4003	5p	IN4148	2p
IN4004	5p	OA91	4p
IN4005	6p	OA200	6p

LINEAR I.C.'s

LM380	50p	TBA820	70p
LM741	19p	TCA270SQ	55p
NE555	22p	SN70613N	£1.20
CA1310Q	£1.20	SN76023N	£1.20
CA3089Q	75p	SN76033N	£1.20
TAA350	£1.00	SN76110N	75p
TBA120A	50p	SN76131N	£1.30
TBA120S	70p	SN76660N	75p
TBA800	70p	711	40p

SUB-MIN PRESETS

Horizontal:
100Ω, 220Ω, 470Ω, 1k, 1k5, 2k2, 4k7, 10k, 47k, 100k.

Vertical:
470Ω, 2k2, 4k7, 47k.

All price 5p each

SWITCHES

Push to make switches	16p
Sub-min DPDT Slide switches	14p
Standard DPDT Slide switches	12p
Standard DPDT Toggle switches	49p

Rotary switches 1p 12w, 2p 6w, 3p 4w, 4p 3w All 41p each

VARIOUS ITEMS

P.C. Board	
Approx. 2⅝" x 8¼"	10p
Approx. 4½" x 9"	25p
Etch Resist Pen	85p
PP3 battery clips	6p
PP9 battery clips	14p
Din Plugs 5 pin 180°	10p
Din Sockets 5 pin 180° Standard metal type	10p
Green Phono Plugs	6p
Latch switches 2p 2w	10p
20mm chassis mounting fuseholders	6p

SPECIAL OFFER

(While stocks last)

100	IN4001	£3.00
100	IN4003	£3.50
100	IN4005	£4.00
100	IN4006	£4.00
100	BC107	£7.50
100	BC109	£7.50
100	BC183L	£5.50
25	High Quality CA741 d.i.l. 8 pin (metal can)	£3.25
IN148	100 off	£1.75
	1000 off	£15.00

TTL

7400	10p	7474	23p
7401	12p	7475	24p
7402	12p	7476	19p
7404	12p	7485	50p
7405	12p	7486	21p
7406	25p	7489	£1.25
7408	14p	7490	32p
7409	14p	7491	30p
7410	10p	7492	30p
7411	15p	7493	25p
7412	16p	7494	43p
7414	42p	7495	37p
7416	22p	74107	20p
7420	12p	74121	26p
7421	20p	74122	34p
7427	20p	74123	42p
7430	13p	74132	48p
7432	17p	74141	56p
7437	18p	74151	38p
7438	19p	74153	38p
7440	12p	74154	60p
7441	50p	74160	45p
7442	38p	74164	60p
7446	51p	74174	55p
7447	43p	74175	55p
7450	12p	74192	48p
7451	12p	74193	48p
7470	26p	74194	43p
7472	22p	74196	48p

CMOS

4000	15p	4027	48p
4001	18p	4028	78p
4002	15p	4030	48p
4006	91p	4035	93p
4007	15p	4040	80p
4008	78p	4041	80p
4009	41p	4042	76p
4010	36p	4043	78p
4011	19p	4044	78p
4012	15p	4046	£1.10
4013	42p	4049	42p
4014	73p	4050	42p
4015	70p	4052	65p
4016	40p	4053	65p
4017	76p	4066	48p
4018	78p	4068	15p
4019	43p	4069	15p
4020	80p	4070	22p
4021	80p	4071	20p
4022	85p	4072	20p
4024	64p	4078	20p
4025	15p		

TRANSISTORS

AD161/162 MP	75p	BD116	45p
OC36	47p	BD131	30p
BC107	9p	BD183	90p
BC107B	10p	BF185	19p
BC108	9p	BF194	12p
BC108A	10p	BF195	12p
BC108C	11p	BF198	12p
BC109	9p	BF200	25p
BC109C	11p	BF240	8p
BC142	21p	BF241	7p
BC147	7p	BF244	14p
BC148	7p	BF245	14p
BC149C	8p	BF255	10p
BC149S	9p	BF336	16p
BC153	8p	BFX88	28p
BC154	8p	BFY50	15p
BC171B	10p	BFY51	20p
BC172B	10p	BSX21	10p
BC182L	9p	BU208	90p
BC183A	10p	BF256	15p
BC183L	8p	TIP29	38p
BC207B	11p	TIP30	38p
BC212L	10p	TIP31A	45p
BC213LB	10p	TIP32A	45p
BC308	10p	TIP32B	31p
BC338	10p	TIP41A	65p
BC455	7p	TIP42A	65p
BC456	9p	2N2905	20p
BC547	11p	2N2906	16p
BC548	9p	2N2907	18p
BC549	9p	2N3055	45p
BCY70	11p	2N3702	9p
BCY72	12p	2N3703	9p
BCY79	12p	2N3704	9p

Write or telephone for free pamphlet

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TEL: 0920 3182 TELEX: 817861

CERAMIC PAK

16160 – 24 – 3 of each value – 22pf 27pf 33pf 39pf 47pf 68pf 82pf £0.69
16161 – 24 – 3 of each value – 100pf 120pf 150pf 180pf 220pf 270pf 330pf 390pf £0.69
16162 – 24 – 3 of each value – 470pf 560pf 680pf 820pf 1000pf 1500pf 2200pf 3300pf £0.69
16163 – 24 – 3 of each value – 4700pf 6800pf 01uf 015uf 022uf 033uf 047uf £0.69

ELECTROLYTIC PAKS

A range of paks each containing 18 first quality, mixed value miniatures
16201 — 47mFD-10mFD £0.69
16202 — 10mFD-100mFD £0.69
16203 — 100mFD-680mFD £0.69

CARBON RESISTOR PAKS

16213 – 60 mixed ¼w 100 ohms – 820 ohms £0.69
16214 – 60 mixed ¼w 1K ohms – 82k ohms £0.69
16215 – 60 mixed ¼w 10K ohms – 83K ohms £0.69
16216 – 60 mixed ¼w 100K ohms – 820K ohms £0.69
16217 – 40 mixed ½w 100 ohms – 820 ohms £0.69
16218 – 40 mixed ½w 1K ohms – 82K ohms £0.69
16219 – 40 mixed ½w 10K ohms – 82K ohms £0.69
16220 – 40 mixed ½w 100K ohms – 820K ohms £0.69
16230 – 60 mixed ¼w 1 Meg 10 Meg ohms £0.69
16231 – 40 mixed ½w 1 Meg – 10 Meg ohms £0.69

COMPONENT PAKS

16164 – 200 Resistor mixed value approx (Count by weight) £0.69
16165 – 150 Capacitors mixed value approx (Count by weight) £0.69
16166 – 50 Precision resistors. Mixed values £0.69
16167 – 80 ⅛w resistors. Mixed values £0.69
16168 — 5 pieces assorted ferrite rods £0.69
16169 – 2 Tuning gangs MW LW VHF £0.69
16170 – 1 Pack wire 50 metres assorted volours single strand £0.69
16171 – 10 Reed switches £0.69
16172 – 3 Micro switches £0.69
16173 – 15 Assorted pots £0.69
16174 – 5 metal jack sockets 3 x 3.5mm 2 x standard switch types £0.69
16175 – 30 Paper condensers – mixed values £0.69
16176 – 20 Electrolytics trans types £0.69
16177 – 1 Pack assorted hardware – Nuts, bolts, gromets etc £0.69
16178 – 5 Mains slide switches, assorted £0.69
16179 — 20 Assorted tag strips and panels £0.69
16180 — 15 Assorted control knobs £0.69
16181 – 3 Rotary wave change switches £0.69
16182 – 2 Relays 6-24v operating £0.69
16183 – 1 Pak copper laminate approx 200 sq inches £0.69
16184 – 15 Assorted Fuses 100mA 5 amp £0.69
16185 – 50 metres PVC sleeving assorted size and colours £0.69

METAL FOIL CAPACITORPAK

16204 – Containing 50 metal foil capacitor like Mullard C280 series – Mixed values ranging from 01uf-2.2uf. Complete with identification sheet £1.38

SLIDER PAKS

16190 — 6 slider mixed £0.69
16191 – 6 slider 470 ohms £0.69
16192 — 6 slider 10K ohms 1in £0.69
16193 – 6 slider 22K ohms 1in £0.69
16194 – 6 slider 47K ohms 1in £0.69
16195 – 6 slider 47K log £0.69

TRANSISTORS

Type	Price	Type	Price	Type	Price
AC107	£0.28	AD162	£0.40	BC151	£0.25
AC113	£0.23	AD161/162	£0.81	BC152	£0.23
AC115	£0.23	ADT140	£0.63	BC153	£0.29
AC117	£0.35	AF124	£0.35	BC154	£0.22
AC117K	£0.39	AF125	£0.35	BC157	£0.12
AC121	£0.23	AF126	£0.35	BC158	£0.12
AC122	£0.16	AF127	£0.37	BC159	£0.12
AC125	£0.21	AF139	£0.40	BC160	£0.30
AC126	£0.21	AF178	£0.69	BC161	£0.44
AC127	£0.21	AF179	£0.69	BC167	£0.14
AC128	£0.18	AF180	£0.69	BC168	£0.14
AC128K	£0.30	AF181	£0.67	BC169	£0.10
AC132	£0.23	AF186	£0.58	BC169C	£0.12
AC134	£0.23	AF239	£0.44	BC170	£0.10
AC137	£0.23	AL102	£1.38	BC171	£0.10
AC141	£0.24	AL103	£1.36	BC172	£0.10
AC141K	£0.35	AU104	£1.61	BC173	£0.10
AC142	£0.23	AU110	£1.61	BC174	£0.17
AC142K	£0.35	AU113	£1.61	BC175	£0.40
AC151	£0.23	BC107	£0.09	BC177	£0.18
AC153	£0.23	BC107A	£0.09	BC178	£0.18
AC153K	£0.35	BC107B	£0.10	BC179	£0.18
AC154	£0.23	BC107C	£0.12	BC180	£0.29
AC155	£0.23	BC108	£0.09	BC181	£0.10
AC156	£0.23	BC108A	£0.09	BC182	£0.25
AC157	£0.29	BC108B	£0.10	BC182L	£0.10
AC165	£0.23	BC108C	£0.12	BC183	£0.10
AC166	£0.23	BC109	£0.09	BC183L	£0.10
AC167	£0.23	BC109B	£0.10	BC184	£0.10
AC168	£0.29	BC109C	£0.12	BC184L	£0.10
AC169	£0.23	BC113	£0.18	BC186	£0.25
AC171	£0.29	BC114	£0.18	BC187	£0.25
AC176	£0.23	BC125	£0.20	BC207	£0.13
AC176K	£0.30	BC126	£0.25	BC208	£0.13
AC178	£0.29	BC132	£0.21	BC209	£0.14
AC179	£0.29	BC134	£0.21	BC212	£0.10
AC180	£0.23	BC135	£0.17	BC212L	£0.10
AC180K	£0.32	BC136	£0.21	BC213	£0.10
AC181	£0.23	BC137	£0.21	BC251	£0.17
AC181K	£0.32	BC139	£0.37	BC251A	£0.18
AC187	£0.21	BC140	£0.35	BC301	£0.32
AC187K	£0.32	BC141	£0.32	BC302	£0.33
AC188	£0.21	BC142	£0.25	BC303	£0.32
AC188K	£0.32	BC143	£0.25	BC304	£0.44
AD140	£0.69	BC145	£0.53	BC327	£0.18
AD142	£0.98	BC147	£0.08	BC328	£0.17
AD143	£0.86	BC148	£0.08	BC337	£0.17
AD149	£0.69	BC149	£0.08	BC338	£0.17
AD161	£0.40	BC150	£0.23	BC440	£0.35

Type	Price	Type	Price	Type	Price
BC441	£0.35	BF165	£0.55	2N1305	£0.21
BC460	£0.44	BF167	£0.28	2N1306	£0.29
BC461	£0.44	BF173	£0.23	2N1307	£0.29
BC477	£0.23	BF176	£0.44	2N1308	£0.36
BC478	£0.23	BF177	£0.30	2N1309	£0.35
BC479	£0.23	BF178	£0.32	2N1711	£0.23
BC547	£0.12	BF179	£0.35	2N2219	£0.23
BC548	£0.12	BD239A/240AMP	£1.15	2N2221	£0.23
BC549	£0.12	BF180	£0.35	2N2222	£0.23
BC550	£0.16	BF181	£0.35	2N2369	£0.16
BC556	£0.16	BF182	£0.35	2N2711	£0.25
BC557	£0.15	BF183	£0.35	2N2712	£0.25
BC558	£0.14	BF184	£0.23	2N2714	£0.25
BC559	£0.16	BF185	£0.23	2N2904	£0.21
BCZ10	£0.69	BF186	£0.30	2N2905	£0.21
BCZ11	£0.69	BF187	£0.30	2N2906	£0.18
BCZ12	£0.69	BF188	£0.46	2N2907	£0.23
BD115	£0.58	BF194	£0.12	2N2923	£0.17
BD116	£0.92	BF195	£0.12	2N2924	£0.17
BD121	£0.75	BF196	£0.12	2N2925	£0.17
BD123	£0.75	BF197	£0.14	2N2926G	£0.10
BD124	£0.81	BF198	£0.16	2N2926Y	£0.09
BD131	£0.40	BF199	£0.16	2N2926O	£0.09
BD132	£0.40	MJE340	£1.50	2N2926R	£0.09
BD131/132MP	£0.92	MJE2955	£1.04	2N2926B	£0.09
BD133	£0.46	MJE3055	£0.69	2N3053	£0.18
BD135	£0.44	TIP29A	£0.46	2N3054	£0.46
BD136	£0.40	TIP29B	£0.48	2N3055	£0.46
BD137	£0.40	TIP29C	£0.51	2N3402	£0.24
BD138	£0.41	TIP30A	£0.46	2N3403	£0.24
BD139	£0.41	TIP30B	£0.48	2N3404	£0.33
BD140	£0.41	TIP30C	£0.51	2N3405	£0.38
BD139/140MP	£0.92	TIP31A	£0.46	2N3702	£0.09
BF115	£0.25	TIP31B	£0.48	2N3703	£0.09
BF152	£0.29	TIP31C	£0.51	2N3704	£0.08
BF153	£0.29	TIP32A	£0.46	2N3705	£0.08
BF154	£0.25	TIP32B	£0.48	2N3706	£0.09
BF155	£0.40	TIP32C	£0.51	2N3707	£0.09
BF156	£0.32	TIP41A	£0.51	2N3708	£0.08
BF157	£0.32	TIP41B	£0.53	2N3709	£0.08
BF158	£0.32	TIP41C	£0.55	2N3710	£0.08
BF159	£0.32	TIP42A	£0.51	2N3711	£0.08
BF160	£0.35	2N706	£0.12	2N3772	£1.84
BF162	£0.35	2N707	£0.55	2N3773	£2.53
BF163	£0.35	2N708	£0.16	2N3819	£0.21
BF164	£0.55	2N1302	£0.17	2N3820	£0.40
		2N1303	£0.21	2N3821	£0.69
		2N1304	£0.21	2N3823	£0.69
				2N3903	£0.12

74 SERIES TTL IC's

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.16	7422	£0.18	7448	£0.64	7489	£1.96	74123	£0.46	74175	£0.71
7401	£0.13	7423	£0.24	7450	£0.13	7490	£0.37	74136	£0.60	74176	£0.67
7402	£0.13	7425	£0.22	7451	£0.13	7491	£0.74	74141	£0.63	74177	£0.67
7403	£0.13	7426	£0.28	7453	£0.13	7492	£0.40	74145	£0.63	74180	£1.73
7404	£0.13	7427	£0.28	7454	£0.13	7493	£0.35	74150	£0.76	74181	£0.67
7405	£0.13	7428	£0.30	7460	£0.13	7494	£0.66	74151	£0.65	74182	£0.81
7406	£0.25	7430	£0.15	7470	£0.29	7495	£0.58	74153	£0.55	74184	£0.81
7407	£0.25	7432	£0.25	7472	£0.23	7496	£0.68	74154	£0.94	74190	£0.78
7408	£0.15	7433	£0.35	7473	£0.29	74100	£0.98	74155	£0.58	74191	£0.71
7409	£0.15	7437	£0.24	7474	£0.29			74156	£0.58	74192	£0.69
7410	£0.13	7438	£0.24	7475	£0.33	74104	£0.45	74157	£0.58	74193	£0.67
7411	£0.20	7440	£0.14	7476	£0.29	74105	£0.44	74160	£0.67	74174	£0.71
7412	£0.17	7441	£0.58	7480	£0.51	74107	£0.28	74161	£0.71	74195	£0.69
7413	£0.28	7442	£0.46	7481	£0.98	74110	£0.41	74162	£0.71	74196	£1.21
7414	£0.58	7443	£0.81	7482	£0.78	74111	£0.67	74163	£0.71	74197	£1.21
7416	£0.28	7444	£0.81	7483	£0.67	74118	£0.92	74164	£0.78	74198	£2.13
7417	£0.26	7445	£0.75	7484	£1.01	74119	£1.36	74165	£0.78	74199	£2.13
7420	£0.13	7446	£0.69	7485	£0.78	74121	£0.28	74166	£0.90		
7421	£0.23	7447	£0.55	7486	£0.25	74122	£0.45	74174	£0.75		

CMOS IC's

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.16	CD4012	£0.22	CD4021	£0.94	CD4030	£0.65	CD4045	£1.61	CD4070	£0.20
CD4001	£0.23	CD4013	£0.48	CD4022	£0.94	CD4031	£2.30	CD4046	£1.50	CD4071	£0.20
CD4002	£0.18	CD4015	£0.94	CD4023	£0.22	CD4035	£1.38	CD4047	£1.00	CD4072	£0.20
CD4006	£1.06	CD4016	£0.49	CD4024	£0.75	CD4037	£1.09	CD4049	£0.55	CD4081	£0.20
CD4007	£0.20	CD4017	£0.94	CD4025	£0.22	CD4040	£1.01	CD4050	£0.55	CD4082	£0.25
CD4008	£1.06	CD4018	£0.98	CD4026	£1.38	CD4041	£0.87	CD4054	£1.27	CD4510	£1.27
CD4009	£0.52	CD4019	£0.48	CD4027	£0.58	CD4042	£0.83	CD4055	£1.15	CD4511	£1.44
CD4010	£0.55	CD4020	£1.04	CD4028	£0.78	CD4043	£1.01	CD4056	£1.55	CD4516	£1.15
CD4011	£0.23			CD4029	£0.98	CD4044	£0.94	CD4069	£0.20	CD4518	£1.15

LINEAR IC's

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£1.12	CA3090	£4.14	LM3900	£0.67	NE567	£1.96	741P	£0.23	TBA810S	£0.88
CA3014	£1.55	CA3123	£2.19	MC1303L	£0.98	UA702C	£0.53	UA747C	£0.69	TBA810	£1.13
CA3018	£0.75	CA3130	£1.07	MC1304	£2.19	72702	£0.53	72747	£0.69	TBA820	£0.81
CA3020	£1.96	CA3140	£0.81	MC1310	£1.09	UA703	£0.29	UA748	£0.40	TBA9200	£2.88
CA3028	£0.92			MC1312	£2.19	UA709	£0.29	72748	£0.40	TCA270S	£2.30
CA3035	£1.61	LM301	£0.33	MC1350	£1.38	72709	£0.53	748P	£0.40	TBA800	£0.92
CA3036	£1.15	LM304	£1.84	MC1352	£1.61	709P	£0.29	SN76013N	£1.97		
CA3042	£0.75	LM308	£1.15	MC1469	£3.39	UA710C	£0.46	SN76023N	£1.97		
CA3043	£2.13	LM309	£1.73	MC1496	£1.04	72710	£0.35	SL414A	£2.24		
CA3046	£0.81	LM320-5V	£1.73	NE536	£3.06	UA711C	£0.37	TAA550B	£0.40		
CA3052	£1.84	LM320-15V	£1.73	NE550	£1.09	72711	£0.37	TAA621A	£2.30		
CA3054	£1.27	LM320-15V	£1.73	NE555	£0.26	UA723C	£0.52	TAA621B	£2.88		
CA3075	£1.73	LM320-15V	£1.73	NE556	£0.69	72723	£0.52	TAA661	£1.73		
CA3081	£1.73	LM380	£0.98	NE565	£1.38	UA741C	£0.28	TAD100	£1.60		
CA3089	£2.30			NE566	£1.73	72741	£0.28	TBA540	£2.42		

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA110	£0.19	BA173	£0.17	BY127	£0.18	BYZ13	£0.46	OA81	£0.12	IN34	£0.08
AA120	£0.09	BB104	£0.46	BY128	£0.18	BYZ16	£0.47	OA85	£0.12	IN34A	£0.08
AA129	£0.09	BAX13	£0.08	BY130	£0.20	BYZ17	£0.41	OA90	£0.12	IN914	£0.07
AAY30	£0.10	BAX16	£0.09	BY133	£0.24	BYZ18	£0.41	OA91	£0.12	IN916	£0.07
AAZ13	£0.17	BY100	£0.25	BY164	£0.59	BYZ19	£0.41	OA95	£0.12	IN4148	£0.07
BA100	£0.12	BY101	£0.25	BY176	£0.86	OA5	£0.69	OA182	£0.18	IS44	£0.06
BA102	£0.37	BY105	£0.25	BY206	£0.35	OA10	£0.40	OA200	£0.09	IS920	£0.07
BA148	£0.17	BY114	£0.25	BYZ10	£0.52	OA47	£0.09	OA202	£0.09		
BA154	£0.14	BY124	£0.25	BYZ11	£0.52	OA70	£0.09	SD10	£0.07		
BA155	£0.16	BY126	£0.17	BYZ12	£0.46	OA79	£0.12	SD19	£0.07		

IC PAKS

Manufacturers 'Fall Outs' which include functional and part functional units. These are classes as 'out-of-spec' from the makers very rigid specifications, but are ideal for learning about I.C's and experimental work.
16224 – 100 Gates assorted 7400 01 04 10 50 60 etc. £1.38
16226 – 30 MXI assorted types 7441 47 90 154 etc. £1.38
16227 – 30 Assorted Linear types 709 741 747 748 710 588 etc. £1.00
16228 – 8 Assorted types SL403 76013 76003 etc. £1.15
16229 – 5 I.C's 76110 Eqv. to MC13130P MA767 £1.73

MAMMOTH I.C. PAK

16223 – Approx 200 pieces assorted fall out integrated circuits including Logic 74 series Linear Audio and DTL Many coded devices but some unmarked you to identify £1.44

JUMBO PAK SEMI CONDUCTOR

16222 Transistors Germ and Silicon Rectifiers Diodes Triacs – Thyristors IC's and Zeners. ALL NEW & CODED Approx 100 pieces. Offering the amateur a fantastic bargain pack and an enormous saving. £2.50

UNTESTED SEMI-CONDUCTOR PAKS

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16132 100 Silicon diodes 200mA OA200 £0.69
16133 150 Silicon fast switch diode 25mA IN4118 £0.69
16134 50 Silicon rectifiers top hat 250mA £0.69
16135 20 Silicon rectifiers stud type 3 amp £0.69
16136 50 400 mW zeners DO7 case £0.69
16137 30 NPN transistors BC107 8 plastic £0.69
16138 25 NPN TO39 2N697 2N1711 silicon £0.69
16138 30 PNP transistors BC177 178 plastic £0.69
16140 25 PNP TO39 2N2905 silicon £0.69
16141 30 NPN TO18 2N706 silicon switching £0.69
16142 25 NPN BFY50 51 £0.69
16143 30 NPN plastic 2N3906 silicon £0.69
16144 30 PNP plastic 2N3905 silicon £0.69
16145 30 Germ OC71 PNP £0.69
16146 15 Plastic power 2N3055 NPN TO220 case £1.38
16147 10 TO3 metal 2N3055 NPN £1.38
16149 10 1 amp SCR TO39 £1.38
16150 8 x 3 amp SCR TO66 case £1.38

TANTALUM CAPACITORS

3137	1MFD	35V	£0.13
3138	22MFD	35V	£0.13
3139	47MFD	35V	£0.13
3141	2.2MFD	35V	£0.14
3142	4.4MFD	35V	£0.21
3157	3.3MFD	25V	£0.21
3143	10MFD	35V	£0.26
3144	22MFD	16V	£0.26
3156	33MFD	35V	£0.13

SOCKETS

1611 8 Pin DIL	£0.10
1612 14 Pin DIL	£0.13
1613 16 Pin DIL	£0.14
1614 24 Pin DIL	£0.28
1615 28 Pin DIL	£0.30
1720 18 Pin DIL	£0.20
1721 20 Pin DIL	£0.22
1722 22 Pin DIL	£0.23
1723 40 Pin DIL	£0.31

G.P. SILICON DIODES

300mW 40PIV (min) sum-min. FULLY TESTED. Ideal for Organ builders. 30 for 68p, 100 for £1.85, 500 for £5.75, 1000 for £10.35.

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		4023	20p	4068	20p
		4024	50p	4069	20p
4001	20p	4025	20p	4070	20p
4002	20p	4027	45p	4071	20p
4007	20p	4028	85p	4072	20p
4009	40p	4029	85p	4081	20p
4011	20p	4040	110p	4093	50p
4012	20p	4041	85p	4510	80p
4013	35p	4042	80p	4511	90p
4015	80p	4043	95p	4518	80p
4016	30p	4046	110p	4520	80p
4017	65p	4049	45p	4527	90p
4018	90p	4050	45p	4528	90p

LINEAR

THIS IS ONLY A SELECTION!

		LM308	60p	NE531	98p
		LM324	45p	NE565	23p
		LM339	45p	NE556	60p
		LM348	90p	NE567	100p
		LM377	170p	RC4136	100p
709	35p	LM378	230p	SN76477	230p
741	16p	LM380	75p	TBA800	70p
747	45p	LM381	150p	TBA810S	100p
748	30p	LM382	120p	TBA1022	620p
7106	850p	LM3900	50p	TL081	45p
CA3046	55p	LM1458	35p	TL084	125p
CA3080	70p	LM3909	65p	ZN414	80p
LF356	80p	LM3911	100p	ZN425E	390p
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		MEMORIES			
		21L02	85p	2516	2185p
CPU'S		2112	175p	2716	2185p
6800	550p	2114	390p	AY5-1013	
8080A	390p	4116	570p		360p
Z80	950p	2708	590p		

TRANSISTORS

				TIP32C	80p
				TIP2955	65p
				TIP3055	55p
		BC548	10p	ZTX107	14p
AC127	17p	BCY71	14p	ZTX108	14p
AC128	16p	BCY72	14p	ZTX300	16p
AC176	18p	BD131	35p	ZTX500	16p
AD161	38p	BD132	35p	2N3053	18p
AD162	38p	BD139	35p	2N3054	50p
BC107	8p	BD140	35p	2N3055	50p
BC108	8p	BFY50	15p	2N3442	135p
BC108C	10p	BFY51	15p	2N3702	8p
BC109	8p	BFY52	15p	2N3704	8p
BC109C	10p	MJ2955	98p	2N3706	9p
BC147	7p	MPSA06	20p	2N3819	15p
BC148	7p	MPSA56	20p	2N3905	8p
BC177	14p	TIP29C	60p	2N3906	8p
BC178	14p	TIP30C	70p	2N5459	32p
BC182	10p	TIP31C	65p	2N5777	50p
BC182L	10p				
BC184	10p				
BC184L	10p				
BC212	10p				
BC212L	10p				
BC214L	10p				

DIODES

1N914	3p	1N4006	6p
1N4148	2p	1N5401	13p
1N4002	4p	BZY88ser.	8p

ITT product
1N4148 — £1.40/100.

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		7473	20p	74145	65p
		7474	22p	74148	90p
7400	10p	7475	25p	74150	55p
7402	10p	7476	20p	74154	65p
7404	12p	7486	20p	74157	40p
7408	12p	7490	25p	74164	55p
7410	10p	7492	30p	74165	55p
7413	22p	7493	25p	74174	55p
7414	39p	7496	45p	74177	50p
7420	12p	74121	25p	74190	50p
7430	12p	74123	38p	74191	50p
7432	18p	74125	35p	74192	50p
7442	38p	74126	35p	74193	50p
7447	45p	74132	45p	74196	50p
7448	50p	74141	55p	74197	50p

FULL DETAILS IN CATALOGUE!

OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	7.5p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		

DISPLAYS

DL704	0.3 in CC	130p	120p
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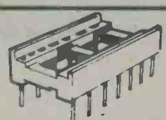
FND500	0.5 in CC	100p	80p

SKTS

Low profile by Texas



8pin	8p	18pin	14p	24pin	18p
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16pin	11p	22pin	17p	40pin	32p

3 lead T018 or T05 socket. 10p each
Soldercon pins: 100:50p 1000:370p

PCBS

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Size in.	0.1in.	0.15in.	
2.5 x 1	14p	–	Vero Cutter 80p.
2.5 x 3.75	45p	45p	
2.5 x 5	54p	54p	Pin insertion tool 108p
3.75 x 5	64p	64p	
3.75 x 17	205p	185p	
Single sided pins per 100	40p	40p	

Top quality fibre glass copper board. Single sided. Size 203 x 95mm. 60p each.
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Carbon film resistors. High stability, low noise 5%.
E12 series. 4.7 ohms to 10M. Any mix:

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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.

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Very high stability, low noise rated at ¼w 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.5	3.2

POTENTIOMETERS

Preset vertical or horizontal 100ohms — 1M . . . 6p
Rotary 5K-2M2 Log or Lin single . . . 28p
Rotary 5K-2M2 Log or Lin double . . . 80p
Slide 60mm travel 5K-500K Log or Lin, single . . . 60p
Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary controls 14p each. Slide type 12p each.

CAPACITORS

POLYSTYRENE

High quality foil type. 63V working, 5% tol.
22pf to 1000pf . . . 6p each
1500pf to 0.01uF . . . 8p each

TANTALUM BEAD
each
0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V . . . 8p
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

POLYESTER

Mullard C280 series
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1. 5p
0.15, 0.22 . . . 7p
0.33, 0.47 . . . 10p
0.68 . . . 14p
1.0uF . . . 17p

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . 2p

MINIATURE TRIMMERS

Miniature film type, in 1.4pF – 5pF, 2pF – 22pF, 2pF – 22pF, 2pF – 10pF, 5.5pF – 65pF. 18p each

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

CONNECTORS

JACK PLUGS AND SOCKETS

	unscreened	screened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

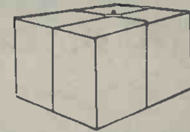
	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

1mm PLUGS AND SOCKETS
Suitable for low voltage circuits. Red & black. Plugs: 6p each Sockets: 7p each.

4mm PLUGS AND SOCKETS
Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

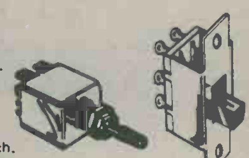
PHONO PLUGS AND SOCKETS
Insulated plug in red or black . . . 9p
Screened plug . . . 13p
Single socket . 7p Double socket . 10p

SPRING SPECIALS



Set of 4 AA (HP7) Rechargeable Cells	~~500p~~	450p
PP3 Rechargeable cell	~~450p~~	410p
Pack of 10 miniature slide switches	~~150p~~	120p
Pack of 10 push to make switches	~~150p~~	120p
Pack of 10 push to break switches	~~200p~~	150p
Murata Ultrasonic Transducers, per pair	~~350p~~	300p
Resistor Development packs. 10 off, each value from 4.7 ohm to 1M ¼w	~~570p~~	500p
½w	~~750p~~	650p
Polyester Development packs. 5 off, each value from 0.01 to 3u2	~~620p~~	520p
Preset Potentiometer pack 5 off, each value 100 ohm to 1M, 65 presets	~~395p~~	305p
Ceramic Development pack 10 off, each value 22pF to 0.1uF, 310 caps.	~~595p~~	525p
LED pack, 10 off, each type 0.2 Red, green, yellow	~~350p~~	300p
Pack of 10 CA3080 Transconductance amps.	~~700p~~	620p
Pack of 10 LM301AN Op. amp.	~~260p~~	230p
Pack of 10 LM380N 2W Audio Amp	~~750p~~	620p
LM380 + LM381 and data	~~235p~~	180p
Pack of 3 LM3909 LED flasher	~~185p~~	150p
Pack of 10 TL081 Jfet Op. amp.	~~450p~~	320p
MM57160 Stac. Timer + data	~~600p~~	550p
SN76477 Sound generator + data	~~240p~~	200p
Pack of 2 ZN414 AM chips	~~160p~~	130p
SS-2 Breadboard	~~1085p~~	990p
Expo Reliant Drill	~~665p~~	570p
Expo Titan Drill	~~1030p~~	920p
Drill stand for above	~~1200p~~	1100p
Pack of 8 2708 Eprom	~~4720p~~	4500p
Pack of 8 2114 Ram LP 300ns	~~3125p~~	3000p
Pack of 8 4116	~~4560p~~	4300p

SWITCHES



TOGGLE
Subminiature toggle. Rated at 2A.
SPST 52p. SPDT 62p. DPDT 69p.
Standard type. Rated at 1.5A.
SPST 34p. DPDT 48p.

SLIDE
Miniature DPDT 15p each.
Standard DPDT 15p each.

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Available in 4 pole 3 way, 3 pole 4 way, 2 pole 6 way, 1 pole 12 way . . . 43p each
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Miniature push to break . . . 20p each
Rockers rated at 10A. SPST 32p each SPDT 42p each.

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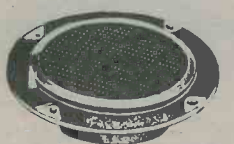
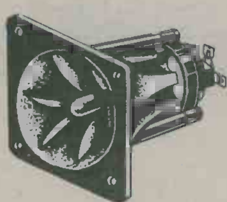
Sturdy ABS black, plastic boxes with brass inserts and lid. 75 x 56 x 35mm **65p.** 95 x 71 x 35mm **75p.** 115 x 95 x 37mm **85p.**

MOTOROLA PIEZO CERAMIC TWEETERS



2.5" Direct Radiating Tweeter, maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8kHz-28kHz, **£4.95.**



3.5" Super Horn (flush mounting), maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8-2.8kHz. **£5.25.**

MORSE KEYS
Beginners practice key **£1.05.** All metal fully adjustable type. **£2.60.**

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1 Centre Zero 17 x 17mm **75p.** 2 (scaled 0-10) 28 x 25mm **75p.** 3 Grundig 40 x 27mm **£1.25.**

JVC NIVICO STEREO CASSETTE MECHANISM. Music centre type. Rev. counter, remote operation **£13.50 and £1.00 p&p.**

JUMPER TEST LEAD SETS
10 pairs of leads with various coloured croc clips each end (20 clips) **90p per set.**

TRANSFORMERS
All 240VAC Primary (postage per transformer is shown after price). MINIATURE RANGE: 6-0-6V 100mA, 9-0-9V 75mA and 12-0-12V 50mA **all 79p each (15p).** 280mA **£1.20 (20p).** 6V 500mA **£1.20 (15p).** 12V 2 amp **£2.75 (45p).** 15-0-15V 3 amp Transformer at **£2.85 (54p).** 30-0-30V 1 amp **£2.85 (54p).** 20-0-20V 2 amp **£3.65 (54p).** 0-12-15-20-24-30V 2 amp **£4.75 (54p).** 20V 2.5 amp **£2.45 (54p).**

TRIAC/XENON PULSE TRANSFORMERS
1:1 (gpo style) 30p. 1:1 plus 1 sub. min. pcb mounting type **60p each.**

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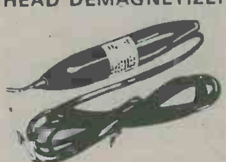
Min. tie pin. Omni, uses deaf aid battery (supplied), **£4.95.** ECM105 low cost condenser, Omni, 600 ohms, on/off switch, standard jack plug, **£2.95.** EM507 Condenser, uni, 600 ohms, 30-18kHz., highly polished metal body **£7.92.** DYNAMIC stick microphone dual imp., 600 ohms or 20K, 70-kHz., attractive black metal body **£7.75.** EM506 dual impedance condenser microphone 600 ohms or 50K, heavy chromes copper body, **£12.95.** CASSETTE replacement microphone with 2.5/3.5 plugs **£1.35.** INSERT Crystal replacement 35X10mm **40p.** GRUNDIG electric inserts with FET preamp, 3-6VDC operation **£1.00.**

LIGHT DIMMER
240VAC 800 watts max. wall mounting, has built in photo cell for automatic switch on when dark **£4.50**

RIBBON CABLE
8 way single strand miniature **22p per metre.**

SPECIAL OFFER TAPE HEAD DEMAGNETIZER



240VAC with curved probe suitable for reel to reel or cassette machines, **£1.95.**

STEREO FM/GRAM TUNER AMPLIFIER CHASSIS, VHF and AM. Bass, treble and volume controls, Gram. 8-track inputs, headphone output jack, 3 watts per channel with power supply. **£14.95 and £1.20 p&p** (CCT supplied).

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Pocket Multimeter, 1,000 opv sensitivity. Ranges IKV AC/DC Volts, 150ma DC current, resistance 0-2.5K, 0-100K, **£4.50.**

20,000 opv., 1,000 volts AC/DC, DC current to 500ma, 5 ranges, resistance 4 ranges to 6 meg. Mirror scale, carrying handle, **£9.75.**

MURATA MA401
40kHz Transducers. Rec./Sender **£3.50 pair.**

TELEPHONE PICK UP COIL
Sucker type with lead and 3.5mm plug **62p.**

RELAYS
Plastic Encap. Reed Relay, 0.1 matrix. 1kΩ coil, 9-12VDC normally open, **35p.** Miniature encapsulated reed relay 0.1 matrix mounting, single pole make, operates on 12VDC **50p each.** Continental series, sealed plastic case relays, 24VDC 3pole change over 5 amp contacts, new **65p.** Min. sealed relay, P.C. mounting, 6-9vdc operation changeover 3 amp contacts, new **85p.** Metal Cased Reed Relay, 50 x 45 x 17mm, has 4 heavy duty make reed inserts, operates on 12VDC **35p each.** Magnets ½" long ⅛" thick with fixing hole, 10 for **40p.**

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Rubber duck type BNC termination, **£3.50.**

CRIMPING TOOL
Combination type for crimping red blue and yellow terminations also incorporates a wire stripper (6 gauges) and wire cutter, with insulated handles only **£2.30.**

POWER SUPPLIES
SWITCHED TYPE, plugs into 13 amp socket, has 3-4.5-6-7.5 and 9 volt DC out at either 100 or 40 0mA, switchable **£3.45.** HC244R STABILISED SUPPLY, 3-6-7.5-9 volts DC out at 400mA max., with on/off switch, polarity reversing switch and voltage selector switch, fully regulated to supply exact voltage from no load to max. current **£4.95.**

AMPHENOL CONNECTORS
(PL259) **PLUGS 47p.** Chassis sockets **42p.** Elbows PL259/SO239 **90p.** Double in line male connector (2XPL259) **65p.** Plug reducers **13p.** PL259 Dummy load, 52 ohms 1 watt with indicator bulb **95p.**

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MINIATURE SOLID STATE BUZZERS, 33 x 17 x 15mm white plastic case, output at three feet 70db (approx), low consumption only 15mA, voltage operating 4-15VDC, **75p each.** LOUD 12VDC BUZZER, Cream plastic case, 50mm diam. x 30mm high **63p.** GPO OPEN TYPE BUZZER, adjustable works 6-12VDC **27p.** 12VDC siren, all metal rotary type, high pitched wail, **£7.50.**

TOOLS
SOLDER SUCKER, plunger type, high suction, teflon nozzle, **£4.99** (spare nozzles **69p each).**
Good Quality snub nosed pliers, insulated handles, 5" **£1.45.**
Antex Model C 15 watt soldering irons, 240VAC **£3.95**
Antex Model CX 17 watt soldering irons, 240VAC **£3.95.**
Antex Model X25 25 watt soldering irons, 240VAC **£3.95.**
Antex ST3 iron stands, suits all above models **£1.65.**
Antex heat shunts **12p each.**
Servisol Solder Mop **50p each.**
Neon Tester Screwdrivers 8" long **59p each.**
Miyarna IC test clips 16 pin **£1.95.**

SWITCHES
Sub. miniature toggles: SPST (8 x 5 x 7mm) **42p.** DPDT (8 x 7 x 7mm) **55p.** DPDT centre off 12 x 11 x 9mm **77p.** PUSH SWITCHES, 16 x 6mm, red top, push to make **14p each,** push to break version (black top) **16p each.**

G.P.O. Telephone handsets **£1.95.** Electrolytic Caps, can type, 2,200mfd and 2,200mfd 50VDC **35p each.**

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Resistance Substitution Box. Swivelling disc provides close tolerance resistors of 36 values from 5 ohms to 1 meg. **£3.95.**

Signal Generator. Ranges 250Hz-100MHz in 6 Bands, 100MHz-300MHz (harmonics) internal modulator at 100Hz. R.F. output Max. 0.1vRMS. All transistorised unit with calibrating device. 220-240VAC operation, **£48.95.**

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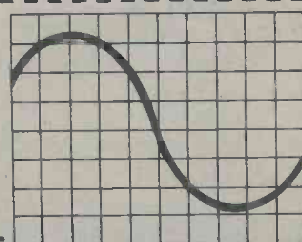

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GENTS MEMORY CALENDAR ALARM CHRONOGRAPH

Latest technology. Constant display of hours, minutes, sec's, weekday and snooze alarm indication. A further two optional display modes are available, one being the calendar and month, which can be increased or decreased to give the appropriate month of the year. A 1/100th sec. chronograph with split and lap mode facilities with a 12 hour capacity. A 24 hour alarm with a 10 minute snooze function is also standard to this watch. A further feature is the back light and fully adjustable stainless steel strap.

£19.95

GENTS MULTI-MELODY CHIME ALARM CHRONOGRAPH

Latest technology. Constant display of hours, minutes, sec's, weekday, date and month, with mode and chime indication display. A musical alarm is built in and can be set to anytime within 24 hours, once activated playing the tune "Oh Suzzana". Two further alarm systems are built in (i) 24 hour alarm, (ii) countdown alarm, the watch can be set to chime on every full hour. A 1/100th sec, chronograph with split and lap mode facility is standard, the watch function may also be switched off. An excellent feature is the mineral glass face. This watch also has a battery hatch, backlight and infinite adjustable stainless steel strap.

£19.95

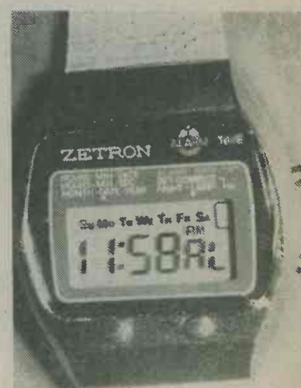
GENTS CHRONOGRAPH

Probably the best looking chrono on the market. Constant display of hours, minutes, sec's, with am/pm indication, also month, date and weekday indication. 1/100th and 1/10th with split and lap mode facilities, backlight and close woven fully adjustable stainless steel strap.

SPECIAL £8.95

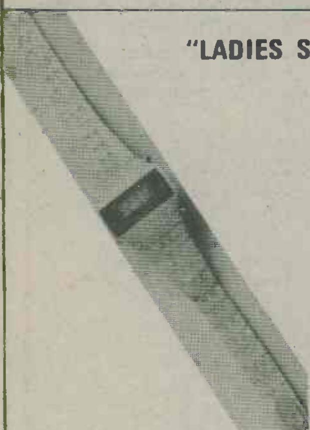
GENTS FRONT BUTTON ALARM

Latest style! Constant display of hours, minutes, sec's, am/pm, weekday and alarm indication. A further two optional display modes are available. The watch comprises of 7 digits, 12 functions and is programmed to the year 2009. The alarm can be set to anytime within 24 hours and operates for 30 seconds. A backlight and a closely woven adjustable stainless steel strap highlight this extremely sleek looking watch — only 8mm thick.



£13.25

"LADIES SUGAR COATED"



Another superb ladies watch with that extremely popular sugar frosted finish, (gold or silver finish). Links can easily be removed from the strap, and the clasp has a spring mechanism built in to give a comfortable fitting. Constant display of hours and minutes, with month, date and seconds mode. Auto calendar and backlight.

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K004 Mylar capacitors, min. 100V type 10 each all values from 1000pF to 10,000pF. Total 130 for £4.05
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K006 Tantalum bead capacitors, 10 each of the following: 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1, 2.2, 3.3, 4.7, 6.8, all 35V; 10/25, 15/16, 22/16, 33/10, 47/6, 100/3. Total 170 for £14.56
K007 Electrolytic capacitors 25V working, small physical size. 10 each of these popular values: 1, 2.2, 4.7, 10, 22, 47, 100uF. Total 70 for £3.59
K008 Extended range, as above, also including 220, 470 and 1000uF. Total 100 for £6.05
K021 Miniature carbon film 5% resistors, CR25 or similar, 10 of each value from 10R to 1M, E12 series. Total 610 resistors. £6.15
K022 Extended range, total 850 resistors from 1R to 10M £8.50
K041 Zenner diodes, 400mW 5% BZY88 etc. 10 of each value from 2.7V to 36V, E 24 series. Total 280 for £16.37
K042 As above but 5 of each value £9.31

£1 BARGAIN PACKS

K101-	16 BC239B N.P.N. Low Noise	£1.00
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K105-	50 IN4148 Silicon Diode	£1.00
K106-	18 BC184L N.P.N. Low Noise	£1.00
K107-	18 BC213L P.N.P. General Purpose	£1.00
K108-	8 2N5060 30N .8A SCR	£1.00
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K114-	15 XK6116 (BF241) N.P.N. 200 MHz	£1.00
K115-	18 SP1218 (2N3702) P.N.P. Gen. Purpose	£1.00
K117-	10 BF450 P.N.P. T.V. IF Amp.	£1.00
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Large range of Standard Veroboard and boxes/cases in stock. Details in catalogue, **45p**

SCOOP! Verobox type 2522, unused but has 3 ½" holes in one end and 1 ⅜" hole the other, so instead of £3.96, we are selling these at **£1.85**

COMPONENT TRAY

Attractive yellow tray 285 x 165 x 42 mm with clear hinged lid and moveable compartments. Up to 15 can be made from dividers supplied. As an added bonus, a selection of new surplus components are included, all for the special low price of **£3.95.**

SCR PANEL & REED-PANEL

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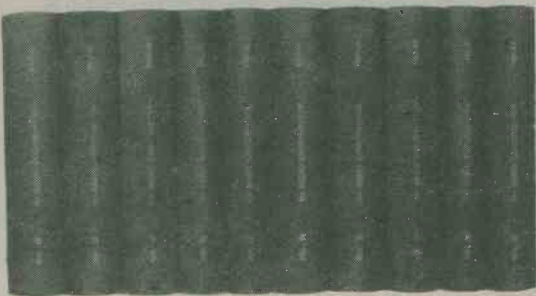

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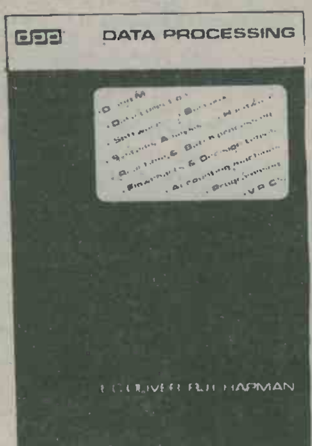

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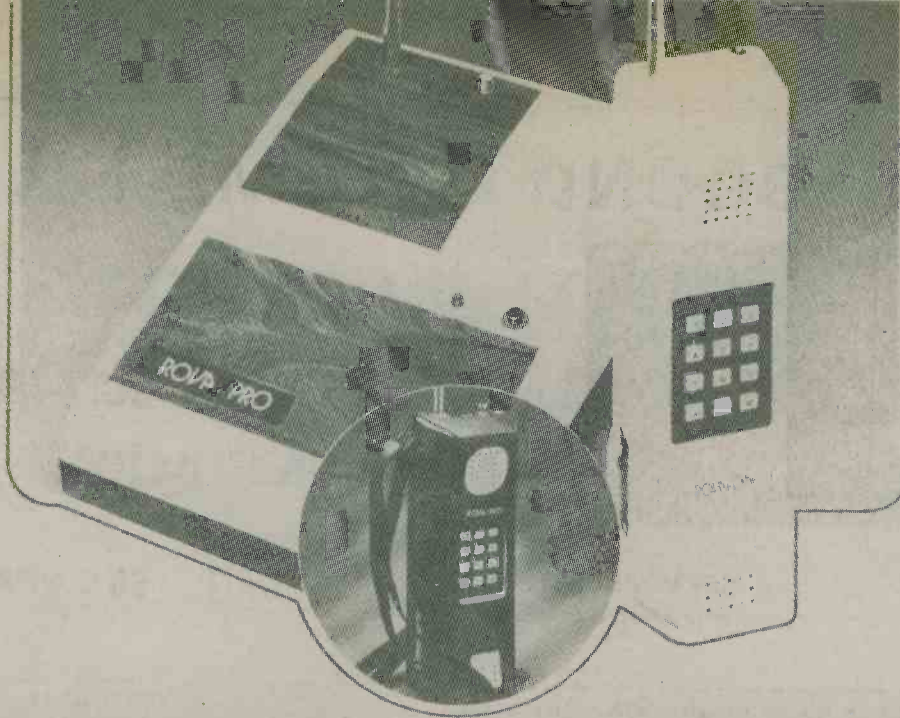

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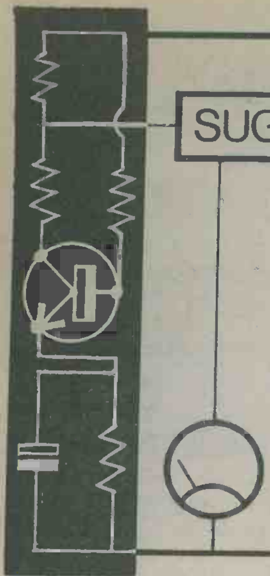


SUGGESTED CIRCUIT

THE "40-20" GAME

By G. A. French

A very useful CMOS integrated circuit which does not appear to have had its fair share of attention in the amateur electronic press is the CD4020. This device is a 14-stage binary counter-divider and it offers 14 divide-by-two stages, coupled internally so that one stage output feeds the following stage input. In consequence, it has the ability of dividing by 2 to the power of 14, or by 16,384.

PIN FUNCTIONS

The pin functions of the CD4020 are illustrated in Fig. 1. Pins 16 and 8 are the usual VDD and VSS supply pins, and pin 11 is the reset pin. When taken to the positive rail, this pulls all outputs to zero regardless of whether an input is being fed to the i.c. or not. Input pulses are applied to pin 10, and divided outputs are available at all the remaining pins.

In the diagram the pin numbers are shown inside the i.c. rectangle. Each figure outside the rectangle in brackets indicates the power of 2 by which division has been made at the pin concerned and the following figure gives the resultant number in decimal. Pin 9 gives a divide-by-two function, and there are no outputs for 2 to the powers of 2 and 3. The next pin, pin 7, gives an output divided by 2 to the power of 4, or 16, and this is followed by pins which correspond to powers of 2 up to the power of 14.

To gain an idea of the manner in which the CD4020 functions, a simple test circuit can be made up in the manner shown in Fig. 2. The input pulses may be obtained from an oscillator of the type to be described later in this article, and outputs are taken from four pins giving divided outputs starting at 2 to the power of 4 and ending at 2 to the power of 7. Each l.e.d. lights up when the output to which it connects goes high.

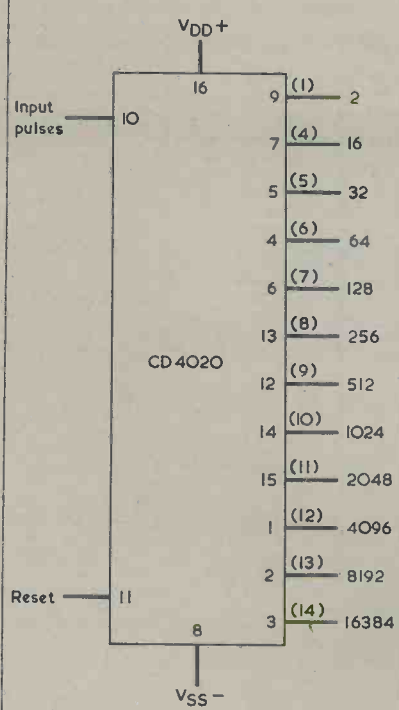


Fig. 1. Pin functions of the CD4020. This i.c. consists of a number of serial coupled binary dividers, and the total dividing capacity is extremely high

The waveforms of the outputs are shown in Fig. 3. As is shown in this diagram, the output at pin 5 goes into transition from one state to the other with every negative-going pulse edge at pin 7. Similarly, transitions at pin 4 occur on negative-going pulse edges at pin 5, and transitions at pin 6 on negative-going pulse edges at pin 5. The same relationshipo between outputs would be given if we were to examine the succeeding divided outputs.

An interesting effect is that the four l.e.d.'s of Fig. 2 will count twice the number of pulses at pin 7 in binary, assuming that a lit l.e.d. corresponds to 1 and an extinguished l.e.d. to 0. At the start of the period designated "8 pulses" (or immediately after taking the i.c. out of reset) all the outputs are low, giving a binary count of 0000. The first pulse at pin 7 gives binary 0001, and when it ends the next binary count is 0010. This proceeds until the middle of the period, where 0111 gives way to 1000, and the l.e.d.'s then go through 1001, 1010, 1011, etc., until they reach 1111. After that all the l.e.d.'s extinguish, to start again at 0000.

There are a number of useful

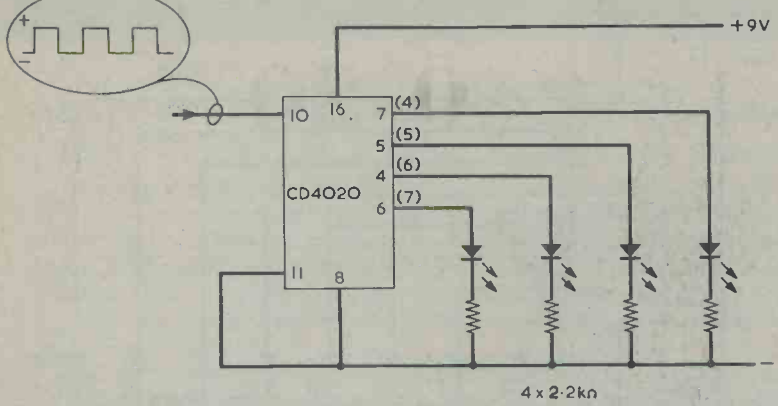


Fig. 2. A test circuit for examining the relationship between four successive outputs of the CD4020

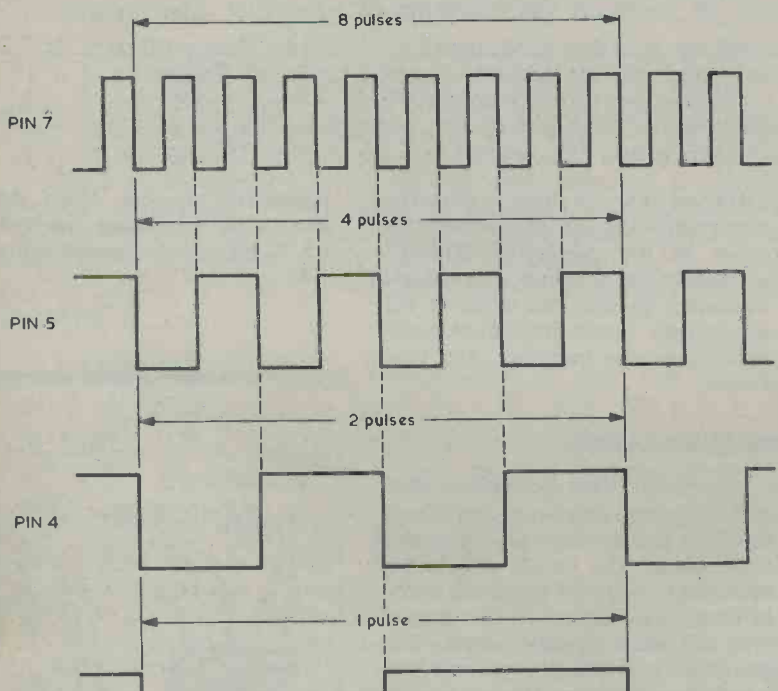


Fig. 3. The output waveforms given by the test circuit of Fig. 2. Each of the three lower waveforms goes through its transitions on the negative-going pulse edges of the preceding waveform. The waveforms also present a binary count

possibilities for which the CD4020 may be used, one of the most obvious ones being in a long-term timer. In this application, an oscillator would feed into pin 10 of the device, and the timed circuit would be activated by an output from, say, pin 3. In the present article, the CD4020 is employed in a simple electronic game in which eight successive outputs of the CD4020 are coupled to eight l.e.d.'s.

GAME CIRCUIT

The circuit of the game is illustrated in Fig. 4, and in this an oscillator feeds the pin 10 input of the CD4020. The oscillator can be started by momentarily pressing S1, and it can be stopped by similarly pressing S2. The eight l.e.d.'s flash on and off following the pattern illustrated in Fig. 3, and the purpose of the game is to stop the oscillator at an instant when all eight l.e.d.'s are alight. A tantalising feature of the game is that all l.e.d.'s are alight only when the circuit has counted up to binary 11111111, after which all the l.e.d.'s extinguish. This binary number is equal to decimal 255, which means that, taking in the all-zeros state, there are 256 l.e.d. states of which only one is the required state.

The oscillator is given by two gates of a CD4011, the feedback loop comprising C1, R3 and R2. The oscillator is enabled when its pin 1 is high and is inhibited when this pin is low. The two lower gates of the CD4011 form a latch, giving an output at pin 11 which is taken to pin 1 of the oscillator gates. If the latch output is high, pressing S2 will immediately cause it to go low and to stay low, thereby stopping the oscillator. Pressing S1 takes the latch output high once more and allows the oscillator to start again. If both S1 and S2 are pressed at the same time, current from the 9 volt supply is limited by R1 to less than 1mA, and the "Stop" function predominates. The oscillator output passes to pin 10 of the CD4020.

A reset function is available by pressing S3, which then takes pin 11 high and sets all outputs to zero. When S3 is open, pin 11 is taken low by way of R5. The reset feature is not entirely necessary for the game application, although it allows new players to gain an idea of the manner in which the l.e.d.'s light up in turn starting from the condition in which they are all extinguished.

The eight outputs from the CD4020 couple to the eight l.e.d.'s as shown. Each l.e.d. has a series

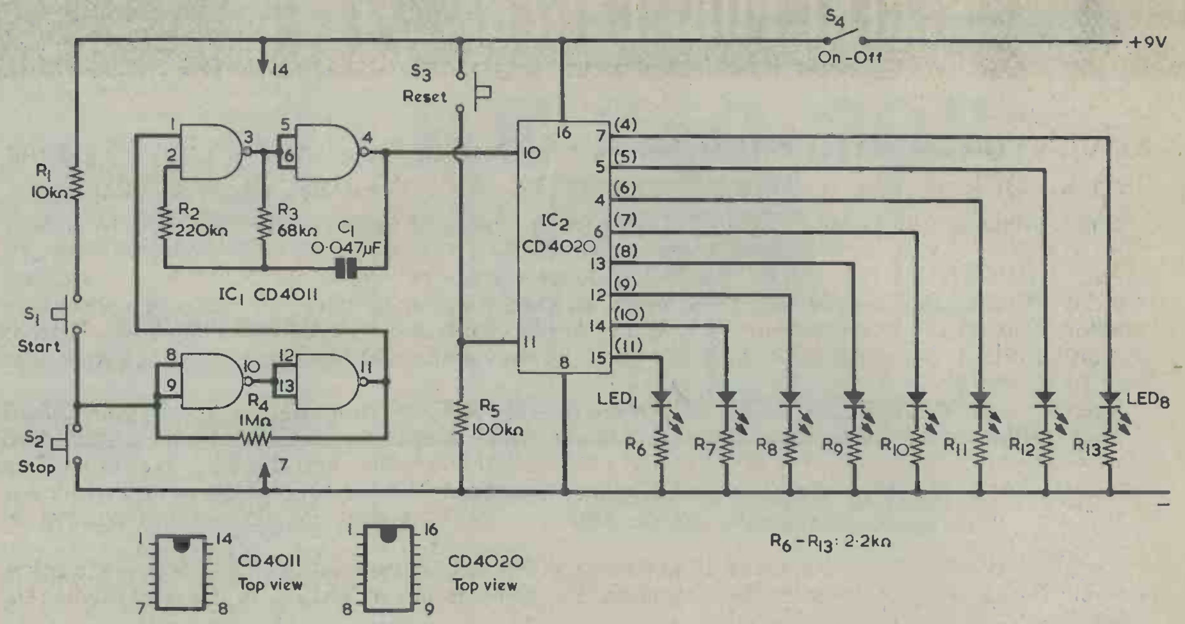


Fig. 4. The circuit of the "40-20" game. The purpose of this is to stop the oscillator at an instant when all eight l.e.d.'s are alight. No connections are made to the pins of the IC2 which do not appear in the diagram

current limiting resistor in order that dissipation inside the i.c. can be kept to a low level. It is found that about 2 volts is dropped inside the i.c. for each l.e.d. that is lit. The l.e.d. current is about 2mA each, giving a total dissipation in the i.c. of around 32mW when all the l.e.d.'s are alight. Current consumption from the 9 volt supply is approximately 15mA when all the l.e.d.'s are lit, and is too low to be measured with a standard testmeter when they are extinguished, Average current is therefore about 7.5mA.

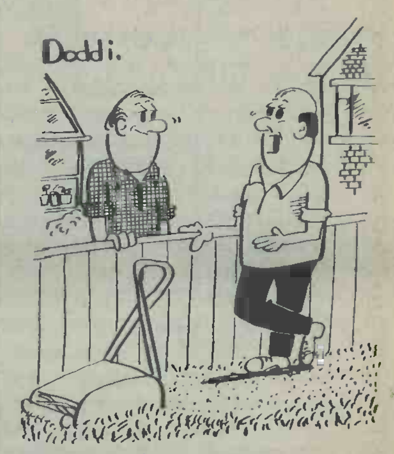
The oscillator frequency is such that LED1 goes through a 20 second cycle, consisting of 10 seconds alight and 10 seconds extinguished. This means that the cycle for LED8 is 20 seconds divided by 128, or 0.16 second. This is shorter than the normal human reaction time of around 0.25 second, with the result that a small element of luck is required to succeed in having all the l.e.d.'s alight. Nevertheless, this can be achieved by judicious operation of the "Stop" and "Start" buttons. If it is found that the cycle for LED1 is significantly longer or shorter than 20 seconds, this will be due to differences in the transfer characteristics of the oscillator gates in the particular CD4011 employed for IC1, and it is merely necessary to alter the value of R3 accordingly. Increasing its value will slow down the oscillator, and vice versa.

PRESENTATION

The circuit may be housed in a plastic case having the four switches and the eight l.e.d.'s on the front panel. The l.e.d.'s should be mounted in a line, in the same order in which they appear in the circuit. This will allow persons playing the game to understand the order in which they light up. The lighting of the l.e.d.'s has an appealing effect as they gradually build up to the condition in which they are all alight. Best results are given by employing the more sensitive, or "ultra-bright", l.e.d.'s which are nowadays available from many suppliers. All the resistors in the circuit are ¼ watt 5% components, and C1 can be a polyester capacitor.

The circuit can also be used to count in binary from zero to 255, and this can be an instructive application. For counting it will be necessary to slow down the oscillator by increasing the value of C1. Suggested increased values are 0.47 μ F or 1 μ F.

■



"I've built and installed a smoke alarm. The only trouble is it keeps going OFF when the wife cooks!"

RECENT PUBLICATIONS

ADVENTURES WITH MICROELECTRONICS. By Tom Duncan. 64 pages, 245 x 190mm. ($9\frac{3}{4}$ x $7\frac{1}{2}$in.) Published by John Murray. Price £3.25.

The availability these days of circuit boards having holes with spring contacts in an 0.1in. matrix make possible the assembly of quite advanced electronic circuits, without even having to think of a soldering iron. The 12 projects in this well produced hard-cover book are built on such a circuit board and include a 2-octave electronic organ, a medium and long wave radio driving a speaker, a reaction timer, a traffic light simulator, a light operated alarm and a warbling/wailing siren. There is also an introductory section which describes each of the component types to be used together with their functions.

The term "microelectronics" in the title refers to fairly complex integrated circuits. Seven CMOS i.c.'s are employed, ranging from the 4011 to the 4047 monostable/astable multivibrator. Also used are three bipolar i.c.'s, the ZN414 and LM380 (for the radio) and the 556 dual timer. The reaction timer employs a 7-segment l.e.d. display for readout. The projects are presented with clear circuit and physical layout diagrams and many of them have suggestions for experimental modifications.

The book will be of especial value to anyone wishing to gain experience in practical electronics. As well as the absence of soldering problems, the projects are all battery driven and involve no shock risk.

ELECTRONICS FOR TECHNICIANS LEVEL 2. By B. F. R. Gillman, C.Eng., M.I.E.R.E. and B. A. Hudgell, B.Sc., C.Eng., M.I.E.E. 175 pages, 215 x 135mm. ($8\frac{1}{2}$ x $5\frac{1}{4}$in.) Published by Hodder & Stoughton. Price £2.95.

B. F. R. Gillman is a Lecturer in Electronics, and B. A. Hudgell is a Senior Lecturer in Electronics, both at Southgate Technical College. The book is intended to benefit anyone studying electronics, telecommunications or electrical engineering, and has a depth of treatment aimed at Level II of the Technical Education Council Programmes. However, some of the subjects dealt with are expanded beyond this level to give a more complete and useful treatment.

Subjects covered are semiconductor materials, the p-n junction, simple power supply circuits, bipolar transistors, the transistor as amplifier, LC oscillators, waveform generators, thermionic valves, the cathode ray tube, and logic gates and circuits. Questions are set at the end of each chapter, with answers at the back of the book.

The volume is a good reliable text-book on the topics discussed, its major attraction being for the student.

ELEMENTS OF ELECTRONICS 2. ALTERNATING CURRENT THEORY. By F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., M.B.I.M. 223 pages, 180 x 105mm. (7 x $4\frac{1}{4}$in.) Published by Bernard Babani (publishing) Ltd. Price £2.25. **ELEMENTS OF ELECTRONICS 3. SEMICONDUCTOR TECHNOLOGY.** By F. A. Wilson. 214 pages. Published by Bernard Babani (publishing) Ltd. Price £2.25.

These two titles appear in the Bernard Babani "Elements of Electronics' series, in which successive books advance from their predecessors without covering the same ground again. Each book can be considered as an entity in its own right, but if the books are read in the series starting with the first they unwind the whole story of electronic technology without repetition. "Elements of Electronics 1", it may be mentioned, dealt with simple electronic circuits and components.

"Elements of Electronics 2" deals extensively with alternating current theory, taking the reader to complex numbers and j notation. Also covered are time constants, reactance, impedance, resonance and transformers. Appendices at the end of the book deal with the trigonometry, mathematics and geometry required for a full study of alternating current behaviour.

In "Elements of Electronics 3" F. A. Wilson commences with semiconductor physics, then proceeds to semiconductor characteristics, basic semiconductor systems and analogue and digital integrated circuit technology. Again, there are appendices at the end of the volume, and these include notes on binary arithmetic and the determination of curve slope by graphical methods and by calculus.

Although these books are small enough to fit in the pocket they contain a mass of information, and at a modest price. Further books in the series will be appearing in the future.

ROYAL OPENING OF MICROELECTRONICS CENTRE

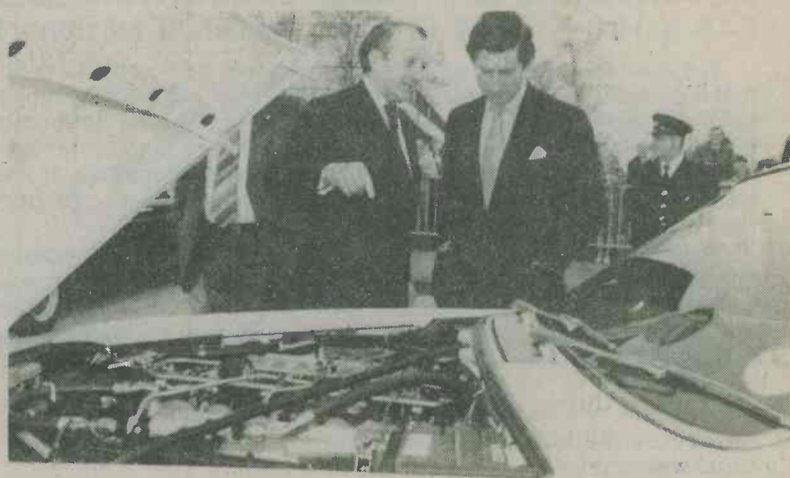
His Royal Highness The Prince of Wales visited Ferranti early in the winter to open the Ferranti Electronics Limited — Microelectronics Centre at Hollinwood near Oldham.

The Centre, the most modern of its type in Europe, was built to meet the Company's expanding world-wide sales of complex LSI (Large Scale Integrated) circuits.

Ferranti Electronics Limited is the major British manufacturer of integrated circuits from simple logic devices to Europe's first, and one of the world's most sophisticated 16 bit microprocessor, the F-100L.

The Company pioneered, and is world leader in ULA (Uncommitted Logic Array) technology, a technique for producing custom designed LSI circuits quickly and economically. Ferranti ULA is one of the most powerful integrated circuit concepts to be developed. It is in high volume production and extensively used in automobile electronics, telecommunications, cameras, computers, microprocessor systems, video games, toys, communications equipment, domestic appliances and precision instrument and test equipment.

The Royal opening was attended by guests from leading West European users and government departments.



On his arrival at Ferranti Electronics Limited. His Royal Highness The Prince of Wales drove the latest Jaguar XJ12 which is fitted with the world's first digital electronic fuel injection system.

BROADCASTING HISTORY MADE

The BBC used digital audio recorders when they recorded the traditional Carol Concert at King's College Cambridge last Christmas Eve.

Duncan McEwan, the BBC's Chief Engineer, Radio Services (right) and engineer Ian Jolly (left) with the recording equipment.

The famous Festival of Nine Lessons and Carols from King's College Chapel, Cambridge made history not once, but twice, last Christmas.

The live broadcast on Christmas Eve, on Radio 4 was transmitted via satellite, in stereo, to 100 coast to coast National Public Radio stations in the United States.

BBC Radio always broadcasts the Festival of Nine Lessons and Carols live on Christmas Eve and a recording of it on Christmas Day on Radio 3.

The stereo recording on Radio 3 on Christmas Day was the first BBC digital recording ever transmitted. By bringing back the recording made on site to London by road, any distortion over the normal analogue circuit between Cambridge and London (used for the live broadcast) was avoided.

Duncan McEwan, the BBC's Chief Engineer Radio Broadcasting, says, "BBC Radio always likes to be in the vanguard of engineering development. We intend to experiment with digital recording on several productions in the coming year. It will give us useful experience so that we will know how to assess the purpose-built digital audio recorders, stereo and multitrack, that will be appearing in the next few years."

"Digital recording offers advantages that could have quite an impact on the technical quality of productions. It allows us to exploit a wider dynamic range much more easily than is possible with analogue equipment. There is a complete absence of wow and flutter and a much lower level of non-linear distortion."

. . . COMMENT

FIFTY YEARS ON

TV Exhibition

The exhibits, outlining television's development since the opening of the 405-line service in 1936, will be punctuated by a series of period room-settings, in each of which it is hoped to show a montage of contemporary programmes on restored receivers of appropriate vintage; these will include a pre-war set with a five-inch tube, and a 'projection' set of the early 1950s. A display of videotape recorders will illustrate the dramatic fall in their size and price since they were first introduced, and there will be a working specimen of a type of British telecine machine that has been used with conspicuous success through three decades.

In March 1930, Baird's much-heralded 'Televisor' was finally on sale, and the experimental 30-line transmissions from the BBC's Brookmans Park station were for the first time accompanied by sound. Television broadcasting, in fact, had arrived, and the fiftieth anniversary of this milestone is being marked by a special exhibition at the Science Museum, opening at the end of March for six months.

The title of the exhibition is "The Great Optical Illusion", and one of its aims is to reawaken the sense of wonder that is properly due to television but that our familiarity with it has inevitably dulled. An introductory exhibit will show what is involved in making a moving picture out of a single spot of light, and the 'illusion' theme will be maintained with other demonstrations: "Chromakey", an electronic overlay technique, will make visitors appear to be performing a feat of aerial daring while actually just off the floor, while 'Front Axial Projection' will insert them optically into a projected scene.

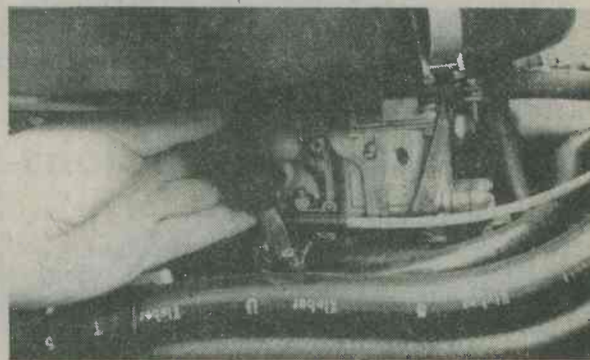
In our last issue we published a short article entitled 'Good Connections', a very pratical article for those inexperienced in constructional work.

In this issue, also concerned with soldering, we include a review of a very interesting film — 'The Right Connection'. The film shows the use of tin-lead solder in the manufacture of printed circuit boards etc.

The film, which should be attractive to members of radio clubs etc., is available on free loan from the International Tin Research Institute of Fraser Road, Perivale, Greenford, Middlesex UB6 7AQ.

The "Presenter" of the film is Michael Rodd of the BBC's TV programme 'Tomorrow's World'.

SMALL IS BEAUTIFUL



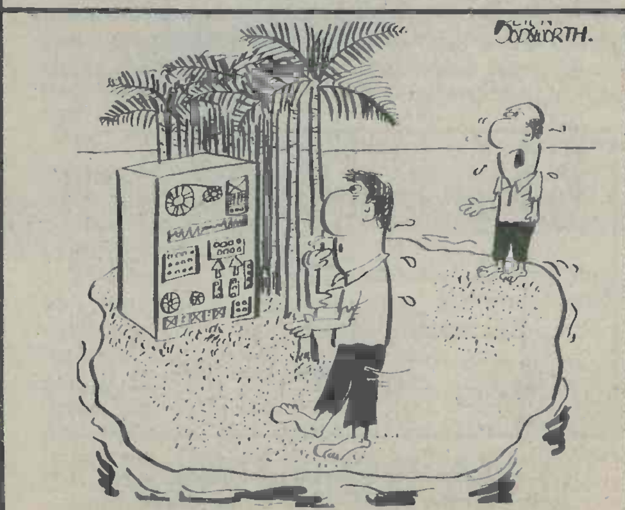
In the confined space of a car engine the Screwmaster's ratchet is invaluable.

Generations of skinned knuckles are a testimony to the fortune to be made by the company which produces a reliable, one-handed ratchet screwdriver small enough to get into awkward corners.

J. Stead & Co. Ltd., of Greenland Road, Sheffield believe they have done it with the Steadfast Screwmaster.

The secret of the Screwmaster is the ratchet mechanism, a miniaturised adaptation of a well-established clutch principle, encapsulated in an immensely strong cellulose acetate handle. The ratchet system utilises roller bearings, which are allowed to freewheel or jam between flat surfaces on the blade and the outer casing. This provides drive and freewheel, full lock and unscrew and freewheel positions.

As long as the blade has the resistance of a screw slot to hold it, the three positions — marked 'Forward', 'Neutral' and 'Reverse' on a rotating sleeve where handle meets shaft — can be selected at the touch of a finger of the hand grasping the handle. Price is £2.25.



"Anything over there, George?"

MICRO CURRENT ICM7555 CIRCUITS

By A. P. Roberts

Two applications for the "CMOS 555".

There can be few readers of this magazine who are not familiar with the popular 555 timer integrated circuit, and it is probable that a substantial proportion have had first hand practical experience with this device. For the amateur user it is certainly one of the most useful and versatile integrated circuits currently available.

However, this device has a few minor drawbacks which make it less than ideal in certain applications. This has led to improved versions of the 555 being produced, including in particular the "CMOS 555", or ICM7555, which forms the basis of this article.

IMPROVEMENTS

One of the more obvious disadvantages of the standard 555 is its relatively high current consumption of about 8mA at 9 volts. Although not excessive, this is considerably higher than that of other modern integrated devices. By using CMOS circuitry the ICM7555 achieves the low level of current consumption that has helped to make CMOS i.c.'s so popular. The actual figure for the ICM7555 is of the order of 80µA; in other words, only about one-hundredth of that required by the standard 555.

Another advantage of the ICM7555 is that it does not, like the 555, produce a negative voltage spike on the positive supply rail as the output switches to the high state. This spike is produced by a sudden surge in the current consumption of the i.c. which can peak to as high as a few hundred milliamps for some 0.1 microsecond. In many applications, of course, this is of little or no consequence, but it can cause spurious operation if the circuit includes t.t.l. devices or any other circuitry which is sensitive to noise on the supply lines. The normal solution is to connect a large value bypass capacitor across the supply lines close to the 555. Such a capacitor is totally unnecessary when using the ICM7555.

Other advantages of the ICM7555 are a wide operating supply voltage range of 2 to 18 volts, and low reset trigger and threshold currents of typically around 20 picoamps. The device will work perfectly well with timing resistances of 100 megohms or more.

One minor drawback of the ICM7555 is that it has a maximum output sink current of 100mA with a supply potential of 18 volts, as compared with a figure of 200mA for the standard 555. The maximum operating frequency in the astable mode is at least 500kHz.

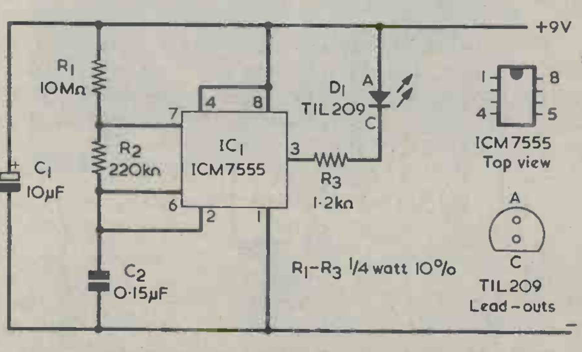


Fig. 1. A flashing light pilot indicator incorporating the ICM7555. This draws an average current from the 9 volt supply rails of only about 0.21mA

FLASHING PILOT LIGHT

The circuit of Fig. 1 shows a simple application in which the ICM7555 works well, and where the ordinary 555 would be totally unsuitable. The circuit is for a flashing indicator light which shows that the battery operated equipment in which it is installed is turned on, and it draws an extremely small current from the supply rails.

In Fig. 1 the ICM7555 is employed in the astable mode to briefly switch on an l.e.d. indicator at intervals of approximately 1 second. This type of pilot light has two advantages over a straightforward l.e.d. indicator permanently connected across the supply rails. First, it requires a much lower supply current because the l.e.d. is switched off for most of the time, whereupon the average current consumption can be made very small. Second, a flashing indicator is subjectively more noticeable than a non-flashing one, particularly under conditions of bright ambient light.

The circuit employs a standard 555 astable multivibrator arrangement. At one part of the cycle, capacitor C2 charges through R1 and R2 until the voltage across its plates reaches two-thirds of the supply voltage. During this part of the cycle, the output at pin 3 is high and the l.e.d. is extinguished. When the voltage across C2 is at two-thirds of supply voltage, a voltage detector coupled to pin 6 triggers the circuit to its alternative state, in which the output at pin 3 goes low, thereby turning on the l.e.d., and a low impedence is given between pin 7 and the negative rail. C2 then discharges through R2 and the internal circuitry of the i.c. until the voltage across it falls to one-third of supply voltage.

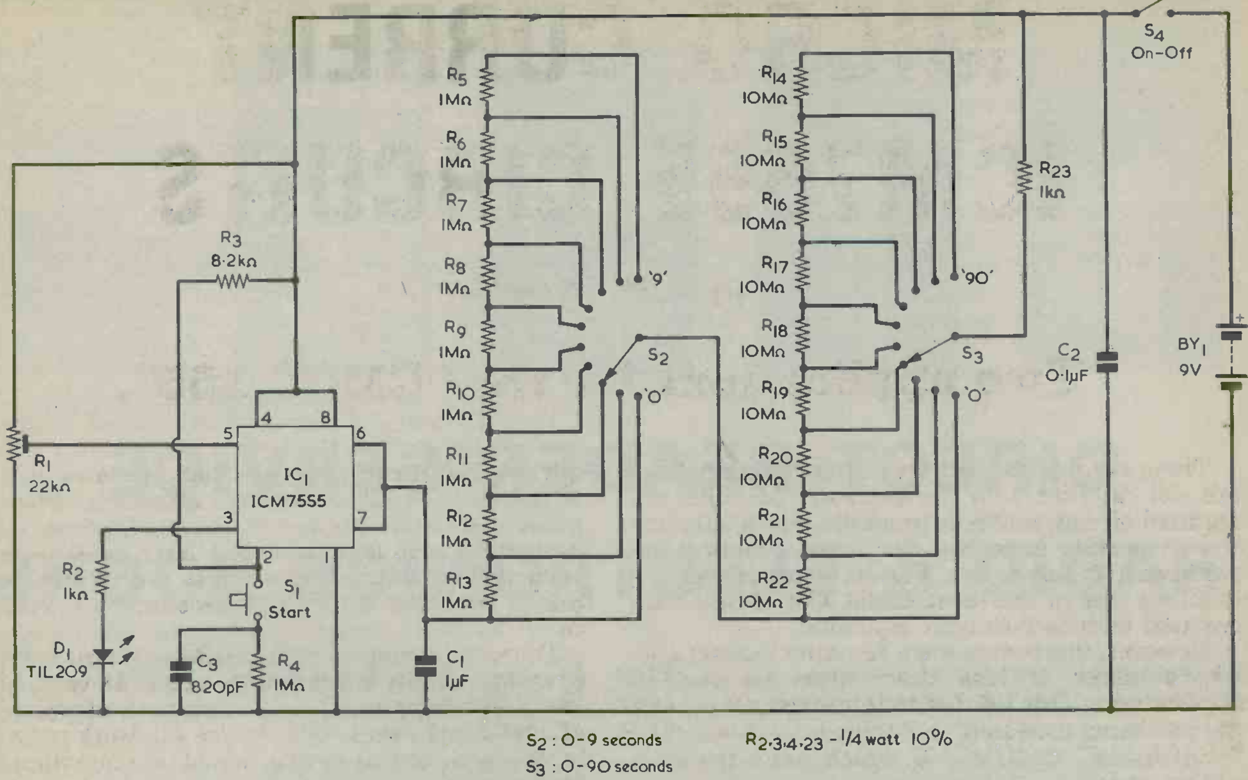


Fig. 2. A photographic timer offering a range of 1 to 99 seconds in 1 second steps. As is explained in the text, R5 to R22 should be close tolerance resistors

This voltage triggers a second voltage detector coupled to pin 2, and the i.c. reverts to the previous state, in which C2 once more charges via R1 and R2.

Because C2 charges through both R1 and R2, but discharges through R2 only, the length of the discharge period (when the l.e.d. is alight) is shorter than the charge period (when the l.e.d. is extinguished). In the circuit of Fig. 1 the discharge period is purposely made considerably shorter than the charge period, since R1 is given a value which is much higher than that of R2. In fact, the ratio of the discharge to the charge period is about 1 to 46. Thus, the brief pulsing on of the l.e.d. indicator is obtained.

The current consumption when the l.e.d. is switched off is only about 80μA, and it rises to approximately 6mA when the l.e.d. is turned on. This gives an average current consumption of only about 210μA, or 0.21mA. If a standard 555 were used in the circuit, this on its own would draw a standing current of around 8mA, which is more than the current consumption of the l.e.d. when it is turned on!

The operating frequency of the circuit in Hertz, is equal to 1.46 divided by CR, where C is the value of C2 in microfarads and R is equal to R1 plus 2 times R2 in megohms. This calculates at about 0.93 Hz, which is close enough to the required nominal figure of 1Hz.

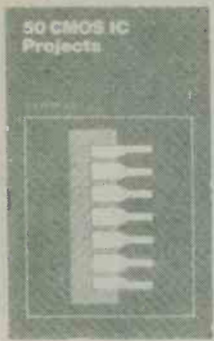
SIMPLE TIMER

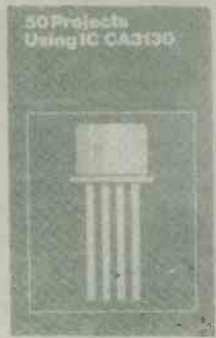
When used in the monostable mode the ICM7555, like the standard 555, produces an output pulse length of approximately 1.1CR. However, whereas the 555 can have a maximum timing resistance of about 10 or 20MΩ, the ICM7555 will operate with a timing resistance of about 100MΩ or more. The ICM7555 also applies a very much smaller stray capacitance across the timing capacitor, and predictable timing results are feasible with a timing capacitance as low as 1pF. A performance of this nature would be impossible with the 555, which has a stray capacitance in the order of 50pF.

It is the ability to use a high value of timing resistance which is probably of more interest to the amateur user. Where, with a standard 555 it would be necessary to employ an electrolytic timing capacitor, with its relatively high leakage current and wide tolerance on value, with the ICM7555 it is possible to employ a non-electrolytic capacitor. An example of a timer circuit incorporating a non-electrolytic 1μF timing capacitor is given in Fig. 2. This is primarily intended for use as an enlarger timer, but it can also be employed when making long time exposures with the camera shutter set to "B".

The timing period is initiated by pressing pushbutton S1. This causes the l.e.d. D1 to turn on. After a time, which is selected by switches S2 and S3, the l.e.d. turns off again to indicate that the timing period is over.

The circuit is based on a fairly straightforward 555 type of monostable. After switch-on, timing capacitor C1 is held discharged via pin 7 and the internal circuitry of the ICM7555, and the i.c. output at pin 3 is low. The trigger input at pin 2 is taken high by R3, and the circuit will start a timing period if pin 2 is taken below one-third of the supply voltage. This is done when S1 is pressed, because C3 momentarily takes pin 2 to the negative rail potential. When S1 is released, C3 is quickly discharged by R4, so that it is ready to initiate another timing period later.



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At the start of the timing period the i.c. output at pin 3 goes high and the l.e.d. lights up. Also, pin 7 goes open, and C1 is able to charge via whatever resistance is switched into circuit by S2 and S3. When the voltage across C1 reaches threshold level (normally two-thirds of supply voltage) the timing period ends. Pin 3 of the i.c. goes low and C1 is discharged via pin 7.

If, in the timing resistor chain, only R13 were switched into circuit (and ignoring R23 for the moment) the timing resistance would be 1MΩ and the calculated length of the timing period 1.1 second. However, this can be altered to exactly 1 second by adjusting R1, which controls the threshold voltage inside the i.c. and can make it other than two-thirds of supply voltage. With R1 correctly set up, S2 provides timing increments of 1 second up to 9 seconds, because each of the resistors R13 to R5 has a value of 1MΩ. Further resistors can be inserted by S3, and as the resistors R22 to R14 are each 10mΩ, S3 offers a timing range from zero to 90 seconds. Operating both switches provides timing ranges from 1 to 99 seconds in 1 second steps. Resistor R23 is included simply to prevent excessive current flow if both S2 and S3 should happen to be set to the "0" positions.

The timing resistors R5 to R22 should have tolerances of 5% or better, and 5% components in carbon film $\frac{1}{2}$ watt are readily available. It is also possible to obtain 1MΩ resistors in $\frac{1}{2}$ watt 2% and even 1%. Capacitor C1 does not need to be a close tolerance component because variations from its nominal value can be taken up by the adjustment of R1. It should be a good quality plastic foil type. Whereas the electrolytic timing capacitors which would be required in a 555 circuit have insulation resistances in the order of megohms, a plastic film capacitor can have an insulation resistance of several gigaohms, i.e. several thousand megohms! Whilst in the subject of insulation resistance it is important that the insulation resistance of S2 and S3 should be of a high order.

After the circuit has been assembled, R1 can be adjusted to give a timing period of 10 seconds when this time is selected by S2 and S3. Then, when a reasonable accuracy has been achieved, the unit can be set to the full 99 second timing period, and final fine adjustments. made. R1 should be the larger 0.25 watt type of skeleton potentiometer rather than the sub-miniature 0.1 watt type.

FINAL POINTS

It should perhaps be pointed out that in order to take advantage of the low current consumption of the ICM7555 it is advisable to use high value timing resistors, otherwise, the current flowing into the timing network will add significantly to the current consumption of the whole circuit. Indeed, if a timing resistance of only a few kilohms were used, the current consumption of the timing network would be many times that of the ICM7555 itself!

Although the ICM7555 is a CMOS device it requires no special handling precautions, as it is fully protected by internal circuitry. ■

TRADE NOTE

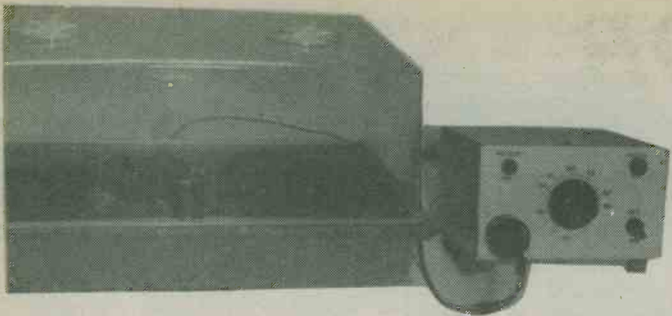
MAGNETISER/DEMAGNETISER FOR THE WORKBENCH

Have you ever wished that you possessed a magnetised screwdriver?

The answer could lie in an ingenious magnetiser/demagnetiser designed specifically for the engineering bench. The unit is compact, inexpensive and instantaneous in operation. At the touch of a button you can produce a bar magnet up to 9 mm diameter and any length. Press again to demagnetise tools before working on clocks, instruments or tape decks. You can remove ferrous particles from oil or instantly magnetise a blade to recover that tiny part you just dropped and just as quickly demagnetise it before it becomes a nuisance on the bench.

The unit, which measures only 135 x 80 x 65 mm, operates on 240 volts, is housed in a steel case and is designed to last a life-time.

At £9.95 (incl. postage and V.A.T.) this piece of equipment is available from Magnadyne Products, 6 Lulworth Road, Welling, Kent, DA16 3LQ.



SEED

By
J. K. Owen

Electronic control of soil temperature

The usual type of inexpensive seed propagator, comprising a plastic tray with a clear dome, offers some considerable advantage over the even more basic wooden seed box. Even so, it can still be inadequate when it comes to dealing with the more exotic seeds, some of which require a constant temperature of up to 80°F for germination. Even the tomato seed requires 60°F.

To maintain a room, even with central heating, at the higher germination temperature both night and day would be prohibitively expensive (not to mention uncomfortable!) whereas "central heating" of the propagator on its own would be much less costly. A propagator measuring around 15 by 9in. could be maintained at a relatively constant high temperature for a power requirement of the order of 5 watts only.

This figure does not mean that a 5 watt propagator heater would be left running continuously. To maintain a constant temperature, a much more powerful heater would be required, this being automatically switched on and off by a temperature sensing circuit. The average power would then be around the 5 watt figure.

TEMPERATURE CONTROLLER

A temperature controller circuit is given in Fig. 1, and this is capable of offering an adequate range of temperatures, from below 50°F to above 90°F. It also incorporates a timing component which provides a small degree of hysteresis so that there is a differential between the "switch-on" and "switch-off" temperatures.

The thermistor, TH1, is the temperature sensing probe, and is buried in the soil or potting compost in which the seeds are to be germinated. Its resistance decreases as its temperature rises.

The base of TR1 is held at about 3 volts, or half the supply voltage, by the equal value resistors, R3 and R4. If the thermistor is cold, and therefore has a high resistance, the components R1, R13 and

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated)
R1 470Ω
R2 10kΩ
R3 10kΩ
R4 10kΩ
R5 220kΩ
R6 1.2kΩ
R7 4.7kΩ
R8 270 Ω
R9 120Ω
R10 75Ω
R11 10Ω 2 watts
R12 10Ω 2 watts
R13 5.6kΩ
VR1 2kΩ potentiometer, wire-wound

Capacitors
C1 0.1μF disc ceramic
C2 220μF electrolytic, 16V. Wkg

Transformer

T1 Mains transformer type CT4, secondary 0-9-17V at 4A (see text)

Semiconductors
TR1 BC108
TR2 BCY70
TR3 BC108
TRI1 NAS 0351X
TH1 G23 (see text)
D1 1N4001
ZD1 BZY88C6V2

Lamps
PL1 6.5V 0.3A, m.e.s. PL2 6.5V 0.3A, m.e.s.

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

Miscellaneous
2 m.e.s. lampholders, panel mounting with bezels
Octal plug
Octal socket
Control knob
Resistance wire (see text)
Heat resistance sleeving (see text)
Materials for case
Materials for printed board
Materials for thermistor probe
Terminal block, 4-way 5A
Wire, bolts, nuts, etc.

PROPAGATOR HEATER

Heating element switching at pre-selected temperature with very close control

VR1 cause the emitter of TR1 to be positive of the level at which base current flows. TR1 is therefore cut off and there is no voltage drop across its collector resistor R2. In consequence, TR2 is also turned off, and its lack of collector current results in TR3 being cut off as well. Gate current therefore flows via R8 and R9 to the triac, turning this on and completing the circuit between the 9 volt secondary of the mains transformer and the heating element.

The soil, and hence the thermistor probe, commences to warm up, causing the probe resistance and the voltage at TR1 emitter to fall. At a predetermined temperature, which is governed by the setting of VR1, the emitter of TR1 becomes negative of its base by about 0.6 volt, whereupon TR1 commences to draw collector current through R2. The voltage across R2 turns on TR2 and this causes TR3 to become conductive also. TR3 collector takes up a potential which is only slightly positive of its emitter, and the gate current to the triac is cut off. The triac is turned off and no power is applied to the heating element.

When, subsequently, the thermistor cools, its rising resistance causes the emitter of TR1 to go positive until TR1 cuts off again. The reverse process then takes place, with all three transistors becoming turned off and the triac turned on once more.

It is desirable to have a degree of hysteresis in the circuit so that there is a "snap-on" and "snap-off" action in the electronic switch. This is provided by the capacitor C1. When, with rising thermistor temperature, TR1 commences to pass collector current, its collector goes negative. Before TR2 commences to conduct, this negative excursion takes TR1 base negative via C1, thereby delaying the instant at which it draws sufficient collector current to make TR2 conductive. As soon as TR2 starts to draw collector current there is a regenerative action, again delayed by C1, in which increased base current passes to TR1 via R5. The delaying effect is also given in the reverse condi-

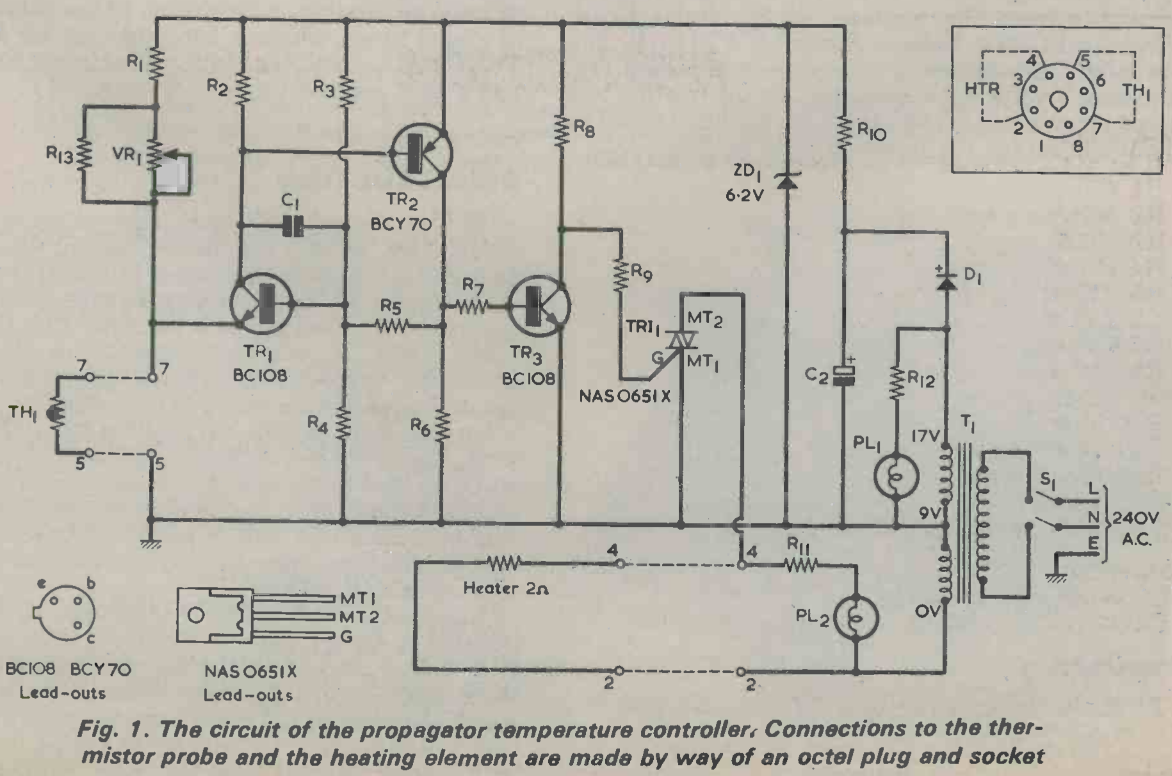
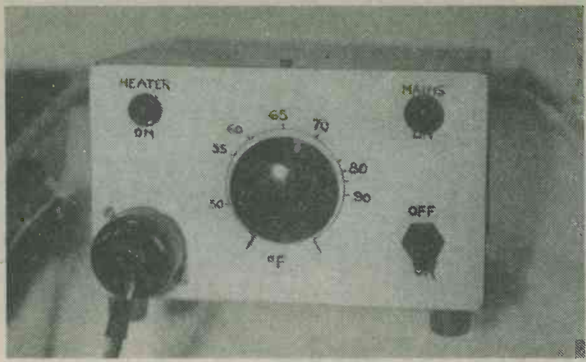


Fig. 1. The circuit of the propagator temperature controller. Connections to the thermistor probe and the heating element are made by way of an octel plug and socket

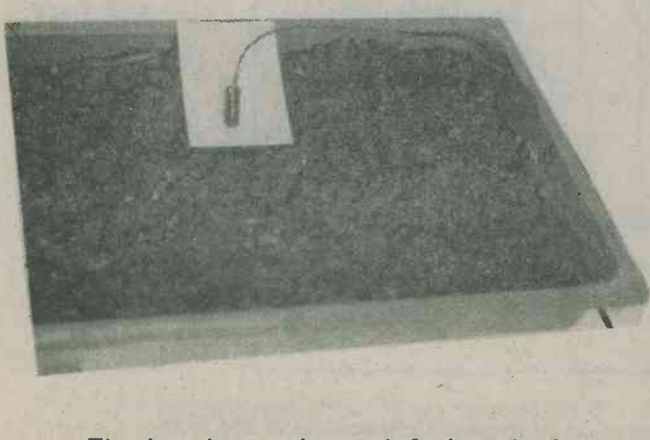


The temperature control unit. The large central knob sets up the temperature to which the propagator is taken

tion, when the thermistor cools and TR1 starts to turn off.

The value specified for R5 controls the hysteresis level and, at 220kΩ, it is found that there is a differential of about plus or minus 1°F. This is an acceptable figure for a seed propagator and ensures that extremes of temperature in either direction are not produced before switching takes place.

Two pilot lights are provided in the circuit, PL1 indicating that the mains supply is switched on and PL2 indicating when power is being applied to the heating element. Both lamps have a small resistor in series to limit the voltage which appears across them. The thermistor and the heating element connect to the remainder of the circuit by way of an octal plug which fits into an octal valveholder. T1 is a "charger transformer" type CT4 having a secondary offering 0-9-17 volts at 4 amps. This is available from Electrovalue, 28 St. Judes Road, Englefield Green, Egham, Surrey, TW20 0HB. The secondary is connected as shown in the diagram, allowing 9 volts to be available for the heating element circuit and 8 volts (17 volts minus 9 volts) to be available for the power supply rectifier, D1.



The thermistor probe, ready for insertion in the soil

THERMISTOR PROBE

The thermistor is a glass bead component with a diameter of 3mm. It is a type G23 and can be obtained from Maplin Electronic Supplies. In the prototype it was encapsulated, using Araldite, in a Paxolin (s.r.b.p.) tube about 1in. long and having an inside diameter of 5mm. If a Paxolin tube is not available, a suitable tube can be made up in the following manner. Wind a short length of polythene film around the shank of a $\frac{3}{16}$in. drill. Then wind around the polythene a 4in. length of paper 1in. wide, smearing the paper liberally with a clear adhesive such as "UHU" as it is wound on. The polythene will prevent the adhesive sticking to the drill and, when the adhesive has set, the polythene can be readily removed from the resulting tube. ("UHU", in common with practically all adhesives, will not stick to polythene.)

The heating element consists of a suitable length of resistance wire, such as Eureka, and it requires a resistance of 2Ω. This can be provided by a 27in. length of 26s.w.g. Eureka wire, which has a nominal resistance of 2.73Ω per yard. (An alternative wire is the 26 gauge resistance wire listed by Home Radio, with a resistance of 2.6Ω per yard. The required 2Ω would be given by 27.7ins. of this wire.— Editor.) The wire should preferably be covered with heat resistant sleeving, available from Maplin Electronic Supplies, to prevent corrosion. The heating element wire should be laid our symmetrically on the base of the propagator, covering the whole area as evenly as possible, and then secured to the base by adhesive. A 4-way 5-amp terminal block can be screwed to the base of the propagator, and this will enable connections to be made to the element and the thermistor proble.

When the heating element is turned on, about 2 volts is dropped in the triac. The power dissipated in the element therefore calculated as 24.5 watts.

The triac employed by the author was an NAS 0351X. If an alternative is used it should be a sensitive type capable of turning on at the gate current of about 15mA which is available via R8 and R9. The C206D, listed by Maplin Electronic Supplies, has a gate turn-on current of 5mA.

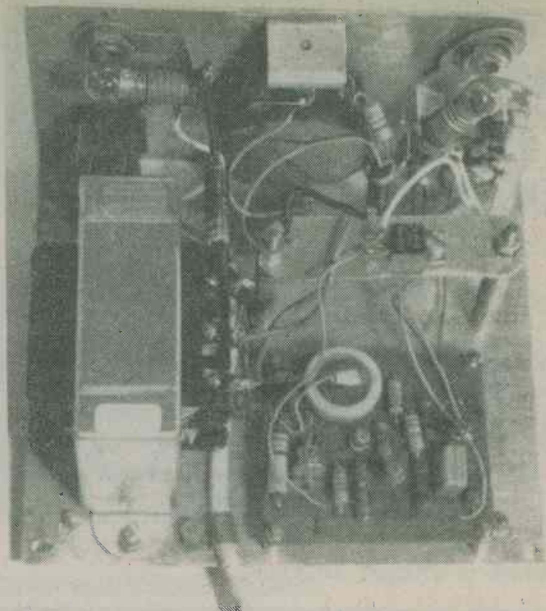
CONSTRUCTION

The prototype unit was housed in a home-constructed metal case measuring 6in. by 4in. by 5½in. deep. The only important criterion of the case is that it should house the components comfortably and without crowding. It is essential that the case, when metal, is reliably connected to the mains earth and that all precautions against accidental shock due to mains voltages are observed.

On the front panel, VR1 is mounted centrally, with a scale behind its knob. PL1 is at upper right and PL2 is at upper left. The mains on-off switch is at lower right with the octal socket at lower left. Any other suitable type of plug and socket offering four connections may be employed instead of the octal plug and socket.

A printed circuit board to take most of the components is shown full size in Fig. 2. R11, R12 and R13 do not appear on the board. The first two of these resistors are mounted close to the lamps to which they connect, a small tagstrip supporting the lead which does not connect to the lampholder. R13 is mounted on the tags of VR1. The triac is

The inside of the control unit case. The large circular component on the printed circuit board is the electrolytic capacitor, C2



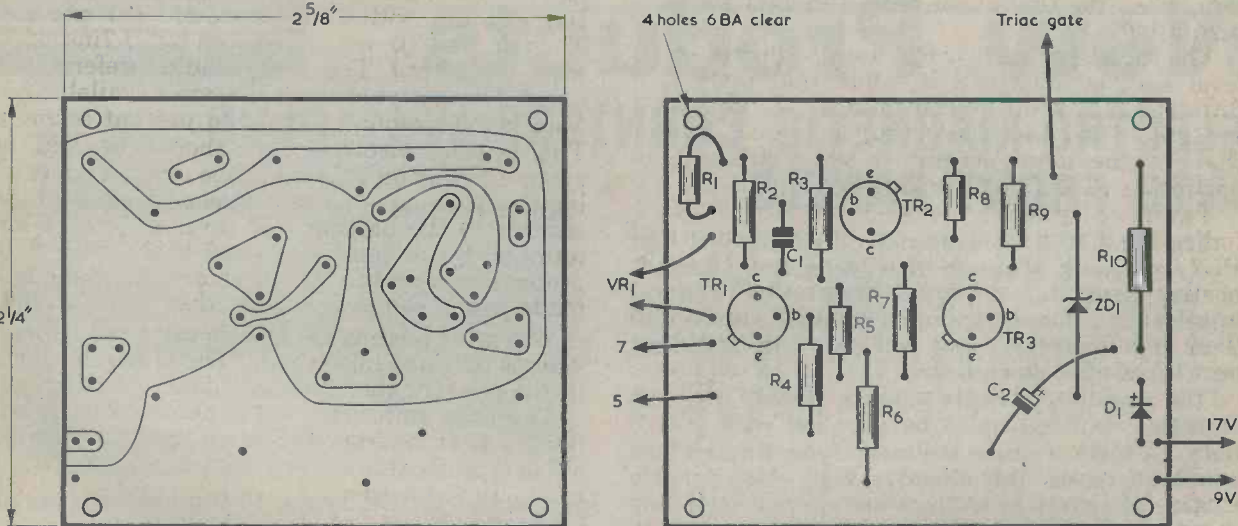
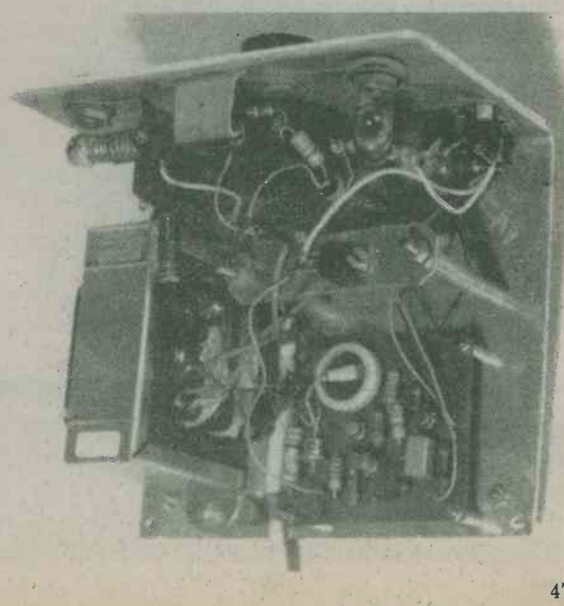
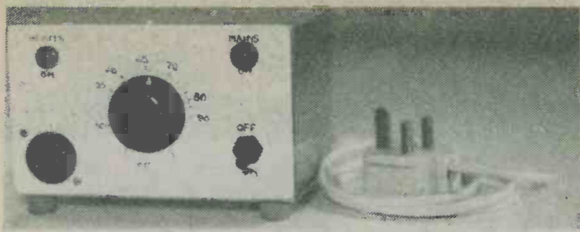


Fig. 2. Many of the components are assembled on a printed circuit board, which is reproduced here full size. The board is spaced off from the bottom of the case by metal spacing washers, which also provide the chassis connection to the board.

Another view of the case interior. The triac is bolted to a rectangular piece of aluminium mounted on spacing pillars just in front of the printed board





The control unit obtains its power from the mains, and is fitted with a 3-way mains lead and plug

mounted on a separate piece of 18 s.w.g. aluminium about 3in. by $\frac{3}{4}$in., which also serves as a heatsink. This aluminium item is supported at both ends by bolts passing through spacing pillars about $1\frac{1}{2}$in. long. All the wiring external to the printed board should be carried out to agree with the circuit diagram. VR1 should be connected such that the resistance it inserts into circuit decreases as its spindle is rotated clockwise.

CALIBRATION

Calibration of the controller is straightforward, requiring nothing more than a supply of hot water and a suitable thermometer. Suspend the tip of the probe in a glass of water together with the thermometer. Start off with the water at 50°F and advance the potentiometer VR1 until the heating element switches on, as indicated by PL2. Mark a scale fitted to VR1 at this point, and add hot water to the glass until the thermometer reads 55°F. Again adjust the potentiometer until the lamp lights and mark the scale accordingly. Proceed in this manner until the whole range has been calibrated.

Finally, it may be mentioned that the use of a shunt 5.6kΩ resistor across VR1 is partly due to the fact that the value required in the potentiometer is 1.5kΩ, whilst 2kΩ potentiometers are more readily available. A further reason is that the parallel combination of fixed resistor and potentiometer results in an opening out of the calibration scale at the most useful part, around 50° to 75°. ■

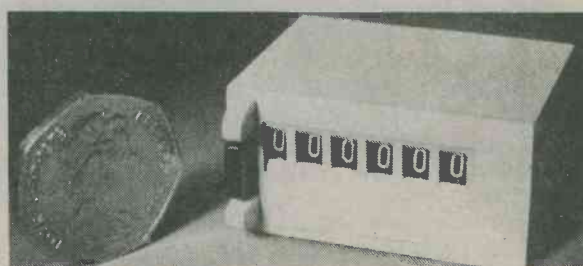
New Products

ELECTRO-MAGNETIC COUNTERS WILL PLUG INTO FRONT PANELS

The new EMO10 range of miniature low cost electromagnetic counters from Impectron Limited, is designed for a wide variety of control applications. The 6-digit units measure just 88 x 50 x 26 mm (LxWxH) and will plug into standard panel-mounted receptacles.

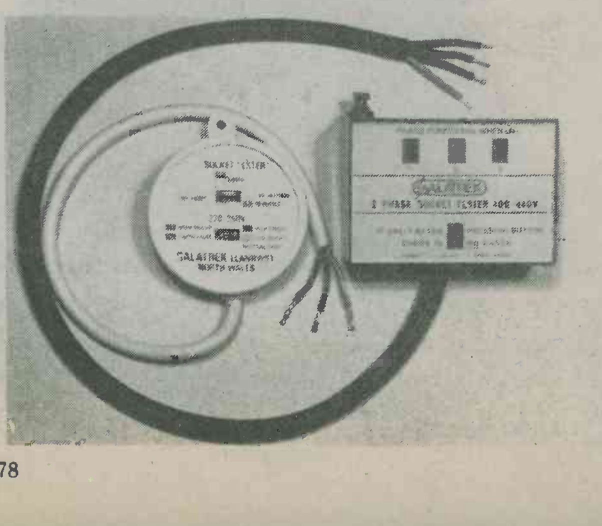
The counters have six 4.5 mm display digits as standard, but may also be supplied with 4 or 5 digits. A further option is a magnifying window lens which increases the effective digit size. A wide variety of operating voltages are offered, including 6, 12, 24, 48, 60, 110, 150 and 220V DC, as well as 12, 48, 60 and 150V AC.

The mechanism operates on electrical pulses, which activate a pawl and ratchet system. The display indexes one count for each complete pulse, and rated life expectancy is in excess of 100 million counts. Maximum counting rates are 50 impulses per second for DC types, 10 impulses per second for AC versions.



Although they are inexpensive, the counters are constructed to very high standards. Main body parts are moulded from resilient ABS while all exterior metal parts are zinc passivated. Operating temperature range is 20°C to 80°C, and coil insulation is greater than 100 Megohm at 500V DC.

TWO NEW SOCKET TESTERS



After the successful introduction of their 13 Amp Socket Tester in 1978 GALATREK ENGINEERING announce the arrival of two new models.

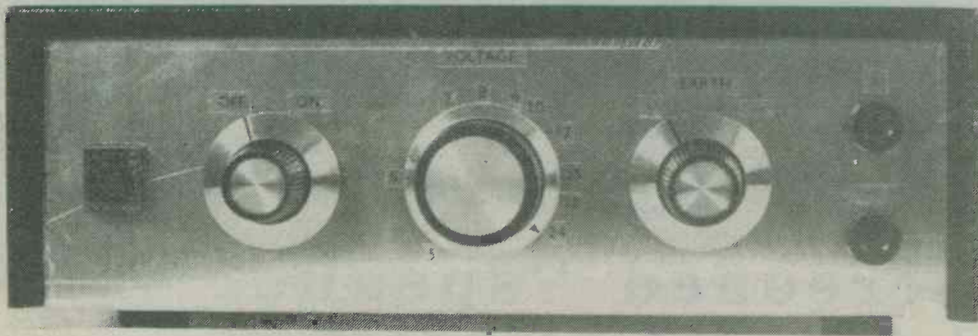
(1) A 6 function socket tester FOR ANY TYPE OF SOCKET (fit your own plug). By means of neons and indications on the front of the tester it shows immediately if:
(a) Socket is A1 OK; (b) DANGER reverse polarity; (c) DANGER no earth; (d) DANGER live fault; (e) DANGER neutral fault; (f) DANGER live earth reversed.
PRICE £4.50 VAT and post paid.

(2) 3 Phase tester which instantly indicates if phases are functional and whether there is an earth.
PRICE £8.95 VAT and post paid.

Designed and manufactured by: Galatrek Engineering, Scotland Street, Llanrwst, Gwynedd.

IN OUR NEXT ISSUE

LABORATORY POWER SUPPLY



THE "DIODYNE" RECEIVER

DUAL POLARITY VOLTMETER

PLUS MANY OTHER ARTICLES

AMPLYFYING INTE

By R. A. Penfold

● Inexpensive 2-way design ● Useful

● Unscreened "speaker cable" gives interconnection ● Call fac

A simple intercom system of the type to be described should be a very useful addition in virtually any household. The system has been tested with an interconnecting lead between the two stations which is 16 metres (52 ft.) in length, and it should be able to work over a greater distance than this if necessary. Only an unscreened 2-way cable is needed to connect the two stations. These are battery powered and, with normal use, battery life should extend over a considerable period.

INTERCOM SWITCHING

The standard basic switching circuit for an amplifying intercom is shown in Fig. 1. In the "Receive" mode, the main unit amplifier output is coupled to a local loudspeaker and its input is connected to a second, remote, loudspeaker at the slave unit. This second loudspeaker functions as a moving-coil microphone, whereupon the sound it picks up is amplified and reproduced over the main unit loudspeaker. A loudspeaker does not function particularly well, in terms of audio quality, when used as a microphone, but its performance is perfectly adequate for the transmission of intelligible speech. Since it presents a low impedance output to the connecting cable its signal output voltage is low, being typically well below one millivolt. In consequence the amplifier has to have quite a high voltage gain in order to give adequate volume at the reproducing loudspeaker. An advantage given by working at low impedance is that a long connecting cable can be used without incurring losses due to self-capacitance in the cable. Also, stray pick-up of mains hum, radio signals and other forms of interference is greatly reduced when compared with high impedance operation.

When the function switch in the main unit is set to the "Send" position, the local loudspeaker is connected to the amplifier input and the amplifier output is coupled by the connecting cable to the slave loudspeaker. The functions of the two loudspeakers are now reversed: the loudspeaker at the main unit is employed as a microphone and the amplified sound signal is reproduced over the slave loudspeaker.

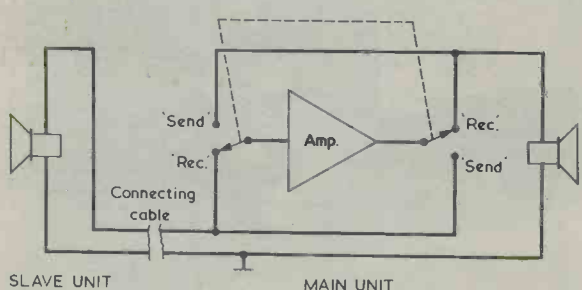
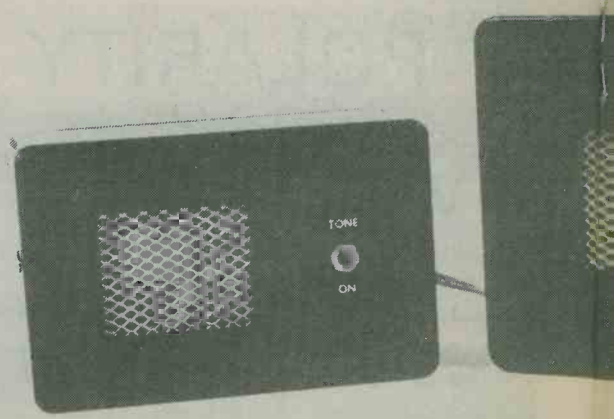


Fig. 1. A basic amplifying intercom system. According to the position of the "Send-Receive" switch in the main unit one or other of the loudspeakers functions as a microphone. The system has the disadvantage that the slave unit cannot call up the main unit when the amplifier is switched off

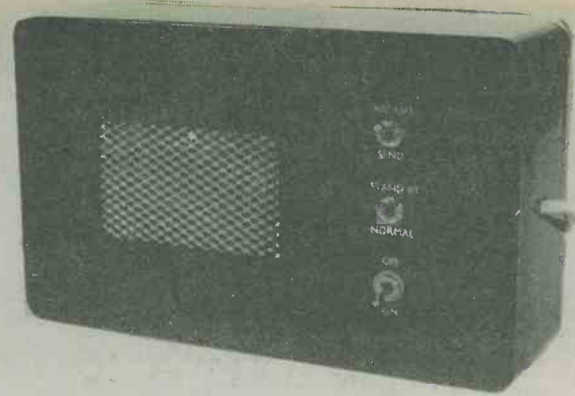


A picture taken just to show the neat mtc
practice they have to be separated fromea

ERCOM

addition to any household

ility from slave station



The main unit. At the right of the front panel S1 is at the top, S2 is in the middle and S3 is at the bottom

An obvious shortcoming of this system is that a call facility is available in one direction only. It is possible for a person at the main unit to call up the slave unit by simply setting the function switch to "Send" and speaking into the main loudspeaker. However, it is not possible for the slave unit to attract the attention of someone at the main unit. Additional circuitry must be incorporated in the design to give the slave unit a calling up facility.

The method employed in the present system is illustrated in Fig. 2. The slave station is equipped with a battery supply, a very simple and inexpensive audio oscillator and a d.p.d.t. "Call" switch. This switch is spring biased so that it normally switches off the supply to the oscillator and connects the slave loudspeaker to the connecting cable. When it is put in the "Call" position, power is applied to the audio oscillator and the oscillator output is coupled to the connecting cable, thereby causing an audio tone to be reproduced by the main station loudspeaker. The slave unit switch is biased away from the "Call" position so that the slave unit loudspeaker is normally in circuit all the time, ready to receive a call from the main unit. The bias ensures that the switch cannot be accidentally left at or knocked into the "Call" setting.

The call facility requires a second biased switch at the main unit, this being normally in the "Standby" position, where it ensures that the main unit loudspeaker is connected to the connecting cable ready to receive a call from the slave unit. When it is required to use the intercom for 2-way conversation, this switch is held in the "Operational" position and it connects the main unit loudspeaker to the same send-receive switching circuit that was shown in Fig. 1. Reference to Fig. 2 will show that, when the slave unit calls up, the output of the audio

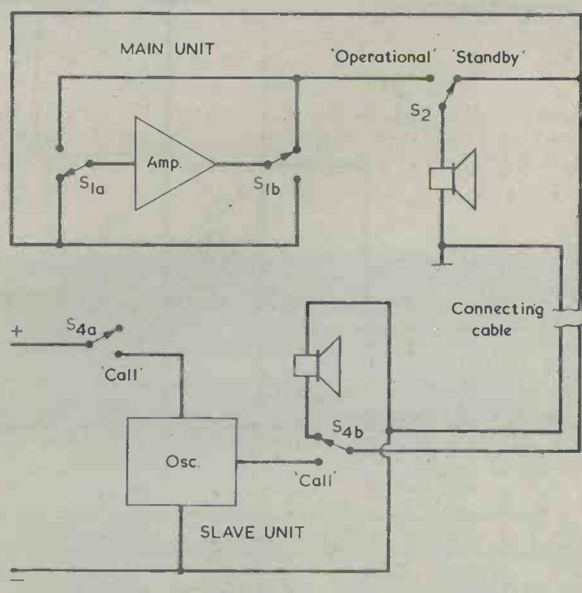
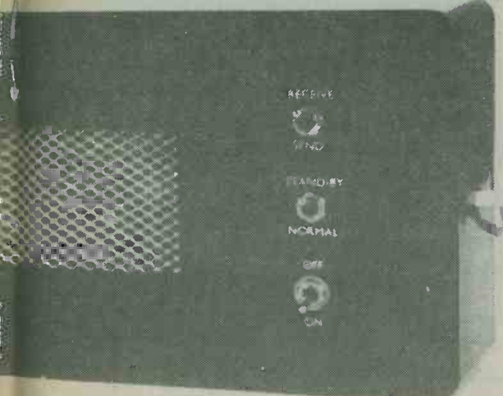


Fig. 2. A more complex version which permits calling up from the slave unit. The switches are given the same number references that they have in the full circuits



atching appearance of the two stations. In each other to prevent acoustic feedback oscillator is fed to the input or output of the amplifier according to the position of the send-receive switch. This does not cause any damage to the amplifier nor does it result in any significant amount of the audio tone signal being diverted from the loudspeaker. There are similarly no ill effects if the slave unit switch is inadvertantly set to "Call" whilst the main unit switches are at "Operational" and "Receive", in which instance the main unit loudspeaker is not connected across the connecting cable. Although it is capable of giving an acceptably loud call signal from the main unit loudspeaker, the audio output power from the slave unit oscillator is relatively low.

Not shown in Fig. 2 is an on-off switch for the main unit amplifier. This is turned off at the main unit when the intercom system is not in use, and is turned on when the main unit wishes to call the slave unit or when a call has been received at the main unit from the slave unit.

COMPONENTS

Resistors

(All $\frac{1}{4}$ watt 5% unless otherwise stated)

R1 2.2M Ω 10%	
R2 4.7k Ω	R7 2.7M Ω 10%
R3 10k Ω	R8 180 Ω
R4 10k Ω	R9 4.7k Ω
R5 680 Ω	R10 39k Ω
R6 47k Ω	R11 33 Ω

Capacitors

C1 330 μF electrolytic, 10 V. Wkg.
C2 0.33 μ F type C280
C3 2.2 μF electrolytic, 63 V. Wkg.
C4 0.1 μF type C280
C5 100 μF electrolytic, 10 V. Wkg.
C6 100 μF electrolytic, 10 V. Wkg.
C7 22pF ceramic plate
C8 100 μF electrolytic, 10 V. Wkg.
C9 0.1 μF type C280
C10 10 μF electrolytic, 10 V. Wkg.
C11 0.22 μF type C280

Semiconductors

TR1 BC109	IC1 CA3130T
TR2 BC109	IC2 555

Switches

S1 d.p.d.t. miniature toggle.
S2 s.p.d.t. miniature toggle, biased one way
S3 s.p.s.t. miniature toggle
S4 d.p.d.t. miniature toggle, biased one way

Loudspeakers

LS1, LS2 miniature moving coil, 50 Ω to 80 Ω impedance

Batteries

BY1 9 volt battery type PP6
BY2 9-volt battery type PP3

Miscellaneous

2 plastic cases (see text)
Veroboard, 0.1in. matrix
Connecting cable, 2-way "figure of 8" type, length as required
2 battery connectors
2-way terminal block (see text)
Speaker fabric
Wire, nuts, bolts, etc.

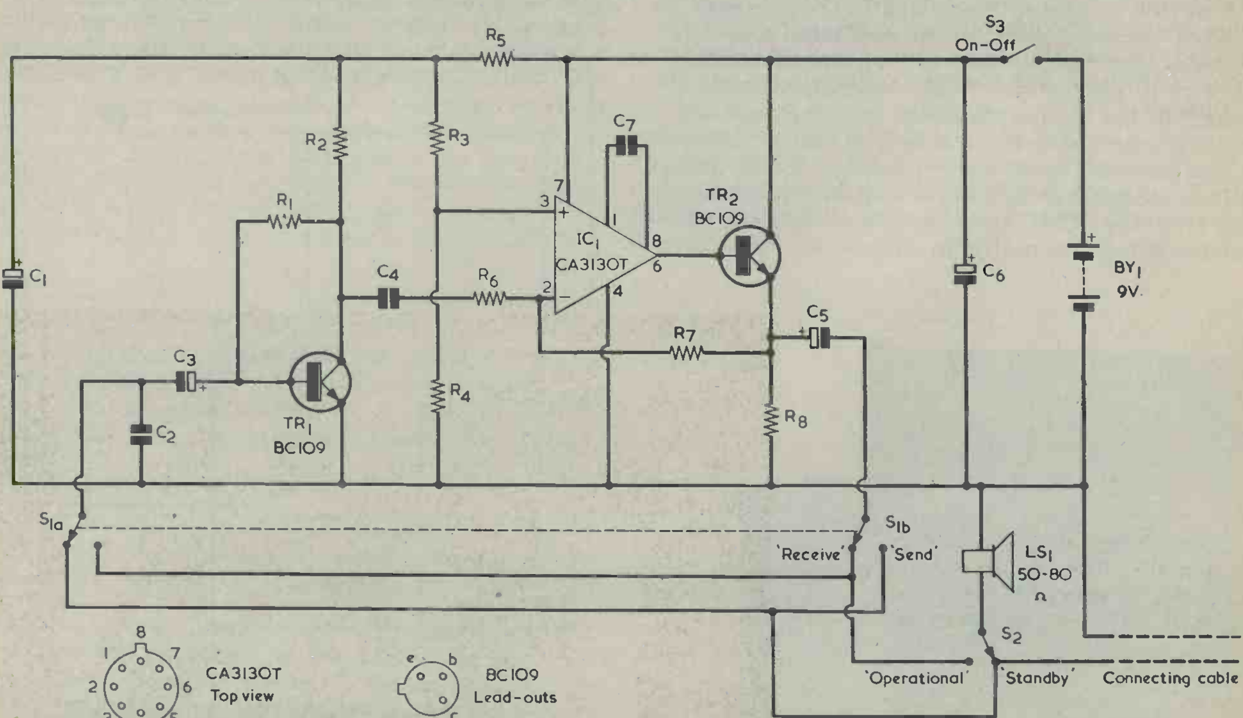
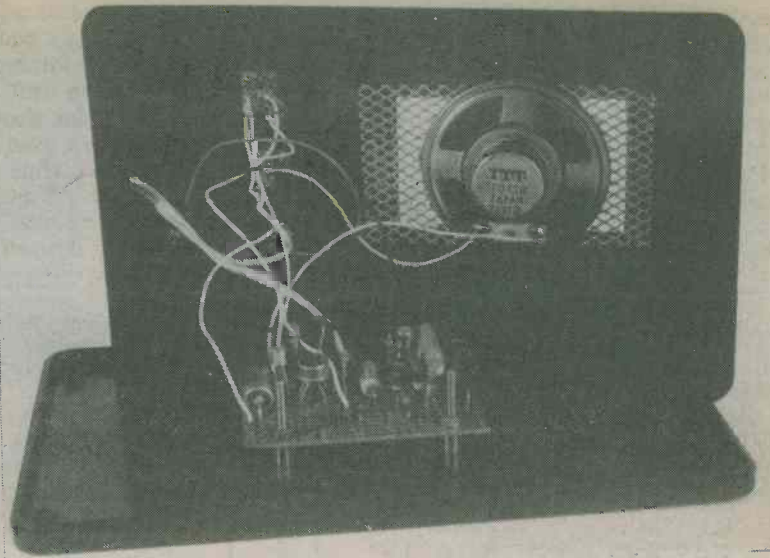


Fig. 3. Full circuit diagram for the master unit in the intercom system

The Veroboard component module for the main unit is bolted to the rear panel of the case



MAIN UNIT CIRCUIT

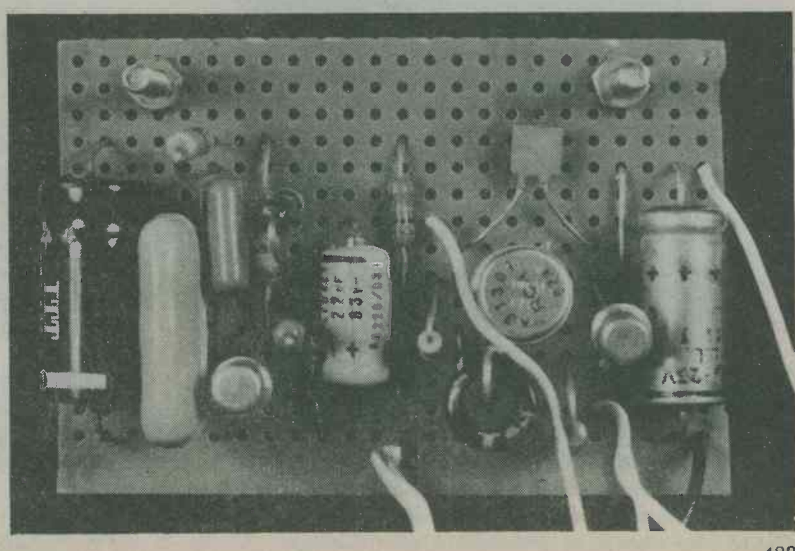
The circuit for the main station is shown in Fig. 3. Only a low power output is required in this application, and the unit is unlikely to be used for long periods since equipment of this type is normally employed only to pass short messages. In consequence a very simple Class A amplifier is used instead of a more complex Class B circuit.

At the input, C2 is an r.f. filter capacitor, and its high value ensures that no r.f. break-through occurs. It causes no significant a.f. treble attenuation because of the low impedance of the slave unit loudspeaker when used as a microphone. TR1 is connected in a conventional high gain common emitter pre-amplifier stage, and it provides slightly more than half the overall voltage gain of the amplifier.

The output stage employs operational amplifier IC1, connected in the inverting mode, and the buffer emitter follower TR2 to give a suitably low output impedance. R7 and R6 provide a negative feedback loop which sets the voltage gain of the output stage at approximately 57 times. The CA3130T employed for IC1 does not have an internal compensation capacitor, and this function is provided by the discrete component, C7.

Despite the use of Class A output, good supply decoupling is required due to the high amplifier gain, and this is provided by C1, R5 and C6. Apart from on-off switch S3, the switching circuit is the same as that of Fig. 2, which has already been explained. The current consumption of the amplifier is approximately 25mA, which gives many hours of operation from the PP6 size 9 volt battery employed.

The main unit component module. This is secured in place by two 6BA bolts and nuts with spacing washers



The slave station. The only control which this has is the "Call" switch, S4

SLAVE STATION UNIT

The circuit of the slave station appears in Fig. 4. The audio oscillator uses the popular 555 timer i.c. in the astable mode. Timing components R9, R10 and C9 give an operating frequency of about 175Hz, and the frequency can be altered if desired by changing the value of C9. The frequency of oscillation is inversely proportional to the value of this component.

A low impedance rectangular waveform is available at pin 3 of the 555, and this is coupled to "Call" switch S4 by means of d.c. blocking capacitor C10 and an r.f. filter which is comprised of R11 and C11. This filter is needed to attenuate high frequency harmonics present in the 555 output, as these could be radiated by the connecting cable and possibly cause radio interference.

The current consumption of the oscillator is about 30mA. This can be supplied economically by a PP3 size 9 volt battery, as the call oscillator will only be used intermittently for brief periods.

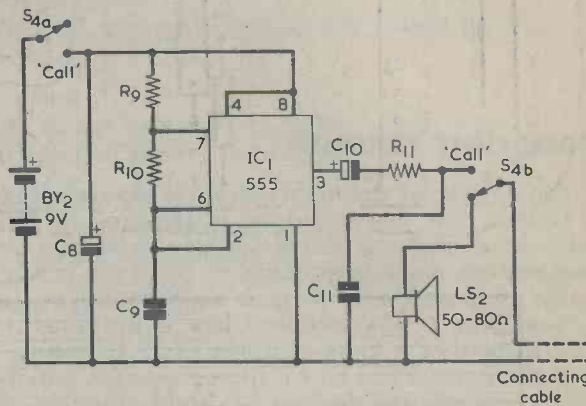
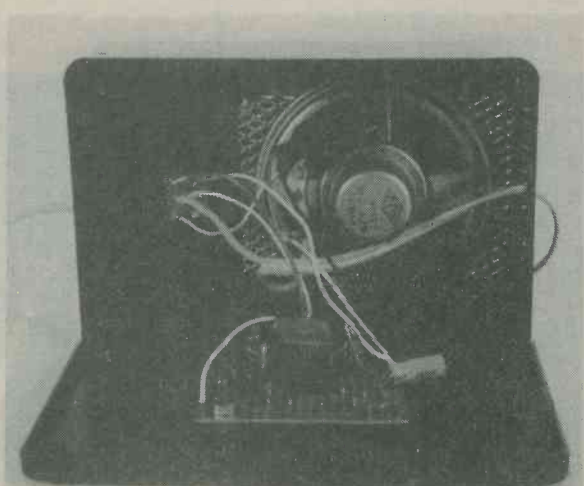


Fig. 4. The slave unit circuit. When S4 is set to "Call" an audio tone is sent to the main unit



Inside the case of the slave station. The Veroboard component panel is mounted to the rear of the case in the same way as occurs in the main unit housing

CONSTRUCTION

The prototype main unit is housed in a Verocase type 75-2861D which measures approximately 180 by 110 by 55mm., and the slave unit in a Verocase type 75-2860J having approximate dimensions of 120 by 80 by 35mm. These cases are available from Maplin Electronic Supplies under catalogue numbers LH51F and LH50E respectively. (The Verocases are not listed in the Maplin catalogue current at the time of writing, and are shown in the catalogue supplement for May 1979.)

A speaker aperture must be made in the front panel of each case and its size and shape can be judged from the photographs. The apertures can be cut out by means of a fretsaw or a coping saw. A piece of speaker "fret" or fabric is glued in place behind each aperture. Few miniature speakers have any integral mounting arrangements, and need to be glued in position. A good quality adhesive such as Bostik No. 1 or an epoxy resin should be used, and only a small amount should be applied to the front rim of each speaker, which is then glued behind the "fret" or fabric. Take care not to get any adhesive onto the speaker diaphragms, as this could impair performance.

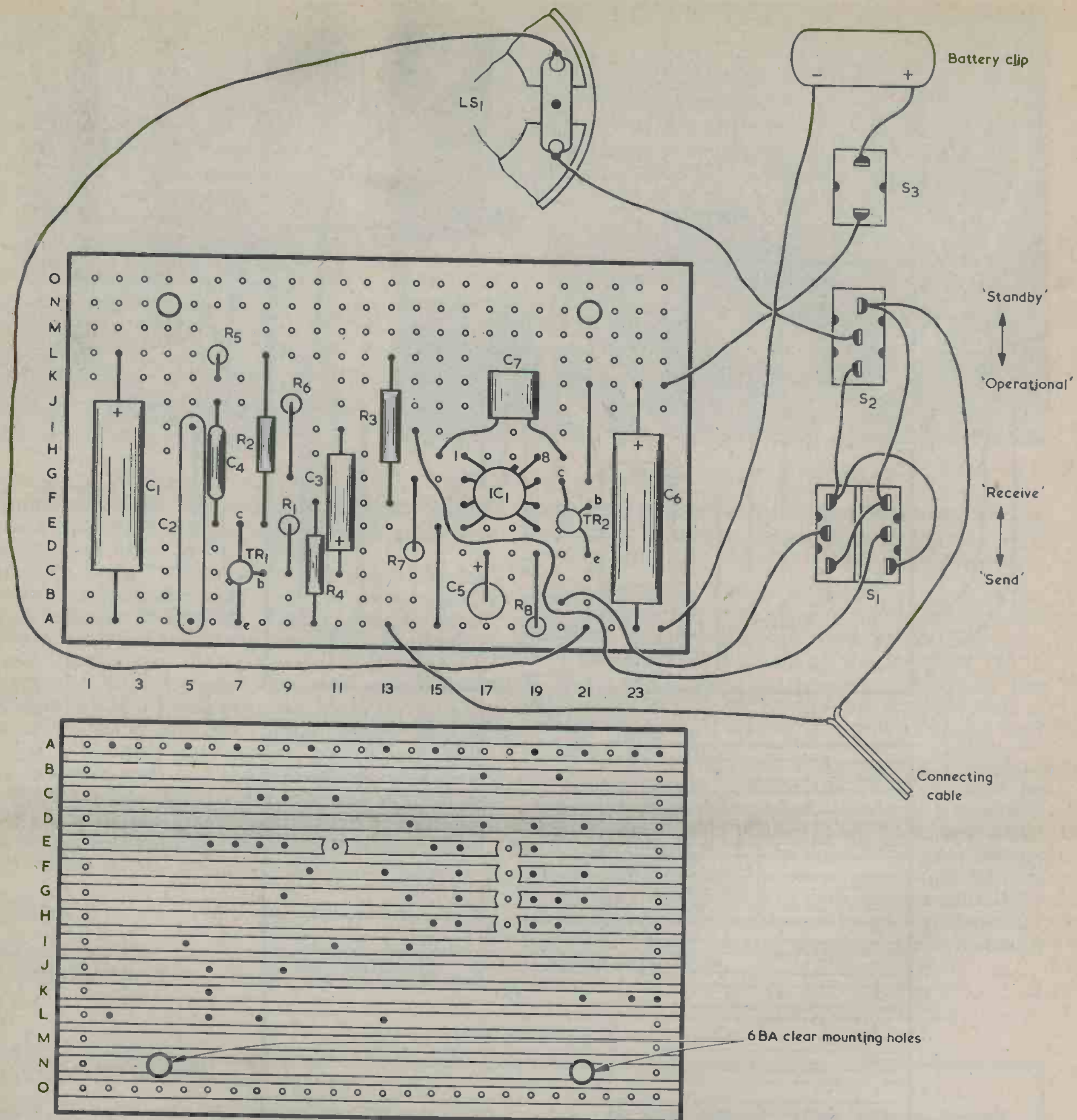


Fig. 5. Details of the wiring at the main unit. Nearly all the components are assembled on a Veroboard panel. The arrows and legends alongside S2 and S1 indicate the contacts which close for the functions indicated

Most of the main unit circuitry is wired up in an 0.1in. matrix Veroboard having 15 copper strips by 24 holes. This is illustrated in Fig. 5, which also shows the wiring external to the board. When the veroboard panel has been cut out the 5 breaks in the copper strips are made, after which the two mounting holes are drilled out. The components are then soldered into position. IC1 has a MOS input stage, and the normal handling precautions should be taken. It should be the last component to be soldered to the board and it should be kept in its protective packaging until this time. It should then be handled as little as possible and soldered into circuit with an iron having an earthed bit.

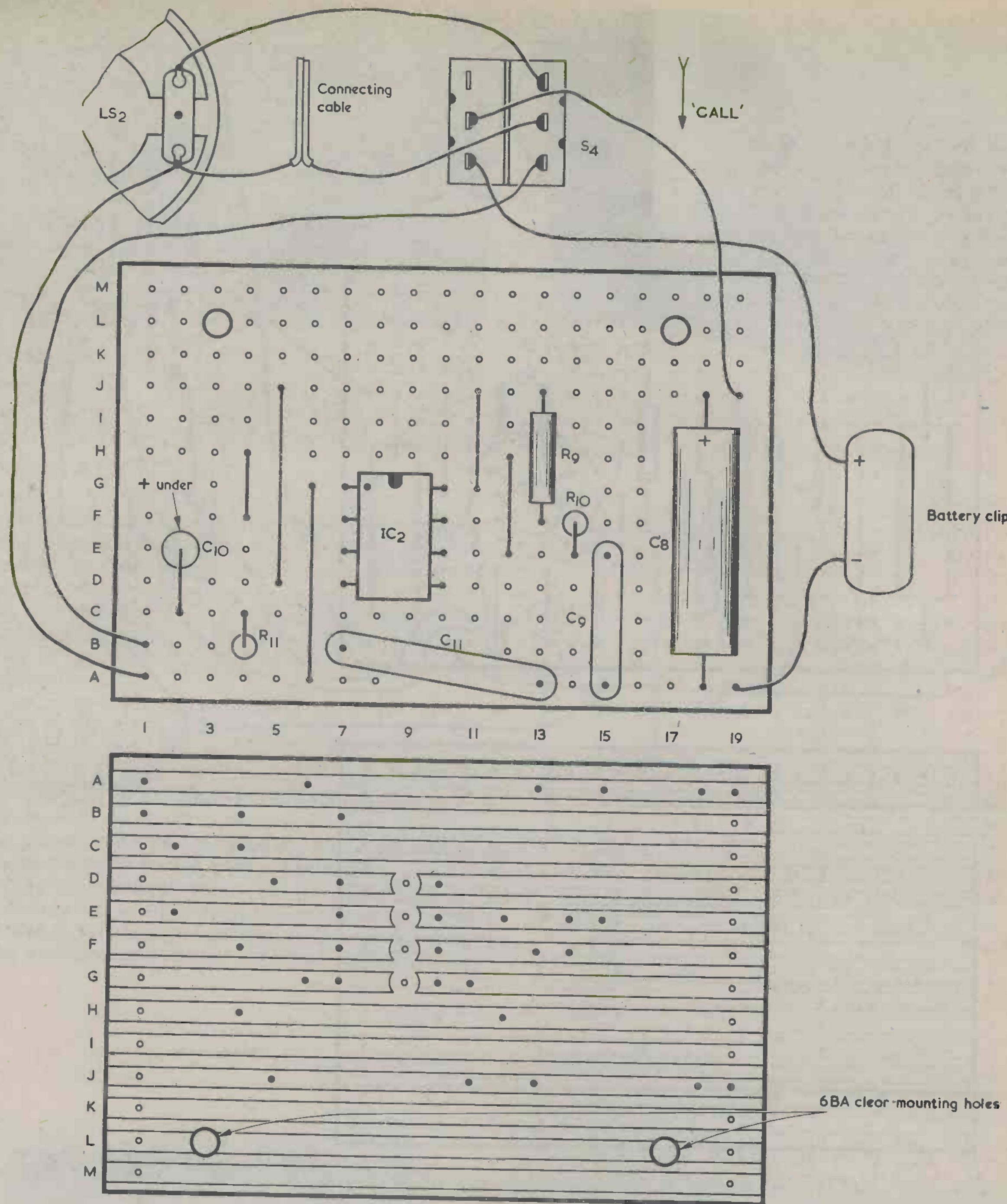
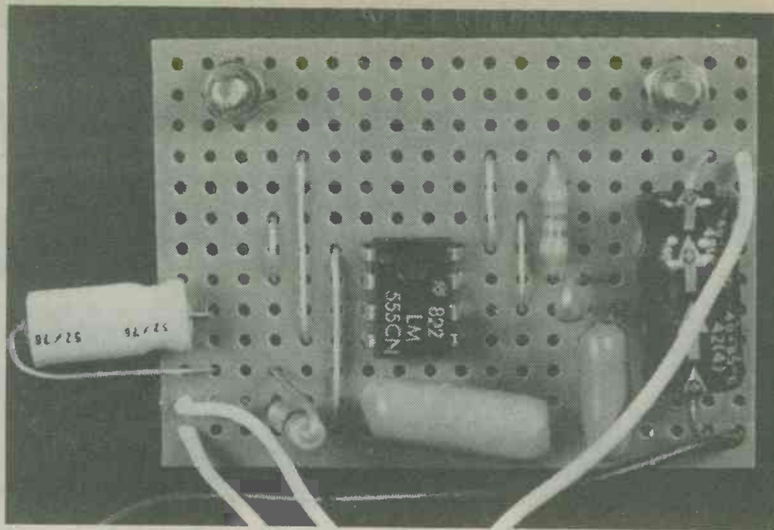


Fig. 6. Wiring details for the slave unit. Again, a Veroboard panel provides a convenient means of wiring up the components. C10 should be positioned in the manner shown in the photograph of the board assembly

When the component panel has been completed it may be wired up to the remaining components external to the board. Remember that S2 is biased to the "Standby" position. The Veroboard is then mounted on the rear panel of the case by means of two 6BA bolts and nuts, with spacing washers to keep the board underside clear of the rear panel. Ensure that the Veroboard components will not touch the loudspeaker when the rear panel is fitted to the case.

The main circuitry of the slave station is assembled on another Veroboard panel of 0.1in. matrix, this having 13 copper strips by 19 holes. It is prepared, wired up and mounted in the same general manner as the other Veroboard panel. Remember that S4 is biased away from the "Call" position. In this instance it is even more important to ensure that the components do not foul the speaker, as the slave unit case is shallower than the master unit case. In consequence, the board should



Due to the shallowness of the slave unit case, care has to be taken to prevent the Veroboard components fouling the loudspeaker. It is for this reason that C10 lead-outs have been bent so that the capacitor projects sideways from the board

be mounted on the rear panel in a position which ensures that there is adequate clearance when the rear panel is fitted to the case.

In both units there is adequate space for the battery required, and these may be secured with simple clamps, if desired. The connecting cable between the units passes through a hole in the side of each case. Since this may raise difficulties in routing the wire between the two units, it is desirable to add a 2-way terminal block on the outside of the slave unit rear. This can be used to provide a junction between the connecting cable from the main unit and the connecting cable from the slave station, thereby allowing the connecting cable to be routed and cut to the desired length. The use of the terminal block also enables a final check to be carried out more easily.

TESTING

When completed, the system is ready for testing and installation. The stations should be spaced away from each other by at least 5 metres (16ft.) as there may otherwise be acoustic feedback, with howling from one or other of the loudspeakers.

In some cases it may be beneficial to alter the gain of the amplifier to allow for loudspeakers with lower or greater efficiency than usual. The gain may be increased by raising the value of R7 to 4.7M Ω, and it may be reduced by lowering the value of R7 to 1.5M Ω. Ensure that the alteration is carried out using a soldering iron with an earthed bit to prevent damage to IC1.

This connecting cable to the slave unit may be connected either way round. However, it is worth checking the "Call" facility to the main unit when S1 is set to "Receive" with the cable connected one way round and then the other way round. If it is found than one method of connection results in a louder call tone from the master unit loudspeaker then that is the method of connection which should be finally adopted.

■

ELECTRONIC CATALOGUE

Featuring 48 large pages plus an index, the 1980 Greenweld component and equipment catalogue has now become available. Many new lines have been introduced and a welcome fact is that a high proportion of prices have actually been reduced. A large number of items are priced with discounts for quantity.

The catalogue embraces a very wide range of components having particular interest to home constructors as well as to retail outlets, and includes a reference to Greenweld's associate company, Technical Circuits 79, who are specialists in printed circuits and can process a design from layout to the completed board. New items introduced include a regulated power supply, an audible warning device and a 40 watt amplifier module, these all being exclusive Greenweld designs. There is also a comprehensive range of linear i.c.'s CMOS devices, voltage regulators and transistors. An unusual inclusion consists of storage trays and drawers.

Included with every catalogue is a first class reply-paid envelope, an order form and the latest Bargain List. The catalogue costs 40p plus 20p postage, which may be recouped from five 12p discount vouchers inside the back cover, and the full address of Greenweld is Greenweld, 443 Millbrook Road, Southampton, S01 0HX.

DATABUS series No. 9

really explains microprocessors

By Ian Sinclair

THE STATUS REGISTER

The status register of the CPU is unlike any of the other registers we have considered so far. All the other registers store one or two bytes of bits, and each byte represents a binary number, which may be an address, a data number or a code number representing a letter or other symbol. In the status register, though, each bit is a separate signal, and the complete set of bits doesn't represent anything in particular. In an 8-bit status register, the 8 bits don't really behave like a byte of data, to be added to or subtracted from other bytes, but we may very well wish to AND, OR or XOR the bits in the status register with the bits contained in a byte that is in the accumulator.

Before we start on the uses of the status register, let's go over what each bit does. Different types of CPU use their status registers in different ways, but there are nearly always four bits labelled zero (z), carry (c), overflow (o) and sign (s).

CARRY BIT

Now we've met the carry bit already — it's changed (or set) from zero to 1 when two 8-bit binary numbers are added and there is a carry out of the highest order (8th) bit. The carry, in other words, acts as a temporary ninth bit in such an addition. If the numbers that are being added are two bytes long, the carry must be added in to the next two bytes and the carry flag reset to zero for the next time.

The overflow status bit (or flag) is not too easy to explain until we have discussed signed binary arithmetic. For the moment, take it that a carry out of the 7th bit (Fig. 2) cannot always be loaded into the 8th bit without causing an error, because the 8th bit is being used to represent the sign (+ or –) of the number. When this happens, the carry out of the 7th bit is loaded into the OV (for "overflow") bit of the status register — in microprocessor jargon, the overflow bit is set.

The zero flag is straightforward — this bit is set to logic 1 if an operation in the accumulator causes a zero result. If an addition or subtraction leaves zero in the accumulator, then the status flag is set to 1. If a number is left in the accumulator, the zero status flag is left at 0. We make use of this for programming jumps, which may take place when the accumulator is at zero (flag at 1) or when the accumulator is not at zero (flag at 0). The other flag which is always provided is the sign(s) flag which is set to 1 when the byte in the accumulator has a logic 1 in the highest place (more on sign in Part 10).

Now these are the normal status flag bits which will be found on any microprocessor, but they are just four bits out of a possible eight. How the other four bits of the status register are used depends very much on what the designer of the CPU had in mind and so we can expect considerable differences between different microprocessor chips. The INS8060 (SC/MP), for example, has three flag bits

CYL	OV	SB	SA	IE	F2	F1	FO

CYL – carry/link bit
OV – overflow bit
SB – set or reset by a signal at pin 18
SA – set or reset by a signal at pin 17 (used as interrupt input) } pin input only
IE – interrupt enable flag
F2, F1, FO } can be set or reset by program instructions, outputs on pins 22,21,19 respectively

Fig. 1. The INS86060 (SC/MP 2) status register bits

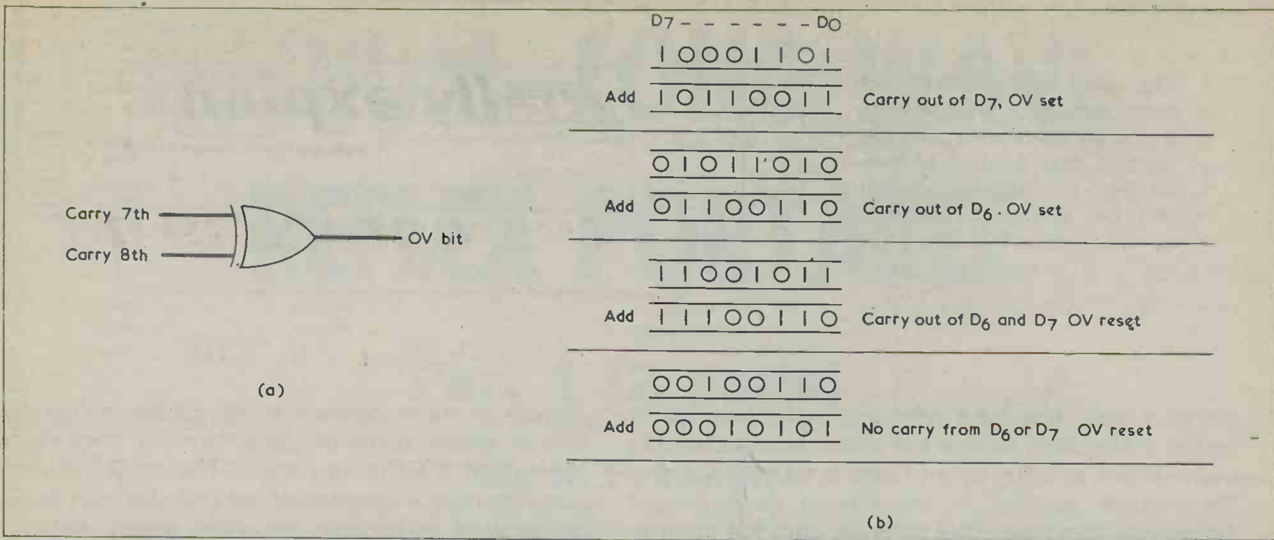


Fig. 2. The overflow bit. (a) The internal logic circuit. (b) Example showing when the overflow bit is set (1) or reset (0)

which can be set (to 1) or reset (to 0) by an instruction in the program, and which will cause the same voltages to appear at pins on the chip. This allows external devices to be operated under program control without the complication of input/output ports and is a popular method of using the SC/MP to generate square waves by alternately setting and resetting one of these status flags.

The 8080 has no overflow flag (because an overflow signal can be obtained on other ways), but has a parity flag and an auxiliary carry flag. The parity flag is set to 1 when an operation leaves the accumulator with an even number of 1's — as described earlier in Part 7, this allows the CPU to detect a byte which has an error. The auxiliary carry flag is used for BCD addition and subtraction, this flag is also used on the Motorola M6800 and the Mostek 6502.

FLIP-FLOPS

The status register is not, however, just a set of flip-flops put in to record what happens in the accumulator. When a carry flag is set, for example, a bit exists which has to be added in to the next byte, if the number is a two-byte number. Practically every instruction that the microprocessor program uses will have an effect on one of the flag bits of the status register and these effects have been carefully thought out by the designers. A microprocessor instruction set, such as we shall examine in Part 11, will show which status flags are set by what instructions. A few of these flags may be used only occasionally — for example, if the microprocessor is used only for machine control the parity flag may never be used, since parity is used only to check if a coded letter or character is correct — it does not apply to numbers.

The use that is made of status flags, other than the obvious use of the carry flag in arithmetic, is in deciding when a program will branch. Now branching is an idea which will, once again, be familiar to readers who have followed the "Tune-in to Programs" series which started in the January, 1979, issue of ***Radio & Electronics Constructor*** for new readers a quick summary is as follows. Very often in a program we want to go one or two ways depending on the value of a quantity in the accumulator. We might, for example, use a program to load seven bytes of data in from one part of memory and transfer them to another part. How can we instruct the micro-processor when to stop? The usual method is to load the number 7 (in binary) into a memory, unload a byte, reload it, take out the number 7 from the memory and decrement it, making 6. Now at this point, we instruct the microprocessor to compare the number in the accumulator with zero. If the number is more than zero (and 6 certainly is) then the number 6 is returned to

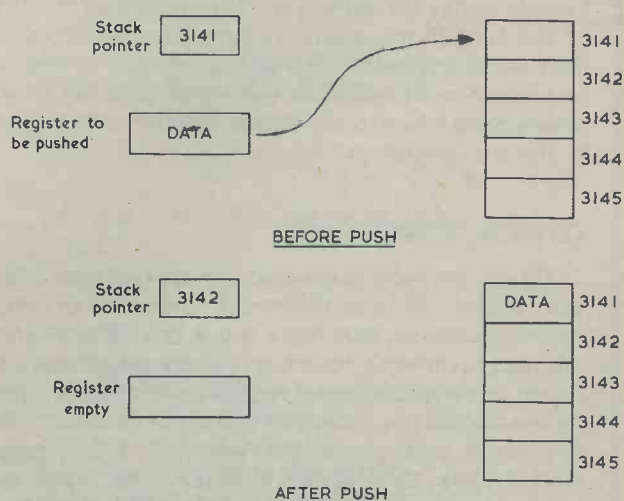
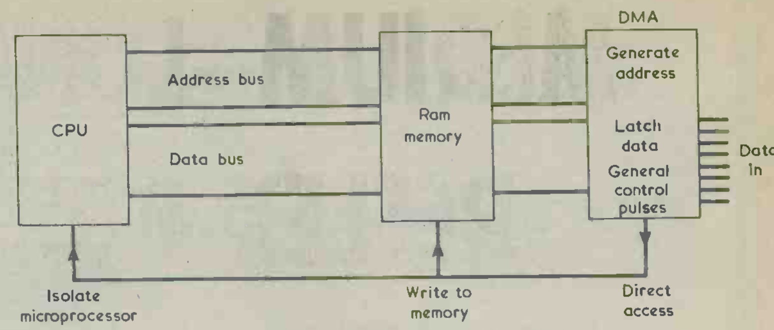


Fig. 3. Using the stack pointer. The stack pointer contains the address of the first vacant memory in the stack. After a push operation, the stack pointer is incremented so that the next push will be to the next vacant position. The counter is automatically decremented before the pop operation

Fig. 4. Direct Memory Access (DMA). A DMA control chip generates address signals and control pulses, so that the microprocessor can be isolated and data written directly into the memory



memory and the next program instruction is to return to the start, so that the action is repeated. On the next run, another byte of data is transferred, and the counter number in memory is decremented again to 5 this time. This goes on until the counter number at the last run is decremented to zero. When the compare-to-zero step is made, the program now skips or branches — the next step is not a return to the start, but a different part of program.

BRANCH INSTRUCTIONS

Branching is extremely useful, and there are very few useful programs which do not include branching of some type — just to give one example, we can test the byte in the accumulator to see if it is equal to, less than, or more than a byte in memory.

Using four status flags makes eight possible branch instructions possible. The zero flag is, as the above example suggests, the one most used for branching, and the branch instruction can be to branch if the zero flag is set (accumulator 0) or not set (accumulator contains a number which is not zero). Similarly, instructions can be given for the overflow or sign flags. A set of instructions will also include codes for setting (to 1) or resetting (to 0) all of the bits in the status register. Some CPUs can load any number into the status register, or test the bits which are present in the status register, by exchanging the bits in the status register with the bits in the accumulator.

OTHER REGISTERS

So far, we have discussed various registers which are found in one form or another in most microprocessors, but there are a few others which are also commonly found, and some which are a bit more unusual. Another register which very commonly appears is known as the stack counter; it has the same relation to the stack as the program counter has to ordinary memory. The stack was briefly described in Part 8 — it's a bit of memory which is the only piece of memory included inside the CPU (in several examples of CPU types) and it's being used to store the contents of registers while an interrupt is being served. The stack is used to store the data bytes, and the stack pointer is a register which is used to address the correct place in the stack memory. When bytes are being written into the stack memory (a push operation) the stack pointer stores an address which guides the first byte into an empty piece of stack memory. Immediately after such a write operation, the stack pointer is automatically incremented, so that the next byte to be pushed goes into the next empty chunk of memory. The process works the other way round when data is being popped out of the stack again. This time, though, the stack pointer has to be decremented (1 subtracted) before reading, because the last push operation will have left the stack pointer aimed at the next spare bit of memory. If we popped this we would find nothing, — even worse we might find some random value left over from a previous operation. By arranging that the stack pointer is decremented before the pop operation, the CPU designer has ensured that the first byte taken back out of the stack is the same as the last byte stored there.

Not all CPUs have a stack memory built in, notably the INS8060 (SC/MP). When a stack is needed, a piece of RAM is used, addressed by one of the pointer registers (P2).

Most CPUs permit data to be moved from one register to another without passing through the accumulator. This type of operation has the advantage of being carried out very much more rapidly than a fetch-from-memory, because all the signals are inside the CPU chip. A few CPUs have a second accumulator register, some have three or more, so that several operations can be carried out without having to shift bytes around. In general, the way a CPU is designed very much affects the way in which it can be used, and it takes quite a long time to adapt completely from one to another. Learning to handle a new CPU is one thing — learning all its tricks and how to program it most economically is quite another!

Another point, not strictly belonging here but needing a mention, is direct memory access. Some CPUs can be switched so that they lose control of both address and data lines — this requires the CPU to be fitted with tri-state buffers, so that all the address and data outputs go to a high impedance. When this happens, bytes can be stored directly into memory without having passed through the accumulator, making it possible to store data whenever it comes along rather than when the program requests data. Direct memory access needs a separate i.c. which has an address register, and this separate i.c. must be under the control of the CPU.

(To be continued)

MEDIUM–LONG WAVE REFLEX PORTABLE

Part 1 (2 parts)

By R. F. Haigh

When embarking on the construction of a portable radio, the basic choice lies between a simple t.r.f. and a more complex superhet design. Although a high level of performance can be given by the superhet, complexity and cost are drawbacks, and small portables can be purchased for less than the cost of the components needed to construct a receiver of this kind. It must be admitted, however, that spurious responses and poor audio quality often mar the performance of inexpensive manufactured radios.

Bearing this in mind the author carried out experiments involving a number of t.r.f. circuits, and it soon became apparent that a satisfactory level of sensitivity and selectivity can be obtained if manually controlled reaction is incorporated. The circuit finally adopted is based on a design due to G. W. Short which was published in this magazine some years ago. Incorporating currently available high gain transistors and modified by the addition of a reaction system, the sensitivity and selectivity of the receiver which forms the subject of this article approach those of a superhet. Using a suitable audio amplifier and a speaker of reasonable size, the overall performance will be found superior to that offered by most cheap imported radios.

COMPONENTS

Resistors
(All fixed ¼ watt 5%)
R1 4.7k Ω
R2 4.7k Ω
R3 680 Ω
R4 100 Ω
R5 10k Ω
R6 56 Ω
R7 1 Ω
VR1 100k Ω potentiometer, linear
VR2 4.7k Ω potentiometer, log

Capacitors
C1 4,700pF polystyrene
C2 1,000pF polystyrene
C3 10 μF electrolytic, 10V. Wkg.
C4 0.01μF polyester or ceramic
C5 220μF electrolytic, 10V. Wkg.
C6 470μF electrolytic, 10V. Wkg.
C7 10μF electrolytic, 10V. Wkg.
C8 1,000pF ceramic
C9 470μF electrolytic, 10V. Wkg.
C10 0.1μF polyester
C11 220μF electrolytic, 10V. Wkg.
C12 1,000pF ceramic
C13 1,000μF electrolytic, 10V. Wkg.
C14 0.1μF polyester
C15 6,800pF ceramic or polystyrene
VC1 500pF variable (see text)

Inductors
L1 — L4 see text
L5 2.5mH r.f. choke type CH1 (Repanco)

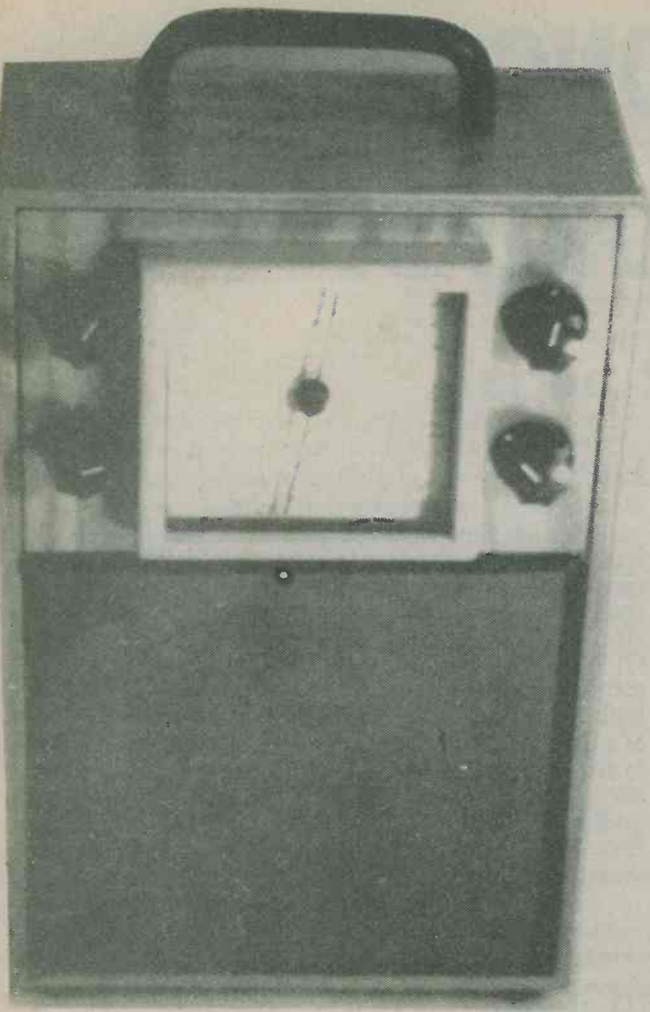
Semiconductors
TR1 BC169C D1 OA47 (see text)
TR2 BC169C IC1 TBA810AS

Switch
S1 4-pole 3-way miniature rotary

Speaker
LS1 3 Ω, 4 Ω or 8 Ω, 6in. round (see text)

Battery
9-volt battery type PP6 or PP9 see text)

Miscellaneous
2 ferrite rods, 6in. x ⅜in. diameter
26 s.w.g. enamelled wire
38 s.w.g. enamelled wire
2 28-way tagstrips, ¼in. pitch
Drive drum, spindle and cord
4 knobs
Battery connector
24 s.w.g. aluminium sheet (see text)
Speaker fabric
Materials for front panel, brackets, etc.
Nuts, bolts, wire, etc.



The completed receiver housed in a simple cabinet

CIRCUIT DESIGN

The complete circuit of the receiver is given in Fig. 1, and in this switch S1 is shown set to the medium wave position, Separate ferrite rod aerials are used for the two wavebands. This avoids absorption effects which are given when the coils are wound on the same rod; the long wave winding resonates with its own self-capacitance when switched out of circuit at a frequency in the medium wave band and it causes a "dead spot" at that frequency. L1 and L2 are windings in the medium wave ferrite rod aerial, whilst L3 and L4 are the long wave windings. L1 and L3 are tuned by VC1, and L2 and L4 couple the tuned circuits to the base of TR1 and also act as reaction windings.

TR1 and TR2 are connected in a reflex circuit and both transistors amplify at radio and at audio frequencies. TR1 acts in the common emitter mode at radio and audio frequencies. TR2 works as an emitter follower at radio frequencies, its collector being bypassed for r.f. by C4. Its r.f. voltage gain is therefore slightly less than unity, but it performs the desirable function of matching the relatively high impedance at TR1 collector to the low impedance of the diode detector circuit.

The germanium diode, D1, demodulates the signals developed across the r.f. choke, L5, and the resulting audio frequency signal is fed back via the aerial coupling windings to the base of TR1, which then amplifies these. This amplified signal is passed to the base of TR2 which, at a.f., functions as a common emitter amplifier.Thus, after two stages of a.f. amplification the audio signal appears across R2, the collector load of TR2, and it is then fed, via C7, R5 and volume control VR2 to the integrated circuit audio power amplifier, IC1.

REACTION

A proportion of the r.f. signal is present in the output from D1, and the values of C1 and C2 have been chosen to ensure that the correct proportion of this is fed back to the tuned circuit via the base windings L2 or L4. Reaction is adjusted by VR1, which determines the collector voltage of TR1 and thereby controls its gain. In practice, the reaction control will be found to be extremely smooth and free from backlash. Weak signals which would otherwise be inaudible can be brought up to good loudspeaker volume, and selectivity is very much enhanced.

For regeneration to take place, the feedback has to be in phase with the signals picked up by each ferrite rod aerial and the base windings must be connected as shown in Fig. 1 to ensure this. In the diagram the letter "S" indicates the start of a winding and the letter "F" its finish. It will be noted that the long wave base winding is not connected in the same sense as the medium wave base winding. This is an unusual feature of the design, and clearly the circuit action is such that the phase of the feedback changes with signal frequency. This may be partly explained by the fact that the tuned windings are not physically connected into the reaction loop, whereupon the actual coupling of these windings into the loop is more complex than a first sight of the apparently simple reaction circuit might indicate.

COMPONENTS

The components are readily available and few of them are in any way critical.

The 500pF air spaced variable capacitor VC1 should be a single-ganged component such as that available from Home Radio. Alternatively, it can be one half of a salvaged 2-gang capacitor, or the two gangs of a lower value capacitor can be connected together to give the required capacitance range. However, the capacitor employed should not have too great a depth or it may not fit into the layout. If the loss of the extreme low frequency end of the medium wave band can be accepted, a 365pF variable capacitor can be used. The 500pF component gives continuous coverage over the two bands from 1,800kHz (167 metres) to below 150kHz (2,000 metres).

The tuning capacitor is adjusted by way of a standard cord drive, and a suitable drive drum and spindle are available from Home Radio. A drive drum and spindle may also be obtained from an old discarded radio. Precise details here are not particularly important and are left to the constructor.

The r.f. choke, L5, is a 2.5mH Repanco component type CH1. In some relex circuits it would need to be oriented for best results, but its orientation is not critical with the layout to be described. A

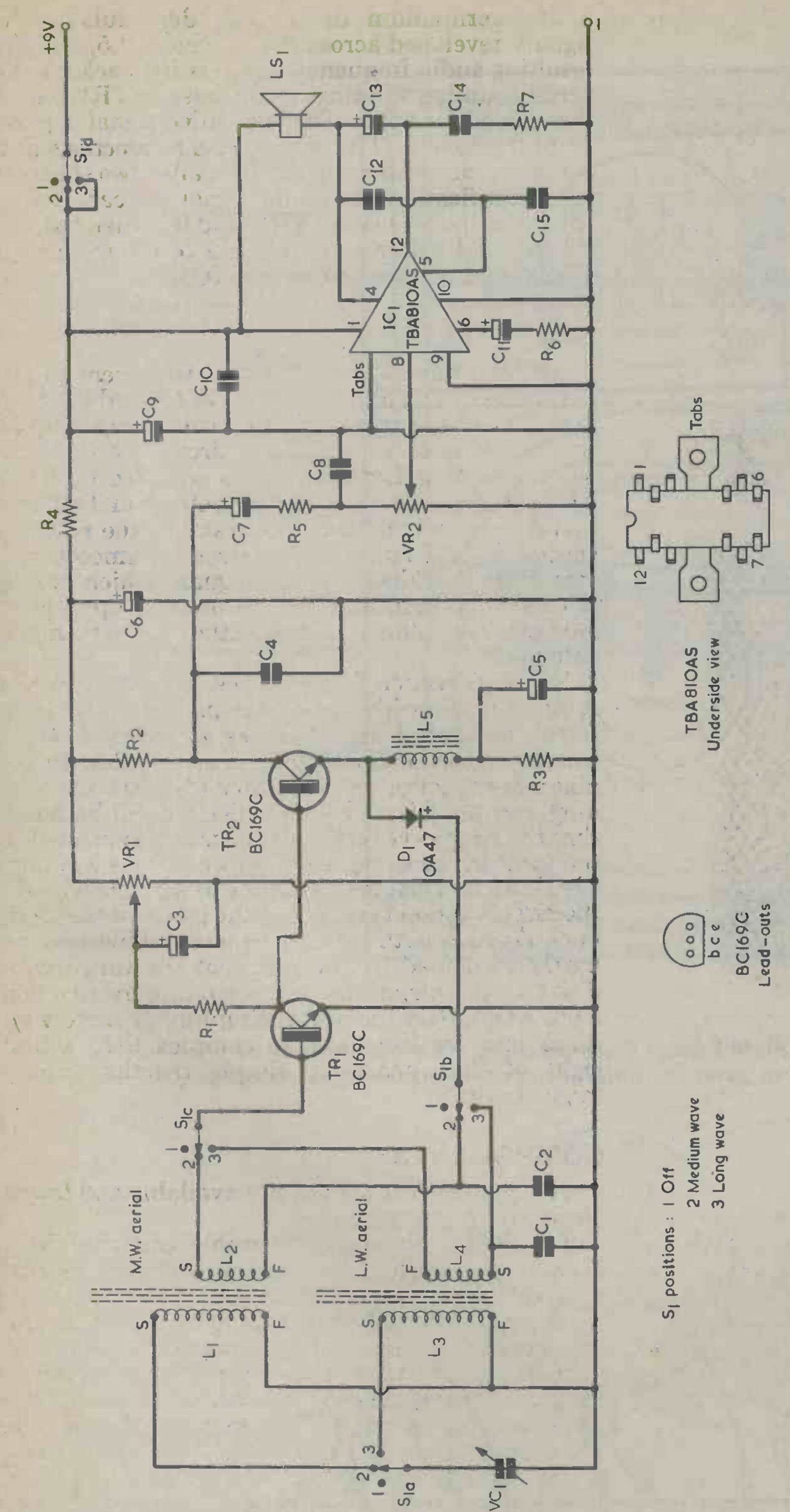


Fig. 1. The circuit diagram for the reflex medium and long wave receiver. The letters "S" and "F" alongside the ferrite aerial windings indicate "Start" and "Finish". The inset giving the i.c. pinout shows an underside view instead of the usual top view

number of high gain n.p.n. silicon transistors, including the 2N2926G and the BC108C, work reasonably well in the circuit, but the specified BC169C affords the greatest sensitivity. It is important that the high gain group "C" device should be used. It is found that almost any germanium signal detector diode, as well as the specified OA47, will prove suitable for D1. This diode must be connected with correct polarity or the set will not function at all.

A number of tagstrips are required, and these can be cut from two 28-way tagstrips having tags at a pitch of $\frac{1}{4}$in. These tagstrips are available from Electrovalue.

The integrated circuit employed for IC1 can be obtained from Ambit International. It is capable of around 1 watt output when powered by a fresh 9 volt battery, and its no-signal current consumption is low, being less than 10mA. It will work into a 3 Ω load, and salvaged speakers of this impedance are often to hand. It will also function satisfactorily with 4 Ω or 8 Ω speakers.

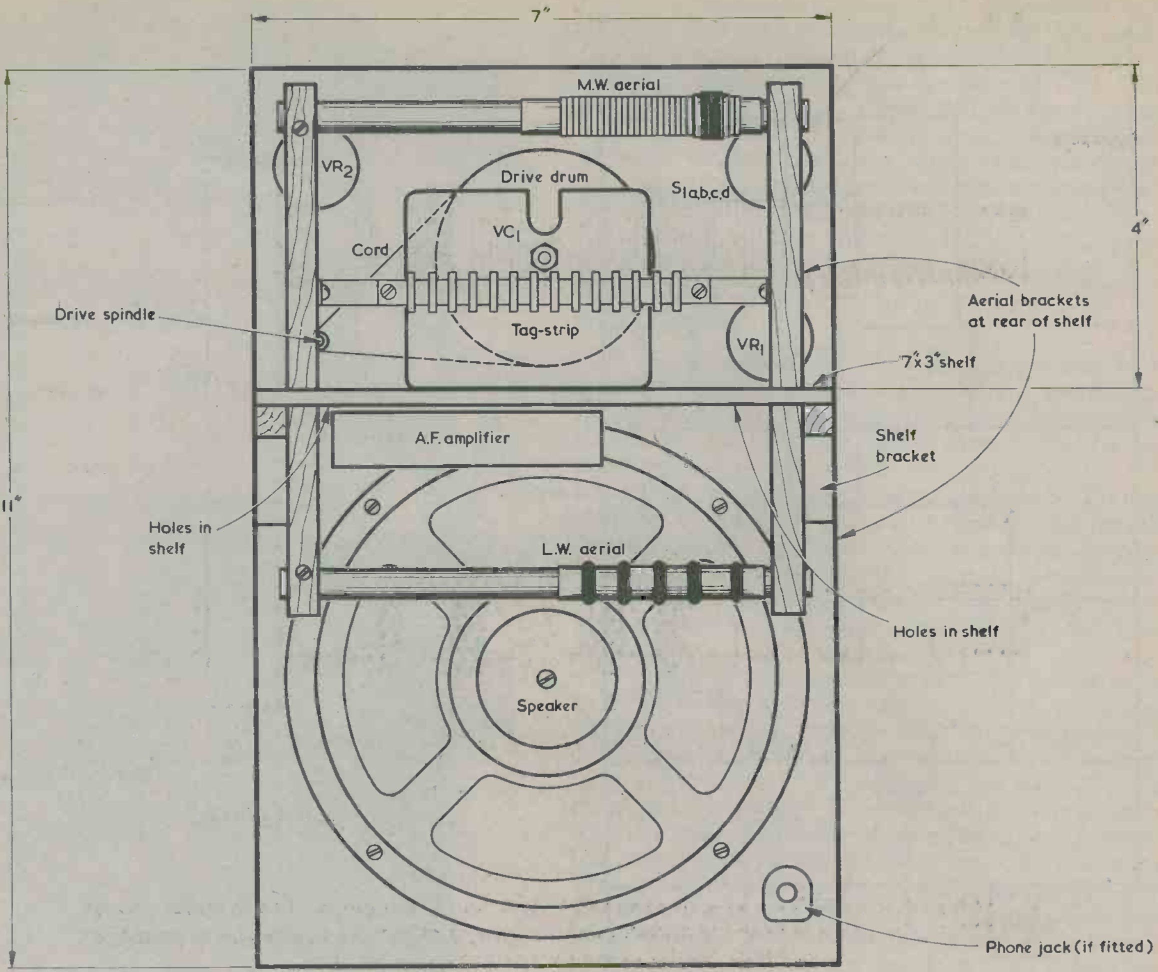
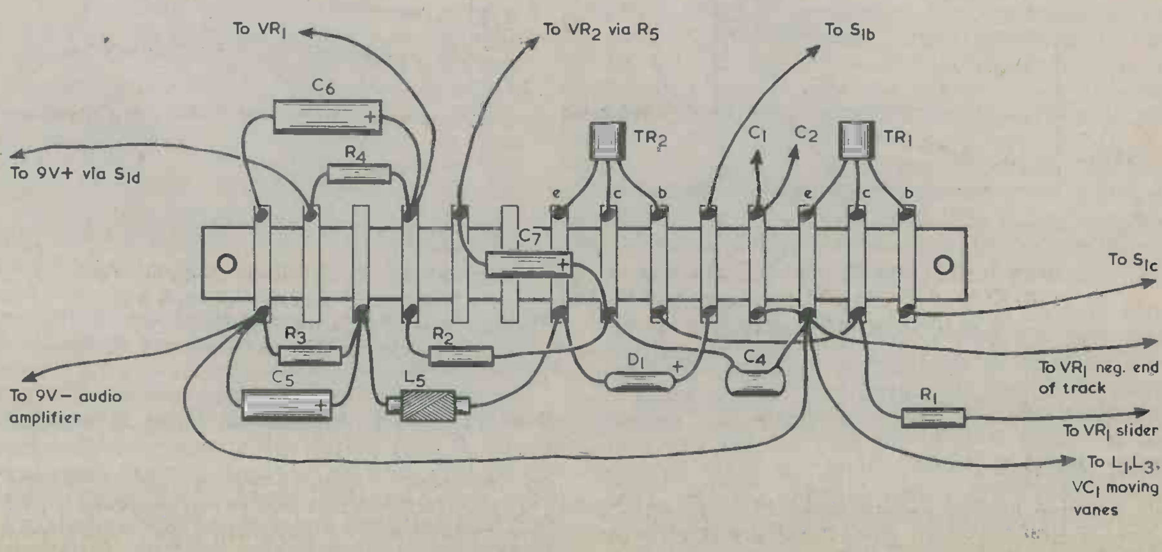
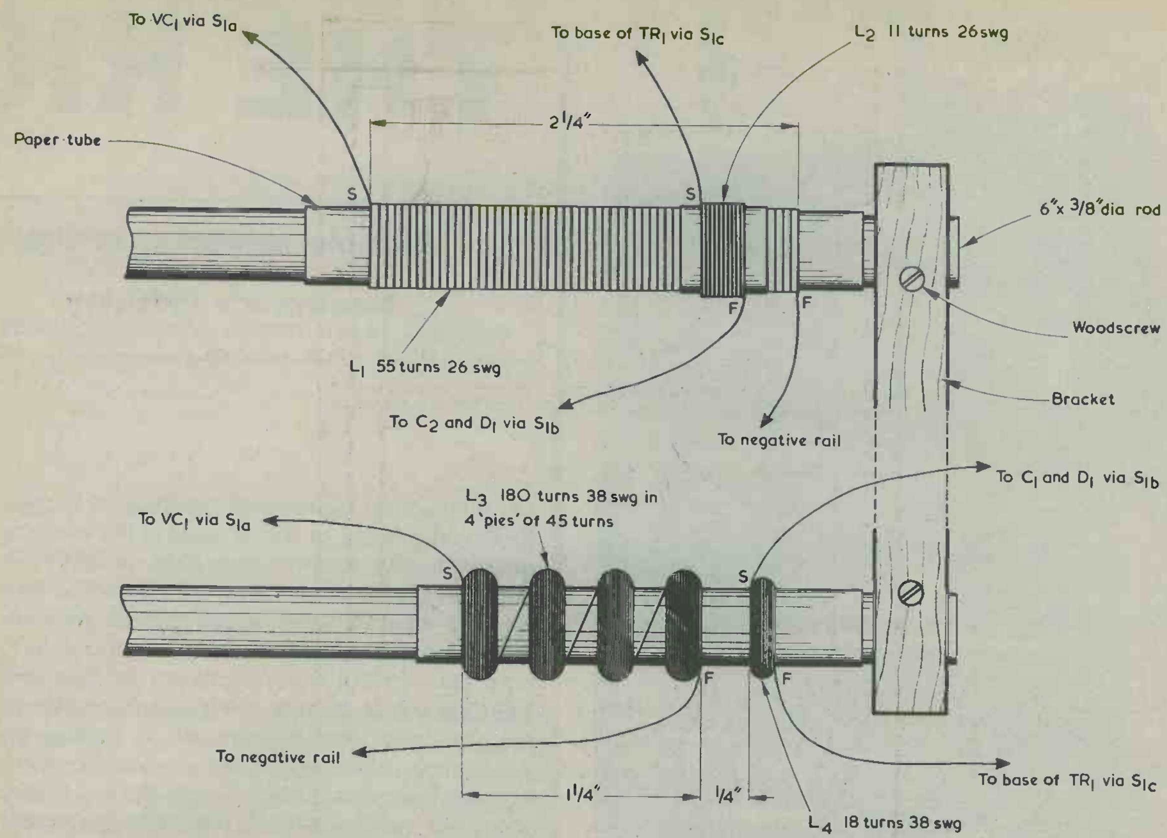


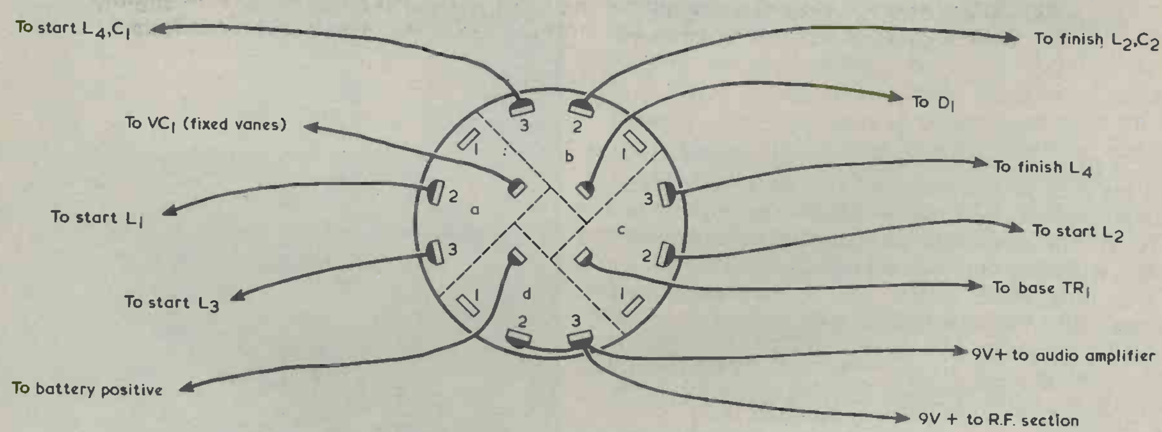
Fig. 2(a) General layout of parts behind the front panel. Dimensions may be slightly amended, if necessary, to cater for different speakers or variable capacitors



(c) Wiring up the 14-way tagstrip



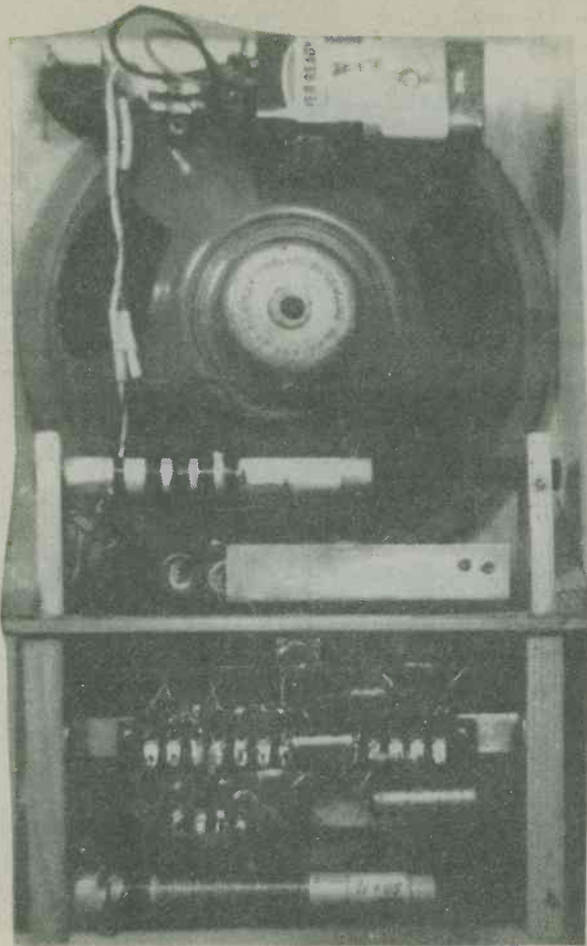
(b) Details of the medium and long wave ferrite aerial windings. The woodscrew in each aerial mounting bracket is driven in sufficiently to hold the ferrite rod in position without applying excessive pressure on it



(d) Connections to the wavechange switch. Before wiring to the switch check the positions of inside and outside tags with a continuity tester. Some switches may have relative tag positioning which is different from that shown here

AERIAL COILS

The general layout of the receiver is shown in Fig. 2(a), whilst Fig. 2(b) gives details of the ferrite rod aerial coils. Both rods are 6 in. by $\frac{3}{8}$in. diameter and paper tubes support the coils. These are formed from stout writing paper wound round the rods and glued with balsa cement or a similar quick setting adhesive. The medium wave tuned winding, L1, consists of 55 turns of 26 s.w.g. enamelled wire spaced out over a length of $2\frac{1}{4}$in. A layer of sticky



Looking down on the rear of the receiver. The battery is on the loudspeaker side opposite to the r.f. section and audio amplifier

tape is placed over the negative rail end of the coil, and on this is close-wound the base winding, L2, which consists of 11 turns of the same wire. It is important that the base winding be wound over the tuned winding and not alongside it.

The long wave tuned coil, L3, consists of 180 turns of 38 s.w.g. enamelled wire wound in 4 "pies" of 45 turns each. The base winding is alongside it and consists of a single "pie" of 18 turns of the same wire. Approximate dimensions are given in the diagram.

As with Fig. 1, the letters "S" and "F" indicate the start and finish of each winding respectively. All turns must be wound in the same direction, and the windings may be smeared with balsa or polystyrene cement to hold them in position if required.

Editor's Note

The constructional details will be given in next month's concluding article.

To be concluded

THE RIGH

Reliable soldering in the electronics industry

Tin-lead solder represents the second largest outlet for tin, and much of this is used in the electronics industry. In this fast-moving field, reliability is more important even than cost when components may have to operate unattended over a service life of many years. The preferred aim therefore, is to make sure that the soldered joints are as near perfect as possible when leaving the production line and this requires the development of a closely specified production plan which takes into account at all stages, from specification and design to manufacture and quality control, the need for good joints.

This is the theme of a film issued by the ***International Tin Research Institute*** which is intended as a guide towards achieving reliable soldering. It is essentially a training film and in order to present a more personalised approach, the services of Michael Rodd (best known for his work on BBC's TV Programme ***Tomorrow's World***) was engaged as "presenter".

Michael Rodd in a public telephone box at Beaconsfield, for the film's opening sequence

T CONNECTION...

Filming soldering operations at Standard Telephones and Cables, New Southgate.

The film opens with the presenter making a telephone call and he steps out of the telephone booth into the interior of a telephone exchange. He explains how modern communications systems employ many thousands of soldered joints, and reliability depends on the integrity of these joints. The viewer is then guided through the stages of printed circuit board production, which for simplicity are divided into four distinct steps "Specification, Evaluation, Control and Assessment" best remembered by the acronym "SECA". "Specification" includes type of circuit board, location and disposition of conductive tracks and through holes, and finishes to protect the copper tracks. "Evaluation" of incoming materials, laminates and circuit boards, terminations and components is dealt with next, in a number of scenes showing typical operations in a quality control laboratory. Newer methods of testing for solderability, such as the surface tension balance and the globule tester are included in this sequence.

Michael Rodd being filmed in the I.T.R.I. laboratories

The next production stage is "Control", of the soldering process and the presenter takes the viewer to a typical industrial assembly line, where boards are assembled, by hand forming and by automatic insertion, and then soldered. Factors influencing mass soldering operations such as wave soldering are illustrated and the need for control of solder bath composition and temperature and flux composition is stressed. Hot dipping is shown as an example of mechanical soldering and characteristics of the soldering iron for manual soldering are considered.

The final stage is "Assessment" and inspection personnel are seen subjecting completed boards to visual scrutiny. Photographic guides, which illustrate good and defective wetting and joints. Typical defects, such as bridging are presented in close-up, and re-working of faulty joints by hand soldering is also illustrated. The film ends with a recapitulation of the four basic SECA principles.

Editor's Note

The Right Connection, a 16 mm colour film with optical sound, produced for the Institute by Chess Valley Films Ltd., Little Chalfont, Bucks.

This film will be available soon on free loan from the Institute by arrangement. An accompanying booklet is currently being prepared.

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT — *Frequencies* = kHz

● **ITALY**

Rome on **11800** at 1455, female announcer with station identification in French, guitar music then into a programme of local pops.

Rome on **11905** at 1854, young lady (YL) with the programme in Italian directed to Canada, Central America and the West Indies, scheduled from 1830 to 1905.

● **SPAIN**

Madrid on **11920** at 1900, male announcer (OM = Old Man) with the programme in Spanish intended for Europe, the Middle East and Africa, scheduled from 1800 to 2035.

● **CANADA**

Sackville on **11905** at 1905, OM with the world news in the English programme directed to Europe, scheduled from 1900 to 1930.

● **ROUMANIA**

Bucharest on **11940** at 1850, YL with a programme in French. Intended for European consumption, this programme is scheduled from 1830 to 1900.

● **BULGARIA**

Sofia on **11720** at 1930, OM with station identification and programme details followed by YL with a newscast in the English programme for the U.K. and Eire, scheduled from 1930 to 2000.

● **KUWAIT**

Kuwait on **11665** at 1933, YL with a newscast in the English programme, scheduled on this channel from 1800 through to 2100.

● **MONTE CARLO**

Trans-World Radio (TWR) Monte Carlo on **11725** at 1300, OM with station identification in English after the interval signal. A programme in Russian followed — "Govorit Monte Carlo" (Here is Monte Carlo).

● **AUSTRALIA**

Melbourne on **11870** at 1503, OM with a newscast in English. The schedule on this channel is from 1500 to 1730.

● **MADAGASCAR**

Radio Nederlands Relay on **11730** at 1920, OM with station identification at the end of the English programme for Africa, scheduled from 1830 to 1920.

● **ANTIGUA**

Deutsche Welle Relay on **11785** at 2130, OM with station identification at the commencement of the Portuguese programme for Brazil and Latin America, scheduled from 2130 to 2300.

● **BRAZIL**

Radio Tupi, Sao Paulo, on **11765** at 2127, OM with a talk in Portuguese during a sporting event. The power is 10kW and the schedule is unknown.

Radio Nacional, Brasilia, on **11780** at 2110, OM with an excited commentary on futebol (football = soccer). The power is 250kW and the schedule is from 1900 to 2400.

Radio Bandeirantes, Sao Paulo, on **11925** at 2123, OM with a commentary on a local sporting event. The power is 10kW and the schedule is from 2100 to 0305.

Radio Pernambuco, Pernambuco, on a measured **11867** at 2225, OM announcer with recorded local pops. The power is 1kW and the schedule is from 0800 to 0430.

● **NORTH KOREA**

Pyongyang on **11350** at 2205, YL with a talk in the Korean Domestic Service, scheduled on this channel and in parallel on **6600** from 2000 to 0300, 0400 to 0900 and from 1500 to 1800.

That completes a brief survey of the 11MHz band. Most of the stations listed are quite easy to log and should not present any great difficulty to most readers of these columns. The more difficult loggings follow:

● **CHINA — REGIONALS**

CPBS (Chinese People's Broadcasting Station) Peking on **3220** at 2150, OM with a talk in Chinese in the Domestic Service 1 programme, scheduled from 2000 to 2200 and from 1343 to 1735.

PLA Fuzhou, Fujian, on **4840** at 2210, YL in Chinese to Taiwan. The schedule is from 2000 to 0610 and from 0830 to 1900.

PLA Fuzhou on **4045** at 1513, OM in Chinese to Taiwan. The schedule is from 1000 to 0530.

YPBS Kunming, Yunnan, on **4760** at 1518, YL and OM with duet in a Chinese opera. The schedule is from 2150 to 0600 and from 0920 to 1600.

CPBS Changsha, Hunan, on **4990** at 1531, YL and OM in Chinese, Chinese orchestral music, heard under Yerevan on the same channel. The Changsha schedule is from 2105 to 1600.

CPBS Guiyang, Guizhou, on **3260** at 1531, YL with Chinese opera programme. The schedule is from 2130 to 0020, from 0150 to 0620 and from 0850 to 1605.

PLA Fuzhou, Fujian, on **2430** at 2225, YL songs in Chinese in the Network 2 programme. The schedule is from 1525 to 2100 but obviously extended on this occasion.

PLA Fuzhou, Fujian, on **2490** at 2215, OM and YL in Chinese in the Network 1 programme, scheduled from 1530 to 2230 on this channel.

PLA Fuzhou, Fujian, on **3400** at 1520, Chinese orchestral music, OM announcer in the Network 2 programme, scheduled here from 1330 to 2100.

Urumqi, Xinjiang, on **3990** at 1530, OM's with a rousing chorus in the Uigher programme scheduled from 2300 to 1730.

● VIETNAM

Hanoi on a measured **4944** at 1527, OM in Vietnamese followed by a programme of local-type orchestral music in the Home Service 1, scheduled on this channel from 2130 to 1700.

● INDONESIA

RRI (Radio Republik Indonesia) Palembang on **4855** at 2350, OM with songs in Indonesian. The schedule is from 2230 to 0115 (Sundays to 0700) and from 0900 to 1600. The power is 10kW.

RRI Palu on **3960** at 1522, OM and YL announcing in Indonesian followed by a programme of local-style music. The schedule is from 0900 to 1520 but closing time is variable. The power is 10kW.

RRI Bukittinggi, on a measured **3232** at 1529, OM announcements, YL with songs and local-type orchestral music.

● NEPAL

Radio Nepal, Khumaltar, on **3425** at 1527, local-style music, YL with vocals. The schedule is from 0020 to 0350 (Sundays to 0450) and from 1150 to 1720. The power is 100kW.

● MALAYSIA

Penang on **4895** at 1544, YL with a programme of songs together with local-type music. The schedule is from 2200 to 2300 and from 1000 to 1500, the power being 10kW.

Kuala Lumpur on **4845** at 1509, Indian-type songs and music in the programme, scheduled from 2130 to 0130 and from 0545 to 1530 to 1530 Monday to Friday, from 2130 to 0330 and from 0545 to 1530 on Saturdays; from 2130 to 1530 on Sundays. The power is 50kW.

● NORTH KOREA

Pyongyang on a measured **3559** at 1538, YL with a talk in vernacular — presumably Korean. This station is listed on a nominal **3560** the schedule being from 0400 to 0050.

Pyongyang on **3015** at 2132, YL in Korean to South Korea, scheduled on this channel from 2000 to 0100, from 0300 to 0900 and from 1500 to 1950. The power is 120kW.

● AFGHANISTAN

Kabul on **4775** at 1553, YL with a talk in English. The schedule is from 0030 to 0330 and from 1430 to 1630 with the Home Service 1; Foreign Service in Urdu from 1300 to 1400 and in English from 1400 to 1430 — but this has obviously been altered.

The power is 100kW.

● THAILAND

Bangkok on **4830** at 1555, a programme of local music — lots of cymbals, drums and other percussion instruments — YL with songs. The schedule of this one is from 2200 through to 1600 and the power is 10kW. The frequency can at times vary to **4831**.

● INDIA

AIR (All India Radio) Kurseong on **3355** at 1533, YL with a newscast of local affairs in English — a relay of the Delhi news service in English. The schedule of the Kurseong transmitter is from 1130 to 1700, the English newscast being timed at 1530. The power is 20kW.

AIR Delhi on **3365** at 1535, YL with the same programme as above but logged on a different occasion. The schedule is from 0025 to 0230 and from 1330 to 1740 with a programme for the Armed Forces from 1235 to 1315.

● INDONESIA — 2

RRI Padang on a measured **4003** at 1518, a programme of what sounded like Indian-type music and songs, not a bit like an Indonesian broadcast. Oh well, I long ago ceased to be surprised at what one can hear on the short waves! The schedule of this one is from 2230 to 0045 and from 1000 to 1600. The power is 10kW.

RRI Jakarta on a measured **4774** at 1553, a programme of local music, YL with a ballad in Indonesian, newscast at 1600. According to the schedule, this one operates from a reported 1030 to 1505 on the occasion of special events only. I wonder what the festivities were about on this occasion! The power is 50kW and the signal was heterodyning with Kabul on **4775**.

● MOZAMBIQUE

Radio Mozambique, Maputo, on **4925** at 2140, OM with a song in vernacular together with a programme of local-style music. This is the B programme in Portuguese and vernaculars, scheduled from 0255 to 0600 and from 1600 to 2210. The power is 20kW but the frequency can vary up to **4926** on occasions.

NOW HEAR THIS

Luang Prabang, Laos, on a measured **6997** at 2232, local-style music (similar to that often radiated by Radio Peking), YL with a plaintive song. The signal was wiped-out by commercial QRM at 2234. According to my information, this station should open at 2300, but obviously on this occasion it was varying from the norm. Or does it sign-on earlier? We shall now have to wait until the next Far East 'season' comes round — September through to March for best results.

"If I knew how I got it caught in there I'd have some idea how to get it out!"

In your workshop

MONOCHROME VIDEO FAULT

A lack of vision

"Hallo," said Smithy, looking at the "For Repair" rack, "I don't think we've had one of these in here before."

From his bench, Dick glanced over. A small monochrome television receiver in a neat white cabinet stood on the shelves.

"It's one of those Jap jobs," he remarked. "There seem to be plenty of that particular model in the TV shop windows these days."

"Humph," grunted Smithy. "We haven't got any service gen on this particular make. Let's hope the fault is something fairly obvious."

He lifted the set from the rack and carried it over to his bench. As he did so, a small folded sheet of paper slipped unnoticed from one of the slots in the cabinet back grille and lay on the Workshop floor.

Smithy placed the set on his bench, plugged in an aerial and connected it up to the mains. On the front of the receiver were four controls, these being a slow motion tuning control, two slide potentiometers for contrast and brightness, and a combined volume control and on-off switch. Smithy found that the knob of the last control was free to rotate and so he experimentally pulled it out. There was a click and the sound channel of one of the local transmitters became immediately audible from the loudspeaker. He waited expectantly and, after a short while, the screen lit up. But it lit up with a completely blank white raster. There was no picture information in it whatsoever.

Smithy adjusted the tuning control and was able to pick up the sound channels of the remaining two local stations. There was a hiss from the loudspeaker between transmissions, and each sound signal was reproduced clearly and at adequate volume level. The tuning adjustments caused no change whatsoever in the steady raster. Smithy adjusted the contrast control, but this had no effect. He then adjusted the brightness control, to find that this merely increased and decreased the brightness of the raster.

PIXIES

"Well," said Smithy, turning off the set, "this one shouldn't be too difficult to sort out. It's almost certain that there's a fault between the video detector and the modulating electrode of the picture tube."

"You always sound so darned certain about these faults," exclaimed Dick in an exasperated tone. "What is more annoying is that you almost always turn out to be correct!"

"You don't have to be a magician to form a diagnosis with this set," stated Smithy. "Just look at the situation. For starters, we're picking up the transmitted sound signals. This means that the video signal ***must*** be getting past the video detector because the 6MHz intercarrier sound amplifier takes up its input after that detector. We're not getting any picture on the screen but we ***are*** getting this blank raster. So there must be e.h.t. getting to the tube final anode and the line and frame timebases are bound to be working. I admit that we can't tell whether they're working properly until we see a picture, but it's obvious that the first thing which has to be done is to find out what's stopping the picture getting to the tube."

He turned back to the set.

"The only niggling thing," he went on, a note of irritation in his voice, "is that finding the fault is liable to take quite a lot longer without service information than it would do if I had that information."

Dick's eyes travelled back to the music centre he had been repairing on his own bench. As he did so he spotted the folded paper on the floor. Switching off the music centre, he got down from his stool and picked up the paper. As he opened it out a grin appeared on his face and he walked over to Smithy.

"How about this, then?" he chuckled.

Smithy took the paper from his assistant and glanced over it.

"Well, I'm blowed," he remarked, scratching his head, "this is the circuit for this TV! Where on earth did it come from?"

"It must have dropped out of the set as you carried it over. Don't forget that a lot of these imported receivers provide a small-size circuit diagram with the customer instructions. Perhaps the chap who sent in this set for repair thought he'd be doing us a favour if he included the circuit as well."

"He's certainly done that," said Smithy, laying out the scaled-down diagram on his bench. "Let's see if this will help us to find the gremlins which are stopping the picture getting on to the screen."

Dick peered over the Serviceman's shoulder at the diminutive circuit diagram. A bemused expression slowly crept over his face.

"I don't know about gremlins," he said unhappily, "but from this distance there seem to be pixies in the circuit!"

"Pixies?"

"Yes, look," said Dick, pointing to the diagram. "There's a first pixie, a second pixie and a third pixie!"

"You steaming great nit," exploded Smithy. The term isn't 'pixie', it's 'PIX IF'. There's a first 'PIX IF' transistor, a second 'PIX IF' transistor and a third 'PIX IF' transistor. They are the three transistors in the video

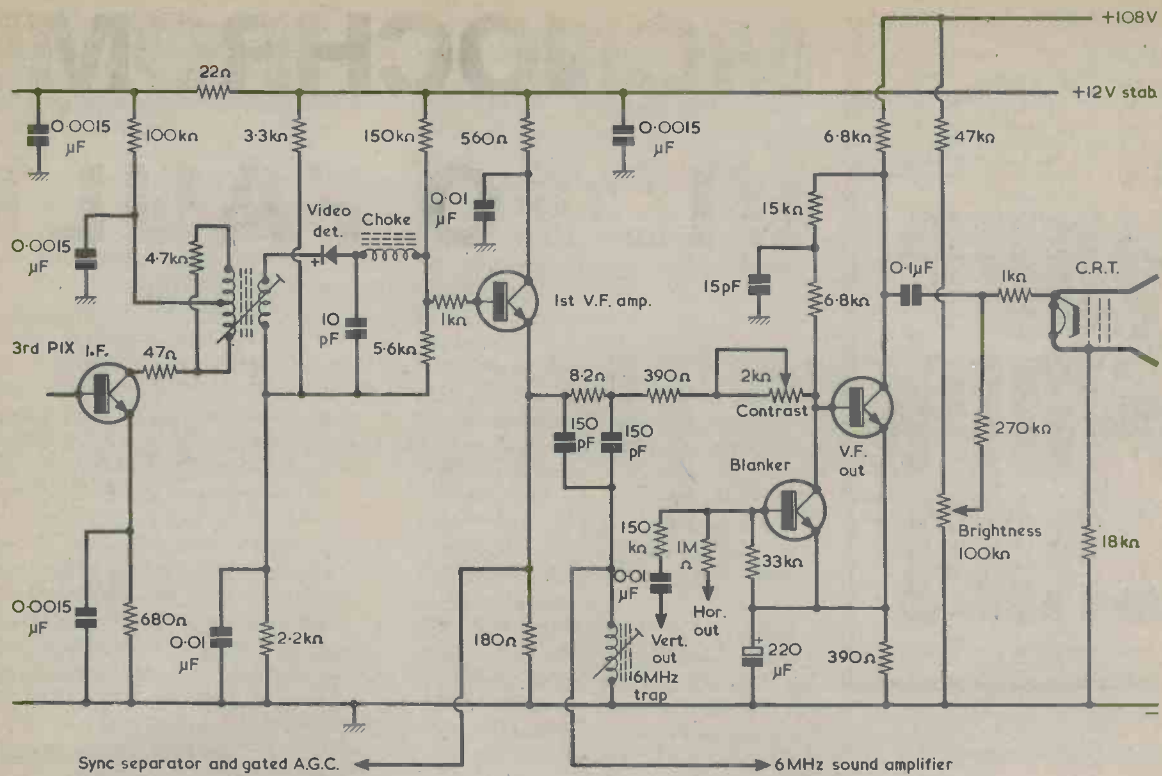


Fig. 1. The stages between the last video i.f. amplifier transistor and the cathode ray tube modulating electrode in the television receiver selected by Smithy. This circuit is employed in the Teleton monochrome receiver type TW-12BS Mk.II. The transistors are Japanese with 2SC type numbers

i.f. amplifier!"

Dick looked more closely at the diagram.

"Oh yes, I see now," he remarked brightly. "The last letter is 'F' and not 'E'. But what is this 'PIX' business, Smithy?"

"It's an old American abbreviation for 'pictures'," explained Smithy. "Quite a few American TV service diagrams use the word 'PIX' instead of 'video'. Well now, let's have a look at the part of the circuit which most interests us. This starts at the video detector, which follows the third PIX IF transistor, and extends up to the tube modulating electrode. Which, in this set, is the tube cathode."

Smithy indicated the section of the overall circuit with his finger. (Fig. 1.).

"That third i.f. transistor," volunteered Dick, "seems to couple into an i.f. transformer which then feeds the video detector."

"That's right," agreed Smithy. "The anode of the detector diode couples into a 10pF parallel capacitor and the detected video signal then passes through an i.f. choke and a 1kΩ resistor to the base of the first video amplifier. This circuit uses the term 'VF' which, of course, stands for 'video frequency'. The transistor is a standard emitter follower, which presents a reasonably high input impedance to the video detector circuit and which allows the detected video signal to be developed at a nice low impedance across the 180Ω emitter resistor. The signal across this resistor is then fed to the sync separator and gated a.g.c. stages, which are elsewhere in the receiver."

"The signal also goes to a 150pF capacitor," said Dick, "and an 8.2Ω resistor." (Fig.2.)

TRAP CIRCUIT

"That's true," confirmed Smithy. "Those two components are part of the 6MHz trap, which also includes the second 150pF capacitor and the adjustable iron-dust cored coil which connects between their junction and the negative rail. The two capacitors and the coil form a series tuned circuit. This offers a very low impedance at its resonant frequency, which in this case is 6MHz, and it prevents the 6MHz sound carrier from being passed on to the video output transistor. The 8.2Ω resistor will introduce a small amount of resistance into the tuned circuit and make it a little less peaky."

"There's a line going from the top end of that coil," put in Dick, examining the circuit intently. "Where does that go to?"

"It goes to the 6MHz intercarrier

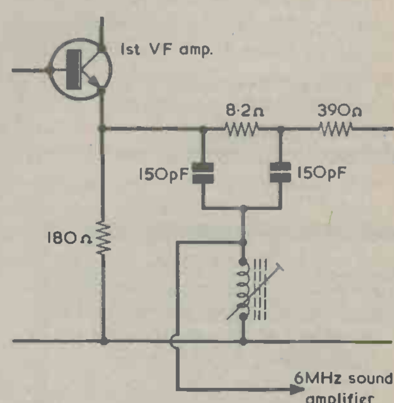


Fig. 2. The 8.2Ω resistor, the two 150pF capacitors and the variable inductance coil form a 6MHz trap. Not only does this prevent the sound carrier being passed on to the video output stage but it also picks out the 6MHz carrier for the intercarrier sound amplifier

sound amplifier," stated Smithy. "Although, as I've just said, the series tuned circuit which forms the 6MHz trap presents a low impedance at its resonant frequency, the 6MHz signal appears at its maximum amplitude across the coil on its own or across the capacitors on their own. These high amplitude signals are of opposite polarity and cancel each other out to give the overall trap low impedance, but at the same time the high amplitude signal across the coil on its own offers a high signal level at trap frequency for the intercarrier sound amplifier. Got it?"

"I've got it," confirmed Dick. "Let's get back to the video signal."

"Righty-ho," said Smithy. "Well, the video signal goes through a 390 Ω resistor and the contrast control and it then hits the base of the video output transistor. This is a very basic common emitter stage, and it has another 390 Ω resistor in its emitter circuit which is bypassed by a 220μF electrolytic. The collector couples to a 108 volt positive rail via a 6.8kΩ load resistor, and the amplified video signal is passed to the cathode of the picture tube by way of a 0.1μF capacitor. You couldn't get things much simpler than that."

"Where does the 108 volt positive rail come from?"

"It's a rectified voltage taken from a tap on the line output transformer."

"Fair enough," commented Dick slowly. "As you say, it's a very simple circuit. Hang on a bit, though!"

"What's up?"

"There's another transistor connected up to the base and emitter of the video output transistor. Blimey, it's called a 'blanker'! What does that do?"

"It provides line and frame flyback blanking," stated Smithy. "Incidentally, this set has got one of

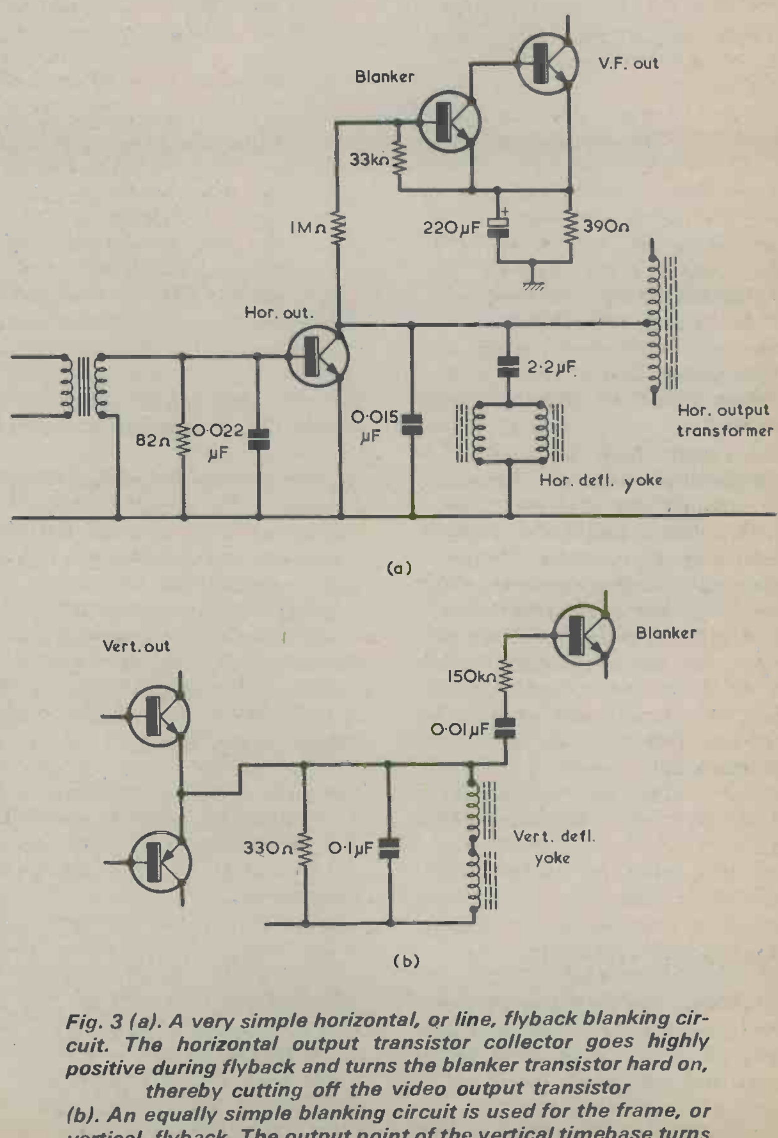


Fig. 3 (a). A very simple horizontal, or line, flyback blanking circuit. The horizontal output transistor collector goes highly positive during flyback and turns the blanker transistor hard on, thereby cutting off the video output transistor
(b). An equally simple blanking circuit is used for the frame, or vertical, flyback. The output point of the vertical timebase turns on the blanker transistor during the flyback period

the neatest blanking arrangements I've seen for many a long day. Let's have a look at the line blanking part first. In this circuit the word 'horizontal' is used to describe the line circuits, so let's have a quick look at the horizontal output stage. Here it is."

Smithy indicated the section of the television circuit diagram in which the horizontal output transistor appeared. (Fig.3(a).)

"Again," he went on, "everything is very nice and easy. The horizontal output transistor is turned hard on during the scan period of the line waveform, and it turns off during the flyback period. When it turns off, a high positive voltage appears on its collector and this voltage is passed, via a 1MΩ resistor, to the base of the blanker transistor. The transistor turns hard on, causing the voltage between the base and the emitter of the video output transitor to be only about 0.1 volt, whereupon the video output transistor is cut off. And that's all there is to it — a 1MΩ resistor from the horizontal output transistor and a single blanker transistor. Beautiful, isn't it?"

But Dick did not seem to share Smithy's admiration for the simplicity of the circuit.

"I suppose," said Dick slowly, "that the video output transistor will be a silicon type which normally needs about 0.6 volt between its base and emitter if it is to conduct."

"You suppose right," said Smithy. "All the transistors in the circuit are silicon types."

"What about the frame flyback blanking?"

"The word here is 'vertical'," stated Smithy. "And the circuit is, again, delightfully simple. If you trace through the diagram you'll see that the base of the blanker transistor couples via a 150kΩ resistor and a 0.01μF capacitor to one side of the vertical deflection coils, or 'yoke' as they are called in this diagram. The point to which the capacitor connects goes highly positive during the vertical flyback, so you get vertical flyback blanking this time. The circuit is a bit more complicated than the horizontal blanking circuit because, instead of one resistor, it uses one resistor and one capacitor!" (Fig.3(b).)

CONTRAST CIRCUIT

"Stap me," said Dick, catching Smithy's enthusiasm. "This circuit really is cut to the bone. There's only one other thing that puzzles me now."

"Dear, oh dear," sighed Smithy.

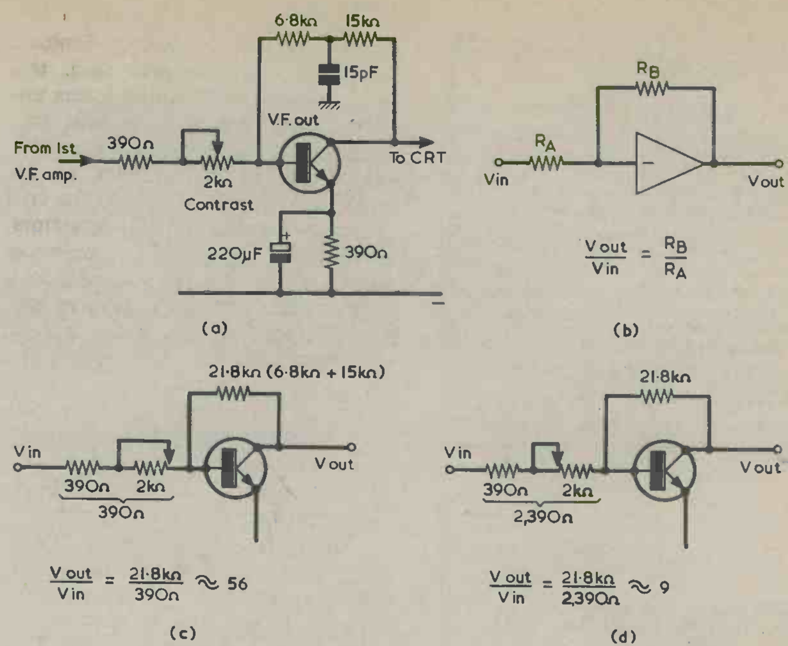


Fig. 4 (a). Basically, the contrast control varies the signal base current in the video output transistor by providing varying resistance between the signal input and the base. However, the feedback circuit from collector to base also affects the performance of the circuit

(b) Classic inverting amplifier circuit with series input resistance and resistive feedback

(c). Assuming infinite base input impedance the circuit of (a) can be reduced to the form shown here. The 21.8kΩ resistor is given by the 6.8kΩ and 15kΩ resistors in series

(d). Theoretical voltage gain when the contrast control inserts maximum resistance into circuit. In practice, the transistor input impedance will cause the gain figures to differ considerably from those shown here, but the effect illustrated will nevertheless have a significant influence on circuit performance

"When you start with your questions you never know when to stop."

"It's that contrast control circuit," said Dick. "All it seems to consist of is a 2kΩ pot in series with the input to the base of the video output transistor." (Fig.4(a).)

"That's virtually all that it is," replied Smithy, "although things are a little more sophisticated than that. At first sight, the contrast control merely varies the video signal voltage applied between the base and the emitter of the transistor. Speaking in very general terms, the input impedance at the transistor base will be of the order of several hundred ohms, with the result that, as the resistance inserted by the contrast control pot decreases, the signal voltage between the transistor base and emitter increases. But there's a secondary circuit which affects the issue to a small but significant extent."

"Secondary circuit? Where?"

"There's a negative feedback circuit from the video output transistor collector back to the base and it's given by the 15kΩ and 6.8kΩ resistors in series. You'll see that there's a 15pF capacitor between the junction of these resistors and chassis. This capacitor reduces the level of negative feedback at the higher video frequencies so that a boost is given to these higher frequencies. High frequency boost arrangements are normal in video amplifiers, and they overcome high frequency losses due to stray capacitances to chassis. But there's another little matter here."

"What's that?"

"If you assume that the input impedance of the video output transistor is high you have a classic inverting amplifier circuit with feedback resistor and series input resistor. Like this."

Smithy took out a pen and scribbled out the circuit on his notepad. (Fig.4(b).)

"In that circuit," commented Dick, "the voltage gain is equal to the feedback resistance divided by the input series resistance, isn't it?"

"It is," confirmed Smithy. "Just for the fun of it, let's see what the gain of the video output transistor would be at different contrast control settings under the assumption that there is a high input impedance at the transistor base. We can forget the 15pF capacitor for this exercise, as it will have little effect on the lower video frequencies, whereupon we can say that the feedback resistance is 21.8kΩ. When the contrast control inserts zero resistance the series input resistance will be 390Ω. So that the voltage gain will be 21.8kΩ divided by 390 Ω."

Smithy scribbled the figures on his note-pad and carried out the calculation. (Fig.4(c).)

"That gives a voltage gain of about 56 times," he continued. "Now, when the contrast control inserts all its resistance into circuit the gain will be 21.8kΩ divided by 2,390Ω. Let's see what that is."

Smithy made a further calculation. (Fig.4(d).)

What's the result?"

"The voltage gain," replied Smithy, "is about 9 times. In practice the actual gain figures at the two contrast control settings will be considerably different from these calculated ones, because we have been ignoring the low input impedance of the transistor. Nevertheless, the effect of an inverting amplifier with feedback resistor is still present, and it will have a significant bearing on the actual performance of this video output stage and its contrast control."

Smithy turned and beamed silently at his assistant. Dick shifted uncertainly under Smithy's steady gaze.

"Well, that's great," he said uncomfortably.

"No more questions?"

"None that I can think of."

"Good, then we'll have a stab at fixing this set! Seeing that you're over here you might as well help me find the fault. With a bit of luck it shouldn't take too long. To start off, you could get the set back off so that we can get at the printed board."

FAULT FINDING

Dick soon had the receiver ready for checking whilst Smithy studied the circuit diagram. The Serviceman then switched on the receiver, switched his testmeter to a high volts range and clipped its negative lead to the receiver chassis.

"Since we're getting a sound signal," he stated briskly, "I'm going to make a guess that the first video transistor is all right, and I'll concentrate on the video output transistor. Voltage checks first. I'm going to put the positive test prod of the meter on the top end of the 6.8kΩ collector load resistor. You tell me what voltage I get."

Smithy examined the receiver printed board and then carefully placed the meter prod on the resistor lead-out. (Fig. 5(a).)

"You're getting a voltage," said Dick, "of about 110 volts."

"Good," said Smithy. "So there is a supply voltage for the output stage. Transistor collector next!"

Smithy moved his test prod. (Fig. 5(b).)

"The meter," called out Dick, frowning down at its scale, "says 85 volts."

"Humph," grunted Smithy. "That seems rather high. Let's try the transistor emitter."

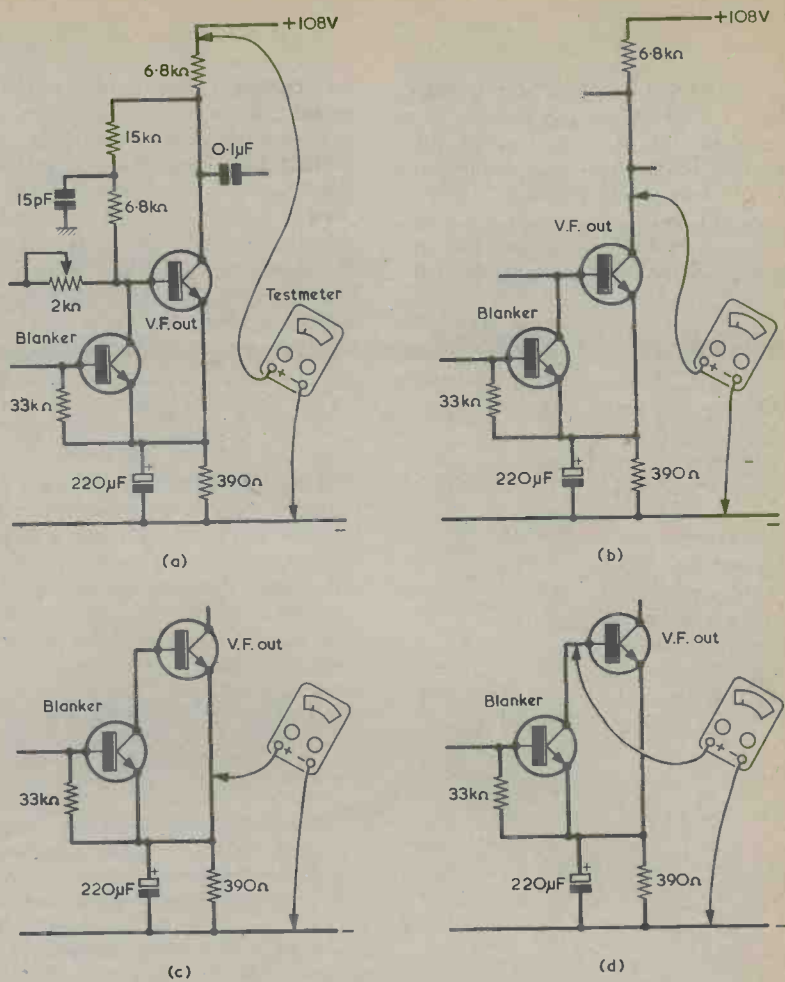


Fig. 5 (a) Smithy first confirmed that a correct supply voltage was available for the video output transistor
(b). Next to be checked was the transistor collector voltage
(c). He followed this by measuring the voltage at the emitter
(d). The clincher! The voltage reading at the video output transistor base led him directly to the fault in the receiver

He applied the prod to the video output transistor emitter. Dick selected a lower voltage range on the meter. (Fig. 5(c).)

"The meter is reading almost exactly 1.8 volts."

"And that," said Smithy, "seems to me to be a bit low. I'll try the base next."

He once more applied the test prod to the board. (Fig. 5(d).)

"1.8 volts again."

A gleam of elation appeared in Smithy's eyes.

"You're sure?"

"Of course I'm sure," responded Dick indignantly. "Blimey, I may not be so hot on theory but at least I *can* read a meter!"

To Dick's utter astonishment, Smithy burst into song.

"The rain in Spain," carolled Smithy exultantly, "falls mainly on the plain!"

Dick moved away uneasily.

"We've got it," sang Smithy happily, "I think we've got it!"

"Blow me, Smithy," asked the alarmed Dick, "have you fallen out of your tree, or something?"

"Don't worry," grinned Smithy. "I'm just exceptionally pleased at having located the fault in this set so very quickly."

"Well, I wish you'd give me a bit of warning before you do things like that. Stap me, you nearly gave me heart failure suddenly singing away like that! And what do you mean — we've got it?"

"We've got the fault," chortled Smithy happily. "The voltage reading on the transistor base should have been 0.6 volt higher than the reading on its emitter. But it wasn't. It was precisely the same. So, assuming that there are no shorts across the circuit print or anything silly like that, there are pretty well only two things that can be wrong. Either we've got a short-circuit between the base and emitter of the output transistor, or we've got a short-circuit across the emitter and collector of the blanker transistor. In either case the output transistor will not be able to amplify the video signal passed to its base. Also, it will be passing zero collector current."

"But the reading on its collector was lower than that of the 108 volt supply rail. There must have been some current in the collector load resistor."

"The collector voltage still wasn't as low as it would have been if the transistor had been passing collector current. With zero collector current, there is still a current path to the negative rail from the bottom of the 6.8k Ω collector load resistor. The path is through the 15k Ω resistor, the lower 6.8k Ω resistor, the short-circuit which is causing the fault and the 390 Ω resistor at the bottom. It was that current which caused the bottom of the 6.8k Ω load resistor to be below the potential of the 108 volt rail, and not any transistor collector current."

FAULTY TRANSISTOR

It turned out that it was the blanker transistor which had become short-circuit. After a check through the Workshop copy of the invaluable ***Tower's International Transistor Selector,*** Smithy was soon able to find a suitable replacement for the Japanese transistor type employed in the receiver. When it had been connected into the receiver circuit, the set reproduced an excellent picture.

"Another one done," commented Smithy cheerfully as Dick replaced the back on the television receiver cabinet. "Nice one, too."

To Dick's relief, there were no further observations that day from the Serviceman concerning the proclivity of Spanish clouds to concentrate over level terrain. Indeed, Smithy's refrain about the rain did not entertain but caused strain and pain, went against the grain and did nothing to retain, sustain or maintain the normally sane and mundane atmosphere of their domain.

And you can say that again. ■

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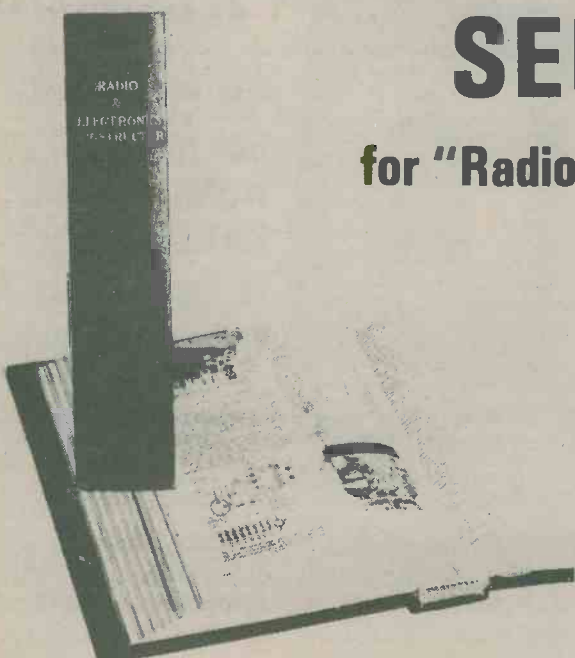

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(Continued on page 511)

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(Continued from page 509)

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