PRACTICAL ELECTRONICS

JUNE 1972

20p

VERSATILE LIGHT EFFECTS UNIT.....

- STROBE
- SOUND SYNC+STROBE
- SOUND SYNC

for DISCOTHEQUES and PARTIES

Great new OFFER from DIOTRAN

TRANSISTORS

BRAND NEW FULLY GUARANTEED DEVICES

AC107	15p	AF115	17p	BC140	35p	BCY31	22p	BF272	80p	EC403	15p	ORP60	40p
AC113	20p	AF116	17p	BC141	35p	BCY32	25p	BF273	30p	GET880	27p	ORP61	40p
AC115	23p	AF117	17p	BC142	45p	BCY33	17p	BF274	30p	MAT100	15p	5T140	12p
AC125	17p	AF118	30p	BC143	40p	BCY34	20p	BF308	35p	MAT101	17p	5T141	17p
AC126	17p	AF124	21p	BC145	45p	BCY70	17p	BF309	37p	MAT120	15p	TI543	40p
AC127	17p	AF125	20p	BC147	17p	BCY71	30p	BF316	75p	MAT121	17p	UT46	27p
AC128	17p	AF126	20p	BC148	12p	BCY72	15p	BFW10	55p	MPF102	43p	V405A	25p
AC141K	17p	AF127	20p	BC149	17p	BCZ11	20p	BFX29	27p	MPF105	43p	V410A	45p
AC142K	17p	AF139	33p	BC150	17p	BD121	85p	BFX84	20p	OC19	30p	2G301	19p
AC151	15p	AF178	50p	BC151	20p	BD123	85p	BFX85	27p	OC20	50p	2G302	19p
AC154	15p	AF179	50p	BC152	17p	BD124	75p	BFX86	22p	OC22	30p	2G303	19p
AC155	17p	AF180	50p	BC153	27p	BD131	80p	BFX87	25p	OC23	33p	2G304	20p
AC156	17p	AF191	50p	BC154	30p	BD132	80p	BFX88	22p	OC24	45p	2G306	35p
AC157	17p	AF186	45p	BC157	20p	BDY20	£1	BFY50	20p	OC25	25p	2G308	35p
AC165	17p	AF239	37p	BC158	17p	BF115	22p	BFY51	20p	OC26	25p	2G309	35p
AC166	17p	AFZ11	37p	BC159	20p	BF117	45p	BFY52	20p	OC28	40p	2G339	17p
AC167	20p	AFZ12	45p	BC167	13p	BF118	60p	BFY53	17p	OC29	40p	2G339A	15p
AC168	20p	AL102	85p	BC168	13p	BF119	70p	BSX19	15p	OC35	33p	2G344	15p
AC169	14p	AL103	85p	BC169	13p	BF152	35p	B5X20	15p	OC36	40p	2G345	15p
AC176	23p	ASY26	25p	BC170	13p	BF153	35p	BSY25	15p	OC41	20p	2G371	13p
AC177	20p	ASY27	30p	BC171	13p	BF154	35p	BSY26	15p	OC42	22p	2G371B	10p
AC187	30p	ASY28	25p	BC172	13p	BF157	45p	BSY27	15p	OC44	15p	2G374	17p
AC188	30p	ASY29	25p	BC173	13p	BF158	25p	BSY28	15p	OC45	12p	2G377	27p
ACY17	25p	ASYS0	25p	BC174	13p	BF159	30p	BSY29	15p	OC70	15p	2G378	15p
ACY18	20p	ASY51	25p	BC175	22p	BF160	30p	BSY38	15p	OC71	9p	2G382	15p
ACY19	22p	ASY52	25p	BC177	17p	BF162	30p	BSY39	15p	OC72	12p	2G401	30p
ACY20	20p	ASY54	25p	BC178	17p	BF163	35p	BSY40	30p	OC74	12p	2G414	30p
ACY21	20p	ASY55	25p	BC179	17p	BF164	35p	BSY41	35p	OC75	15p	2G417	25p
ACY22	19p	ASY56	25p	BC180	20p	BF165	35p	BSY95	12p	OC76	15p	2N388	30p
ACY27	18p	ASY57	25p	BC181	22p	BF167	22p	B5Y95A	12p	OC77	25p	2N388A	50p
ACY28	19p	ASY58	25p	BC182	10p	BF173	22p	BU105	£3·90	OC81	15p	2N404	22p
ACY29	30p	ASY58	25p	BC182L	10p	BF176	35p	C111E	60p	OC81D	15p	2N404A	30p
ACY30	25p	ASZ21	40p	BC183	10p	BF177	35p	C400	30p	OC82	15p	2N524	55p
ACY31	25p	BC107	10p	BC183L	10p	BF178	45p	C407	25p	OC82D	15p	2N527	60p
ACY34	18p	BC108	10p	BC184	13p	BF179	50p	C424	17p	OC83	20p	2N696	12p
ACY35	18p	BC109	11p	BC184L	13p	BF180	30p	C425	40p	OC84	20p	2N697	15p
ACY36	30p	BC113	25p	BC186	27p	BF181	30p	C426	30p	OC139	15p	2N698	24p
ACY40	15p	BC114	30p	BC187	27p	BF182	30p	C428	20p	OC140	17p	2N699	55p
ACY41	18p	BC115	30p	BC207	11p	BF183	30p	C441	27p	OC170	15p	2N706	7p
ACY44	35p	BC116	35p	BC209	11p	BF184	25p	C442	35p	OC171	15p	2N706A	8p
AD140	40p	BC117	35p	BC209	11p	BF185	30p	C444	37p	OC200	25p	2N708	12p
AD142	40p	BC118	25p	BC212L	11p	BF188	30p	C450	17p	OC201	27p	IN709	45p
AD149	43p	BC119	45p	BC213L	11p	BF194	23p	C720	12p	OC202	27p	2N711	40p
AD161	35p	BC125	35p	BC213L	11p	BF195	24p	C722	25p	OC203	25p	2N717	42p
AD162	35p	BC126	35p	BC214L	12p	BF196	30p	C740	25p	OC204	25p	2N718	24p
AD161/		BC132	25p	BC225	25p	BF197	35p	C742	17p	OC205	35p	2N718A	50p
162(MP)	63p	BC134	30p	BC226	35p	BF200	45p	C744	17p	OC309	35p	2N726	27p
ADT140	50p	BC135	30p	BC317	12p	BF222	80p	C760	17p	P346A	17p	2N727	27p
ADZ11	£2	BC136	30p	BC318	12p	BF257	35p	C762	17p	P397	45p	2N743	17p
ADZ12	£2·10	BC137	35p	BC319	12p	BF270	25p	C764	60p	OCP71	43p	2N744	17p
AF114	17p	BC139	45p	BCY30	20p	BF271	17p	EC401	15p	ORP12	43p	2N914	17p

2N918	30p	2N2714	25p	2N3704	15p
2N929	22p	2N2904	25p	2N3705	12p
2N930	25p	2N2904A	30p	2N3706	12p
2N1131	20p	2N2905	25p	2N3707	13p
2N1132	22p	2N2905A	30p	2N3708	8p
2N1302	17p	2N2906	25p	2N3709	8p
2N1303	17p	2N2906A	27p	2N3710	10p
2N1304	20p	2N2907	25p	2N3711	10p
2N1305	20p	2N2907A	30p	2N3B19	40p
2N1306	22p	2N2923	13p	2N3820	£1
2N1307	22p	2N2924	13p	2N3903	25p
2N1308	27p	2N2925	13p	2N3904	27p
2N1309	27p	2N2926		2N3905	25p
2N1613	17p	(G)	12p	2N3906	27p
2N1711	20p	2N2926(Y)	11p	2N4058	15p
2N1889	35p	2N2926		2N4059	10p
2N1890	45p	(O)	10p	2N4060	12p
2N1893	37p	2N3010	80p	2N4061	12p
2N2160	60p	2N3011	20p	2N4062	12p
2N2147	75p	2N3053	20p	2N5172	12p
2N2148	60p	2N3054	50p	2N5459	43p
2N2192	30p	2N3055	63p	2S034	75p
2N2193	30p	2N3391	17p	2S301	50p
2N2194	27p	2N3391A	20p	2S302A	45p
2N2217	20p	2N3392	17p	2S302	45p
2N2218	25p	2N3393	15p	2S303	60p
2N2219	27p	2N3394	15p	2S304	£1·10
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2N2221	22p	2N3402	22p	2S306	£1·10
2N2222	27p	2N3403	22p	2S307	£1·10
2N2368	17p	2N3404	32p	2S321	60p
2N2369	15p	2N3405	45p	2S322	50p
2N2369A	15p	2N3414	20p	2S322A	45p
2N2411	50p	2N3415	20p	2S323	60p
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2N2646	55p	2N3525	74p	2S325	£1·20
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BY100	15p	BYZ17	35p	OA95	7p
BY101	12p	BYZ18	30p	OA200	6p
BY105	15p	BYZ19	25p	OA202	7p
BY114	12p	OA5	17p	SO10	4p
BY126	15p	OA10	22p	SO19	4p
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500,000 SILICON PLANAR TRANSISTORS

NPN-PNP PLASTIC AND METAL CAN TYPES

Clearance of manufacturers' seconds, selected in types and guaranteed no open or short circuit units. Ideal cheap transistors for radio enthusiasts, manufacturers, schools and colleges.

TYPE STN18. Silicon Planar Transistors npn TO-18 Metal Can. Types similar to: 2N706, 2N2220, BSY27–95A, BSX44–76–77.
Price: 500 £9; 1,000 £15

TYPE STP18. Silicon Planar Transistors pnp TO-18 Metal Can. Types similar to: BCY70–72, 2N2906–7, 2N2411 and BC186–7. Also used as complementary to the above npn type device type STN18.
Price: 500 £9; 1,000 £15

TYPE STN5. Silicon Planar Transistors npn TO-5 Metal Can. Types similar to: BFY50–51–52 and 2N2192–92.
Price: 500 £9·50; 1,000 £16

TYPE STPL. As above but in pnp and similar to types 2N5354–56, 2N4058–2N4061 and 2N3702–3. Also used as complementary to the above npn devices type STNL.
Price: 500 £7·50; 1,000 £13

TYPE STNK. Silicon Planar Plastic Transistor npn with TO-18 pin circular lead configuration, I.C. 200mA, 300mW and similar to BC107–8–9, BC170, BC173, BC182–184, BC237–8–9 and BC337–8.
Price: 500 £9·50; 1,000 £16

When ordering, please state type required, i.e., STNK or STN18, etc.

200,000 SILICON ALLOY TRANSISTORS

Clearance of pnp Silicon Transistors from the 2S300 (TO-5) and 2S320 (SO-2) range and similar to the GC200-205 and BCY30-34 series. Ideal for *Amateur Electronics, Radio Hams and for experimental use in Schools, Colleges and Industry.*

Approximate count by weight:
100 off—**75p** (plus p. & p. 10p)
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1,000 off—**£4** (plus p. & p. 25p)
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Large quantities quoted for on request.
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10 MILLION DIODES

Silicon or Germanium

State which when ordering

200	50p	10,000	£10·00
1,000	£2·00	50,000	£30·00
5,000	£7·00	100,000	£50·00

2,000,000 SILICON PLANAR TRANSISTORS

TO18 P.N.P. & N.P.N. TYPES

State which when ordering

100	£1·50	10,000	£90·00
500	£6·00	50,000	£400·00
1,000	£10·00	100,000	£625·00

LINEAR INTEGRATED CIRCUIT 709/PC S.G.S.

TO-5 can 8 lead. Full specification high gain Operational Amplifier data supplied. *Lowest ever price.*

***QUANTITY:* 1-9, 10-24, 25-99, 100-999**
***PRICE EACH:* 37p, 34p, 30p, 25p.**

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Listen in to **AIRLINES, PRIVATE PLANES, JET-PLANES.** *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PREST-WICK, ETC. ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument *can be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables) **NO CONNECTIONS WHATEVER NEEDED. SEND ONLY £2·85** + 20p p & p for kit including case, nuts, screws, wire, etc. etc. (Parts available separately.)

SLEEP INDUCER

ONLY £3·25

Do you wake up in the night and can't get off to sleep again? Would you like to be gently soothed off to satisfying sleep every night? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* All transistor. No knowledge of electronics or radio needed. Step-by-step instructions. *No soldering necessary.* Kit includes case, nuts, wire, screws, etc. **SEND £3·25** + 25p p & p. (Parts available separately.)

FIND BURIED TREASURE!

Transistorised Treasure Locator

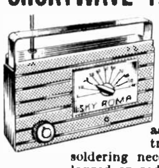
This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES, ETC. ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground!* No knowledge of radio or electronics required.

ONLY £2·85

Can be built with ease in one short evening by anybody from nine years of age upwards. with the clear, easy-to-follow, step-by-step, fully illustrated instructions—uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·85** + 25p p & p. (Sectional handle as illustrated **95p** extra.) Parts available separately. Made up looks worth £15!

SHORTWAVE TRANSISTOR RADIO

ONLY £2·75



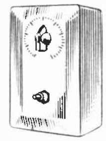
Anyone from 9 years up can follow the step-by-step, easy as ABC, fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins—**Russia, Africa, USA, Switzerland, etc.** Experience thrills of world wide news, sport, music, etc. **Eavesdrop on unusual broadcasts.** Uses PP3 battery. Size only 3in × 4¾in × 1¼in. **Only £2·75** + 20p p & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately.)

BUILD 5 RADIO AND ELECTRONIC PROJECTS

ONLY £2·45

Amazing Radio Construction set! Become a radio expert for **£2·45.** A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc., all you need. Presentation box **45p** extra as illus. (if required) (parts available separately) no soldering necessary. **Send £2·45** + 20p p & p.

SOOTHE YOUR NERVES RELAX WITH THIS AMAZING RELAXATRON



CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! The RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones, Components nuts, Screws, Wire, etc., no soldering. **Send only £2·75** + 25p p. & p. (Parts available separately.)

ONLY £2·75

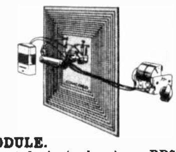
ELECTRONIC ORGAN

ONLY £3·25

Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds, etc. Fully transistorised. **SELF-CONTAINED LOUDSPEAKER.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne", etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated, step-by-step, simple instructions.* **ONLY £3·25** + 25p p & p for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

READY BUILT AND TESTED TREASURE LOCATOR MODULE

ONLY £4·95



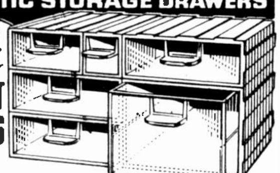
FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** EXTREMELY SENSITIVE—PENETRATES EARTH, SAND, ROCK, WATER, ETC. EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! **£4·95** + 30p carr. etc.

CONCORD ELECTRONICS LTD. (PE6U), 8 Westbourne Grove, London, W.2. Callers Welcome 9 a.m.-5.30 p.m. inc. Sat.

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS

NEAT! HANDY! TIDY!

DISCOUNT PRICES



5 SIZES ALL INTERLOCK

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots/removable space dividers. Build up any size cabinet for wall, bench or table top.

BUY AT TRADE PRICES!

SINGLE UNITS (1D) (5ins × 2¼ins × 2¼ins). £1·35 DOZEN.

DOUBLE UNITS (2D) (5ins × 4¼ins × 2¼ins) £2·25 DOZEN.

TREBLE (3D) £2·35 for 8.

DOUBLE TREBLE 2 draws, in one outer case (6D2), £3·65 for 8, **EXTRA LARGE SIZE (6D1)** £3·30 for 8.

PLUS QUANTITY DISCOUNTS!

Orders £5 and over DEDUCT 5% in the £
Orders £10 and over DEDUCT 7½% in the £
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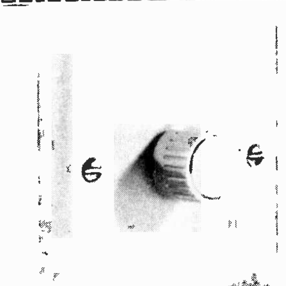
PACKING/POSTAGE/CARRIAGE: Add 35p to all orders under £5. Orders £5 and over, packing/postage/carriage free.

QUOTATIONS FOR LARGER QUANTITIES ALL PRICES TAX PAID

IVORYET LIMITED (Dept. PE6) 124 Cricklewood Broadway, London, N.W.2 Tel. 01-450 4844

Vary the strength of your lighting with a DIMMASWITCH



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

600 Watt—£3·20. Kit Form £2·70
300 Watt—£2·70. Kit Form £2·20

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

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As supplied to H.M. Government Departments

4-STATION INTERCOM

£7·25

Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master and 3 Subs**), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master.** Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 40p.

MAINS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control with lock system. Price **£12·40.** P. & P. 55p extra.

INTERCOM/BABY ALARM

£3·35

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery **14p.** P. & P. 25p.

Transistor TELEPHONE AMPLIFIER

£2·99

Why not boost business efficiency with this incredible De-Luxe **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume control. Battery **14p** extra. P. & P. 22p. Full price refunded if not satisfied in 7 days.

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quite simply — the best

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FULL RANGE OF ISKRA CARBON FILM RESISTORS

¼W (range 4·7 ohms to 470K) 1p each
⅛W and ½W (range 4·7 ohms to 10 Megs) 1p each
1W (range 4·7 ohms to 10 Meg) 2p each
2W (range 4·7 ohms to 10 Meg) 3p each

Iskra Miniature High Stability carbon Film Resistors with negligible noise factor.

All Resistors ±5 per cent (except values over 4·7 Megs). These Resistors are even lower in price than most 10 per cent and older carbon composition types.

PRE-SET POTENTIOMETERS

Standard values of pre-sets from 100 ohms to 5 Meg—
Standard/miniature....... 7p each   Sub-miniature .... 5p each

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Voltage	Capacitance	Price	Voltage	Capacitance	Price
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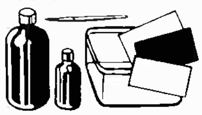
100V	0·15µF	6p	10V	470µF	11p
100V	0·22µF	6p	16V	47µF	7p
100V	0·33µF	9p	25V	10µF	7p
100V	0·47µF	10p	25V	100µF	9p
100V	0·68µF	15p	25V	220µF	11p
			25V	170µF	14p
250V	0·01µF	5p	25V	1,000µF	22p
250V	0·015µF	5p	25V	2,200µF	42p
250V	0·022µF	5p	35V	4·7µF	7p
250V	0·033µF	6p	35V	220µF	14p
250V	0·047µF	6p	100V	10µF	8p
250V	0·068µF	6p	100V	22µF	9p
250V	0·1µF	6p	100V	47µF	14p

SPECIAL INTRODUCTORY OFFER

FREE with all orders value £5 or over we will give absolutely free one GSPK P.C. Kit for making your own printed circuits (normal retail price £1·95).



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AC127	24p	22p	BZY88C Series			OC76	22p	21p
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ACY18	18p	15p	NKT210	24p	19p	IN4002	6p	5p
AD161	27p	25p	NKT211	24p	19p	IN4003	7p	6p
AD162	27p	25p	NKT212	24p	19p	IN4004	8p	7p
AF139	28p	26p	NKT213	24p	19p	IN4005	10p	9p
BC107	9p	8p	NKT214	19p	17p	IN4006	12p	11p
BC108	8p	7p	NKT218	24p	19p	IN4007	18p	16p
BC109	9p	8p	NKT219	24p	19p	IN4148	4p	3p
BC147	8p	7p	NKT223	26p	20p	2N1302	16p	15p
BC148	8p	7p	NKT224	21p	19p	2N1304	21p	20p
BC149	8p	7p	NKT242	14p	12p	2N1613	14p	13p
BCY70	14p	13p	NKT243	51p	44p	2N1711	15p	14p
BCY71	20p	19p	NKT401	70p	56p	2N2904	29p	28p
BCY72	14p	12p	NKT402	75p	59p	2N2905	24p	22p
BDY20	91p	73p	NKT403	64p	50p	2N2906	19p	18p
BFX29	24p	23p	NKT453	41p	33p	2N2907	22p	21p
BFX30	24p	23p	OA47	3p	6p	2N3053	17p	16p
BFY50	19p	18p	OA79	6p	5p	2N3054	49p	47p
BFY51	18p	17p	OA90	5p	4p	2N3055	57p	52p
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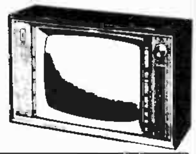

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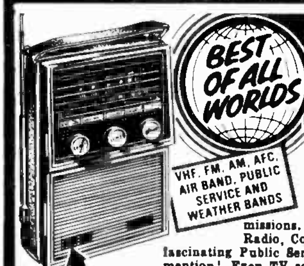
MAINS/BATTERY plus BUILT-IN BATTERY BOOSTER



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Tune into the world with this amazing communications receiver. A truly exceptional unit in performance and looks—leatherette with Stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220-240V domestic mains supply. 14 transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the **8 WAVEBANDS.** Complete with Hi-Fi earphone for personal listening. Frequency ranges: **Long wave** 150-350 kHz. **Medium** 353-1605 kHz. **Marine** 1·6-4·5 MHz. **Short Wave** 12-24 MHz. **FM/VHF** 88-108 MHz. **Aircraft** 108-135 MHz. **PUBLIC SERVICE BANDS** 135-174 MHz. Fully guaranteed.

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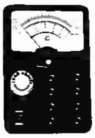
ONLY £40·95 carr. £1 75

METER BARGAINS



MODEL GT800 MULTIMETER
A precision made pocket sized test meter, ideally suited for testing electronic circuits or electronic appliances. Supplied complete with test lead and batteries.
Ranges—D.C. voltages: 10, 50, 250, 1,000V (1,000 O.P.V.). A.C. voltages: 10, 50, 250, 1,000V (1,000 O.P.V.). D.C. current: 1mA, 100mA. Resistance: 0·150 kohms. Decibels: −10 to +22dB (at A.C. 10V range). **£2·47.** P. & P. 25p

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Features large easy-to-read meter, wide choice of ranges. With test leads, batteries and manual. Size: 4½in × 3¼in × 1in.
Ranges: D.C. voltages: 0–5–25–50–250–500–2,500V. A.C. voltages: 0–10–50–100–500–1,000V. D.C. current: 0–50μA–2·5mA–250mA. Resistance: 0–6,000 ohms, 0–6 meg ohms (300 ohms and 30 kohms at centre scale). Capacity: 10uf to ·001uf, ·001uf to ·1uf. Decibels: −20 to +22dB. **£4·90.** P. & P. 25p

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Ranges: D.C. voltages: 0, 5, 25, 100, 500/1,000V (20,000 ohms/V). A.C. voltages: 0, 5, 25, 100, 500, 1,000V (10,000 ohms/V). D.C. current: 0, 50μA, 0mA, 5mA, 50mA, 500mA. Resistance: 0, 6kΩ, 600kΩ, 6MΩ, 60MΩ. Decibels: −20 to +62dB in 5 ranges.
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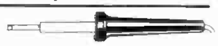
Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat 100/140 watt. 240 volt A.C. **£3·95** P. & P. 50p



"Weller Marksman" Soldering Iron
Lightweight, 3/16in pencil bit, 25 watt. 240 volt A.C. £1·50 P. & P. 16p

VERITAS V-313 TAPE HEAD DEFLUXER

A must for all tape users! Tape heads become permanently magnetized with constant use; this leads to background noise that prevents perfect recordings. Simply applied to recording head the V313 leaves head free of magnetism. Cleans any tape head in seconds. **£1·72.** P. & P. 15p

PREMIER HI-FI OFFERS!

Rogers Ravensbrook 11 Stereo Amplifier in teak case	£38·50
Rogers Ravensbourne Stereo Amplifier in teak case	£49·00
Metrosound ST20E Stereo Amplifier in teak case	£25·50
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Garrard SP25 111 with Goldring G800 cartridge	£15·00

SP25 Mk III SPECIAL!

Garrard SP25 Mk. III Single Record Player. Fitted Goldring G800 Magnetic Stereo Cartridge. Complete in Teak Plinth with Cover.

Total list Price over £34.

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Garrard AP76 less cartridge £18·80

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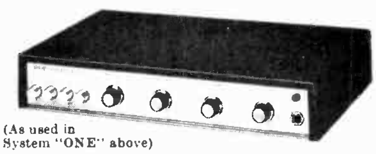
Garrard 2025 T/C with Stereo Ceramic Cartridge £8·50

Garrard 2025 T/C with Stereo Ceramic Cartridge ready wired in teak plinth with cover £12·45

Carriage and Insurance 60p extra any item.

PREMIER 800 STEREO AMPLIFIER



(As used in System "ONE" above)

A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30–20,000Hz ± 2db. Distortion: 1%. Output Impedance 8 ohms nom. Inputs equalised to R.I.A.A.
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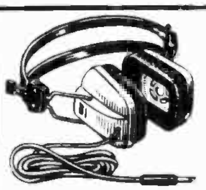
Mk. II Version available with Teak Finish Cabinet. £16·25. Carr. 50p.



HI-FI STEREO HEADPHONES
Designed to the highest possible standard. Fitted 2¼in speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft lead and stereo jack plug. **£2·47** P. & P 25p

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MONO STETHOSCOPE SET Low imp. 52p. P. & P. 10p

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Battery operated 4-channel audio mixer providing four separate inputs. Size 6in × 3in × 2in suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1·5V, max. output 2·5V, gain 6dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

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TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed.

LP3	3"	250'	P.V.C.	28p
TT3	3"	450'	POLYESTER	37p
DT3	3¼"	600'	POLYESTER	57p
SP5	5"	600'	P.V.C.	42p
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DT5	5"	1200'	POLYESTER	75p
LP6	5¾"	1200'	ACETATE	75p
DT6	5¾"	1800'	POLYESTER	£1·12
TT6	5¾"	2400'	POLYESTER	£1·87
SP7	7"	1200'	P.V.C.	62p
LP7	7"	1800'	ACETATE	75p
DT7	7"	2400'	POLYESTER	£1·25
TT7	7"	3600'	POLYESTER	£2·50

TAPE SPOOLS 3" 5p, 5", 5¾", 7" 9p.

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TYPE SW. 100
100 x 80 mm

50µA	£3·60	500µA	£3·20
50-0-50µA	£3·45	1mA	£3·10
100µA	£3·45	20V d.c.	£3·10
100-0-100µA	£3·35	50V d.c.	£3·10
		300V d.c.	£3·10
		1A d.c.	£3·10
		5A d.c.	£3·10
		300V a.c.	£3·10
		VU Meter	£3·75

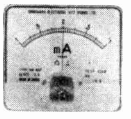
BAKELITE PANEL METERS

TYPE S-80
80 mm square fronts

50µA	£3·20	1A d.c.	£2·60
50-0-50µA	£3·10	5A d.c.	£2·60
100µA	£3·10	300V a.c.	£2·60
100-0-100µA	£3·00	VU Meter	£3·37
500µA	£2·75		
1mA	£2·60		
20V d.c.	£2·60		
50V d.c.	£2·60		
300V d.c.	£2·60		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in × 4¼in fronts.



50µA	£3·60	50mA	£2·80
50-0-50µA	£3·10	100mA	£2·80
100µA	£3·10	500mA	£2·80
100-0-100µA	£3·00	1A	£2·80
200µA	£3·00	5A	£2·80
500µA	£2·90	15A	£2·80
500-0-500µA	£2·80	30A	£2·90
1mA	£2·80	20V d.c.	£2·80
1-0-1mA	£2·80	50V d.c.	£2·80
5mA	£2·80	150V d.c.	£2·80
10mA	£2·80	300V d.c.	£2·80
		15V a.c.	£2·80
		300V a.c.	£2·80
		8 Meter 1mA	£2·87
		VU Meter	£3·60
		1A a.c.*	£2·80
		5A a.c.*	£2·80
		10A a.c.*	£2·80
		20A a.c.*	£2·80
		30A a.c.*	£2·80

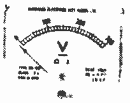
Type MR.52P. 2½in square fronts.

50µA	£3·10	20V d.c.	£2·00
50-0-50µA	£2·60	50V d.c.	£2·00
100µA	£2·60	300V d.c.	£2·00
100-0-100µA	£2·50	15V a.c.	£2·10
500µA	£2·30	300V a.c.	£2·10
1mA	£2·00	8 Meter 1mA	£2·10
5mA	£2·00	VU Meter	£3·20
10mA	£2·00	1A a.c.*	£2·00
50mA	£2·00	5A a.c.*	£2·00
100mA	£2·00	10A a.c.*	£2·00
500mA	£2·00	20A a.c.*	£2·00
1A	£2·00	30A a.c.*	£2·00
5A	£2·00		
10V d.c.	£2·00		

Type MR.65P. 3½in × 3¼in fronts.

50µA	£3·37	20V d.c.	£2·20
50-0-50µA	£2·75	50V d.c.	£2·20
100µA	£2·75	150V d.c.	£2·20
100-0-100µA	£2·65	300V d.c.	£2·20
200µA	£2·65	15V a.c.	£2·30
500µA	£2·40	50V a.c.	£2·30
500-0-500µA	£2·20	150V a.c.	£2·30
1mA	£2·20	300V a.c.	£2·30
5mA	£2·20	500V a.c.	£2·30
10mA	£2·20	8 Meter 1mA	£2·37
50mA	£2·20	VU meter	£3·37
100mA	£2·20	50mA a.c.*	£2·20
500mA	£2·20	100mA a.c.*	£2·20
1A	£2·20	200mA a.c.*	£2·20
5A	£2·20	500mA a.c.*	£2·20
10A	£2·20	1A a.c.*	£2·20
15A	£2·20	5A a.c.*	£2·20
20A	£2·20	10A a.c.*	£2·20
30A	£2·30	20A a.c.*	£2·20
50A	£2·50	30A a.c.*	£2·20
5V d.c.	£2·20		
10V d.c.	£2·20		

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



50µA	£2·10	150mA	£1·60
50-0-50µA	£1·90	200mA	£1·60
100µA	£1·90	300mA	£1·60
100-0-100µA	£1·75	500mA	£1·60
200µA	£1·75	750mA	£1·60
500µA	£1·65	1A	£1·60
500-0-500µA	£1·60	2A	£1·60
1mA	£1·60	5A	£1·60
1-0-1mA	£1·60	10A	£1·60
2mA	£1·60	3V d.c.	£1·60
5mA	£1·60	10V d.c.	£1·60
10mA	£1·60	15V d.c.	£1·60
20mA	£1·60	20V d.c.	£1·60
50mA	£1·60	100V d.c.	£1·60
100mA	£1·60	150V d.c.	£1·60
		300V d.c.	£1·60
		500V d.c.	£1·60
		750V d.c.	£1·60
		15V a.c.	£1·70
		50V a.c.	£1·70
		150V a.c.	£1·70
		300V a.c.	£1·70
		500V a.c.	£1·70
		8 Meter 1mA	£1·70
		VU meter	£2·10

Type MR.45P. 2in square fronts.

50µA	£2·25	10V d.c.	£1·50
50-0-50µA	£2·10	20V d.c.	£1·50
100µA	£2·10	50V d.c.	£1·50
100-0-100µA	£1·87	300V d.c.	£1·50
200µA	£1·87	15V a.c.	£1·80
500µA	£1·75	300V a.c.	£1·80
500-0-500µA	£1·70	8 Meter 1mA	£1·85
1mA	£1·70	VU Meter	£2·25
5mA	£1·70	1A a.c.*	£1·70
10mA	£1·70	5A a.c.*	£1·70
50mA	£1·70	10A a.c.*	£1·70
100mA	£1·70	20A a.c.*	£1·70
500mA	£1·70	30A a.c.*	£1·70
1A	£1·70		
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Type MR.65 3½in square fronts.

25µA	£3·50	500mA	£1·95
50µA	£2·37	1A	£1·95
50-0-50µA	£2·35	2A	£1·95
100µA	£2·35	5A	£1·95
100-0-100µA	£2·25	15A	£1·95
500µA	£2·20	30A	£1·95
1mA	£1·95	50A	£1·95
1-0-1mA	£1·95	5V d.c.	£1·95
5mA	£1·95	10V d.c.	£1·95
10mA	£1·95	20V d.c.	£1·95
50mA	£1·95	50V d.c.	£1·95
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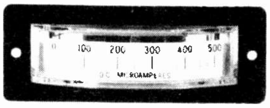
50µA	£5·00	20V d.c.	£4·40
100µA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c.	£4·40
50-0-50µA	£4·65	Dual range	
1-0-1mA	£4·40	500mA/5A d.c.	£4·65
1A d.c.	£4·40	5V/50V d.c.	£4·65
5A d.c.	£4·40		
10V d.c.	£4·40		

EDGEWISE METERS



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

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50-0-50µA	£3·00	1mA	£3·45
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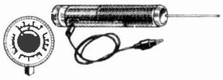
ROUND SCALE TYPE PENCIL TESTER MODEL TS.68



Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V a.c. and d.c. at 2,000 o.p.v. Resistance 0–20kΩ. ONLY **£1·97.** P. & P. 13p.

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Battery operated, 11 meg input. 26 ranges. Large 4½in mirror scale. Size 5¼in × 4¾in × 2¾in. D.c. volts 0·3–1,200V. A.c. volts 3–300V R.M.S. 8·0–800V P-P. D.c. current 0·12–12MA. Resistance up to 2,000M ohm. Decibels −20 to +51dB. Complete with leads/instructions. **£17·50.** P. & P. 20p.

TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120Kc/s–500Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. **£15.** Carr. 37½p. Size 140 × 215 × 170 mm.

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Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V a.c. Supplied brand new and guaranteed with instruction manual and leads. **£17·50.** Carr. 37½p.

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HIOKI MODEL 720X 20,000 O.P.V. Overhead protection. 5/25/100/500/1000V D.C. 10/50/250/1000V A.C. 50µA/250mA. 20K/2 meg ohm. −5 to +62db. **£4·97.** P. & P. 15p.

MODEL PL436. 20kΩ/Volt d.c. 8kΩ/Volt a.c. Mirror scale. 0·6/3/12/30/120/600V d.c. 3/30/120/600V a.c. 50/600µA/60/600mA. 10/100K/1 Meg/10 meg Ω. −20 to +46dB. **£6·97½.** P. & P. 12½p.

MODEL 5025. 57 ranges, giant 5½in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0·125, 0·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50µA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 2K, 10K, 100K, 1 meg, 10 meg. Decibels: −20 to +85dB. **£12·50.** P. & P. 17½p.

HIOKI MODEL 700X
100,000 O.P.V. Overload protection. Mirror scale.

·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200VDC
1·5/3/6/12/30/60/150/300/600/1200 VAC
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−20 to + 63 db
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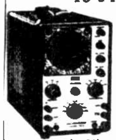

3in tube. Y amp. Sensitivity 0·1V p-p/CM. Bandwidth 1·5 cps-1·5MHz. Input imp. 2megΩ 25pF. X amp. sensitivity 0·9V -800KHz. Input imp. 2 megΩ 20pF. Time base, 5 ranges 10cps-300KHz. Synchronisation. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15¾lb 220/240V a.c. Supplied brand new with handbook. **£40.** Carr. 50p.

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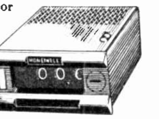

Can be panel or bench mounted. Basic meter measures 1 volt d.c. but can be used to measure a wide range of a.c. and d.c. volt, current and ohms with optional plug-in cards.
Specification:—Accuracy: ± 0·2, ± 1 digit. Resolution: 1mV. No. of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100V d.c. Input: Fully floating (3 poles). Input power: 110-230V a.c. 50/60 cycles. Overall size: 5¾in. × 2 13/16in. × 8 3/16in.
AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. £49·97½ Carr. 50p

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2G309	30p	2N3564	17p	2S301	50p	BC121	20p	BFX30	25p	NKT237	35p
2G371	15p	2N3565	15p	2S302	50p	BC122	20p	BFX37	30p	NKT238	25p
2G374	20p	2N3566	22p	2S303	60p	BC125	15p	BFX44	37p	NKT240	27p
2G381	22p	2N3568	25p	2S304	75p	BC126	20p	BFX68	67p	NKT241	27p
2N388A	49p	2N3569	25p	2S501	32p	BC134	12p	BFX84	25p	NKT242	20p
2N404	20p	2N3570	125p	2S502	35p	BC135	12p	BFX85	30p	NKT243	62p
2N696	15p	2N3572	97p	2S503	27p	BC136	15p	BFX86	25p	NKT244	17p
2N697	15p	2N3605	27p	3N83	40p	BC137	15p	BFX87	25p	NKT245	20p
2N698	25p	2N3606	27p	3N128	70p	BC138	20p	BFX88	20p	NKT261	20p
2N699	30p	2N3607	22p	3N140	77p	BC140	35p	BFX89	62p	NKT262	30p
2N706	10p	2N3638	18p	3N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N706A	12p	2N3638A	20p	3N142	55p	BC147	10p	BFY11	42p	NKT271	20p
2N708	15p	2N3641	18p	3N143	67p	BC148	10p	BFY18	25p	NKT262	20p
2N709	62p	2N3642	18p	3N152	87p	BC149	12p	BFY19	25p	NKT274	20p
2N718	25p	2N3643	20p	40050	55p	BC152	17p	BFY21	42p	NKT275	20p
2N718A	30p	2N3644	25p	40250	50p	BC153	20p	BFY24	45p	NKT278	25p
2N726	30p	2N3645	25p	40251	32p	BC154	20p	BFY29	40p	NKT281	27p
2N727	30p	2N3691	15p	40309	32p	BC157	15p	BFY30	40p	NKT401	87p
2N914	17p	2N3692	18p	40310	45p	BC158	11p	BFY41	50p	NKT403	90p
2N916	17p	2N3693	15p	40311	35p	BC159	12p	BFY43	62p	NKT403	75p
2N918	30p	2N3694	18p	40312	47p	BC160	35p	BFY50	20p	NKT404	55p
2N929	22p	2N3702	10p	40314	37p	BC167	11p	BFY51	20p	NKT405	75p
2N930	20p	2N3703	10p	40315	37p	BC168B	10p	BFY52	20p	NKT406	62p
2N987	40p	2N3704	11p	40316	47p	BC168C	11p	BFY53	15p	NKT451	62p
2N1090	22p	2N3705	10p	40317	37p	BC169B	11p	BFY56A	57p	NKT452	62p
2N1091	22p	2N3706	9p	40319	55p	BC169C	12p	BFY76	42p	NKT453	47p
2N1131	25p	2N3707	11p	40320	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1132	25p	2N3708	7p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1302	17p	2N3709	9p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1303	17p	2N3710	9p	40326	37p	BC175	22p	BSX20	15p	NKT736	35p
2N1304	22p	2N3711	12p	40329	30p	BC177	20p	BSX21	20p	NKT773	25p
2N1305	22p	2N3713	187p	40344	27p	BC178	20p	BSX26	45p	NKT781	30p
2N1306	25p	2N3714	200p	40347	57p	BC179	20p	BSX27	47p	OC16	50p
2N1307	25p	2N3715	123p	40348	52p	BC182	10p	BSX28	32p	OC19	37p
2N1308	25p	2N3716	130p	40360	40p	BC182L	10p	BSX60	62p	OC20	75p
2N1309	25p	2N3773	240p	40361	40p	BC183	9p	BSX61	62p	OC22	50p
2N1507	17p	2N3791	206p	40362	50p	BC183L	9p	BSX76	15p	OC23	60p
2N1613	20p	2N3819	34p	40370	32p	BC184	11p	BSX77	20p	OC24	60p
2N1631	35p	2N3820	55p	40406	57p	BC184L	11p	BSX78	25p	OC25	40p
2N1632	30p	2N3823	50p	40407	40p	BC186	25p	BSY24	15p	OC26	25p
2N1637	30p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	60p
2N1638	27p	2N3854A	27p	40409	55p	BC212L	12p	BSY26	17p	OC29	60p
2N1639	27p	2N3855	27p	40410	62p	BC213L	12p	BSY27	15p	OC35	50p
2N1701	162p	2N3855A	30p	40412	50p	BC214L	15p	BSY28	17p	OC36	60p
2N1711	24p	2N3856	30p	40467A	57p	BCY10	27p	BSY29	17p	OC41	22p
2N1889	32p	2N3856A	35p	40468A	35p	BCY30	27p	BSY32	25p	OC42	25p
2N1893	37p	2N3858	25p	40528	72p	BCY31	30p	BSY36	25p	OC44	15p
2N2147	72p	2N3858A	30p	40600	57p	BCY32	50p	BSY37	25p	OC45	12p
2N2160	57p	2N3859	27p	40603	50p	BCY33	25p	BSY38	20p	OC46	15p
2N2193	40p	2N3859A	32p	AC107	30p	BCY34	30p	BSY39	22p	OC70	12p
2N2193A	42p	2N3860	30p	AC126	20p	BCY38	40p	BSY43	50p	OC71	12p
2N2194	27p	2N3866	150p	AC127	24p	BCY39	60p	BSY51	32p	OC72	12p
2N2194A	30p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2217	25p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	37p	OC74	30p
2N2218	20p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	22p
2N2219	20p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	22p
2N2220	25p	2N3901	97p	AC176	20p	BCY54	32p	BSY79	45p	OC77	30p
2N2221	25p	2N3903	20p	AC187	25p	BCY58	22p	BSY90	57p	OC78	20p
2N2222	20p	2N3904	25p	AC188	25p	BCY59	22p	BSY95A	12p	OC81	20p
2N2222A	25p	2N3905	30p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2297	30p	2N3906	25p	ACY18	24p	BCY70	15p	C450	15p	OC82	20p
2N2368	15p	2N4058	12p	ACY19	24p	BCY71	20p	GET102	30p	OC82D	15p
2N2369	15p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	20p	OC83	25p
2N2369A	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	20p	OC84	25p
2N2410	42p	2N4061	12p	ACY22	10p	BCY79	30p	GET118	20p	OC139	25p
2N2483	27p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	32p
2N2484	32p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2539	22p	2N4248	15p	ACY40	20p	BD112	50p	GET880	30p	OC171	30p
2N2540	22p	2N4249	15p	ACY41	15p	BD116	112p	GET887	20p	OC200	40p
2N2613	35p	2N4250	18p	ACY44	25p	BD121	65p	GET889	22p	OC201	60p
2N2614	30p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	75p
2N2646	40p	2N4255	42p	AD149	47p	BD124	60p	GET896	22p	OC203	40p
2N2711	25p	2N4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2712	25p	2N4285	17p	AD161	35p	BD132	80p	GET898	22p	OC205	75p
2N2713	27p	2N4286	17p	AD162	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2714	30p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	25p	OC207	75p
2N2904	20p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OCP71	42p
2N2904A	25p	2N4289	17p	AF115	25p	BDY62	100p	MAT121	25p	ORP12	50p
2N2905	25p	2N4290	12p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2905A	20p	2N4291	15p	AF117	20p	BF117	47p	MJ420	80p	ORP61	42p
2N2906	20p	2N4292	15p	AF118	60p	BF152	28p	MJ421	80p	P346A	22p
2N2906A	25p	2N4294	17p	AF121	30p	BF154	20p	MJ430	102p	ST140	15p
2N2907	23p	2N4303	47p	AF124	22p	BF158	15p	MJ440	95p	ST141	20p
2N2923	15p	2N4964	15p	AF125	18p	BF159	35p	MJ480	97p	T1834	62p
2N2924	15p	2N4965	18p	AF126	18p	BF163	35p	MJ481	125p	T1843	40p
2N2925	15p	2N5027	58p	AF127	16p	BF167	18p	MJ490	100p	T1844	10p
2N2926G	10p	2N5028	57p	AF139	28p	BF170	33p	MJ491	137p	T1845	27p
2N2926O	10p	2N5029	47p	AF178	42p	BF173	19p	MJE340	50p	T1846	11p
2N2926Y	10p	2N5030	42p	AF179	45p	BF177	30p	MJE370	80p	T1847	11p
2N3011	20p	2N5172	12p	AF180	50p	BF178	25p	MJE371	80p	T1848	12p
2N3014	22p	2N5174	52p	AF181	40p	BF179	30p	MJE520	60p	T1849	12p
2N3053	18p	2N5175	52p	AF186	39p	BF180	35p	MJE521	70p	T1850	12p
2N3054	46p	2N5176	45p	AF239	30p	BF181	32p	MPF102	42p	T1851	10p
2N3055	60p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	T1852	11p
2N3133	30p	2N5245	45p	AF280	47p	BF184	20p	MPF104	37p	T1853	22p
2N3134	30p	2N5246	42p	AFZ11	32p	BF185	20p	MPF105	37p	XB112	12p
2N3135	25p	2N5249	67p	ASY26	25p	BF194	15p	MPS3638	32p	XC141	35p
2N3136	25p	2N5265	325p	ASY27	30p	BF195	15p	NKT124	42p	ZTX107	15p
2N3390	25p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	15p
2N3391	20p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	15p
2N3391A	30p	2N5307	37p	ASY50	25p	BF198	15p	NKT128	27p	ZTX300	12p
2N3392	17p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	15p
2N3393	15p	2N5309	62p	ASY54	25p	BF224	14p	NKT137	32p	ZTX302	20p
2N3394	15p	2N5310	42p	ASY67	45p	BF225	19p	NKT210	30p	ZTX303	20p
2N3402	25p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	25p
2N3403	22p	2N5355	27p	ASZ21	51p	BF238	22p	NKT212	30p	ZTX500	15p
2N3404	32p	2N5356	32p	AUY10	150p	BF244	23p	NKT213	30p	ZTX501	15p
2N3405	45p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	20p	ZTX502	20p
2N3414	22p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
		2N5367	57p	BC109	10p	BFW88	20p	NKT216	35p	ZTX504	40p
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CA3020A	160p	FJH241	25p	SN7454	20p
CA3021	156p	FJH251	25p	SN7460	20p
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CA3023	126p	FJJ111	60p	SN7473	40p
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CA3029	87p	FJJ181	75p	SN7483	87p
CA3029A	165p	FJJ191	65p	SN7486	33p
CA3030	137p	FJJ211	125p	SN7490	87p
CA3035	122p	FJJ251	125p	SN7492	87p
CA3036	72p	FJL101	125p	SN7493	87p
CA3039	82p	FJY101	25p	SN7495	87p
CA3041	109p	IC12	180p	SN7496	87p
CA3042	109p	L900	40p	SN74107	52p
CA3043	137p	L914	40p	SN74153	135p
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CA3045	122p	LM380	£1·22p	SN74160	180p
CA3046	81p	MC724P	60p	SN74161	260p
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CA3049	160p	MC790P	124p	SN74192	175p
CA3050	186p	MC792P	66p	SN74193	175p
CA3051	134p	MC799P	66p	TAA241	162p
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CA3064	120p	MC1552G	461p	TAA310	125p
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1R5	40p	30C17	90p	EM85	100p
1S5	30p	30C18	80p	EM87	70p
1T4	25p	30F5	85p	EY51	40p
1U4	30p	30FL1	75p	EY86	40p
1U5	60p	30FL12	120p	EY87	42p
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3Q4	50p	30L15	85p	EZ41	50p
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6AK5	35p	50B5	50p	PC97	45p
6AK6	60p	50C5	50p	PC900	48p
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6AM6	30p	85A2	50p	PCC85	40p
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6AT6	35p	5763	70p	PCC189	55p
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6BW7	80p	DL92	35p	PCL82	35p
6BZ6	40p	DL94	45p	PCL83	65p
6C4	33p	DL96	45p	PCL84	45p
6CD6	125p	DM70	40p	PCL85	40p
6CL6	50p	DY86	32p	PCL86	45p
6CW4	65p	DY87	33p	PFL200	65p
6F1	62p	E88CC	100p	PL36	55p
6F6G	35p	E180F	100p	PL81	50p
6F13	45p	EABC80	35p	PL82	45p
6F14	70p	EAF42	35p	PL83	45p
6F15	65p	EB91	20p	PL84	40p
6F18	50p	EBC41	55p	PL500	75p
6F23	85p	EBC81	30p	PL504	80p
6H6	17p	EBF80	40p	PY32	55p
6J4	50p	EBF83	40p	PY33	63p
6J5	25p	EBF89	32p	PY80	40p
6J5GT	30p	EBL21	60p	PY81	30p
6J6	20p	EC86	60p	PY82	35p
6J7	45p	EC88	60p	PY83	38p
6K8G	40p	ECC40	65p	PY88	40p
6L6GT	45p	ECC84	30p	PY800	40p
6LD20	50p	ECC85	40p	PY801	50p
6Q7	40p	ECC88	40p	U25	80p
6SA7	40p	ECF80	35p	U26	80p
6SG7	40p	ECF82	35p	U50	40p
6SJ7	40p	ECF86	65p	U52	35p
6SK7	40p	ECH21	57p	U191	75p
6SL7	35p	ECH35	100p	U281	40p
6SN7	35p	ECH42	75p	U282	40p
6SQ7	40p	ECH81	30p	U301	40p
6U4	65p	ECH83	45p	U801	180p
6V6G	25p	ECL80	45p	UABC80	40p
6V6GT	32p	ECL82	35p	UAF42	55p
6X4	35p	ECL83	70p	UBC41	50p
6X5G	30p	ECL86	40p	UBC81	40p
6X5GT	40p	EF37A	120p	UBF80	40p
10C2	50p	EF39	50p	UBF89	35p
10F1	75p	EF40	50p	UCC84	49p
10P13	60p	EF41	65p	UCC85	40p
10P14	110p	EF42	70p	UCF80	55p
12AT6	30p	EF80	25p	UCH21	60p
12AT7	30p	EF85	30p	UCH42	70p
12AU7	30p	EF86	30p	UCH81	40p
12AX7	30p	EF89	28p	UCL82	35p
12AV6	40p	EF91	30p	UCL83	60p
12BA6	40p	EF92	35p	UF41	60p
12BE6	40p	EF183	35p	UF80	35p
12BH7	45p	EF184	35p	UF85	40p
19AQ5	35p	EH90	40p	UF89	40p
20D1	65p	EL34	50p	UL41	65p
20F2	65p	EL33	125p	UL84	40p
20L1	110p	EL41	60p	UY41	48p
20P1	50p	EL42	50p	UY85	40p
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AA129	10p	BAY38	15p	OA10	22p
AAZ13	10p	BY100	15p	OA47	8p
AAZ15	10p	BY103	22p	OA70	7p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	7p
BA110	25p	BY126	15p	OA81	8p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	52p	OA90	7p
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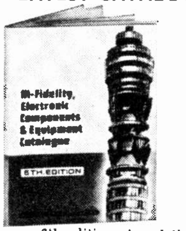

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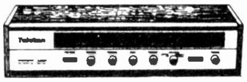

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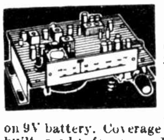

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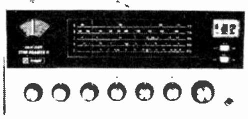

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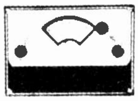

Sine 18–200,000Hz; Square 18–50,000Hz. Output max +10dB (10kΩ). Operation internal batteries.
Attractive two-tone case 7¾in × 5in × 2in. Price **£17·50**. Carr. 17½p.

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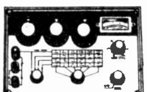

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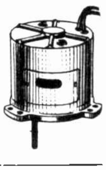

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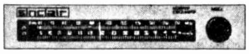

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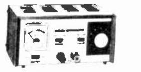

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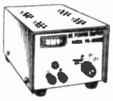

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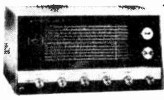

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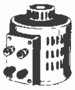

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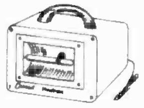

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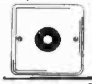

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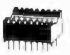

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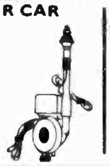

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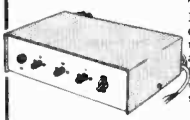

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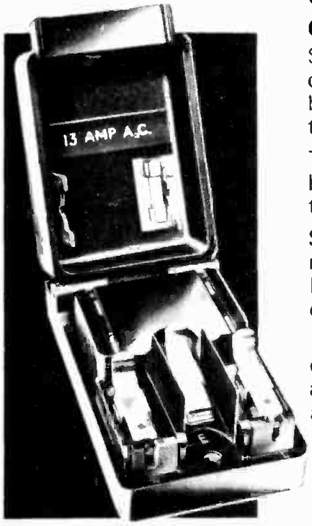

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OC71	0·10	2N3055	0·50
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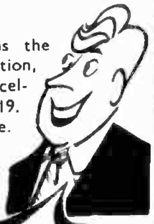

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 **30p** each, 10-50 **25p** each, 50+**20p** each.

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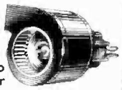

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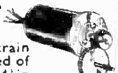

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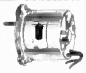
230V/240V COMPACT SYNCHRONOUS GEARED MOTORS



Manufactured by either Sangamo, Haydon or Smith. Built-in gearbox.

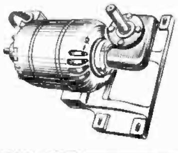
1 r.p.m. cw.	1 r.p.h. a/cw.	10 r.p.h. a/cw.
60 r.p.m. cw.	2 r.p.h. cw.	15 r.p.h. a/cw.
	3 r.p.h. a/cw.	20 r.p.h. cw.
	6 r.p.h. cw.	30 r.p.h. cw.

cw. = clockwise rotation; a/cw. = Anticlockwise. Fraction of makers' price. All at 75p incl. P. & P.

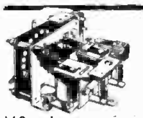
CONSTANT SPEED, PRECISION MADE 6 VOLT D.C. GOVERNED MOTOR

Seven pole armature, ballrace bearing. 2,750 r.p.m. Length 2 $\frac{1}{16}$, Dia. $\frac{13}{16}$, Shaft length $\frac{3}{16}$, Shaft dia. 5/64. No load 40 mA. Normal load 350 mA. Ideal for portable recorders, etc., etc. Price £1·25 P. & P. 10p.

PARVALUX TYPES D19 230/250 VOLT A.C. REVERSIBLE GEARED MOTORS



30 r.p.m. 40 lb. ins. Position of drive spindle adjustable to 3 different angles. **Mounted on substantial cast aluminium base.** Ex-equipment. Tested and in first-class running order. A really powerful motor offered at a fraction of maker's price. £6·30. P. & P. 50p.



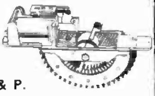
17 WAY SELECTOR SWITCH with RESET COIL

This fascinating electro mechanical device can be switched through 17 positions, and can be reset from any position by energising the reset coil. 110 volt operation, or 230/240V a.c. with 500 ohm, 10W resistor, or 50V d.c. Two for £1. P. & P. 10p.

600 WATT DIMMER SWITCH.

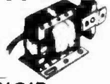
Easily fitted. Fully guaranteed by makers. Will control up to 600W of all lights except fluorescent at mains voltage. Complete with simple instructions. £3 incl. P. & P.

UNISELECTOR SWITCHES



NEW 4 Bank 25 Way 24V d.c. operation. £5·88. P. & P. 25p. 6 Bank 25 Way 24V d.c. £6·50. P. & P. 25p. 8 Bank 25 Way, 24V d.c. operation. £7·62 plus 25p. P. & P.

230V A.C. SOLENOID



Extremely powerful with approx. 14lb pull, 1in travel. Fitted with mounting feet. Size: 4in long, 2⅞in wide, 3in high. £2·00 incl. P. & P.

230-250 VOLT A.C. SOLENOID
Manufactured by Westool Ltd. (similar in appearance to above illustration). Approx. 1½lb pull. Feet size 1⅞in × 1¼in. Price 85p incl. P. & P.

18-24 VOLT D.C. SOLENOID
Size: O.A.L. 3⅞in × 1¼in × 1in. Max. push ½ at 1lb. approx. PRICE: 75p incl. P. & P.

STROBE ! STROBE ! STROBE !

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions £6·30, plus 25p P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1-80 f.p.s. Price £10·50. P. & P. 50p.

HY-LYGHT STROBE MK III
This strobe has been designed and produced for use in large rooms, halls and the photographic field and utilises a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. Light output approx. 4 joules. £12·00. P. & P. 50p. **SPECIALLY DESIGNED. FULLY VENTILATED METAL CASE.** For industrial or Hy-Lyght. Including reflector. £4·00 P. & P. 45p. Post paid with kit.

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Approx. four times the light output of our well proven Hy-Lyght strobe. Incorporating:
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- Reactor control circuit producing an intense white light.

Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY £20 plus 75p P. & P. **ATTRACTIVE, ROBUST, FULLY VENTILATED METAL CASE** specially designed for the Super Hy-Lyght Kit including reflector £7·00 P. & P. 45p.

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Ideally suited for above Strobe kits. Price 53p, P. & P. 13p or post paid with kits.

6 INCH COLOUR WHEEL

As used for disco lighting effects, etc. £5·75 incl. P. & P. can be operated from our one r.p.m. synchronous motor price 75p incl. P. & P.

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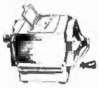
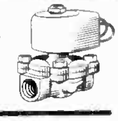


Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in, W.4in, H.6in, weight 6lb. **1,000V, 1,000 megohms, £34·00** carriage paid.
500V, 500 megohms, £28 incl. P. & P.

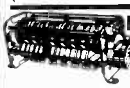
36V 30 AMP. A.C. or D.C. VARIABLE L.T. SUPPLY UNIT

INPUT
220/240V a.c.
OUTPUT
CONTINUOUSLY VARIABLE 0–36V
Fully isolated. Fitted in robust metal case with Voltmeter, Ammeter Panel Indicator and handles. Input and output fully fused. Ideally suited for Lab. or Industrial use. £68 plus £2 P. & P.

240V A.C. SOLENOID FLUID VALVE



Will handle liquids or gases up to 7 p.s.i. Forged brass body, stainless steel core and spring. ⅜in b.s.p. inlet/outlet. Precision made, British mfg. PRICE: £1·75. P. & P. 20p. Special quotation for quantity. *(New in makers' carton)*



PROGRAMME TIMERS
(Mfg. by Magnetic Devices Ltd.). 240V a.c. 5 r.p.m. Crouzet motor. Drives 15 cams, each operating a 10 amp c/o micro switch. Cams are individually variable, allowing innumerable combinations. Ideally suited for machinery control, automation, etc. Also in the field of entertainment, for chaser lights, animated displays, etc. PRICE £5·75. P. & P. 25p.

MOTOROLA MAC 11/6 PLASTIC TRIAC 400 PIV. 10 AMP
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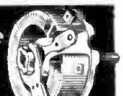
Superior Quality Precision Made NEW POWER RHEOSTATS



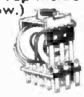
100 WATT. 1 ohm, 10A; 5 ohm, 4·7A; 10 ohm, 3A; 25 ohm, 2A; 50 ohm, 1·4A; 100 ohm, 1A; 250 ohm, 0·7A; 500 ohm, 0·45A; 1 kΩ, 280 mA; 1·5 kΩ, 230mA; 2·5 kΩ, 2A; 5 kΩ, 140mA. Diameter 3½in Shaft length ⅜in, dia. $\frac{1}{4}$in. All at £1·65 each. P. & P. 7½p.
50 WATT. 1/5/10/25/50/100/250/500/1/1·5/2·5/5kΩ. **All at £1·15 each.** P. & P. 7½p.
25 WATT. 10/25/50/100/250/500/1/1·5/2·5/3·5/5kΩ. **All at 90p each.** P. & P. 7½p.
Black Silver Skirted knob calibrated in Nos. 1-9. 1½ in. dia brass bush. Ideal for above Rheostats, 18p ea.

RELAYS SIEMENS, PLESSEY, Etc.

MINIATURE RELAYS

Col. (1) Coil ohms	1	2	3	4
	52	3–6	2 c/o	63p*
Col. (2)	410	10–18	4 c/o	73p*
Working	600	12–24	4 c/o	78p*
d.c. volts	700	16–24	4M 2B	63p*
	700	16–24	4 c/o	78p*
Col. 3	700	12–24	2 c/o	63p*
Contracts	700	15–35	2 c/o HD	73p*
	700	16–24	6M	65p*
Col. (4)	700	6–12	1 c/o HD	50p*
Price	700	20–30	6 c/o	75p
	1,250	24–36	4 c/o	63p*
HD =	2,500	36–45	6M	63p*
Heavy duty	2,400	30–48	4 c/o	50p*
*Incl. Base	9,000	40–70	2 c/o	50p*
Post paid.	15k	85–110	6M	50p*

12 VOLT D.C. RELAY 140 ohm coil
Three sets c/o contacts rated at 5 amps. 78p including P. & P. (Similar to illustration below.)



'DIAMOND H' 230 VOLT A.C. RELAYS (Unused)
Three sets c/o contacts rated at 5 amps. PRICE: 50p. P. & P. 10p. (100 lots £40 including P. & P.)

230 VOLT A.C. RELAYS MFG. KEY SWITCH
One set c/o contacts rated at 7·5 amps. Boxed. PRICE: 40p. P. & P. 5p. (100 lots £32 inc. P. & P.)

MINIATURE RELAYS
9-12V d.c. operation. Two c/o 500 M.A. contacts. Size only 1in × ⅜in × ½in. Price 58p post paid. 30-36V d.c. operation. Two c/o 500 M.A. contacts. 3,200 ohm coil. Size only 1in × $\frac{9}{16}$in × $\frac{13}{16}$in. 43p post paid.

VENNER Electric Time Switch

200/250V Ex. GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 15A £3·25, 20A £3·75. P. & P. 20p. Also available with solar dial ON dusk, OFF dawn. Price as above.

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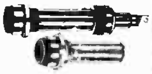
NEW in makers carton. BAKELITE £1·25 per doz. FLEXIBLE £1·50 per doz. Post paid (Minimum 1 doz).

LIGHT SOURCE AND PHOTO CELL MOUNTING



Precision engineered light source with adjustable lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP12 or similar cell. Both units are single hole fixing. Price per pair £2·75. P & P. 18p.

LIGHT SENSITIVE SWITCHES

Kit includes ORP.12 Photocell, Relay Transistor Circuit. For 6 or 12V D.C. operation. Price £1·50 plus 12p P. & P. **ORP. 12 and Circuit 63p post paid.**
220/240V A.C. MAINS MODEL
Mains transformer, rectifier, relay, 1 make 1 break H.D. contacts. price incl. circuit £2·65. P. & P. 20p.

50 in 1 ELECTRONIC PROJECT KIT
50 easy to build Projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price £7·75. P. & P. 30p.

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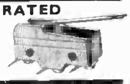

15 amps 250 volt A.C. c/o contacts. NEW in maker's carton. PRICE: 10 for £1·90 incl. P. & P.

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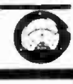

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VOL. 8 No. 6
June 1972

PRACTICAL ELECTRONICS

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BACK TO SCHOOL

It will seem remarkable to many that an industry closely identified with advanced communications and precision control of changing conditions should be unable to organise its own input of technical manpower efficiently. And yet there really does exist a serious mis-match between the educational policies pursued in the schools and technical colleges, and the electronics industry's present and future manpower needs. This unhappy fact is acknowledged in a report entitled *The Electronics Industry and the Schools* issued by the National Economic Development Office last March.

The Report states that greater opportunities than ever before will arise in the future for graduates, technician engineers, and technicians, especially in industries that have not previously employed electronics personnel on any large scale. However, the Report warns against too much emphasis upon graduate entry into industry while there is a real danger of deficiency in the supply of technician engineers and technicians. It is recruitment of the latter categories that should receive special attention. This point was endorsed at the IEETE Conference held at Sheffield last March, where the view was expressed that an ordinary degree for technician engineer status should be introduced.

Coming back to the NEDO Report, we read: "The proper progression of a potential technician's education and training requires a greater degree of vocational awareness and flexibility on the part of both pupils and teachers than is commonly present in schools now." The Report stresses the need for more people with a scientific and engineering background to remedy the shortage in the teaching profession. Perhaps the remedy is to be found in courses such as that planned by Edge Hill College of Education, Ormskirk, Lancs, and recently brought to our attention. Entitled *Science and People* this new course aims to provide "an alternative route into teaching, not only for sixth formers, but also for suitably qualified men and women who may find their present industrial occupations unsuitable or insecure."

We think this kind of feedback is much to be desired. An infusion into the schools of persons with practical industrial experience of electronics will help remove those barriers that apparently still separate some academics from practising technicians and engineers.

continued on page 497

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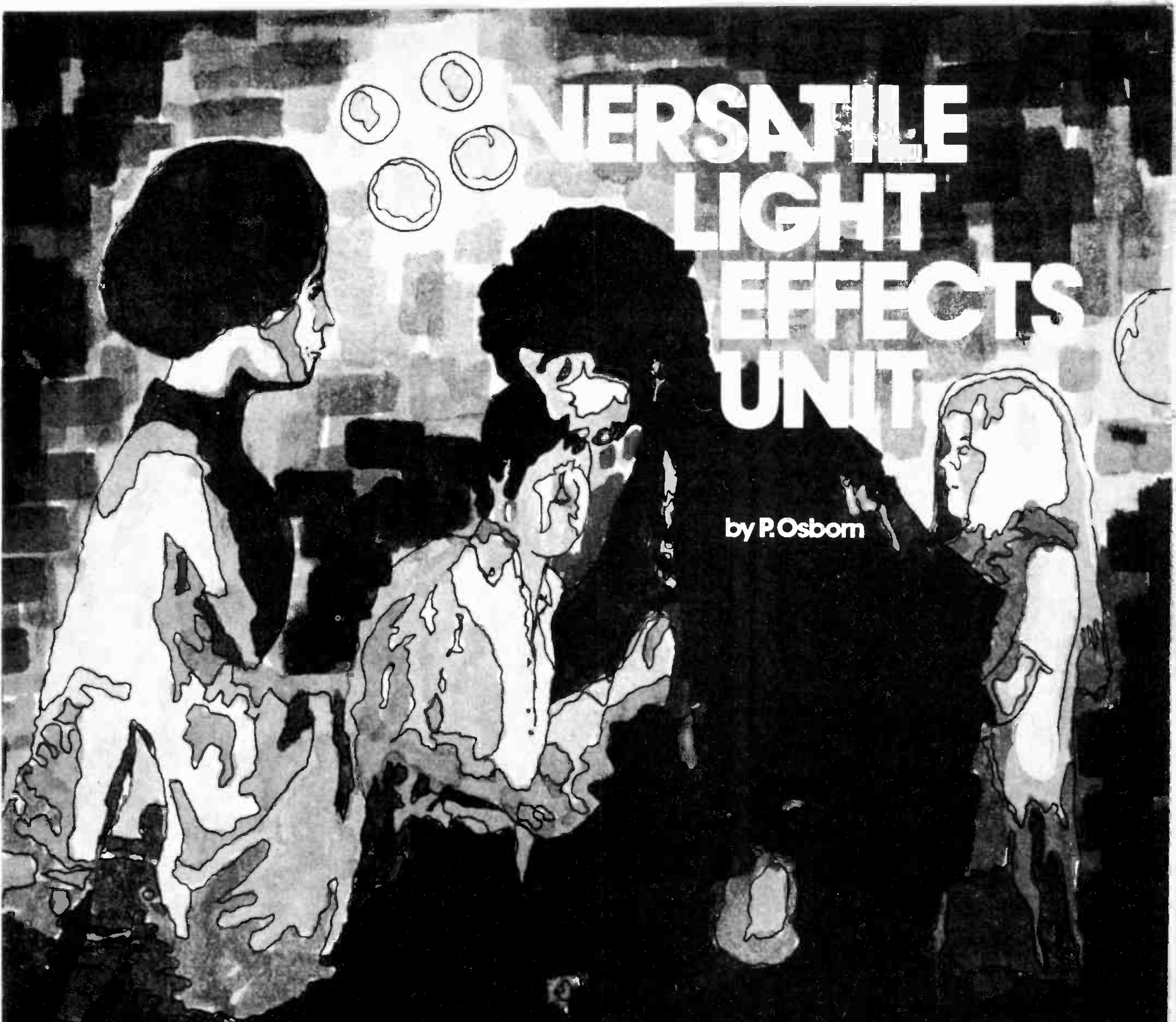


VERSATILE LIGHT EFFECTS UNIT

by P. Osborn

LIGHTING effects units previously described in PRACTICAL ELECTRONICS have been primarily designed to be driven from a sound source. The audio signal has been divided, by filtering into a number of frequency bands, each of which is converted to provide an amplitude sensitive switching current to fire a thyristor or triac.

In this article the author has devised a means for frequency modulating the single channel sound source with a square wave, so that the louder the signal, the faster the flashing rate, or strobing effect.

THREE MODES

The unit described here is capable of driving filament lamps, of total power not exceeding 750 watts in three modes; these are strobe, sound-strobe and sound only. The last two modes are synchronised with sound by a feed from a record player or similar sound source. The unit is suitable for use at parties and as a light show with discotheques or groups.

The author has built several thyristor light units and with them has often had difficulties with the thyristor driver stage "locking on" and it is understood that this is a moderately common fault. Several methods for curing this condition have been tried but were not considered by the author to be good long term solutions.

It was considered necessary at the outset, therefore, to design a reliable and effective driver and pivot the rest of the design around this. The resultant design (showed in the block diagram Fig. 1) has worked well in practice and on occasion has operated continuously for as long as ten hours without mishap. Indeed it has not yet been possible for the author to coax the prototype driver transistors into being more than luke-warm.

SOUND MODE

In the sound mode, the brightness of the lights connected to the output is controlled by the volume of the sound fed to the unit from a record player or similar system, at loudspeaker level via the input jack on the front panel.

STROBE MODE

When operating in the strobe mode the connected lights flash on and off at a rate which may be set by the panel SPEED control. The range of adjustment is not great but sufficient for some interesting effects to be produced.

SOUND-STROBE

When set to operate on sound-strobe, the unit combines the two above functions to provide a stroboscopic effect whose flashing speed is controlled by the volume of the sound arriving at the input socket, i.e. the louder the sound the faster the flash rate. The switching is carried out by a key switch; only the basic functions being shown in Fig. 1.

CIRCUIT DESCRIPTION

In all modes the thyristor is connected to mains neutral input as is shown in Fig. 2. It is at all times driven by the driver TR13 and TR14 on board 2. This driver fulfils the basic switch-on requirements of a thyristor, which is that the gate should be fed with a small positive potential, relative to the cathode, from a current limited source. The brightness control adjusts the limiting and so adjusts the brightness.

To effect sound control of the lights, the sound connected to the input jack is amplified and isolated on board one, then fed via the function switch (contacts B, C, F, E) and the light level control VR5 to TR12.

To produce a stroboscopic effect from the lights it is necessary to feed the thyristor driver with an audio signal pulsed at the flash rate required. This audio signal (of the order of 1·5kHz) is provided from the multivibrator TR8 and TR9. This signal is then gated by TR10 and its impedance at the output of the gate (C12) is lowered by the emitter follower TR11.

The signal at C13 is then routed via the function switch (contacts G, H) to VR4 on board 2. In the sound function the output at pin 2-5 is switched to signal earth, via switch contact I to stop leakage. The required amount of drive, set by VR4, is fed to the driver selector contacts (D, E, F) on the function switch. The gate TR10 is driven from TR7, the strobe multivibrator, via switch contacts J and K.

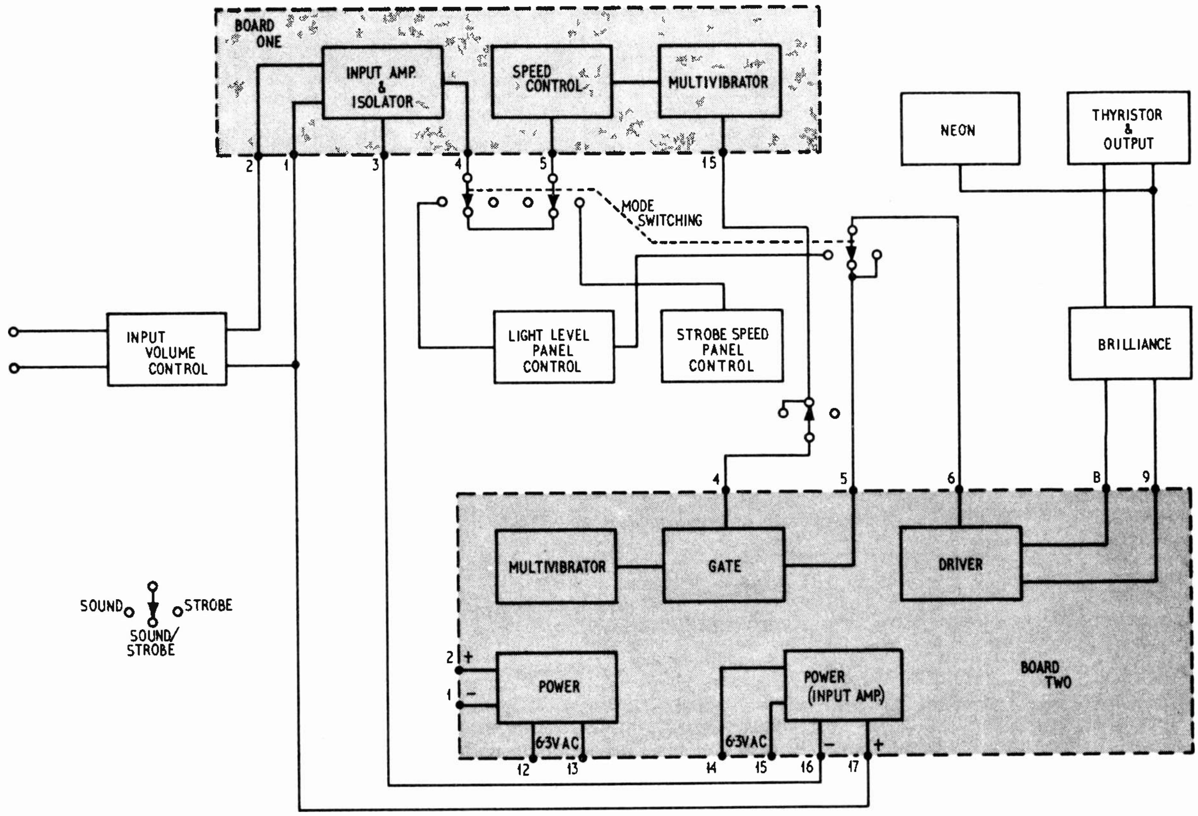


Fig. 1. Block diagram of the main functions of the sound-strobe lighting effects unit. Numbers correspond to terminations shown in Fig. 2

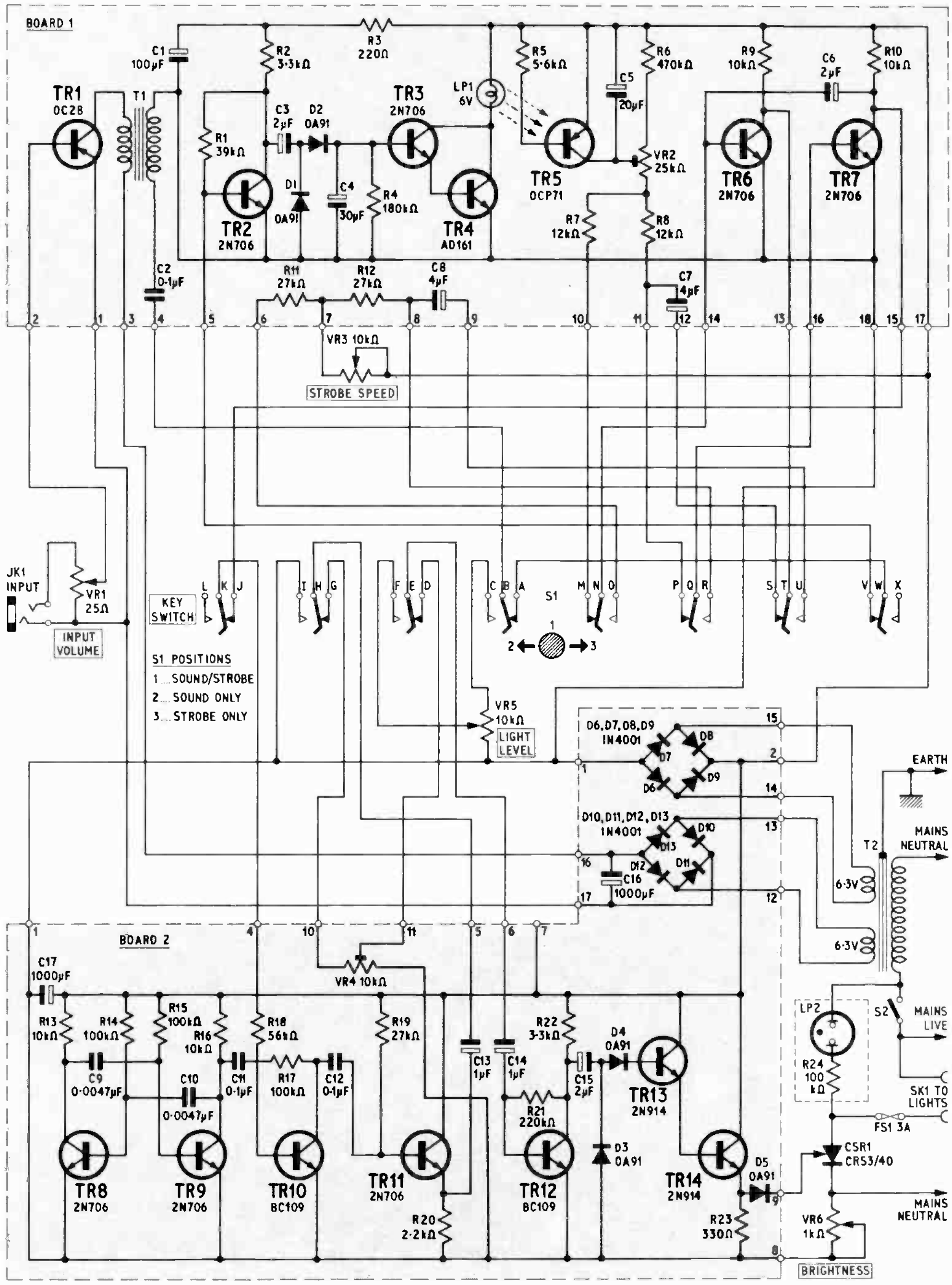


Fig. 2. Complete circuit of the effects control unit as built on two assembly boards, with the switch contacts in the centre. Movement of the keyswitch dolly in one direction (2) operates only contacts A to L. Movement in the opposite direction (3) operates only contacts M to X. The contacts are drawn as with the dolly in the centre position

The function switch selects with contacts M, N, O; P, Q, R; S, T, U, the relevant time-constant networks. The timing capacitor C6 is common to both strobe and sound-strobe function. The network for the strobe function is completed by R11, R12, C8 and the front panel "speed" control, VR3.

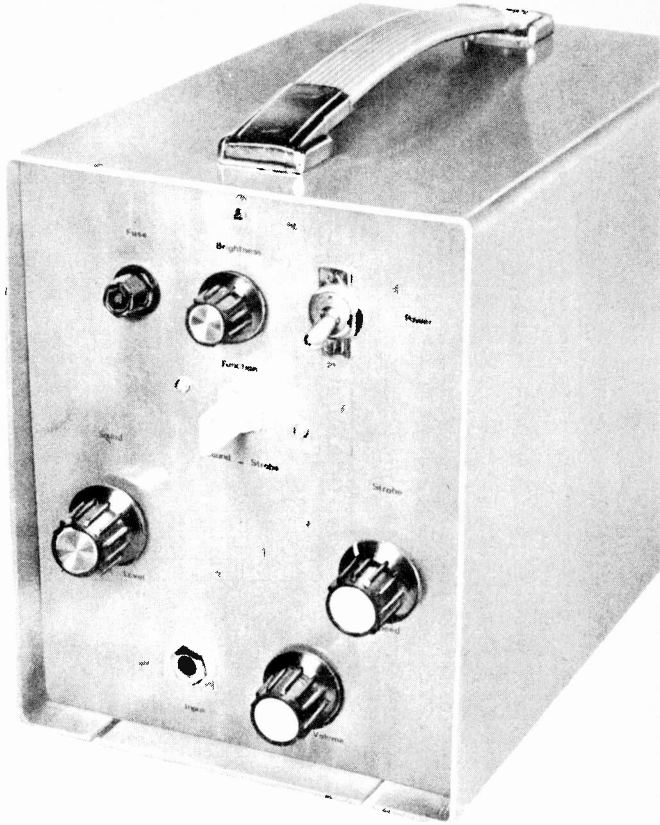
PHOTOTRANSISTOR

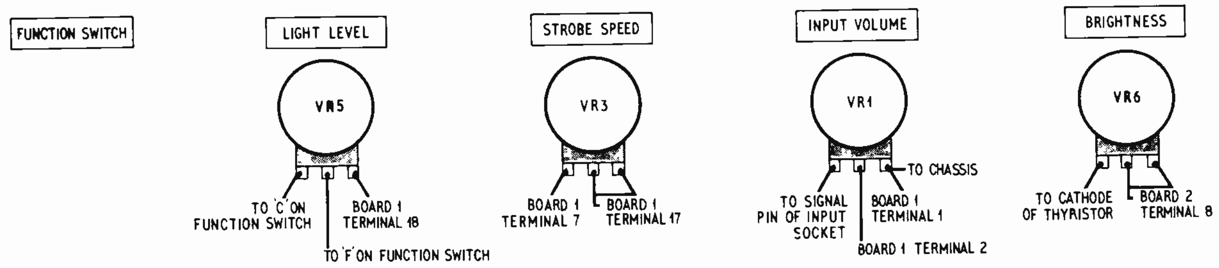
When in the sound-strobe position the function switch selects R7, R8 and C7. This network is completed as a d.c. path to the positive supply line by the phototransistor TR5 assisted by VR2 and R6. Because of this configuration, the speed of the multivibrator in the sound-strobe function may be controlled by the light emitted by the bulb LP1, which in turn is controlled through TR2, TR3, TR4, and the input amplifier by the sound supplied through the input jack.

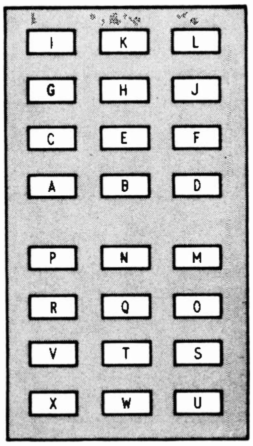
The preset potentiometer VR2 enables adjustment to be made of the amount of speed change the lamp/phototransistor gives. This configuration looks perhaps a little complicated but was considered after a trial of other methods to give the best compromise between ease of operation and economy.

The wiring for the mains input, fuse, neon, thyristor, and transformer is shown bottom right of Fig. 2, and particular attention should be paid to the neon connections which give the neon two functions. When the on/off switch is closed, the neon functions as an output monitor and follows the output to facilitate easy setting up of the controls when the controlled lights are at a distance.

With the mains switch "off" the neon will only light when a continuous path exists from the neon resistor through the fuse and connected lights to the live mains connection. This is because the neon takes very little current and so there is little voltage drop across either the transformer or the resistor R24.







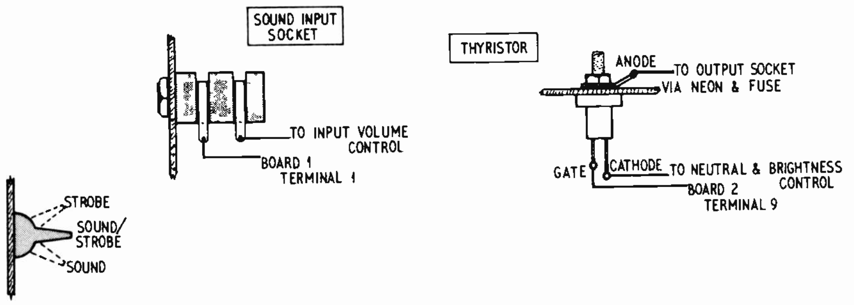


Fig. 3. Position of contacts and connection tags on the back of the keyswitch

Fig. 4. Connections to controls, jack and thyristor

COMPONENTS . . .

BOARD ONE

Resistors

R1 39kΩ	R5 5·6kΩ	R9 10kΩ
R2 3·3kΩ	R6 470kΩ	R10 10kΩ
R3 220Ω	R7 12kΩ	R11 27kΩ
R4 180kΩ	R8 12kΩ	R12 27kΩ

All ±10%, ¼W carbon

Potentiometer
VR2 25kΩ linear preset (skeleton type)

Capacitors

C1 100μF elect. 12V	C5 20μF elect. 10V
C2 0·1μF polyester	C6 2μF elect. 6V
C3 2μF elect. 12V	C7 4μF elect. 12V
C4 30μF elect. 12V	C8 4μF elect. 12V

Transformer
T1 Miniature push pull output transformer (e.g. type T/T7 or similar)

Transistors

TR1 OC28	TR3 2N706	TR6 2N706
TR2 2N706	TR4 AD161	TR7 2N706
TR5 OCP71 (phototransistor)		

Diodes
D1, D2 OA91 (2 off)

Lamp
LP1 6V 40mA

Miscellaneous
S.r.b.p. wiring board 0·1in matrix or printed wiring board

BOARD TWO

Resistors

R13 10kΩ	R17 100kΩ	R21 220kΩ
R14 100kΩ	R18 56kΩ	R22 3·3kΩ
R15 100kΩ	R19 27kΩ	R23 330Ω
R16 10kΩ	R20 2·2kΩ	

All ±10%, ¼W carbon

Potentiometer
VR4 10kΩ linear preset (skeleton type)

Capacitors

C9 0·0047μF	C14 1μF elect. 12V
C10 0·0047μF	C15 2μF elect. 12V
C11 0·1μF	C16 1,000μF elect. 12V
C12 0·1μF	C17 1,000μF elect. 12V
C13 1μF elect. 12V	

Transistors

TR8 2N706	TR11 2N706	TR13 2N914
TR9 2N706	TR12 BC109	TR14 2N914
TR10 BC109		

Diodes
D3, D4, D5 OA91 (3 off)
D6 to D9 1N4001 (4 off)
D10 to D13 1N4001 (4 off)

Miscellaneous
S.r.b.p. wiring board 0·1in matrix or printed wiring board

OTHER COMPONENTS

Potentiometers
VR1 25Ω (input volume) VR5 10kΩ (light level)
VR3 10kΩ (strobe speed) VR6 1kΩ (brightness)

Transformer
T2 Mains transformer. Two secondary winding s , each 6·3V 0·1A or more

Thyristor
CSR1 400V 3A or higher. Type CRS3/40

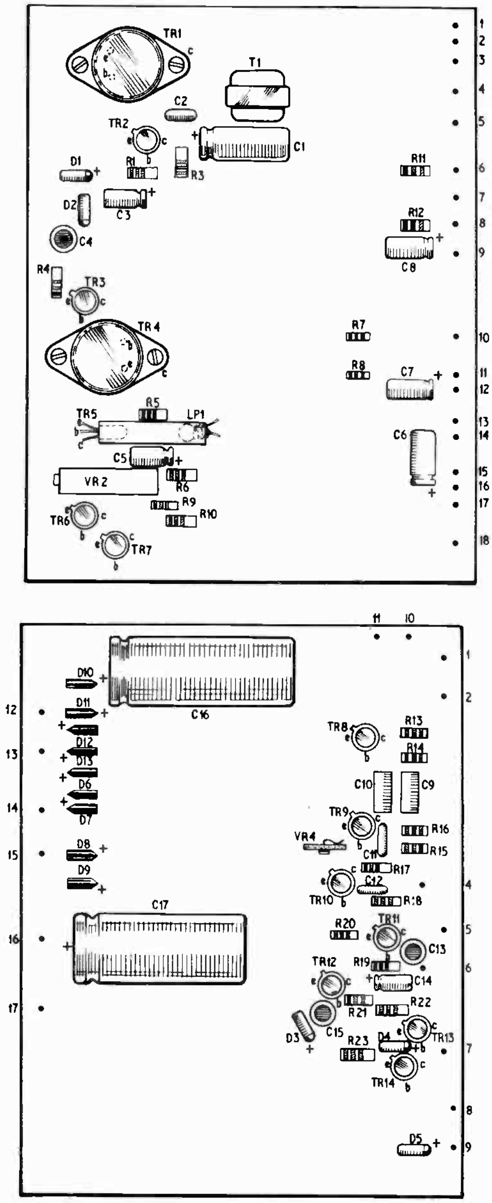
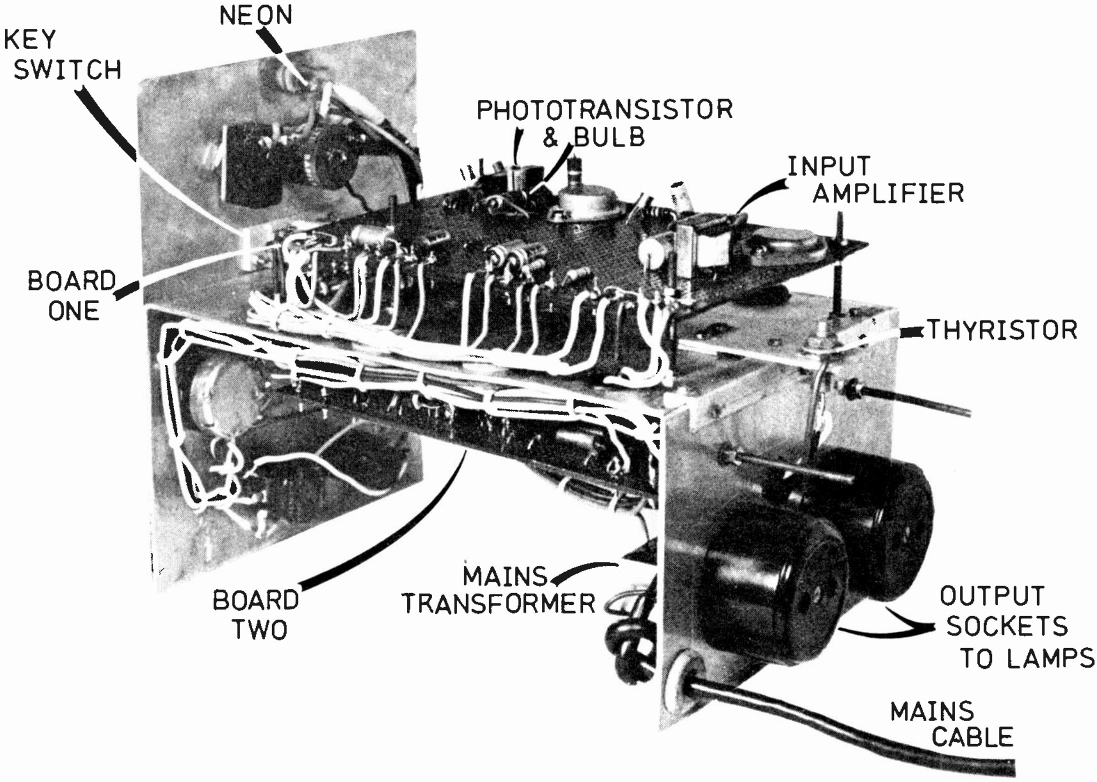


Fig. 5. Suggested positions only of components on two separate boards as on the author's unit

Switch
S1 Keyswitch, P.O. type, three-position locking, 2×4 poles
S2 Single-pole on-off toggle switch

Sockets
JK1 Input jack
SK1 Two pin, 5A socket for lights, or two 2A sockets

Miscellaneous
Case and chassis to choice to suit board assembly
LP2 Lamp assembly, mains neon with 100kΩ ballast resistor (R24)
FS1 Fuse 3A
Mains cable and light fittings to choice



This property of the circuit gives an easy check on the lights and the wiring to them and also on the fuse, for if any of them are defective the neon will remain unlit.

CONSTRUCTION

Mechanical construction, it is felt, is rather at the discretion of the constructor. The author used a spare instrument case as shown in the photographs and the chassis and the front panel were made from sheet aluminium. The case was approximately 7in by 5¾in by 9½in and the unit fitted into it well. The circuitry was built up on two perforated s.r.b.p. matrix boards which were approximately 4½in by 5¾in, but any suitable printed wiring board can be adopted. It is possible to build the circuitry for both board one and board two on one s.r.b.p. or fibreglass board as small as 3½in by 9in using a printed circuit or ready made printed wiring board.

The main concern in the layout and positioning of components is that none of the more sensitive circuits on the boards should be mounted or wired in close proximity to any large signal components or wiring. Care should be taken, for example, when mounting the power transformer and thyristor circuit and wiring them to the rest of the circuit. It is advisable to tie all wires into cable forms and then route these out of the way of the boards.

The function switch specified is a G.P.O. type keyswitch and has 24 contacts, 22 of which are used. Care should be taken with this component because any mistakes made are difficult to rectify because of the close proximity of the contacts.

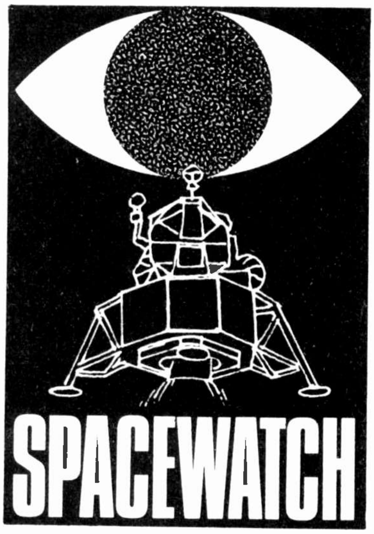
In the author's unit the thyristor was mounted on a piece of glass fibre board. This was then rigidly mounted on the chassis. It should be remembered when siting this component that the anode is at the mains line potential and is therefore somewhat dangerous. Do not allow contact between the thyristor and any other metallic conductor other than the intended connecting wires.

CONCLUSION

Since its completion this unit has worked quite satisfactorily. It was found, however, that one or two minutes are needed after switch on, for the auto speed circuit to settle down. When switched on the idle speed tends to race slightly but this effect disappears after about one minute. This was not found to be too objectionable.

One thing the described design does lack is a large dynamic range. The unit has to be readjusted after a quiet record for use with a loud one. This was not felt to be too objectionable but a compressor or a.v.c. would help to overcome this. ★

This month's cover picture was photographed in the "Bird's Nest" pub in the Kings Road, Chelsea, London.



BY FRANK W. HYDE

FOURTH UK SATELLITE

The fourth U.K. satellite *Ariel 4* weighing 222lbs carried five experiments relating to an integrated experiment. There is on board an experiment contributed from America and was the first to go into orbit aboard a U.K. satellite. The satellite orbit is inclined at 83 degrees at a height of approximately 340 miles.

The main purpose of the mission is the exploration of the Earth's upper ionosphere and the relationship and interaction of this area with charged particles, plasma and electromagnetic waves. There is also equipment for studying the special noise which appears in the radio spectrum in these regions.

The American experiment relates to study of the spectrum of electrons and protons from 5·0eV and 50,000eV. This experiment is under the direction of Prof. L. A. Frank of the University of Iowa.

The other experiments are co-operative between Jodrell Bank under Prof. F. G. Smith and the space research station at Slough under R. Dalziel. These experiments use two 20ft extending aerials whose length can be controlled from Earth. The object is to study radio waves set up by the Cerenkov radiations from particle streams impinging on plasma in the magnetosphere and the ionosphere. These radiations are detected by a swept frequency receiver which operates from 0·75 to 4·0MHz and a receiver with a fixed frequency of 2·0MHz..

The VLF (very low frequency) and ELF (extra low frequency) radiations in the ionosphere caused by the instability of energetic particles, are detected by very sensitive receivers, each covering a very wide band, and fed from an aerial system slung between the satellite paddles which carry the solar power cells. Correlation of the satellite data is between Sheffield University under Prof. T. R. Kaiser with an earth based station and another installation at Halley Bay.

Finally, their is an experiment for the study of electron density and temperature which is vital to an understanding of the structure of the magnetosphere and the electrical conductivity. This is gauged by grids at the end of booms which are fixed to opposing power cell paddles.

Due to mutual interference of experiments, arrangements are available for switching off individual units to remove this hazard.

In addition to the main experiments there is a small package receiver which will count thunderstorms and their distribution.

UHURU SATELLITE

The Uhuru satellite is providing a great deal of important data. This is particularly the case with the X-ray experiments. There is an extended region of such activity in the Coma cluster of galaxies. It contains some 800 galaxies, with a powerful radio source over a wide area and central X-ray source.

There is a weak magnetic field extending through the cluster with a strength of about 100 nanogauss. The high energy electrons that traverse the field generate electromagnetic waves in the radio range. At the same time collisions between photon and electrons give rise to X-rays.

To the question: How did this weak magnetic field appear, the researchers who have measured it, G. Perola and M. Reinhardt, suggest that it may be a relic of the primeval field that once filled the Universe. A requirement of such a suggestion is that a hot gas permeates the cluster and holds these field lines. Cosmopologists have always required a certain minimum amount of matter to hold a field and in this case the amount stated is enough to satisfy them.

There is, however, an alternative possibility. If very old radio sources have decayed and left a skeleton field, an appreciable amount of gas will be needed to support it. There are other clusters, Hercules and Proteus for example, which possess X-ray and radio sources and, if it is a fact that clusters all have this type of field, its origin is of the utmost importance to cosmologists.

THE VELA PULSAR

For some time the X-ray counterpart of the Vela pulsar has been sought by theoretical astronomers. They have made a number of abortive attempts to detect X-rays and astronomers will be relieved that this pulsar does, as it should with the short period of 89 milliseconds, emit X-rays. There are some puzzling difficulties still and it may be that there are more than one family of pulsars.

JUPITER HAS DEUTERIUM

Infra-red spectrometer measurements have revealed that deuterium in the form of deuterated methane (CH_3D) is present on the planet Jupiter. It is probably the first time that this isotope has been found outside the earth and there is evidence that this spectroscopic line appears in the spectrum of Jupiter as a whole.

The low density of the planet suggests it must consist for the most part of a mixture of hydrogen and methane. What the proportion of the deuterium is to the hydrogen is difficult to determine at this stage.

EARTH RESOURCES SATELLITE

The satellite to be launched to study the earth's resources will add enormously to the survey abilities available to investigators of the environment and ecology. The ability of the return beam vidicon camera and the multispectral scanner owes much to the successful *Nimbus* operations.

Multispectral techniques, with a coverage beyond that of the unaided human eye, can show detail which cannot be achieved in any other way. It is possible to distinguish between fields of oats, sorgham, wheat and maize. It can be shown that diseased crops and healthy crops have a different appearance not easily detectable at close hand.

Using the scanner each type of crop has a different spectral "signature". It will also be possible to chart the movement of fish and monitor pollution worldwide. To list the benefits would occupy a good deal of space if dealt with in detail.

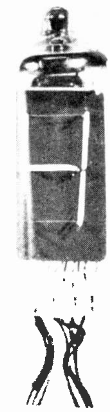
However, the importance of this activity is so great that it is justifiable to recount some specific items. Direct benefits are the detection of forest fires and the advent of locust storms; observations of ice movements, winter and monsoon conditions in India and Japan. The study of the hydrologic cycle in the Santa River basin in Peru, snow surveys in Norway to assess spring flooding; soil erosion in Guatemala.

More than 50 scientists from all over the world will be cooperating in this venture.

The data from this satellite will be freely available to all nations.

ALPHA NUMERIC DISPLAYS Part

By R.W. Coles



Decoding & Driving circuits for filament displays

IN LAST month's article some of the various incandescent filament displays were described. The discrete character and bar matrix type displays require different circuits for decoding the binary coded decimal (B.C.D.) into a form suitable to drive the display devices. This month some of these circuits are discussed, in particular those using the now widely available TTL integrated circuits.

DISCRETE CHARACTER DISPLAYS

The first type of display described in Part 3 last month was the discrete character type, where a separate circuit, i.e. an individual bulb, is used for each character.

A suitable decoding and driving circuit for this type of display is shown in Fig. 4.1. The input to the decoder is in the form of binary coded decimal and in order to drive the display this must be decoded into a one out of ten output.

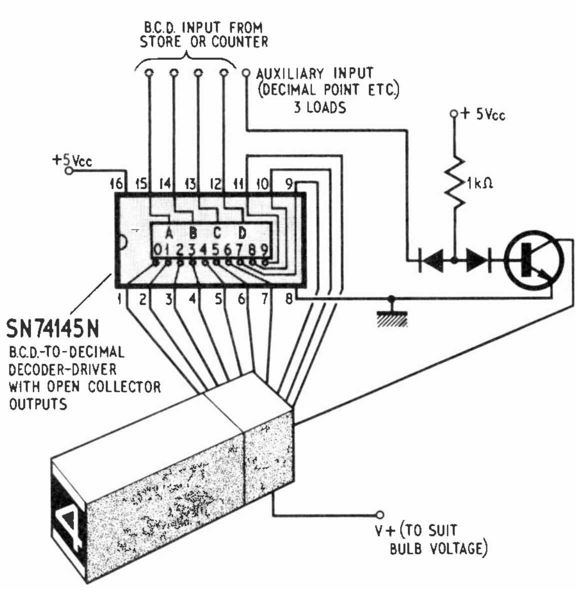


Fig. 4.1. A decoding and driving circuit suitable for use with a discrete character type display

This can be achieved using the SN74145N integrated circuit. This has ten outputs, only one of which will be conducting at a time. Thus only the bulb corresponding to the decimal equivalent of the B.C.D. input will be illuminated.

If the display device has a decimal point then a separate circuit of discrete components will be necessary. Any transistor which will withstand the current and voltage rating of the lamp is suitable.

DECODING/DRIVING CIRCUITS FOR MATRIX DISPLAYS

There is one fundamental difference between matrix and discrete character displays: the former requires a switching system which encodes the basic number or letter information into a series of on/off responses for each part of the matrix, whereas the latter uses the number or letter information directly to energise the correct character.

If the original information is in some other coded form (specifically Binary Coded Decimal, B.C.D.) then this information must first be decoded to decimal before being re-encoded in the form to drive the matrix. Only the decoder is required for the discrete type.

This decoding/encoding makes the logic of a seven segment "decoder/driver" i.c. quite complex, as can be seen from the gate diagram of the SN7447 device, which is part of the TTL Medium Scale Integration (M.S.I.) family, and which is shown in Fig. 4.2.

This complexity need be of no concern however, since the widespread use of seven segment indicators has brought the price of the 7447 down to a very low value in recent months, making it very competitive on a "decoder plus indicator" cost comparison with cold cathode tubes.

THE SN7447 INTEGRATED CIRCUIT

This decoder is typical of a variety of types available, and is suitable for directly driving the "Atron" and similar indicators, its ouputs sinking 20mA at up to 15 volts (the 7446 is selected for use up to 30 volts).

The inputs to this decoder must be in B.C.D. form, and thus only the numerals 0 to 9 are catered for; the "invalid" binary codes of 10 to 14 do produce a display, but it is meaningless. In addition to the four

B.C.D. inputs and the seven segment drive outputs, a number of other useful facilities have been provided.

The "lamp test" input can be grounded through a gate or switch to force all the segments to "on", thus showing up any open circuit filaments, a handy, and simply arranged facility.

The other input and output are the "Ripple Blanking Input" (R.B.I.) and the "Ripple Blanking Output, or Blanking Input" (R.B.O.). These two lines are used to achieve the leading or trailing edge ripple suppression of insignificant zeros in multi-digit displays, giving a much easier to read number.

In addition the R.B.O. can be used as an input to blank the display, a feature which is often employed to vary the brightness by switching the indicator on and off at high speed, the mark-space ratio of this on/off waveform altering the effective intensity.

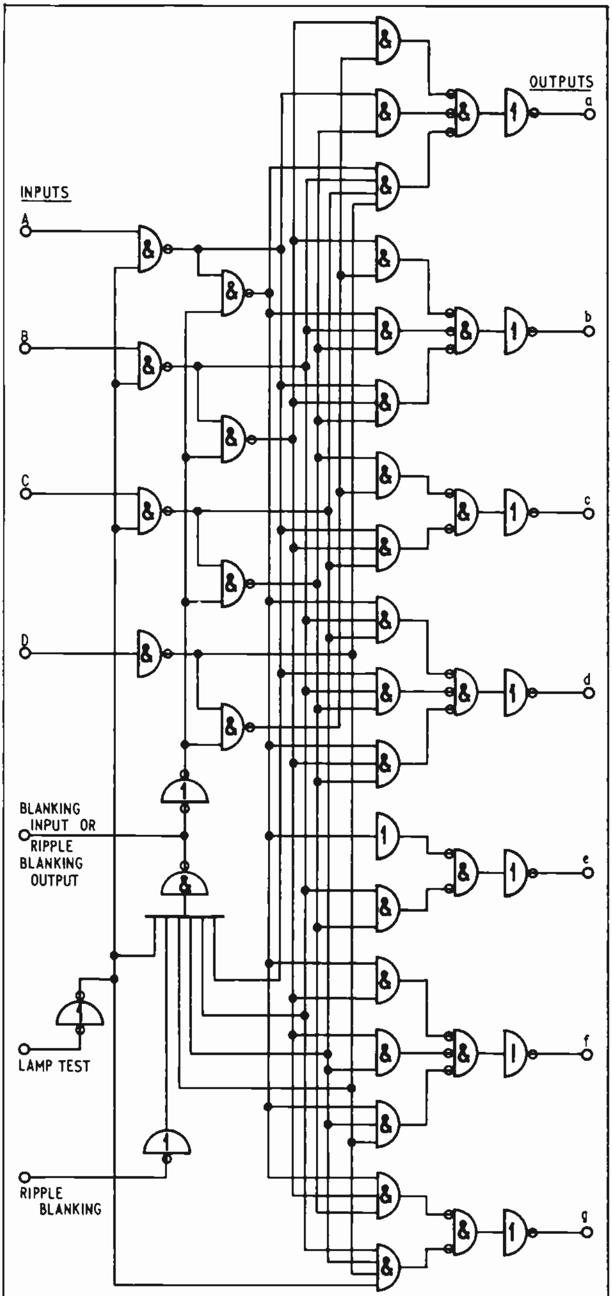


Fig. 4.2. The internal logic of the SN7447 integrated circuit. The SN7446 has the same internal logic but the output drivers can handle higher voltage

ZERO SUPPRESSION

Ripple blanking itself was introduced when dealing with the 74141 decoder/Nixie tube combination in Part 2, and it is a neat little trick to prevent the display of meaningless zeros in long numbers, e.g. a six digit display system with a central decimal point would display 2·8 like this without ripple blanking:

002·800

but with ripple blanking the display would appear like this:

2·8

an obvious improvement!

The 74141 system required some quite complex gating external to the decoder to achieve ripple blanking, but with the 7447 seven segment decoder this gating is inside the device, only wire being required to make it work in a large display.

Just how easily a sophisticated six digit display can be made is demonstrated in Fig. 4.3. Here six Atrons are driven by six 7447s, and the display incorporates lamp-test, intensity control, and leading and trailing edge ripple blanking. Only one 5V supply is required, and the whole thing can be made very small, an excellent choice for a counter or voltmeter.

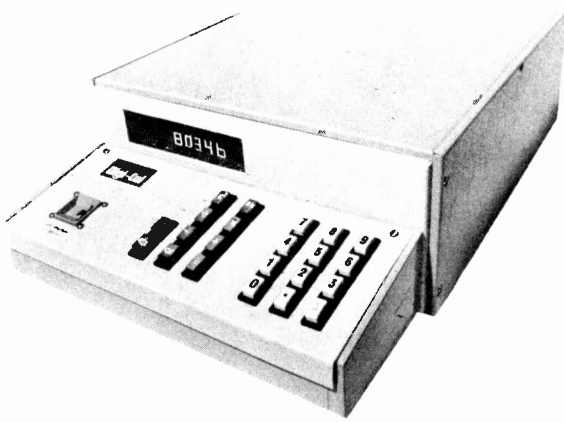
The ripple blanking is not connected for the two digits on either side of the decimal point; this improves readability and ensures that all numbers are displayed as we would write them, e.g. 0·005 will be displayed as:

0·005

rather than as:

·005

as it would be with all decades connected for blanking.



Eight seven-segment filament indicators are used in the P.E. Digital electronic calculator to be seen next month

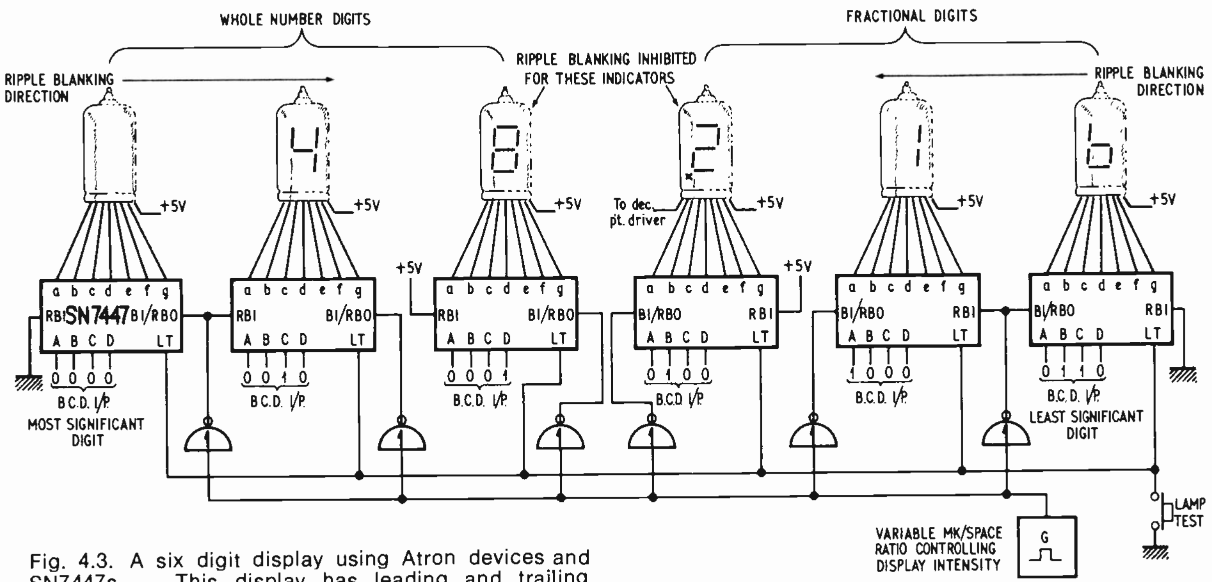


Fig. 4.3. A six digit display using Atron devices and SN7447s. This display has leading and trailing edge zero suppression and a facility for brightness control. The inverters must be open collector (SN7405) type

The intensity control scheme uses an open collector inverter package (SN7405) as the driver to each decoder. This is necessary (rather than a common wire to all decoders) because the R.B.O. is "wired-OR" connected with the intensity modulation. "Wired-OR" logic was described in *Making the Most of Logic IC's*, but those who have not come across this article, just remember that an open collector buffer is necessary to use this facility.

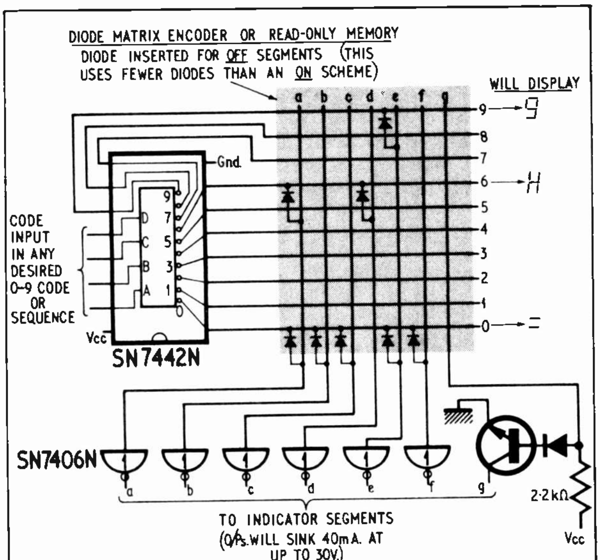


Fig. 4.4. A custom programmable seven segment decoder/driver. By suitably placed diodes, the seven segment display can be made to give characters not normally available from i.c. decoder/drivers

OTHER DECODERS

When discussing formats in Part 1 it was stated that a variety of letters and symbols, as well as the numerals, could be displayed on the seven segment design, but the 7447 does not help at all, being intended only to give 0 to 9, so what can be done to include these other character options? The answer is a "do-it-yourself" custom decoder, which is not as complicated as may be expected, and gives a high degree of flexibility.

A scheme to achieve this is shown in Fig. 4.4, where two i.c.s and a number of diodes are arranged in the form of a "Read Only Memory" (R.O.M.) which is programmed by the constructor to give any desired character out for any particular input, simply by wiring in diodes.

The R.O.M. is really a decoder/encoder combination, but it is easier to visualise when described as a R.O.M.

In this circuit a 7442 is used to generate the ten separate outputs for any of the possible B.C.D. inputs, and the particular output which is "addressed" by the input code then "reads" the particular set of diodes to produce the required on/off output arrangement. This is inverted and buffered by a hex power-driver i.c. (with one extra transistor to make the number up to the required seven) which drives the indicator directly.

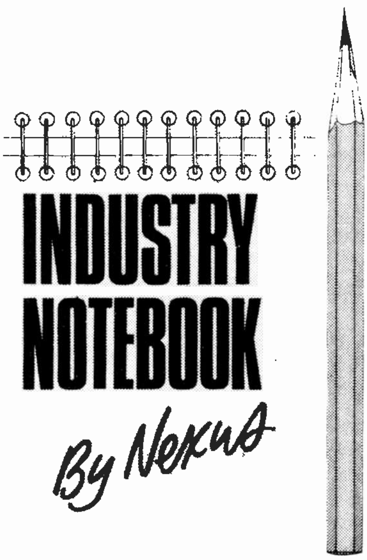
Only three examples of possible coding are shown, diodes being inserted in the matrix wherever an "off" segment is required. If a 74154 (four to 16 line) decoder is used instead of the 7442, then the complete number set can be programmed along with up to six letters or symbols, handy for those special applications encountered occasionally.

Next month: Light Emitting Diode (L.E.D.) Displays

OUTLOOK FAIR

The first of the great trade barometers, the annual Paris Electronic Components Exhibition, while not exactly forecasting sunshine ahead was nonetheless far less gloomy than last year's event. The tone was set by the French themselves who reported a fortnight before the opening that the professional equipment sector of the French industry showed a 25 per cent growth in 1971 and an order book indicating that exports would be up by no less than 50 per cent.

Prior to the show I had been to Toulouse to visit the Motorola semiconductor plant and my personal impression was that the worst was over and while nobody was foolish enough to start counting their chickens there was a feeling of renewed buoyancy.



The impression was reinforced when I arrived at the Porte de Versailles exhibition centre in Paris where 1,000 exhibitors from 25 countries had set up shop. At the turn of the year it was feared that only a handful of British companies would be exhibiting following last year's depressing show. In the event the turnout was creditable, a number of companies having come in at the last moment.

Factors influencing the latecomers included Britain's imminent entry to the Common Market, hopes (which were later justified) of a businessman's Budget in March, and the realisation that there was a perceptible but quite genuine upturn of trade in the UK and therefore they could afford, perhaps, to appear in Paris after all.

Any exhibitor will tell you that the Paris Salon is about the costliest exercise in the year's publicity and promotional budget—even with the financial support of the Department of Trade and Industry. But many companies still say, whatever the expense, that Paris is a "must". Plessey, in fact, used Paris as the key show of the year and balanced the books by ignoring the IEA at Olympia. I am told, however, that Plessey will be back at Olympia for the 1973 London Components show.

British instrument manufacturers made a brave show either on their own stands or those of their agents. New instruments using LED's for readout were shown by Marconi Instruments and Solartron. New counters were shown by Advance Electronics, and SE Laboratories exhibited a 150MHz counter-timer with eight-decade readout. Other British companies in the instrument field were G. and E. Bradley (low cost counters), Farnell Instruments (RF signal generators), and Wayne Kerr (automatic test equipment).

Although Paris attracted about 100 fewer exhibitors this year it remains a brilliant, if tiring, exhibition. Now, having counted the cost, the salesmen are sweating it out hoping that the optimism engendered by a brisk enquiry rate will be justified in terms of orders.

YOU KNOW IT MAKES SENSE

I have long held the view that the advance of technology during the past decade has outpaced applications. That before a new development had been fully exploited there was always something to take its place and that development engineers almost automatically specified the newer—and generally more expensive as well as less proven—device to its predecessor.

In Britain we discovered the virtue of using the devil-you-know some little while back, a good example being the electronics in the Nimrod maritime reconnaissance aircraft which, while recognised as being among the most (if not the most) advanced in the world from the operational viewpoint, was put together largely from off-the-shelf equipment. Clever systems engineering gave us a quick and cost-effective solution to anti-submarine warfare. Even the Nimrod airframe is a modified Comet.

Now, I note that our cousins in the U.S. are feeling the financial pinch and following our lead. New contracts are specifying that current state-of-the-art components will be used as far as possible rather than exotic third or fourth generation devices still on the drawing board. This, of course, is a sad letdown for the back-room boys who have made a rich living out of inventing better and better devices which not only cost a lot more but don't always live up to expectations.

So worried are the Americans about escalating R and D costs in the defence field that an even worse fate is in store and one that would have been unthinkable in the U.S. five years ago. It is actually suggested that Uncle Sam should purchase ready-made defence systems from Europe. In fact the proposal is more than a suggestion and the British Rapier surface-to-air missile system is just one of the items now being evaluated and, one hopes, that is high on the U.S. Department of Defence shopping list.

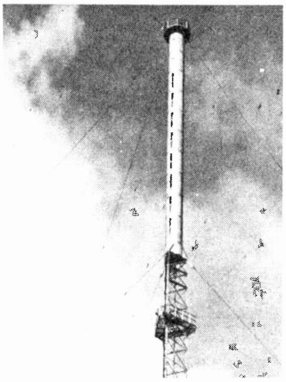
This raises new hopes for the future of the British Clansman military communication system for which Racal Electronics recently announced the first production orders worth £11 million, divided £6 million for the British Army and £5 million for the Iranian Army. When I asked Racal Chairman and Managing Director, Ernie Harrison, if he thought there was much chance of it being specified for the U.S. Army he was not too optimistic. Nonetheless, Clansman is a production reality and is recognised as the best in the world after many years of development, while the Americans are only now putting out tenders for a Clansman-like equipment.

The Americans are clearly coming round to the idea that there is no profit in re-inventing the wheel or, for that matter, Clansman. They should think again before spending millions on duplication of other people's efforts.

HUMBLE PIE

Those who thought GEC were out of the semiconductor business for good, following last year's losses in the low-cost volume market and the subsequent closing of the Witham and Glenrothes plants, may yet have to eat humble pie. The custom-built business, based at Wembley, is gearing up towards a throughput of 2 million devices a year and products will include bipolars, MOS and thick-film hybrids. Full use will be made of the expertise of the famous Hirst Research Centre plus computer-aided design (CAD) and advanced production processes including ion implantation.

Technical Director and General Manager of GEC Semiconductors, Clive Foxell, has a closely-knit team, a fully integrated facility with everything he needs on hand, some captive clients within the giant GEC organisation as well as plenty outside and, above all, freedom from the commercial pressures and atrocious price structure of the TTL rat race. We wish him well.



Stereo Reception

By M. G. Foster, C.Eng., M.I.E.E.

THE FIRST BBC experimental stereophonic transmissions were broadcast from the Old Vic, in London, in 1926 using two medium-wave transmitters. In those days the medium wave band was not so congested, the power of transmitters was less and radio reception was possible using comparatively simple equipment.

By the late 1930s the position had radically altered and consideration was being given to ways of providing interference-free domestic radio services. In the event, however, it was not until after the war that any real progress became possible.

MEDIUM WAVE LIMITATIONS

By this time the number of medium wave channels available to the BBC had become insufficient, and their quality inadequate, for the satisfactory national distribution of three programmes.

Fading, increasing interference from powerful foreign stations and the necessity for synchronized working were severely limiting the range of existing stations, mainly as a consequence of the unsatisfactory working of the Copenhagen Wavelength Plan in Europe.

To overcome these difficulties the BBC put forward a plan to establish a v.h.f. broadcasting service within the band allocated for sound broadcasting in the European Region. The BBC plan was subjected to a long series of practical tests both as regards its feasibility and in respect of the system of modulation to be used.

As nothing in this world is perfect it was only to be expected that snags existed, and among these the most noticeable from the listener's viewpoint were likely to be receiver hiss and impulsive interference such as that produced by motor car ignition systems.

ADVANTAGES OF F.M.

One result of the tests was that frequency modulation was adopted for the v.h.f. service because its use resulted in a considerable reduction in both these forms of noise and interference. It was also decided to use horizontal polarization throughout.

Propagation conditions in the v.h.f. band differ considerably from those in the medium and low frequency bands. Signal strength decreases rapidly with distance from the transmitter and terrain contours exert a greater influence on signals between transmitter and receiver; hills cast partial "shadows", similar to optical shadows.

Fading may occur at times owing to changes in weather conditions, reflections from aircraft, and similar causes depending on the distance from the transmitter.

It is not possible to give as precise an estimate of the service area of a v.h.f. station as it is for one operating on medium waves. Listeners living in particularly unfavourable positions within a nominally "first class" service area may obtain only second class results, whereas those in geographically favourable locations outside such an area may still get a first class service.

Two other matters which could cause deterioration in reception are interference from stations operating on the same frequency, and interference from those on closely adjacent frequencies.

The first can be reduced to negligible proportions by carefully siting transmitters using the same frequencies so as to provide the greatest possible geographical separation between them. The second can be mitigated by similar action but is also to some extent dependent on receiver design.

F.M. RECEIVERS

Two essential requirements for a good v.h.f. f.m. broadcast receiver are (a) that it should be provided with a limiter able to operate efficiently at the minimum field strength for which the receiver is designed, and (b) that oscillator drift should be reduced to reasonable limits. This latter point is inherent in the design of any v.h.f. receiver, but, with modern circuitry and sometimes the application of automatic frequency control it can be achieved without undue difficulty.

The first requirement is of the greatest importance because, unless the limiter does become fully operative the principal advantage of f.m., that of noise suppression, is partially or wholly lost.

EXPERIMENTAL STEREO BROADCASTS

The v.h.f. broadcasts by the BBC passed out of the experimental stage and became a service, from the Wrotham station in Kent, in 1955. Within a year or two, however, stereophony was reaching, and interesting, a much wider audience through the medium of stereo recordings and reproducing equipment and a demand for stereophonic radio programmes began to assert itself.

A series of experimental transmissions using the pilot tone system was inaugurated by the BBC from Wrotham in 1962. These continued at intervals until, on 30 July 1966, the then Postmaster General authorised the BBC to introduce a limited stereo service using this system, which had been agreed as the stereo broadcasting system for the U.S.A. and certain other European countries.

This system permits the stereo signal to be broadcast on a single v.h.f. channel without any significant increase in bandwidth and provides a satisfactory mono signal for listeners using existing v.h.f. receivers. It also offers a stereo service comparable with if not better than that obtainable from good stereo gramophone records.

ENCODING OF STEREO SIGNALS

Fig. 1 shows diagrammatically the distribution of the signals in the transmitted spectrum, including the 19kHz pilot tone.

The left plus right (L + R) section provides for mono reception by any f.m. receiver and, suitably combined with the left minus right (L − R) sidebands and the pilot tone in a multiplex decoder, the three signals provide a stereo output.

To achieve this modulation the left and right signals from the microphones—or the appropriate outputs from a stereo microphone—are connected to a matrixing network from which two new outputs, the L + R and the L − R, are derived. The whole chain is shown in diagrammatic form in Fig. 2. The L + R is the equivalent of the mono signal but, as only a single transmitter is to be used, the L − R signal has also to be conveyed without its causing any interference to the reception of the mono signal.

The L + R signal normally has a frequency range of about 30Hz to 15kHz and, although the audio frequency spectrum may be considered to extend outside this range, receiver design precludes the reproduction of other frequencies. The L + R signal is therefore used to modulate the transmitter in a conventional manner.

To handle the remaining information which must be sent simultaneously, a very stable 19kHz oscillator is used to generate the pilot tone which is used as additional modulation for the transmitter for ultimate recovery and processing in the receiver.

A second output from the oscillator is frequency-doubled to produce a 38kHz r.f. carrier. This, together with the L − R signal, is fed to a suppressed-carrier modulator in which sidebands are generated whilst the actual carrier is suppressed. The two sidebands obtained by this method provide the third source of modulation for the transmitter.

THE STEREO RECEIVER

At the receiver these well spaced signals will permit a mono set to reproduce only the L + R, or audio signal, shown on the left in Fig. 1, thus providing the mono programme. In a stereo receiver, however, one of two alternative types of decoder is present.

In the sum and difference type, shown in the diagram Fig. 3, the received f.m. signal is fed to three filters. The first, being tuned to pass only audio frequencies, rejects all but the L + R signal. The second accepts only frequencies above 23kHz and thus rejects the L + R signal and the 19kHz pilot tone, but passes the L − R sidebands.

The final filter, being sharply tuned to 19kHz, rejects all but the pilot tone. The pilot tone is passed through a frequency doubler whose output is fed, together with the L − R sideband signals into a demodulator at the output of which the L − R signal is recovered.

The L − R and L + R signals then pass into a matrix network from which the original L and R signals are reproduced. This decoding system is, in essence, a reversal of the transmitting arrangements but it suffers from the disadvantage that each of the filters delays the signal by a different amount thus necessitating the inclusion of phase-correcting networks to re-establish the correct phase relationship between them prior to reproduction. This entails added complication and cost.

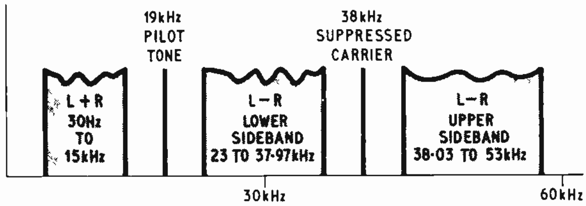


Fig. 1. Diagram showing the various components of the modulation of an f.m. stereo transmission. The signal bands are spaced for clarity; their positions on the frequency scale are only approximate

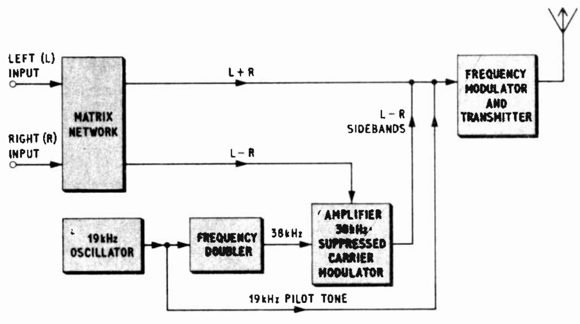


Fig. 2. Block diagram showing the method of modulating an f.m. transmitter with a multiplex stereo signal

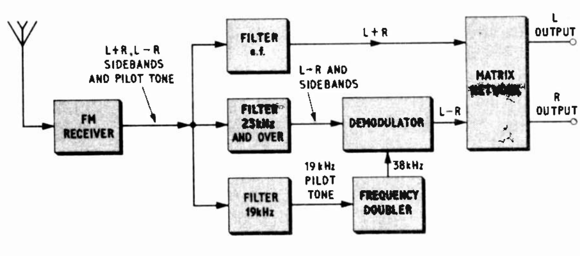


Fig. 3. Block diagram of a sum and difference type stereo decoder

SWITCHING DECODER

The second type of decoder, the switching decoder, was developed to overcome the disadvantage inherent in the sum and difference type. It is shown in schematic form in Fig. 4.

The 19kHz pilot tone is again extracted using a suitable filter and is frequency doubled as before to produce the 38kHz sub-carrier. This is fed to two demodulator units in which it is used as a switching signal to direct the entire output alternately to the left- or right-hand channel.

The v.h.f. transmissions certainly provide the best quality reception of sound radio available in the U.K. Interference from foreign stations is virtually eliminated and the f.m. system provides a much wider frequency range than is possible on the a.m. services on medium wave. Radio 3 also offers the stereo service over a wide area of the country as shown in Fig. 5.

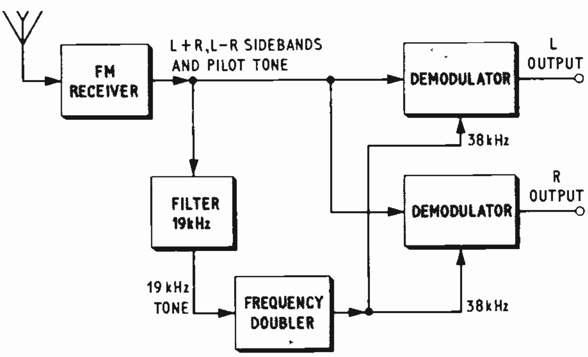


Fig. 4. Block diagram of a switching type stereo decoder

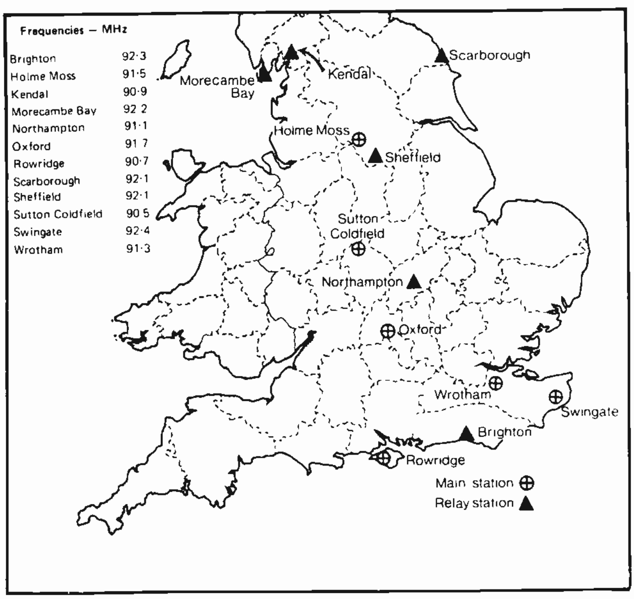


Fig. 5. The present area served by Radio 3 stereophonic transmissions. Good stereo reception should be obtainable over most of the area indicated by the unshaded part of the map, but the receiving aerial requirements are far more critical than those for monophonic reception

V.H.F. AERIALS

If, however, full advantage is to be taken of the improved reception which the service offers it is essential that a suitable aerial be used.

V.h.f. aerials are directional and thus the signal strength received depends upon the position of the aerial in relation to the direction of the transmitter. Freedom from interference and noise in a v.h.f. receiver depends partly on the strength of signal delivered to the receiver which, in turn, is dependent on the aerial.

The better the aerial the better the reception and the greater the freedom from noise.

This is particularly important when stereo programmes are being broadcast, as the slight reduction in the mono service area due to the fact that a small proportion—9 per cent to be exact—of the permissible deviation available for the f.m. transmitter is used to carry the 19kHz pilot tone; also some of the programme is carried in the supersonic part of the spectrum around 38kHz.

The only effect this is likely to have on a mono receiver is to make it slightly more susceptible to background noise, particularly motor car ignition noise if the receiver is located near a busy road. Tests have shown, however, that in nearly every case where such degradation was perceptible, it could be cured by the use of a more efficient aerial.

STEREO SIGNAL TO NOISE RATIO

A situation similar to that described above also exists when a stereo receiver is used, but there is an additional, inherent, reason for some worsening of the signal to noise ratio. The mono receiver is concerned purely with noise occurring within the frequency range 30Hz to 15kHz, whereas the stereo receiver must receive frequencies up to 53kHz, and thus any additional noise in this part of the spectrum, together with any intermodulation products falling within the audible range, will cause some degradation of the reproduced sound.

Some amelioration of these undesirable features can be achieved by suitable decoder design but, once again, practical experience has shown that very considerable improvement in the stereo reception at a given location is almost always possible by using a more efficient aerial to provide a higher input to the receiver.

From the foregoing it will be seen that, given a satisfactory receiver and a reasonable signal strength probably the most important single factor affecting v.h.f. reception in either mono or stereo is the use of a really efficient aerial to deliver the signal to the set. So important does the BBC consider the question of aerials that it has produced a leaflet entitled V.H.F. Receiving Aerials which can be obtained on request.

ADJACENT CHANNEL INTERFERENCE

In certain areas there is also the question of adjacent channel interference to be considered when receiving a stereo broadcast. Such interference can be caused by stations separated in some cases by only 200kHz. Under these circumstances the fifth harmonic of the 38kHz sub-carrier—190kHz—produces a difference frequency of 10kHz which is carrying both amplitude and frequency modulation.

This in turn gives rise to whistles or warbles, often referred to as "birdies". The insertion of a low pass filter between the discriminator and decoder to remove the 190kHz component prevents this undesirable effect. The filter should be designed to pass only those frequencies below about 70kHz.

23KHZ PILOT TONE

On page 311 of the April 1972 issue it is stated that the BBC "have the unfortunate habit of putting a 23kHz pilot tone on top of mono programmes" and it may be of some interest to outline the reason for this tone.

Continuity monitoring of frequency-modulated transmissions over radio paths is the purpose of this low-level pilot tone. Originally the frequency used was 20kHz but, with the introduction of the stereo service, it was changed to 23kHz to prevent any mis-switching of stereo receivers.

The tone is injected into the audio system at a transmitting station at a level of −30 dB with reference to zero level and produces approximately 4·5kHZ deviation at the transmitter output.

At the receiving station it is detected by a receiver, filtered out and used to start up or close down transmitters, or to change from one programme source to another.

If the tone is to be used on the next radio path it is removed from the programme by a low-pass filter and tone from a local oscillator substituted prior to re-transmission. Some systems rely on detecting the main station carrier to start or close down relay transmitters. These, however, suffer from the disadvantage that it is possible for noise to produce sufficient output from the receiver after the main station has shut down for the relay to remain switched on.

LISTENING TO STEREO

For best stereophonic listening the two loudspeakers should ideally be spaced 6 to 12 feet apart and the listener should sit at a point which is equidistant from them and preferably not closer to them than their distance apart.

The programme announcements will usually be made from a central position and the receiver should be adjusted using the balance control, if fitted, so that the speaker's voice appears to come from a point midway between the loudspeakers.

The acoustics of the listening room will affect the results and different listening and loudspeaker positions should be tried to obtain the best result.

SERVICE AREA

At present the stereophonic transmissions are available to listeners within the service areas of the BBC's v.h.f. transmitting stations at Wrotham, Rowridge, Sutton Coldfield, Holme Moss and Swingate and of the following relay stations: Brighton, Oxford, Northampton, Sheffield, Scarborough, Morecambe Bay and Kendal, and the approximate area of the U.K. in which they can be received is shown in Fig. 5.

Stereophonic programmes are available in these areas on v.h.f. Radio 3 and are marked in *Radio Times* by a special "S" symbol. The emphasis is mainly on music, because this type of programme derives the greatest benefit from stereophonic reproduction.

Equipment is being installed to enable the number of stereophonic programmes in Radio 3 to be increased. The BBC would like to extend stereophony throughout the country and to more than one of the radio services and it is hoped that the necessary finance can soon be found to bring this worthwhile improvement to the listener. In the meantime it is planning to expand its stereo service considerably during the next few years. The extension beyond the present Radio 3 service will take place in three phases.

EXTENSION OF STEREO SERVICE

First the installation of stereo origination facilities for Radio 2 (with Radio 1) and Radio 4. This has called for a major re-equipment programme involving modifications to the continuity suites and central control equipment in London as well as a considerable increase throughout the United Kingdom in the number of tape machines, gramophone desks, studios and outside broadcast units equipped for stereo.

This phase is already in progress, and it is expected that it will be possible to originate a major proportion of stereo programmes on Radio 2 by the end of 1972, and also to make possible the transmission of some stereo programmes on Radio 4. Further increases in stereo capability will continue during the succeeding years.

PULSE CODE MODULATION

The second phase concerns the extension of Radio 2 and Radio 4 stereo to those transmitters already radiating Radio 3 in stereo. For this a new system of super high frequency (s.h.f.) radio links is planned, using pulse code modulation (PCM).

The PCM system to be used on the s.h.f. radio links has been developed by the BBC. It will carry ten audio circuits. Each stereo programme will use two circuits, for the L and R channels, and the stereo coding will be carried out at each main transmitting station.

The PCM system will provide improved quality in respect of both audio bandwidth and signal-to-noise ratio, from which mono as well as stereo listeners will benefit. It thus forms part of the BBC's plan to improve still further the quality of its v.h.f. transmissions throughout the country.

It is expected that the three-network service, which involves the construction of several new radio link sites on the main route, will be available in the London area and the Midlands by the end of 1972 and in the North of England during 1973. Rowridge, serving central southern England, will be included in this phase and a full stereo service from Belmont, serving Lincolnshire, will follow the extension to the North of England.

THIRD PHASE

The third phase of the plan is the extension of the three network stereo service northwards to Central Scotland and westwards to the Bristol Channel area. The Post Office Corporation and the BBC are working towards this phase which it is expected will start in 1974.

ACKNOWLEDGEMENT

The author wishes to thank the Director of Engineering BBC for permission to publish this article. ★

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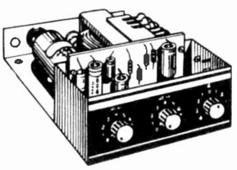

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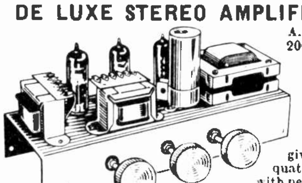

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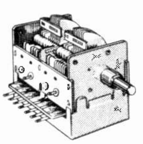

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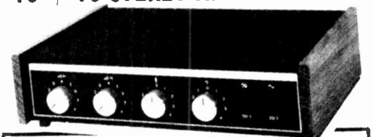

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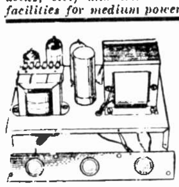

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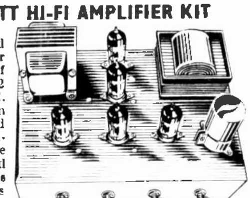

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½	2%	10Ω–1MΩ	E12	3·5p	3p
⅛	10%	1Ω– 3·9Ω	E12	1·0p	0·8p
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AC127	12p	BC147	13p	BZY10	20p	OC81	12p	2N2926R	9p
AC128	12p	BC148	13p	BZY13	20p	OC82	12p	2N2926O	9p
AC131	12p	BC149	13p	OA85	7p	OC82D	12p	2N2926Y	9p
AD140	50p	BC157	14p	OA90	5p	ORP12	50p	2N2926G	10p
AF114	20p	BC158	14p	OA91	5p	1N4001	6p	2N3055	60p
AF115	20p	BC159	14p	OA202	7p	1N4002	10p	2N3702	13p
AF116	20p	BC179	32p	OC26	45p	1N4003	10p	2N3703	11p
AF117	20p	BFY50	22p	OC44	12p	1N4004	10p	2N3707	13p
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160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF **3½p.** 0·15μF **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

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2½ × 5	24p	24p
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3¾ × 5	27p	27p
17 × 2½	75p	57½p
17 × 3¾	100p	78p
17 × 5 (plain)	—	82p
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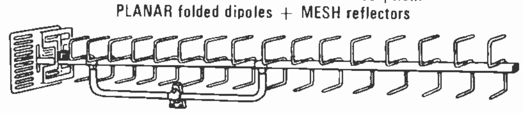

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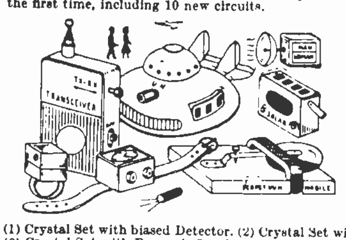

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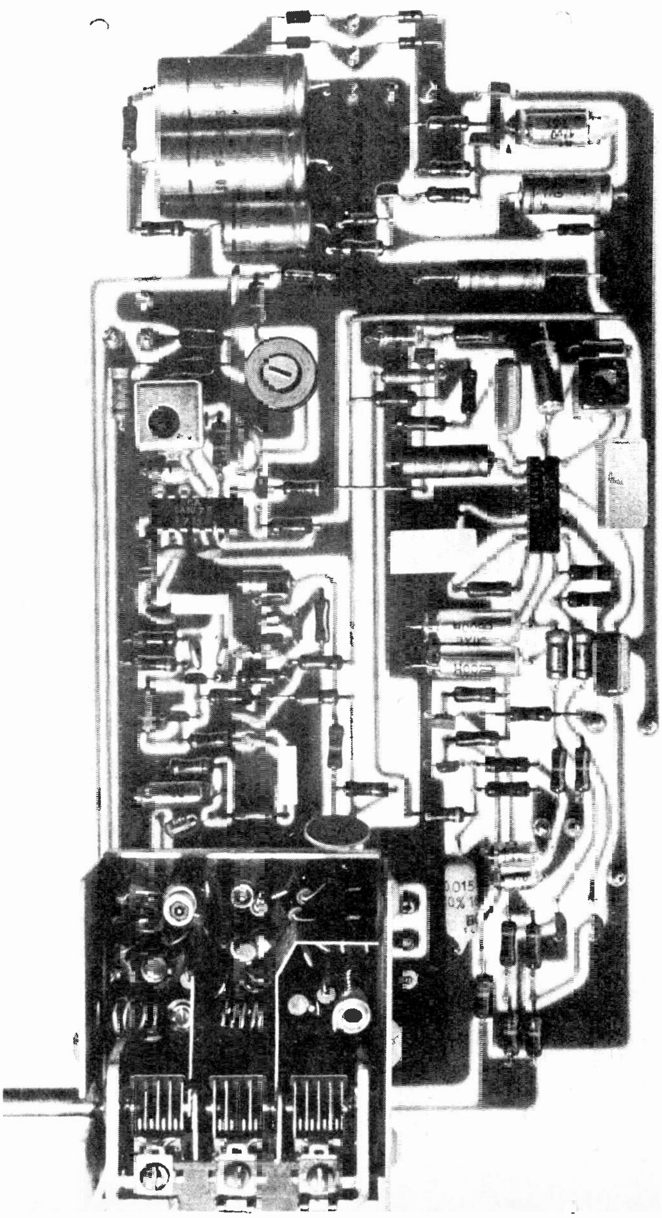
P.E. GEMINI STEREO TUNER

PART THREE

BY D.S.GIBBS & I.M.SHAW



THIS is the final article describing the printed circuit board assembly, cord drive, and setting up procedure.

COILS

Coil L2 is available as a ready made unit, but L1 has to be specially wound by the constructor on a Neosid NS/E3 former. Wind 17 turns of 30 s.w.g. enamelled wire neatly on to this former and solder the ends to the pins shown in Fig. 21. The winding should be secured with a smear of polystyrene model cement or a single layer of coloured adhesive tape, to ensure that the tuning of the coil remains stable.

Now apply a little polystyrene cement to the bottom of the coil former and slip the ferrite sleeve over the coil. Then apply a dab of polystyrene cement to the top of the coil former and push on the polythene clamp ring. Leave for 30 minutes to dry and then screw in the ferrite core until the top of the core just protrudes from the top of the coil former. Finally, carefully solder the 47pF tuning capacitor (C16) in place.

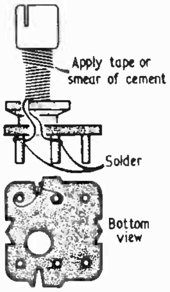
It is very important to handle the ferrite coil former for L1 with great care, as it is very fragile, and any damage could alter the properties of the complete assembly.

PRINTED CIRCUIT BOARD

Most of the components are mounted on a single glass fibre printed circuit board. The conductor pattern of this is shown in Fig. 22 and the component layout in Fig. 23. If you do not purchase a ready drilled p.c.b. you will need a No. 60 drill for component and i.c. leads; a No. 46 drill for the turret tags. Solder the tags to the copper before any of the components are inserted.

The wiring of the board is self-explanatory but the following sequence is preferable, and will minimise the risk of damage to the integrated circuits and the tuner head.

Insert and solder all the resistors except R14, and then all the capacitors. Mount the two coils. The semiconductor devices can now be inserted, but before doing so *make sure that the soldering iron is earthed* and that the circuit board is completely "floating" above earth (for example, placed on an insulated table top).

1


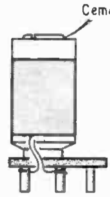
1. Carefully wind on 17 turns of 30 s.w.g. enamelled wire and solder to the pins shown. Secure the winding with a smear of polystyrene cement or a single layer of adhesive tape. Handle the former very carefully or it will break

2. Apply a little polystyrene cement to the bottom of the coil former and slip the ferrite sleeve over the coil

3. Apply a dab of polystyrene cement to the top of the coil former and push on the polythene clamp ring. Leave for 30 minutes to dry

4. Screw in the ferrite core until it just protrudes from the top of the coil former. Use a trimming tool, a screwdriver may break the core. Carefully solder the tuning capacitor in place as shown

5. Insert in the printed circuit board, together with the screening can



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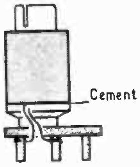
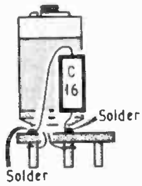




4

Fig. 21. Construction of L1

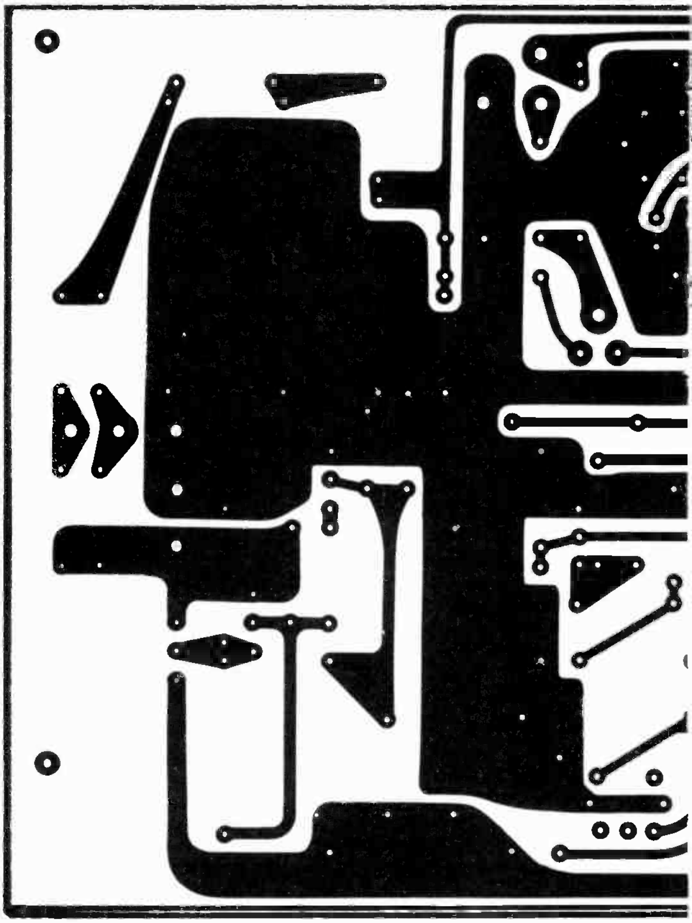


Fig. 22. The printed circuit board, copper side (full size)

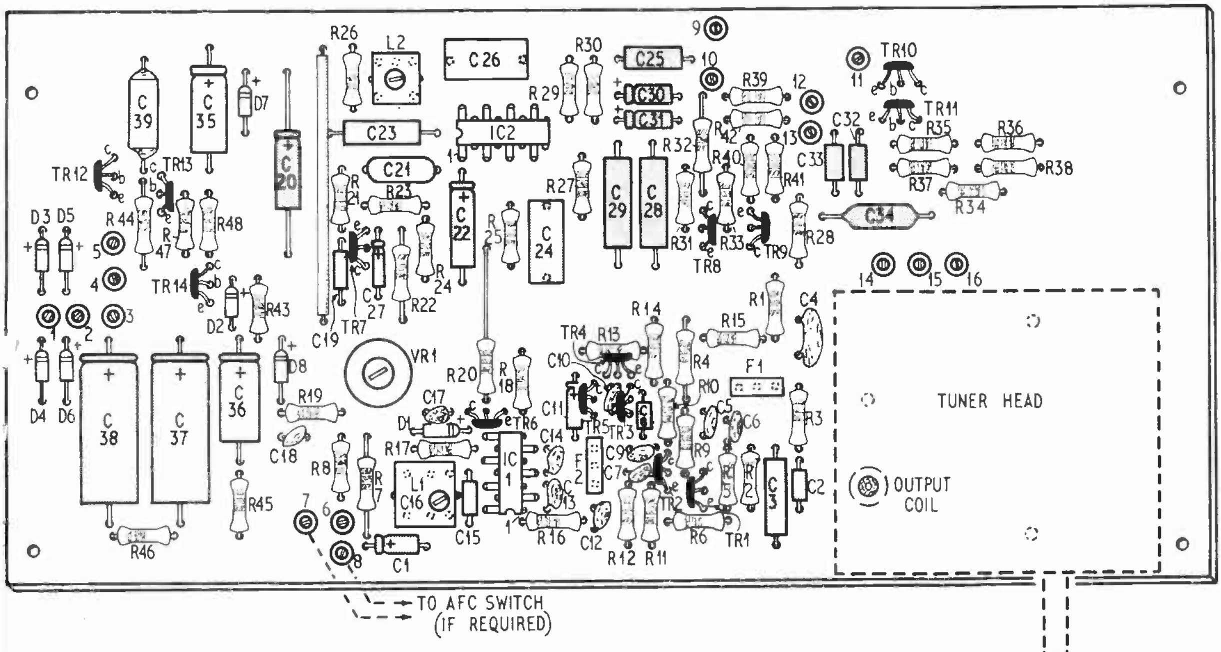
Fig. 23 (top right). The components assembled on the printed circuit board

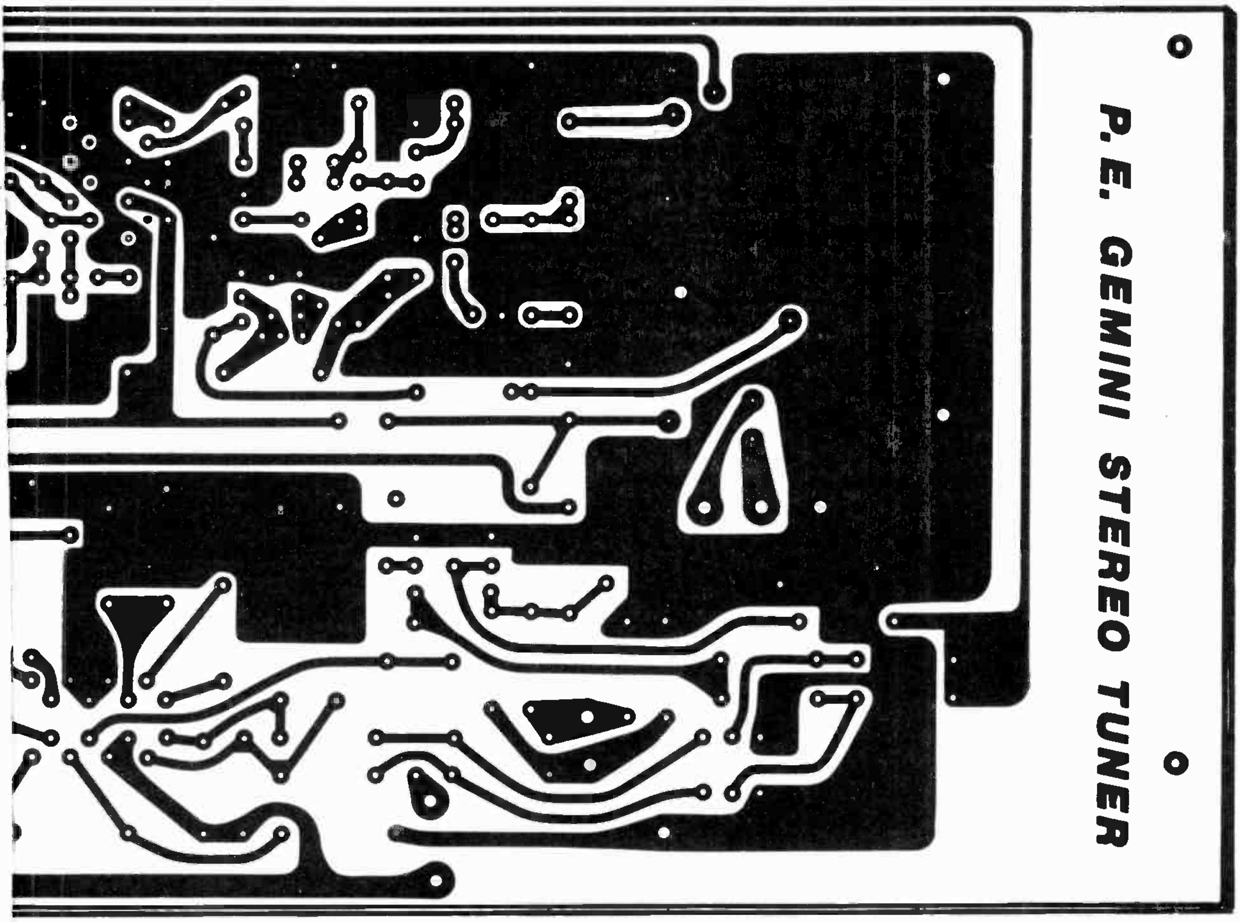
FURTHER NOTES

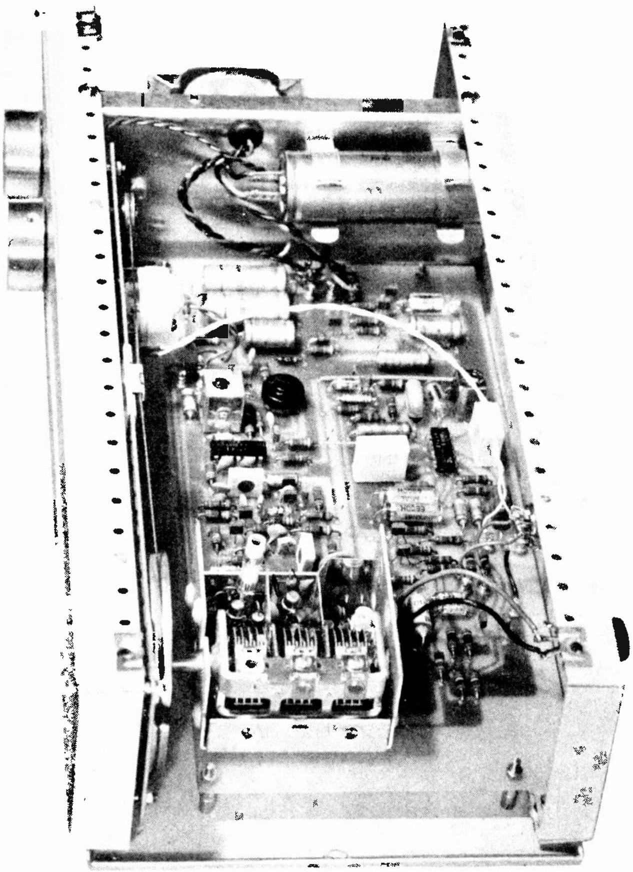
Some readers have informed us that they have had cases of the ZTX550 (TR12) blowing up.

The authors have investigated this and have been unable to duplicate the fault, even when operating the power supply at a considerable overload. As the ZTX550 is worked within its ratings they can only assume that these cases were due to "rogue" devices, but TR12 does run hot and constructors who would like an additional safeguard can fit a heat dissipating clip if they wish. Suitable types are the I.E.R.C. type RUR67B1U or the Redpoint type 92DC.

In Fig. 14, the dimension from the left-hand end of the panel to hole A for the pilot lamp should be $2\frac{7}{8}$in.


TUNER HEAD
OUTPUT COIL
TO AFC SWITCH
(IF REQUIRED)


P.E. GEMINI STEREO TUNER



Semiconductor devices can easily be damaged by high voltage transients from unearthed soldering irons, and a damaged CA3090Q will cost you over three pounds to replace. Heat shunts are not necessary with silicon semiconductors provided the joint is made quickly with a clean hot iron.

An iron of 15 or 25 watts with a small bit (less than ¼in diameter) is preferable, and 22 s.w.g. cored solder should be used. Take great care not to allow solder "bridges" between adjacent tracks on the printed circuit board.

Finally, mount the tuner head and solder the pins that protrude from the underside and pass through holes in the board.

WIRING UP

The mains transformer and C40 are mounted on the small chassis plate shown in Fig. 20 last month. The mains switch is mounted on the front panel and the transient suppressor capacitor C41 should be wired directly on the switch terminals that are connected to the transformer. Sleeve the leads of this capacitor to prevent the possibility of a short circuit to the case. Mount the fuse holder, mains socket, aerial socket, and audio output socket on the back panel.

The printed circuit board is supported on five ½in spacers, and it is advisable to place a thin insulated washer over the top of the centre spacer because of the closeness of one of the copper tracks. In some cases it may be necessary to increase or decrease the height of the p.c.b. slightly to ensure that the tuning drum fits inside the front panel without touching the top or the bottom. The top of the tuning drum should be approximately level with the top of the inner front panel.

There is very little wiring to do; this is shown in Fig. 24. If you are using a 75 ohm aerial the braid of the coax feeder should be connected to tag 16 and the inner to either tag 14 or tag 15 (it doesn't matter which). For a 300 ohm balanced feeder connect to tags 14 and 15; tag 16 is not used. The wiring shown in Fig. 24 is for the usual 75 ohm arrangement.

CORD DRIVE

Make a loop of nylon or similar drive cord approximately 25 inches total length and thread it around the drum, pulleys, and tuning drive as shown in Fig. 16 last month. Wrap two turns around the small drive shaft. It will probably be necessary to experiment with the length of the drive cord to obtain a satisfactory tension. If the cord is too slack remove it and shorten it slightly, or if it is too tight try a slightly longer loop.

Now turn the tuning knob so that the vanes of the tuning capacitor are fully interleaved. Slip the pointer over the front panel, slide it up to the 88MHz mark on the scale, and fasten to the cord. Make sure that the drive works smoothly over the whole length of the scale. If it slips the cord may be too slack, or there may be oil on the drive shaft. If everything is satisfactory the pointer can be secured with a blob of adhesive.

SETTING UP THE R.F. CIRCUITS

Before switching on check the board and the wiring carefully for errors, particularly the power supply. It is a good idea to complete the power supplies and test these before the integrated circuits or the tuner head are wired into circuit. Both power supplies should give between 11·2 and 12·5 volts.

Initially, resistor R14 should be left out or one end disconnected, so that the tuner head and the i.f. amplifier do not operate. Set VR1 to it's mid-position, and if necessary adjust the mechanical zero of the tuning meter. Now switch on and adjust VR1 to bring the tuning meter back to zero. Switch off, disconnect the tuner from the mains, and solder R14 in place.

Temporarily short out the a.f.c. by connecting a link between tags 7 and 8, or if you have fitted an a.f.c. switch put it in the "out" position. Connect the tuner to an audio amplifier and the aerial socket to a suitable dipole aerial. Now switch on and tune the receiver through the f.m. band. It should be possible to find a station, although it will probably be badly distorted at this stage. As you tune through the station the background noise will fall and then will start rising again. Tune for minimum noise (pay no attention to the signal at this point as minimum noise may well coincide with minimum signal), or alternatively try to set the tuning midway between the two points where the noise becomes perceptible, as shown in Fig. 25. Now insert a trimming tool into the core of L1 and adjust it to bring the tuning meter back to zero. The reproduction should now be virtually noiseless and undistorted. Check that the tuning meter swings approximately equal amounts either side of zero as you tune through the station, and if not make a slight

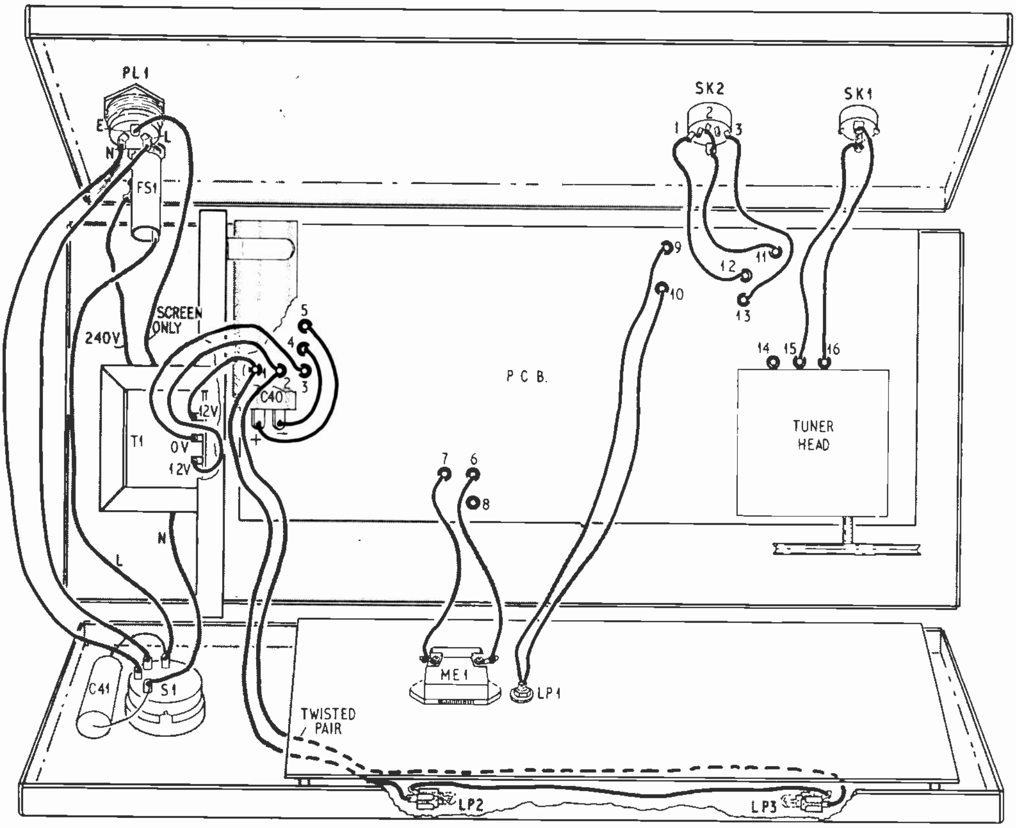
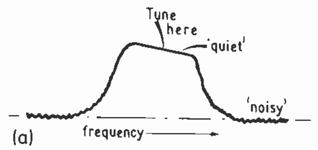
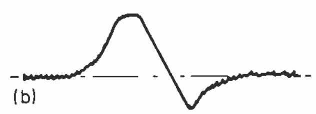


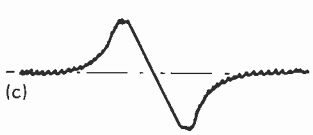
Fig. 24. Connections from the printed circuit board turret tags to components mounted on the case



1. When you first switch on, the response of the discriminator as you tune through a station will probably be like this. Try to tune to the centre of the quiet band. This may well coincide with minimum signal



2. Adjust the core of L1 to bring the tuning meter back to zero. Use a trimming tool, a screwdriver will break the core.
If your tuning was not quite accurate to start with the response may look like this



3. Tune through the station and check that the tuning meter swings approximately equal amounts either side of zero. If not, make a slight readjustment to L1

Fig. 25. Adjustment of L1

readjustment to L1. Finally, adjust the output coil of the tuner head for minimum background noise. This is best done on a stereo transmission. This adjustment is only required to take up the tolerance of the external tuning capacitors (C2 and C3) and it should not be necessary to tune the core more than about one turn either way. Use a hexagonal nylon trimming tool of the correct size as a screwdriver will break the core and may damage the coil as well. **ON NO ACCOUNT MUST ANY OTHER ADJUSTMENTS BE MADE TO THE TUNER HEAD.**

Disconnect from the mains and remove the short on the a.f.c.

ALTERNATIVE METHOD

If you live in a strong signal area and have a test meter of 10,000 ohm/volt or more there is a more simple and accurate method of adjustment as follows:

After adjusting VR1 as described earlier, short out the a.f.c. and solder R14 back in place. Connect an audio amplifier and an aerial. Connect the test meter, on the 10V range, to the collector of TR5 and tune in to a station.

Normally the collector voltage of TR5 will be about 0·2V, but when a strong signal is being received it rises. Adjust the tuning for maximum reading on the voltmeter, and adjust the output coil of the tuner head for maximum. Then, without altering the tuning, adjust the core of L1 to bring the tuning meter back to zero.

BBC STEREO TEST TRANSMISSION

Test No.	Time (approx.)	Left Channel (A)	Right Channel (B)
1	23.42	250Hz at zero level	440Hz at zero level
2	23.44	900Hz at +7dB	900Hz at +7dB antiphase to left channel
3	23.48	900Hz at +7dB	900Hz at +7dB in phase with left channel
4	23.49	900Hz at +7dB	No modulation
5	23.50	No modulation	900Hz at +7dB
6	23.51.20	Tone sequence at —4dB. 60Hz, 900Hz, 5kHz, 10kHz. Repeated	No modulation
7	23.52.20	No modulation	Tone sequence as at 23.51.20
8	23.53.30	No modulation	No modulation
	23.55	Monophonic transmission	

Note: If programme material extends beyond 23.42, test transmission begins two minutes after close. To facilitate channel identification and adjustment of channel crosstalk, 250Hz is transmitted in the left channel only from about four minutes after the end of Radio 3 until 23.55.

Zero reference level corresponds to 40 per cent of maximum modulation applied to either stereo channel before pre-emphasis.

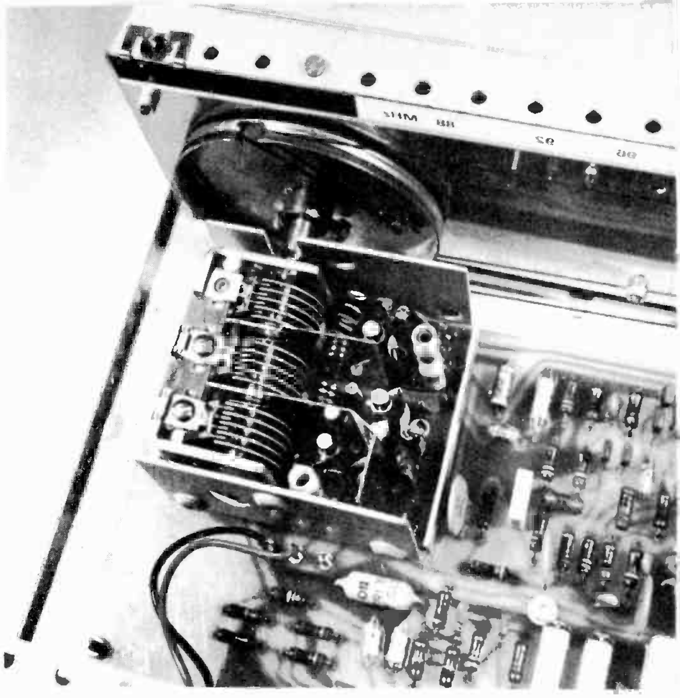
The prime purpose of the above test transmissions is described on the BBC leaflet mentioned in the text of this article.

STEREO DECODER

Screw the core of L2 fully down and tune in to a stereo transmission. The pilot indicator lamp should light; if it does not screw the core of L2 up slightly until the lamp comes on. Make sure that the lamp does not light on a mono programme, due to the stereo decoder locking on to the 23kHz signal which the BBC sometimes transmit.

The exact tuning of L2 is not critical since once the phase lock loop locks, the coil is pulled into tune by the reactance circuit. However, best results can be obtained by adjusting the coil on the test tones which are transmitted by the BBC every Wednesday and Saturday night after 11.30 p.m. Details of these tones are given on information sheet 1605 issued by the BBC Engineering Information Department, Broadcasting House, London W1A 1AA.

The core in L2 should be adjusted to give maximum separation, i.e. minimum signal in the right-hand channel when only the left-hand channel is being transmitted, and vice versa. You might have to make more than one attempt at doing this as no announcements are made between the various test tones transmitted and it is very easy to get lost. This completes the setting up of the tuner.



MONO TUNERS

Constructors who do not require stereo operation can build a mono version of the tuner as follows:

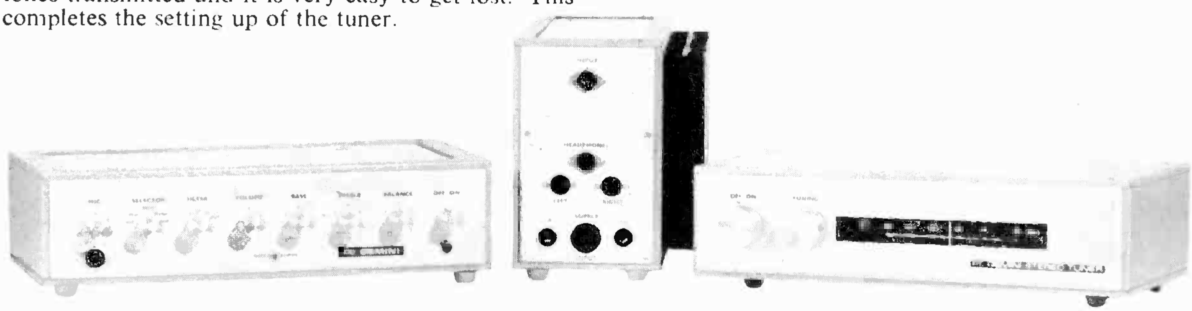
1. Omit all the parts associated with the stereo decoder, including R21 to R42, C21 to C34 and TR7 to TR11. Leave C20 in circuit.
2. Increase C19 to 0·01μF and take the output from point X to the output socket via a capacitor of 0·22μF. The load resistance presented by the amplifier should be 47 kilohms or greater.

AERIAL

In strong signal areas the tuner will probably perform adequately from a short piece of wire connected to the aerial socket, but for best results, particularly from stereo transmissions, a dipole aerial of correct dimensions for the area of reception should be mounted as high up as possible. The signal-to-noise ratio of stereo programmes is always worse than mono programmes because of the increase in bandwidth from 15kHz for mono to 53kHz for stereo. Also there is a slight drop in signal level on stereo. In order to achieve the best possible stereo results, the need for a good aerial system cannot be over-emphasised.

ACKNOWLEDGEMENT

We are grateful to Ferranti Limited for permission to publish this article. ★



The central apparatus room at the Churches Television Centre

The latest Ampex Video Tape Recorder, type AVR-1

Churches TV Centre goes Colour

IN AN AGE when congregations are slowly dwindling away, even the Church has to look to the mass media as a fast and efficient method of spreading the message.

The Churches Television Centre has been established since 1959 and has three main aims: to train people on both sides of the camera; to produce material for religious education; and to carry out research into the problems of communication. The centre is financed by a Trust Fund created by the late Lord Rank.

The Centre has a fully equipped closed circuit studio at Bushey, near Watford, and with its latest planned changeover to colour, at an estimated cost of nearly a quarter of a million pounds, it is expected to become the most up to date closed circuit system in the world.

The new colour equipment includes the advanced Marconi Mark VIII Automatic colour cameras (seen undergoing tests, bottom left). With automatic line-up and colour balance achieved within three minutes of switch on, as compared with the normal half hour, they are claimed to attain new standards in both performance and operational simplicity.

This system together with the latest Ampex Video Tape Recorder (upper left) will enable the Churches TV Centre to produce programmes of a quality suitable for any of the major broadcasting authorities.

Marconi Mark VIII colour cameras under test

A review of the techniques used in some high fidelity audio equipment seen at . . .

By M. A. COLWELL

How valuable are technical specifications to the buyer of hi fi equipment. "Vital!" you might say, and we would be inclined to agree with you. But does this mean that all other considerations go by the board in the potential buyers' assessment.

If one stops to think about this, one will then realise that perhaps these other considerations (for example, aesthetic appearance, personal auditory opinion, suitability for the intended auditorium) have a very important place in equipment choice.

Listening to recorded music over a period of time often spurs the listener to make auditory comparisons due, no less, to a wide variety of recording qualities. Is there something wrong with the recording, or is it the equipment? Such a perplexing problem is very real to the chap who has, by this time, joined the bands of hyper-sensitive critics looking for ways to cure that undesirable feature of his musical pleasures.

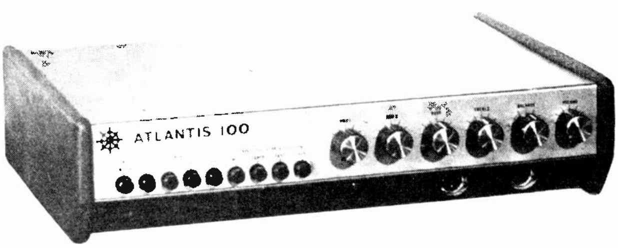
TRIP TO SONEX

Picture this chap for a moment embarking on his first trip to Sonex (such as held recently at the Skyway Hotel, London Airport); rows of small rooms, on four floors—most of which are emitting recorded sound in two or perhaps four channel stereo. Where does our perplexed friend start—with a catalogue? 'Fraid not! This is one exhibition that does not seem to believe in such necessities.

We could not even find the programme of seminar titles and times, until someone in the Press office made enquiries for us. We could not find many photos; we really had to hunt the whole four floors for the latest in audio equipment techniques.

But where was all that four-channel stuff we were promised would sweep the market (that was a couple of years ago). Still in the hands of the Japanese? like Sansui and JVC. Where is that British sense of innovation; still riding the stiff upper lip perhaps! Oh well! perhaps next year, or the year after?

Helme Atlantis 100 55 watt amplifier



CYBERNETIC HI FI

Going back to our friend with a desire to find out what he is missing, the best start is, believe it or not, the end of the chain, the loudspeaker, or sometimes referred to as "the weakest link".

However, some of the modern loudspeaker systems offer improvements over several five-year-old predecessors and if you are anxious to cut on size without loss of quality, we suggest you try to arrange a listen-in to "Servo-Sound Cybernetic Hi Fi". Don't be fooled by the fancy title; you should be truly surprised by the results.

These are small speakers (approximately 11in × $10\frac{1}{4}$in × 7in) that reproduce church organ music, bass guitars, full orchestras, as good as several others six or more times the size. The secret is in the feedback technique that the makers use in conjunction with the built-in power amplifiers.

The "cybernetic circuit" senses the motion of the speaker diaphragm, compares this with the original signal, and corrects the drive signal to balance the speaker output. The significant feature is the suppression of undesirable cabinet resonances, typical of such a size.

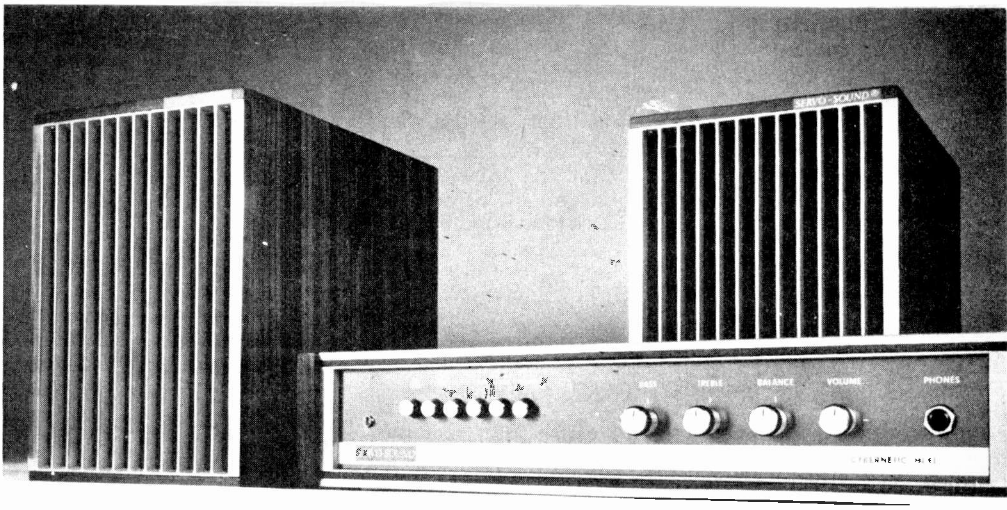
The price quoted for the unit, which includes the 15 watt (r.m.s.) amplifier is £55. A more robust version with ceiling or wall mounting cradle, for public address or discotheque work is offered for £64. Further details of these and stereo mixers, attenuators, and pre-amplifier control units are available from Sono-Sound, 5 Queen Street, London, EC4N 1SU.

SPEAKERS

BBC monitors are the currently accepted standard by which to assess speaker performance, following the extensive trials carried out over the past few years. Incorporated in these are, among others, the rolled p.v.c. cone suspension pioneered by that fast growing firm KEF.

Now that KEF have successfully established themselves as quality manufacturers, they have breathed new life into the smaller bookshelf styles with the Coda (£18·75 each plus purchase tax) and the Cantor (£22·25 each plus purchase tax), both of which are available as matched pairs.

The Coda is intended to handle up to 15 watts r.m.s. (plenty for a domestic room) with a B110 15cm bass/mid-range unit and a T27 tweeter. System resonance is quoted as 60Hz. The Cantor, rated at 20W r.m.s. uses a B200 20cm bass unit and T27 tweeter; system resonance 70Hz. Both units will sit on a shelf 6in deep.



Servo-Sound Cybernetic Hi Fi speaker system and pre-amplifier

The company responsible for the original BBC monitor, IMF Products, of High Wycombe, exhibited at Sonex and created considerable interest with an add-on system of speaker units. For those whose speakers lack the clean resonance-tamed low frequency response, IMF are offering a £50 bass only speaker which comprises a transmission line system folded to take on the appearance of a 33in × 22in × 20in coffee table. Omni-directional radiation is achieved by the downward facing drive unit, and it is claimed that 17Hz can be reproduced. (Wonder what size organ pipe this would be.)

Also recommended are the "Studio" range of speakers from £61·95 to £73 plus purchase tax. Although somewhat expensive they are an excellent range and come from Spendor Audio Systems Ltd, of Redhill, Surrey. Main constituents are an 8in woofer of their own make, coupled with tweeters from Rola Celestion and ITT.

If you see the name Yamaha in connection with speakers, don't associate them with the noise of motor cycles. The Japanese certainly do come up with some unusual ideas, not the least being the Yamaha NS (for Natural Sound—what else?) range coded JA-6001, JA-5002, and many more.

The slim-line cone is of unusual shape, perhaps best described as a combination of semi-elliptical and small round (or those for guitars, more trapezoidal). Presumably this is a combination of woofer and tweeter on one chassis and one cone. For the added manufacturing complication and perhaps non-linear cone excursions, I personally fail to see any advantage over separate units. These types vary considerably in price and are imported by Jonathon Fallowfield Ltd, 60 St John Street, London, E.C.1.

TV SOUND THROUGH HI FI

It is worth noting that for addicts who crave to feed television sound signals through their hi fi systems, Rola Celestion are offering the Telefi ED10. This is one of those precious boxes claimed to get round the problems of live television chassis. This unit picks up the radiated 6MHz f.m. sound field from u.h.f. 625-line receivers only and converts in the normal way to an audio signal ready to feed into the "tuner", "aux", or "phono" input of the amplifier.

No electrical connection is made to the television receiver; only a pick-up transducer is mounted on the cabinet close to the i.f. strip. Rola Celestion are acting as distributors for the manufacturers Dinosaur Electronics Ltd of Windsor.

SUPER AMPLIFICATION

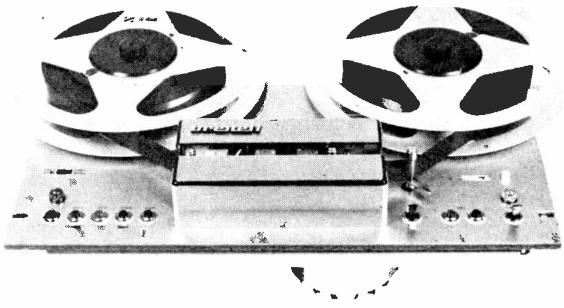
Since some of the foregoing indicate continuing improvements in loudspeaker design, the same cannot always be said for amplifiers. The standard of reproduction from a few is now approaching the ultimate possible with currently available components. It is all the more surprising therefore that several manufacturers do not seem to have the resources to improve their amplifiers measurably.

One well-known quality brand was in evidence in most of the non-amplifier demonstrations and in one room alone three were being used side by side. Have the rest accepted defeat?

There is very little to report on this subject but if you have the chance, listen-in to the Helme Atlantis 100 from P. F. & A. R. Helme Ltd of Harrogate. If you can detect −70dB noise at something like 55 watts r.m.s. into 8 ohms or 0·1 per cent distortion at 50 watts r.m.s., then you may not like this amplifier, but you would probably go a long way to find better figures than these quoted from the specification for such power output.

This brings us back to earlier comments; this amplifier has what is termed "Dynamic Matching Control". There are l.f. and h.f. controls which are set up during listening tests to an optimum to suit the listener's interpretation of how the loudspeakers are performing.

We gather that this is a kind of manual version of the Servo-Sound idea already described, in that speaker cabinet resonances can be damped by judicious settings of the controls. The idea is primarily to make up for deficiencies inherent in small bookshelf systems. The suggested retail price is quoted as £119.



Brenell Type 19 professional 1in tape deck

FRONT END

Now for the front end, and it is a pity that f.m. tuners were not as evident as they should be. Would this be due to difficult f.m. reception conditions so close to the moving aircraft at Heathrow, or lack of interest in a market that should grow after expansion of stereo broadcasting later this year.

So we are left with tape and disc, the former showing the boom in cassette cartridge systems with Dolby B incorporated. The success of chromium dioxide tapes added to Dolby makes tape recording and reproductions at 1⅞in per second an excellent proposition for acceptable quality music reproduction.

BASF introduced a combined radio/cassette recorder, the CC9300 priced at £67·97. With such a small size the cassette will undoubtedly be widely considered for incorporating with other equipment in one package, providing a very versatile system for domestic sales.

TAPE RECORDERS

Mention the words tape recorder and Philips are bound to be somewhere nearby. The interesting point about this organisation is diversity. Their products range from good value low price cassette machine that will go in a coat pocket, to professionally engineered studio transcriptors for broadcasting. Their latest is a three-motor, three-speed stereo machine and built-in 10 watt stereo amplifier, with illuminated tip-touch buttons allowing remote control boxes to be used.

The electronics has mixing, monitoring, multiplay and echo facilities, all demanded these days by the progressive musician who records at home or in a studio. This recorder, coded N4418, is offered at £189·75 including purchase tax, but if you want quality it is worth paying the price.

Brenell Engineering Co. seem to be on their own in supplying tape transport systems (to the general public) that can be applied to tailor-made self-constructed tape amplifiers. Brenell make a wide variety of decks and complete recorders.

They now produce a rugged tape deck Type 19 for industry that uses a Papst hystresis synchronous motor and two spool motor. Two speeds are available, 3¾ and 7½in per second, and the solenoid operated mechanics confirms the principles of older transcription machines, that use these for reliability.

However, for domestic applications, Brenell cater for less expensive tastes without neglecting quality, for example, the Mk 6 Deck at £62·04 and the Mk 610 at £79·60 including purchase tax. Bogen heads are available as optional extras for the Type 19, while the Mk 6 and 610 will accept a wide variety of heads at extra cost.

Goldring G101 record deck with G850 pick-up

FOUR CHANNEL DISC

Turning for a moment to four-channel matters, it was a welcome sight to see the new RCA compatible discrete CD-4 disc record which will become available in May. RCA have been working with JVC and National Panasonic to produce this disc specially for four-channel equipment, and at the same sort of price as a top grade two-channel stereo disc. They are also willing to offer their expertise to other disc manufacturers to produce these recordings. Is this the kind of boost that the British want after Japan has already a choice of 65 CD-4 recordings?

LOW PRICE RECORD DECK

On the two-channel front, Goldring now produce the GL85, which was described in our Audio Fair report, and a newcomer, the G101, which is also belt driven and uses a magnetic cartridge—the G850. The aim of this new model is to offer Goldring quality at an economic price. At £24 plus purchase tax, including plinth and cover, this model is certainly good value.

PURCHASE TAX

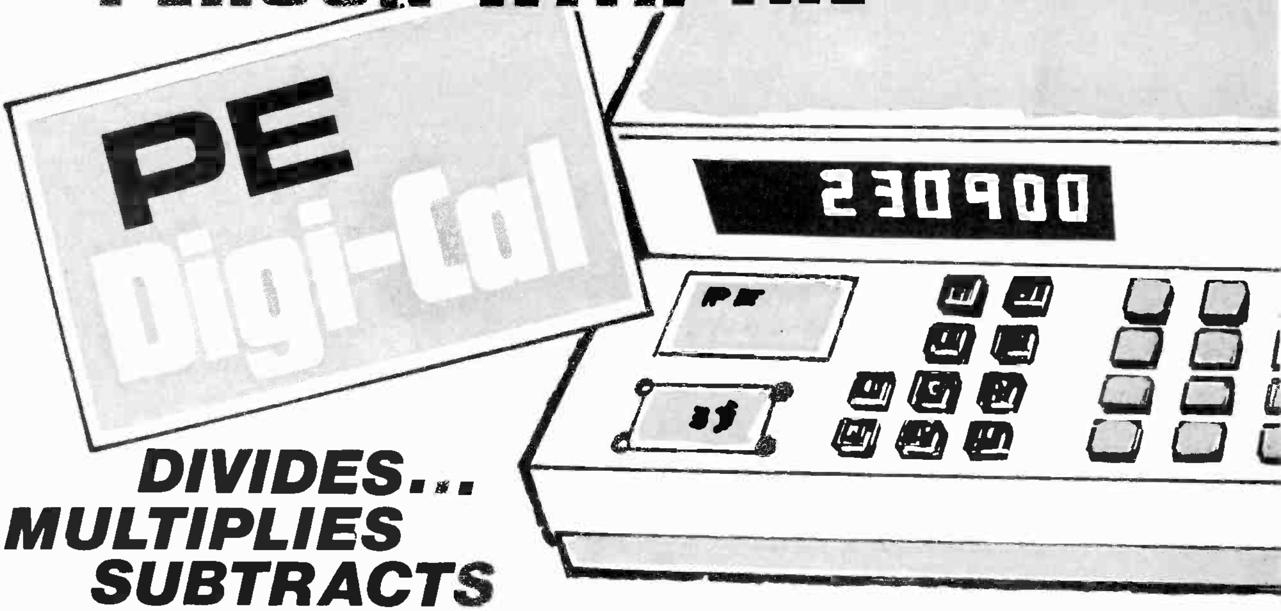
Finally a note concerning prices; those quoted here were correct to the best of our knowledge at the time of going to press. Where purchase tax is not quoted, a reasonable estimate only would be to add about 17 per cent of the recommended retail prices.

As purchase tax is based on manufacturers' trade prices, it is always wise to confirm the correct figures from them. Recent budget changes in purchase tax rates could in some cases mean "no change" where it is not applicable, or about 25 per cent of trade prices where reductions become effective.

The next date for your diary is October 23 to 28, the Audio Fair in the large Grand Hall, Olympia, London. ★

Philips N4418
professional tape recorder

.... BECOME A CALCULATING PERSON WITH THE



DIVIDES... MULTIPLIES SUBTRACTS ADDS.... PLUS AUTOMATIC SQUARING

Get the answers at your fingertips with the P.E. Digi-Cal, the first digital calculator designed specifically for the amateur constructor.

P.E. Digi-Cal is a high-speed electronic calculator which can add and subtract, multiply and divide—all at the touch of a switch. It can store any constant for repeated use and perform squaring simply by pressing a single key.

Entries of up to six digits may be made, and the answers are given in up to eight digits. Calculations are carried out just as they are written.

Construction employs readily available TTL logic i.c.s in easily accessible plug-in boards. The display consists of eight miniature seven-segment indicators to display keyboard entries and answers.

ALSO—

THE CALLERCORD

There are times when it is impossible to answer a call at the door. The "Callercord" will answer callers and record messages on magnetic tape.

DIGITAL ELECTRONIC ORGAN SYSTEMS

A look at the more up-to-date methods of organ design

in the JULY issue of

PRACTICAL
ELECTRONICS

ON SALE JUNE 9

2-20 minute TIMER

By R. Verrill B.Sc.

THIS simple electronic timer can be used for any operation where it is required to switch on an apparatus for a length of time and then automatically switch off. Alternatively, it can be used to switch on the apparatus automatically after the preset time, and remain on until switched off manually.

CIRCUIT DESCRIPTION

The circuit diagram of the timer is shown in Fig. 1. Here, when the mains switch S2 is turned on, the bridge rectifier (D1–D4) supplies the circuit with about 35V d.c. smoothed by the capacitor C1. The 250μF capacitor C2 is charged up to this voltage via the resistors R1 and R2. Some of the charging current flows through the base of the *pnp* transistor TR1 so that this remains on for a few seconds after closing S2 until C2 has become charged.

During the time that TR1 is on, capacitor C3 is charged up to the line voltage via TR1, R4 and the diode D5. As soon as TR1 goes off, the voltage on C3 starts to fall slowly because of the small current being leaked away by TR2. This transistor acts as a constant current source because its base is at a fixed potential and there is resistance in the emitter lead whose value is determined by the position of S1. The value of the emitter current is approximately equal to the emitter voltage divided by the emitter resistance. A fine control over the discharge current is obtained by adjustment of VR1 which alters the base voltage of TR2.

The Schmitt trigger circuit, comprising TR3, TR4, operates when the voltage on C3 has fallen to about 2 volts. TR3 then starts to turn off and TR4 starts to turn on. Current through the resistor R20 biases the emitter of TR3 positive thus turning TR3 further

COMPONENTS . . .

Resistors

R1	22k Ω	R18	4·7M Ω
R2	10k Ω	R19	100k Ω
R3	4·7k Ω	R20	6·8k Ω
R4	1k Ω	R21	56k Ω
R5	390k Ω	R22	56k Ω
R6	15k Ω	R23	10k Ω
R7–R17	5·6k Ω (11 off)	R24	390 Ω

All 10%, ½W carbon

Potentiometer
VR1 22k Ω carbon linear

Transistors
TR1 ZTX503 (Ferranti)
TR2–TR5 ZTX107 (Ferranti) (4 off)

Diodes
D1–D4 ZS170 (Ferranti) (4 off)
D5–D7 ZS120 (Ferranti) (3 off)

Switches
S1 Double-pole, mains toggle switch
S2 Single-pole 11-way wafer switch

Relay
RLA 2-pole 2-way 26V 700 Ω, STC4189 GD (Henry's Radio)

Transformer
T1 Mains transformer, secondary 25V 0·5A Douglas MT102AT (Henry's Radio)

Miscellaneous
Diecast box $8\frac{3}{4}$in × $5\frac{3}{4}$in × $3\frac{5}{32}$in, Veroboard 3·4in × $5\frac{1}{2}$in 0·1in matrix, FS1–100mA fuse and holder, SK1–six pin plug and socket (Bulgin).

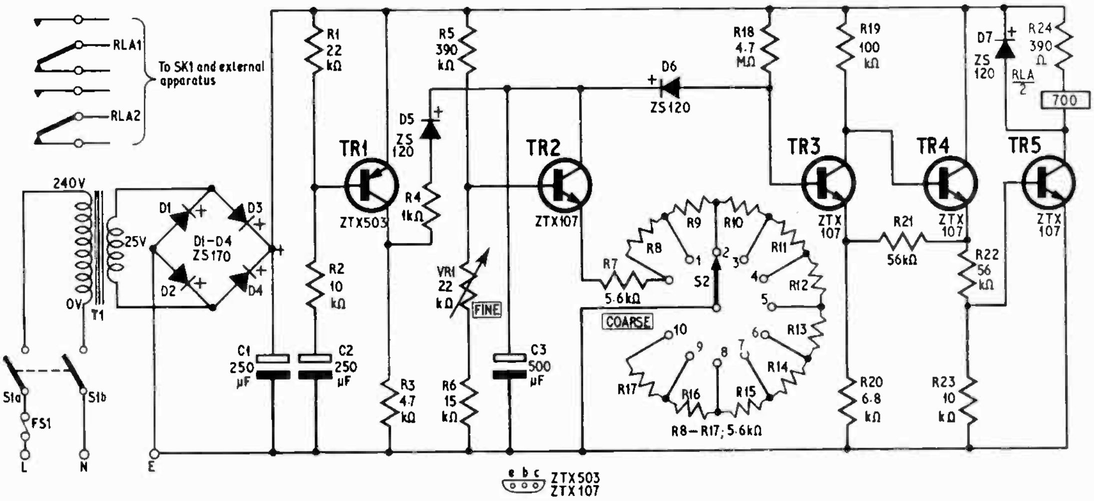


Fig. 1. Circuit diagram of process timer

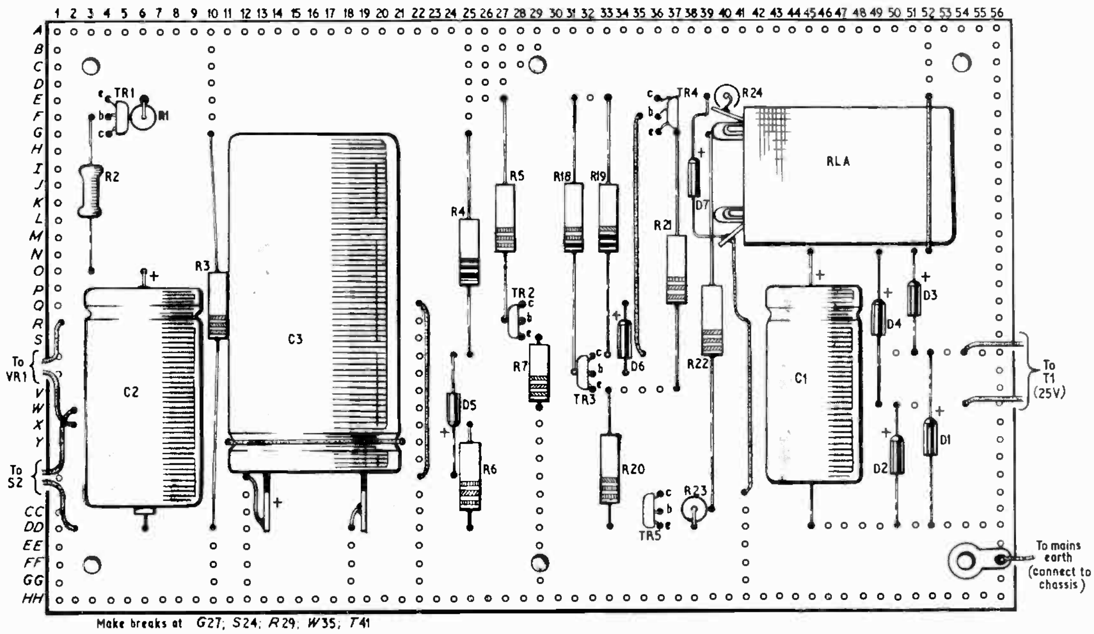
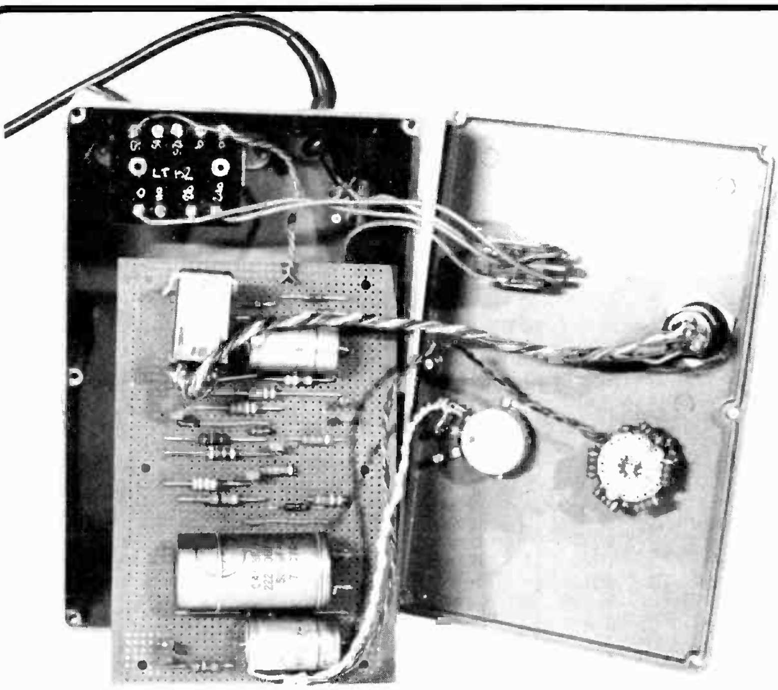


Fig. 2. Component mounting and wiring details of Veroboard sub-assembly



Interior photograph of the timer. Here, the relay strap also serves as a link wire

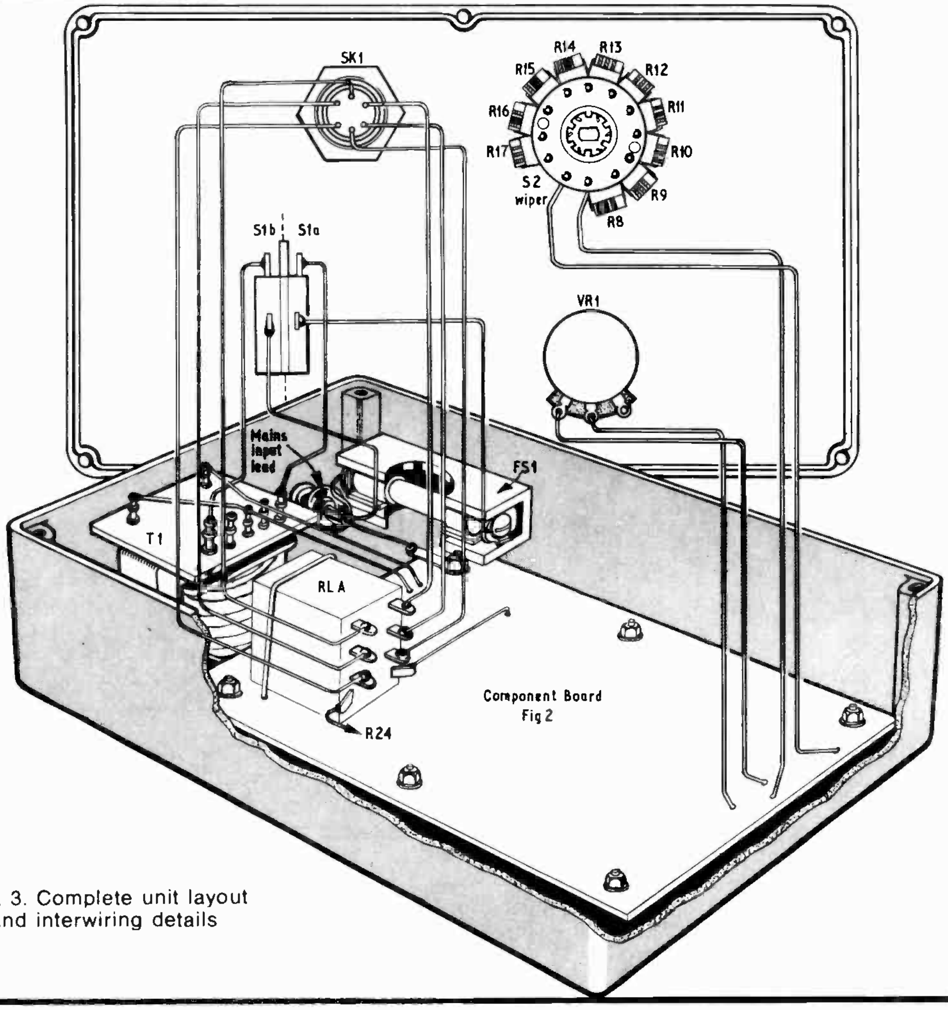


Fig. 3. Complete unit layout and interwiring details

off. Regenerative feedback occurs so that TR3 is turned completely off and TR4 is turned on supplying current through R22 to the base of TR5 which operates the relay. The appropriate relay contacts are used to turn on or off the external apparatus as required.

CALCULATING THE PERIOD

The actual length of the timed period can be calculated as follows. The time taken for the voltage on a capacitor of C farads to fall by a voltage V volts when a constant current of I amperes is drawn from the capacitor is CV/I seconds.

The voltage at the base of TR2 is

$$\frac{35\,(VR1 + R6)}{VR1 + R5 + R6}$$

which works out at about 2·2V with VR1 wiper in the mid-position. Since the case/emitter drop is 0·7V the voltage at TR2 emitter is (2·2–0·7) which is 1·5V. If S2 is set for maximum resistance (61·6kΩ) the emitter current

$$I_e = \frac{1\cdot5}{61\cdot6 \times 10^3} = 24\mu A$$

In the expression CV/I we can now substitute:—

$C = 500\mu F$

$V = 33$ volts (the voltage dropped from 35V to 2V)

$I = 27\mu A$

Therefore

$$\text{period (CV/I)} = \frac{33 \times 500 \times 10^{-6}}{24 \times 10^{-6}} = 690 \text{ s}$$

If VR1 had been set to zero resistance, the period would work out as 25 minutes, 40 seconds.

CHOICE OF CAPACITOR

Some readers may be of the opinion that the use of electrolytic capacitors in timing circuits should be avoided. This is true in some circuits especially where very accurately timed periods are required. The objection to using electrolytics arises mainly from their high internal leakage currents. For example, the type of capacitor used in this timer has a leakage of up to 1mA when used at its maximum working voltage of 64V. Since the discharge current in the circuit can be as low as 10μA we would require the leakage current to be less than 1μA and to change by less than 0·1μA to give any degree of stability to the timed period. In practice the degree of stability obtained is at least as good as this when a capacitor of the type specified is used.

LOW LEAKAGE

When a voltage is supplied to an electrolytic capacitor, besides the current required to give the capacitive charge, a forming current flows through the electrolyte until an insulating layer is formed of sufficient strength to withstand the voltage. If the voltage is then reduced, the insulating layer is more than sufficient to withstand the voltage now present so the forming current is no longer required and the leakage current is extremely small.

In the timer circuit, after the initial charge, the voltage on the capacitor is reduced at a constant rate, so the above conditions for low leakage are ideally satisfied.

CONSTRUCTION

All of the small circuit components are mounted on a 5¼in × 3¾in 0·1in matrix Veroboard as in Fig. 2. Since, with this type of circuit, layout is not particularly critical, other forms of assembly can be made.

In Fig. 3 the timer is shown completely assembled. When wiring up SK1 to the relay use different coloured sleeving, so that the switches of the relay can be identified.

SETTING UP

Before any setting up is done the circuit wiring should be thoroughly checked. If this checks out with Fig. 3 set the "Coarse" switch to position "1" and the "Fine" control (VR1) to a minimum. Switch on and you should find the relay changes over after a period of about two minutes.

Exact time multiples can be set up on S1 if VR1 is set for a 130 second delay. This has the effect of multiplying each of the "Coarse" range switch positions by a factor of 2. This means that position "1" will produce a delay of two minutes, position "2" four minutes and so on, up to 20 minutes at position "10". The error on each range will be about 10 seconds which is the time taken for C2 to be charged initially.

Repeated checks of timing periods produced an error of 10 seconds on the 20 minute range and proportionately less for shorter times.

RELAY CONTACT RATING

The relay specified has a contact rating of 2A but the actual load can be doubled if the switch contact pairs are used in parallel. ★

BACK TO SCHOOL

continued from page 463

Finally, a domestic note which is not entirely out of place here. A magazine such as PRACTICAL ELECTRONICS finds itself in a unique position in that while catering for the interests of private individuals it becomes to some extent a bridge between the educational establishments and the industry. This is because we are in regular contact with both sides and receive contributions from members of both the teaching and the engineering professions. We do not claim to be an educational journal in the formal sense, and are flattered and delighted that so many of the teaching profession do turn to PRACTICAL ELECTRONICS for instruction in applied modern electronics. We feel confident that they will be able to rely on this service equally in the future.

As to some recent critical comment aired in these pages, we wonder what teacher would like to be judged and outrightly condemned simply on one single lecture, delivered when Sir was perhaps somewhat under par?

F.E.B.

PATENTS REVIEW...

THUNDERSTORM WARNING

BY a quaint coincidence the waterproofing patent mentioned last month was published only one week later than British Patent 1 248 300 from Nitro Nobel AB of Sweden. The Nobel specification is concerned with a thunderstorm warning system.

Not surprisingly Nitro Nobel are concerned mostly with predicting thunderstorms for the benefit of those working with explosives, but the invention will probably find much wider interest.

It is customary in thunderstorm warning systems to detect both the quasistatic electric field, which occurs between the electric charge of a thundercloud and earth, and the pulses of longwave electromagnetic radiations that are transmitted from lightning discharges. The signals are usually detected in two threshold steps; alert and alarm, which can be audible and/or visual warning.

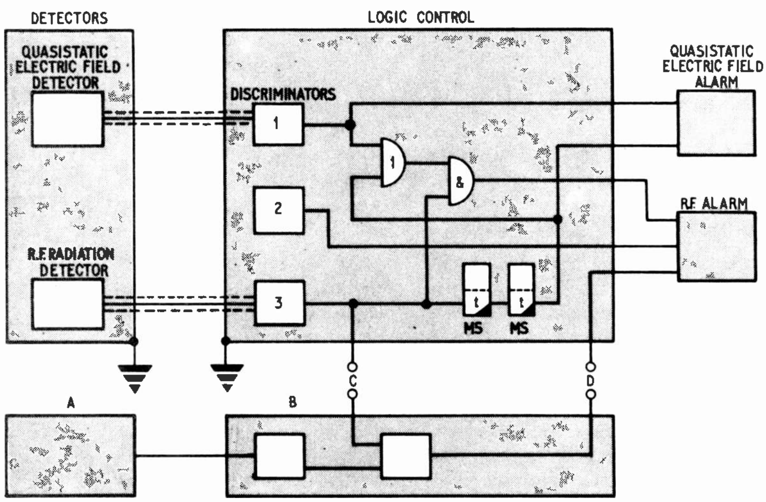
The radiation pulses are detected by an aerial wire, often of considerable length and the obvious problem is that this aerial is likely to be struck by lightning. Another problem is that the device may mistake local machine spark discharges for lightning flashes.

The Nobel invention relies on an electronic logic system which ensures that the alarm is triggered by radio frequency radiation pulses only if these pulses are repeated within a predetermined time interval, or combined with simultaneous pulses in another (for example, spectral) range. The alarm can be triggered by a quasistatic electric field of above a threshold intensity. The alarm will also be triggered if the electric field alone rises to a predetermined high level.

Nobel suggest a field detector formed from a capacitor and a rotatable diaphragm positioned in front of the capacitor and operating in accordance with the so-called field mill principle. The detector can be of relatively small size and the diaphragm actually housed inside an antenna for longwave radio pulses. It is claimed that this arrangement is unlikely to attract a lightning strike.

In Fig. 1 Nobel show how a detector system is connected to a logic unit by shielded cable. The detector system is earthed and includes the two component detectors for electric field and electromagnetic radiation emission. The former provides a signal proportional to the intensity of the quasistatic electric field, for example, a sinusoidal voltage of 200Hz. This signal is fed to two amplitude discriminators 1 and 2 having different threshold values. Discriminator 1 output is connected to the electric field warning circuit so as to activate it all the time that the quasielectric field is higher than a selected base threshold. This discriminator also feeds one input of an OR circuit.

BP 1 248 300 **Fig. 1**



An output signal from discriminator 2 triggers the alarm circuit which holds "on" when activated.

When a lightning strike occurs, the r.f. radiation detector sends pulses to discriminator 3 which has a discriminating level corresponding to a normal flash of lightning at a distance of 10 to 15 kilometres. A radiation pulse exceeding this provides a signal pulse from discriminator 3 which is connected to the first input of an AND circuit, and to a timing circuit composed of two monostable multivibrators in series. One monostable is set by the pulse from discriminator 3 and the other is set by the trailing edge of the output of the first monostable.

An output signal from the second monostable is connected to the electric field warning circuit and to the second input of the OR circuit. The output of the OR circuit is connected to the second input of the AND circuit. The output from the latter AND circuit triggers the r.f. alarm, so that it is sounded if a signal pulse is transmitted from discriminator 3 during the time period in which D1 discriminator is producing a signal, and also if two consecutive signal pulses from discriminator 3 occur within a predetermined time interval. This distinguishes between one single pulse and a pulse train.

Pulses having a large spacing in time, in all probability, do not emanate from a thunderstorm. The actual time period gating must be suited to the geographical location in which the device is to be used.

The system described in this patent may be supplemented by other detectors. Supplementary optical detectors, discriminators, and AND gates can be linked into the system at A, B, C and D. More details are given in the patent specification.

INGENUITY UNLIMITED

A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.
This is YOUR page and any idea published will be awarded payment according to its merits.

RADIO ALARM

HAVING constructed the *Digital Clock* described in the December 1970 issue, I required an additional circuit to enable a transistor radio to be switched on at the same time as the alarm.

A thyristor was tried initially, but the holding current was greater than that drawn by the radio, so that after the ten-minute period that the alarm circuit input is active (i.e. pin 3, IC18 is high), the circuit would turn off (assuming the alarm had been turned off).

The circuit eventually devised is based on an emitter-coupled bistable and is given in Fig. 1.

With the alarm inactive, TR4 is on and TR5 is off. The voltage at the collector of TR4 is just above zero, and hence insufficient to cause the Darlington pair TR1, TR2 to switch on. When the alarm circuit is active, pin 3 of IC18 goes high (point B on the diagram) and TR3 is switched on, grounding the base of TR4. The bistable switches states (TR4 off and TR5 on) and the voltage at TR4 collector rises and the Darlington pair switch on (TR1 hard on).

So far as the radio is concerned, the circuit (Fig. 1) may be considered as a switch and should be connected into one of the battery leads. However, since transistors are used, the "switch" is voltage sensitive, and point "A" must be positive with respect to the circuit earth rail (the other pole of the switch), see Fig. 2a. Alternatively, the circuit may be inserted into the negative lead, if more convenient, but again, care must be taken to ensure that point "A" remains positive, Fig. 2b.

With a 6V battery in the radio, the leakage current through the circuit when "off" is less than 10μA. It should be noted, however, that there is 0·6V dropped across the power transistor so a slight drop in radio volume will be noted.

This circuit may only be used with a battery powered radio and under no circumstances should a mains operated radio be used.

To retain the portability of a battery operated radio a jack plug socket mounted in the case of the radio and wire as shown in Fig. 3 can be used. The socket should be the type used for an earphone accessory.

R. C. Stone,
Hampton,
Middx.

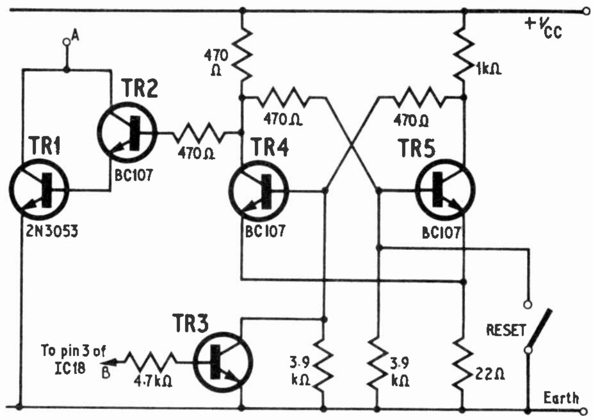
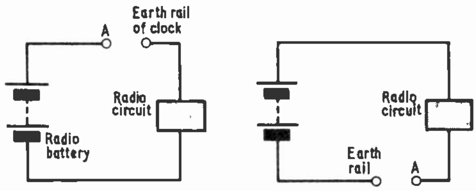


Fig. 1. Circuit of the radio time switch



Figs. 2. Method of connecting different polarity radios to the clock, for point A positive (left); point A negative (right)

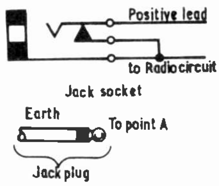


Fig. 3. Wiring of the break jack and plug

PHOTOMETER FOR ECOLOGICAL STUDIES

THE details in Fig. 1, show a simple photometer which was built in order to investigate variations in light intensity beneath various types of vegetation. It is simple to construct and use, and robust enough for field study work.

The basic element of the instrument is two photovoltaic Selenium cells. They consist of circular plates about 6cm in diameter and 2mm in thickness. They are capable of giving a considerable deflection on a milliameter when under full daylight illumination.

The cells are set in a piece of plywood, which has one surface chiselled out to hold them firmly. Below the cells a similarly shaped piece of aluminium foil is inserted so as to give a good electrical contact in the circuit.

A thicker though smaller sheet of foil is applied to the upper surface of the photosensitive plates, big enough to make electrical contact but not covering any appreciable part of the photo-electric surface. It is important that the two sheets of foil do not make contact with each other. To prevent this happening, a small piece of plastics is inserted between them. The entire assembly is then sandwiched by a plate of Perspex, with terminals to the upper and lower aluminium sheets.

Using a standard light source the instrument could be calibrated absolutely. Without such a source, however, a relative calibration is still possible, i.e. the non-linear response of the cell can be determined.

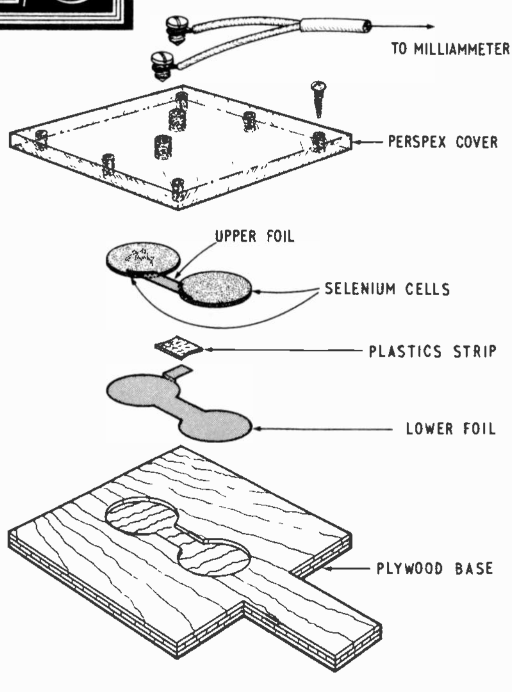


Fig. 1. Constructional details of a simple photometer

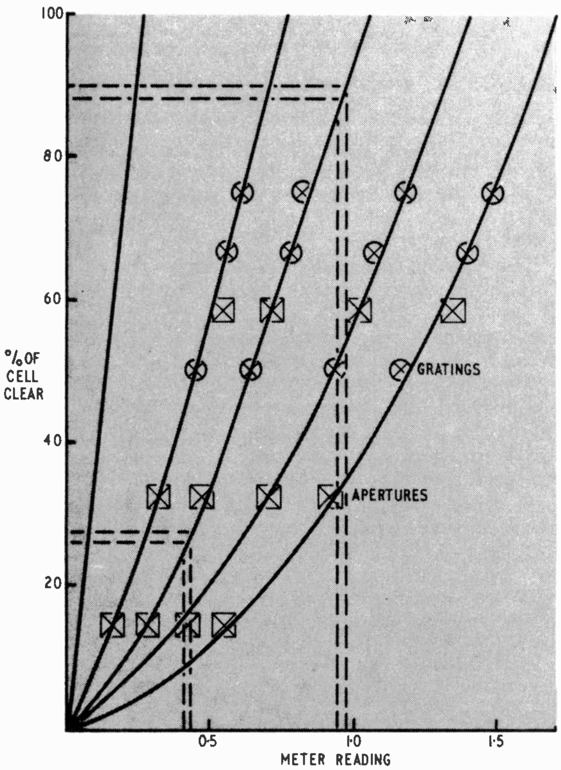


Fig. 2. Calibration graph for the photometer

Two methods were tried. The first utilised the inverse square law (placing the cell at different distances from a light source). In practice, this did not prove very successful, and instead the following method was devised.

A set of apertures and gratings were constructed out of black paper, transmitting 75%, 66·6%, 50%, of the total light. These apertures were fixed, in turn, with adhesive to the Perspex cover. Starting with the full cell area, a light source is moved to a position which gave a realistic reading on the milliameter. Then, without changing this distance, one of the apertures or gratings is placed over the Perspex cover and the current recorded.

Recalibration, with the apertures moved slightly so as to cover different parts of the cell surface, will give more accurate results. These are in Fig. 2.

Using the latter, relative transmissions of the different types of foliage can be determined. For example, the following results were obtained on an overcast October day (instrument held horizontally for all readings).

Open sky reading	Under foliage
0.96	0.44
0.98	0.42

Taking the 1.06 calibration curve, a 0.96 meter reading is equivalent to 88 per cent transmission, and 0·44 reading to 27 per cent transmission.

We therefore, obtain a relative transmission of:

$$27/88 \times 100 = 30{\cdot}7 \text{ per cent.}$$

Similarly, the second pair of results give about 27·5 per cent relative transmission.

E. D. Dale,
Worsley, Lancs.

POINTS ARISING

SEMICONDUCTOR LEADOUT IDENTICHART *May*
The outline diagram for the 2N3702 to 2N3711 types should be diagram number 59a not 35a. On diagram 22a, reverse the b and e connections.

TAPE SPEED CONTROL *(Ingenuity Unlimited April 1972)*
Page 299, Fig. 3. Transistors TR7 and TR8 should be OC81 and OC35 types respectively.

P.E. SCORPIO IGNITION SYSTEM *(November and December 1971)*
Some constructors have had difficulty with using certain makes of 2N3055 in the "Scorpio" ignition system. What happens is that the circuit oscillates normally (at about 2kHz) until the output of the inverter is shorted, when the inverter goes into a high frequency mode at around 200kHz and remains in this mode when the short is removed.

This arises because 2N3055 transistors are made by a very large number of manufacturers and there are large variations in characteristics such as f_t between different makes. Only minimum or average values are normally quoted on the data sheet.

This trouble does not occur with the specified Ferranti 2N3055, or with RCA devices. It has occurred with Fairchild 2N3055's and may also occur with Motorola devices due to their high f_t.

MARKET PLACE

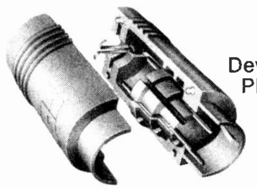
Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned.

PLUGS AND SOCKETS

To help rationalize the profusion of plug and socket connecting configurations in the continental Din range, **Parry Electronic Developments** have introduced a PD Din connector that can be easily assembled in either 2-pin, 3-pin or 5-pin stereo configurations.

These connectors do not require soldering but use small terminal tags which are crimped, at one end, to the required wire and then have a pin inserted in a sprung triangular section at the other end. The pins are placed in any required arrangement on a centre bush, placed in one half of the outer casing and then the two halves are snapped together to form the complete connector.

Details of other connectors in the series and addresses of nearest stockists can be obtained from Parry Electronic Developments Ltd., 28 Greville Street, London EC1.



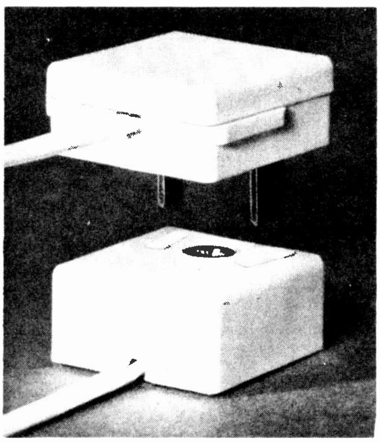
Parry Electronic Developments PD Din Plug

A miniature 2-pin plug and socket, useful for extension leads, is now being marketed by **Senate Engineering.**

A feature of the plug and socket is that it is rated at 25A and has a claimed contact resistance of less than 1·4 milliohms. Again, leads are connected without the use of solder or screws.

Typical applications could be for automobile, caravan and boat electrics and emergency supplies. There are also many low current low voltage applications, such as control circuits and loudspeaker extensions where advantage can be taken of the low contact resistance.

The recommended retail price is 25p and further information is available from Senate Engineering Ltd., 77 Cotes Road, Barrow-in-Soar, Loughborough, Leicestershire.

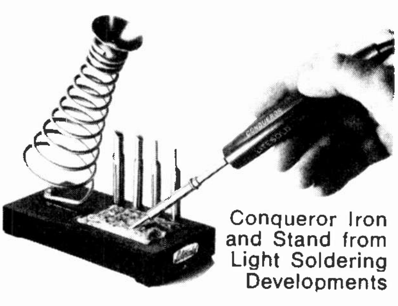


Miniature 25A Plug and Socket made by Senate Engineering

SOLDERING IRON AND STAND

Available as a set or individual items **Light Soldering Developments** recently announced a new soldering iron and stand.

Called the Conqueror, the iron is available with five different slip-on tip sizes from $\frac{1}{16}$in to $\frac{1}{4}$in. Ideal for transistor and i.c. work the iron is available for operating voltages of 12, 24, 115, 220 and 240V.



Conqueror Iron and Stand from Light Soldering Developments

A feature of the stand is the arrangement for mounting four spare bits on the base. The iron stand base is made from heatproof Bakelite and contains a wiping sponge for keeping iron tips clean.

The spring guard is claimed to give complete protection from burns and prevent damage to the iron if knocked. A flared steel ferrule at the narrow end of the spring gives easy location of the iron.

The price of the Conqueror is £1·80 with standard copper bits, or £2·03 with a long-life bit. The cost of the stand is £1·48. Further details and stockists can be obtained from Light Soldering Developments, 28 Sydenham Road, Croydon CR9 2LL.

SOUND SYSTEMS

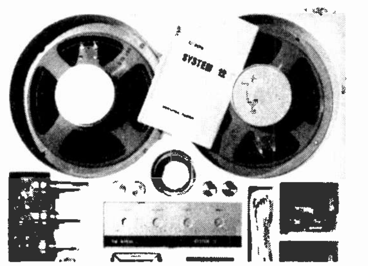
For people who prefer to purchase and choose their own turntable, cartridges, speakers, and design enclosures we can recommend the System 12 from **Bi-Kits.**

The kit consists of a pre-wired pre-amplifier, two integrated circuit power amplifiers, power supply module and two 8in diameter twin cone speakers. The kit also contains all the necessary connecting wire, silver anodised front panel and control knobs.

The power amplifier modules use an SGS integrated circuit which they claim gives an output of 6 watts r.m.s. per channel. The frequency response of the system is claimed to be 20Hz to 50kHz.

Kits are available, price £13·95 plus 35p postage and packing, from Bi-Kits, 63a High Street, Ware, Herts.

The System 12 can be heard at the new **Bi-Pak's** Components Supermarket at 18 Baldock Street, Ware, Herts.



System 12 Kit marketed by Bi-Kits

A new stereo system is now available from **Servicon Dynamics Ltd.** The amplifier moves away from conventional amplifier techniques and incorporates integrated operational amplifiers as the pre-amplifier tone control and driver stages. The output stages, which are transformerless and d.c. coupled, use complementary silicon transistors connected in a common emitter mode.

Total distortion is claimed to be 0·09 per cent at 15W per channel at 1kHz and the cross talk −60dB at 1kHz with tone control flat and 15 watts/zero watts per channel loading.

The amplifier is mounted in a teak finish cabinet with a Perspex/teak lid which can be kept in place with records playing. The deck is the latest Garrard SP25 Mk. III with a ceramic cartridge KS41C-CDS as standard; a magnetic cartridge can be supplied as an extra.

The output is 30 watts r.m.s. per channel into 7·5 ohms with a frequency response of 30Hz to 29kHz (± dB).

The system is sold as a package with two teak finish speaker cabinets each containing an 8in l.f. speaker and 4in tweeter with crossover capacitor. Power output 15 watts r.m.s. at 15 ohms per channel. Frequency 30Hz to 20kHz. A 50 watt system can be supplied as an alternative.

The system is offered at £89·00 for the 30 watt system; the amplifier and deck complete, without spakers, is £70·35. Further details available from Servicon Dynamics Ltd., 186/190 Cirencester Road, Charlton Kings, Cheltenham, Glos.

report from AUSTRALIA

BY J. M. WALDIE

In this new series of "Reports from down-under", the aim will be to cover three broad aspects of Australian electronics: home construction, industrial development, and the local hi-fi scene. It is felt that readers of P.E. intending to migrate to this side of the world would naturally be interested to know if their hobby is perpetuated here, and what form it takes; at the same time it is possible to make useful comparisons between here and the U.K. On the industrial front, items will be selected of interest to both hemispheres, since P.E. enjoys a relatively large readership in Australia.

MAGAZINES

Considering the population here, which may be considered to consist of approximately one and a half times that of Greater London spread over an area the size of America, and also in view of the fact that it is essentially an "outdoor" society, the interest in electronics as a hobby is remarkably widespread. Naturally this is concentrated in the five major cities of Australia, and particularly in Sydney and Melbourne.

This industry is served by two local magazines; all the English magazines, of which P.E. is the most popular, are also available at most newsagents.

Both local magazines, however, do not restrict themselves to home constructional projects. They both examine, in some detail, new commercial products in the hi-fi field and both conduct record reviews.

HOME CONSTRUCTION

A major difference is the fact that published projects are designed in the magazines' own laboratories. As a consequence, commercial units built here are frequently based on designs available to the public which contrasts sharply with the situation in the U.K. and in America where d.i.y. hi-fi projects appear to follow industrial trends. This rather unusual situation offers two important advantages to the home constructor. Firstly, he can build units equal in performance to some local commercial systems and, secondly, the designs presented follow in logical sequence in terms of facilities and improved performance.

What service is offered to the constructor in terms of components, tools and so on? Visitors and migrants should not expect Australian equivalents to the Edgware and Tottenham Court Roads, although small pockets of suppliers do exist. A glance through the local magazines indicate that Sydney possesses twelve kit/component shops; Melbourne has half that number. Only two or three of these advertise themselves as being strictly mail-order. Constructors should note, however, that, unlike the U.K., the great majority of importers and manufacturers will sell direct to individuals. The writer has not bought components in four years from a kit-shop, but rather from "trade-sales" counters in wholesale outlets.

PROJECTS

Readers and intending visitors should not delude themselves into thinking that Australia is simply a place where kangaroos leap down the main streets, and where the bathwater goes down in the opposite direction. Industrially and technically it is well advanced; although f.m. radio and colour television are not yet with us, plans are well advanced for their introduction. The sophistication is amply reflected in the standard and selection of home construction projects. There exists a greater penetration of components of American origin than in the U.K., which has lead to a relatively early introduction of such devices as field-effect transistors, triacs and i.c.s into d.i.y. projects; circuits based on triacs, for example, appeared in 1968.

The projects themselves are basically similar to those in P.E. with possibly a greater emphasis on "outdoor" systems such as water-level alarms for home pools and protective and ancilliary circuits for cars. Mercifully, an all-electronic barbeque has yet to emerge. It seems, too, that there does not appear to be much interest in sophisticated toys and war-games.

This summarises the situation here regarding d.i.y. electronics in Australia and those contemplating a temporary or permanent move need not have any fears regarding the ability to continue their hobby.

COMPUTERISED BETTING SHOPS

One interesting excursion of electronics into traditional areas has been the introduction in Sydney of computerised betting shops. These, in all states, are Government run; they are known as the TAB (Totaliser Agency Board), and provided £1 million profit last year in N.S.W. Bets can be placed not only on horse and greyhound racing, but also on trotting, a form of equine harassment not known in the U.K. The volume of punting is such that an expected 10,000 bets per minute will be placed by 1978.

It was decided to use an IBM 360/44 computer to handle this volume and was installed some 12 months ago. It is supported by AWA (Amalgamated Wireless Australia) branch selling terminals, STC branch printers and PMG telex in country areas. Cut-over of telephone betting from manual to computer has now been completed; the system of transmitting full collation figures to headquarters from the branches is more than half-way complete and 15 of the 380 existing branches converted to machine vending. These are now being converted at the rate of four per week.

UP TO THE "OFF"

The computer checks the validity of each bet, runners and "scratchings" until the "off", the credit standing of the telephone punter and the validity of a winning claim and the amount. The timing is such that a bet placed two seconds after the race is due to close will be rejected.

Tradition dies hard. The cold impersonality of the new system, according to veteran punters, is no substitute for the excitement which occurred in 1964, for example, when crowds queueing outside two TAB branches had to be controlled by police because the windows had closed before all the punters had laid their wagers.

HENRY'S FOR LOW COST **FIRST GRADE** BRAND NEW **BRANDED** GERMANIUM and SILICON TRANSISTORS, DIODES, RECTIFIERS, TRIACS, FETS, ZENERS, BRIDGES and INTEGRATED CIRCUITS

BY ATES · EMIHUS · FAIRCHILD · FERRANTI · I.T.T. · MULLARD · NEWMARKET · PHILIPS · R.C.A. · TEXAS

TRANSISTORS

A SELECTION FROM OUR LIST

AAY30	10p
AAY42	15p
AAZ13	10p
AAZ15	10p
AAZ17	10p
AC107	35p
AC126	30p
AC127	25p
AC127Z	50p
AC128	20p
AC176	20p
AC187	25p
AC188	25p
ACY17	30p
ACY18	25p
ACY19	25p
ACY20	20p
ACY21	20p
ACY22	10p
ACY39	55p
ACY40	20p
ACY41	15p
ACY44	25p
AD140	50p
AD149	50p
AD161	35p
AD162	35p
AF114	25p
AF115	25p
AF116	25p
AF117	20p
AF118	60p
AF124	25p
AF125	20p
AF126	20p
AF127	20p
AF139	30p
AF180	50p
AF181	45p
AF185	50p
AF186	40p
AF239	40p
ASY26	25p
ASY27	30p
ASY28	25p
ASY29	30p
ASZ21	55p
BA100	15p
BA102	30p
BA110	25p
BA115	7p
BAX13	5p
BAX16	7p
BAY31	7p
BAY38	15p
BC107	10p
BC108	10p
BC109	10p
BC109C	12p
BC113	10p
BC114	20p
BC115	20p
BC116	20p
BC116A	25p
BC117	20p
BC118	20p
BC119	30p
BC134	20p
BC135	15p
BC136	20p
BC137	20p
BC138	20p
BC147	12p
BC148	10p
BC149	12p
BC153	20p
BC154	20p
BC167	15p
BC169	12p
BC169C	15p
BC177	20p
BC178	20p
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BC183L	10p
BC184L	12p
BC212L	12p
BC213L	12p
BC214L	15p
BCY30	35p
BCY31	40p
BCY32	60p
BCY33	30p
BCY34	35p
BCY38	45p
BCY39	£1·00
BCY40	50p
BCY70	15p
BCY71	20p
BCY72	15p

BD115	75p
BD123	85p
BD124	80p
BD131	75p
BD132	80p
BDY11	£1·50
BDY17	£1·50
BDY38	65p
BDY60	£1·00
BF115	25p
BF154	20p
BF158	15p
BF159	35p
BF180	35p
BF194	15p
BF195	15p
BF196	15p
BF197	15p
BFX13	25p
BFX29	25p
BFX30	25p
BFX84	25p
BFX85	30p
BFX86	25p
BFX87	25p
BFX88	20p
BFY18	25p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	15p
BFY90	65p
BSX20	15p
BSX21	20p
BSY27	15p
BST95A	12p
BSY95	12p
BU105	£2·25
BY100	15p
BY126	12p
BY124	15p
BY182	90p
BYZ10	35p
BYZ11	30p
BYZ12	30p
BYZ13	25p
BZY78	£1·00
GET102	35p
GET103	25p
GET111	45p
GET113	25p
GET114	20p
GET115	50p
GET116	55p
GET880	45p
GET882	30p
GEX66	£1·50
GM378A	55p
MAT101	25p
MAT121	25p
MC724P	60p
MJ420	80p
MJ421	80p
MJ2801	£1·10
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NKT214	20p
NKT216	35p
NKT403	75p
NKT404	55p
OA5	25p
OA10	25p
OA47	10p
OA70	10p
OA79	10p
OA81	8p
OA90	8p
OA91	7p
OA95	7p
OA200	7p
OA202	10p

OC16	50p
OC20	85p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC42	40p
OC43	50p
OC44	15p
OC45	12p
OC70	12p
OC71	12p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	20p
OC81D	20p
OC81Z	40p
OC83	25p
OC84	25p
OC139	25p
OC140	40p
OC141	60p
OC170	25p
OC171	30p
OC200	40p
OC201	75p
OC202	80p
OC206	95p
OCP71	97p
ORP12	50p
ORP60	40p
ST140	15p
ST141	20p
TIP29A	50p
TIP30A	60p
TIP31A	60p
TIP32A	70p
TIP33A	£1·00
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V405A	25p
VR525	35p
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WO6	45p
ZTX107	15p
ZTX108	12p
ZTX109	15p
ZTX300	12p
ZTX301	15p
ZTX302	20p
ZTX303	20p
ZTX304	25p
ZTX500	15p
ZTX501	15p
ZTX502	20p
ZTX503	17p
ZTX504	40p
ZTX531	26p
1N914	7p
1N916	10p
1N4148	7p
1S44	7p
1S921	7p
1S922	8p
2G301	25p
2G302	30p
2G303	35p
2N404	20p
2N696	15p
2N697	15p
2N698	30p
2N706	10p
2N706A	12p
2N708	15p
2N930	20p
2N987	40p
2N1131	25p
2N1132	25p
2N1302	18p

2N1303	18p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1613	20p
2N2147	75p
2N2160	60p
2N2217	25p
2N2218	20p
2N2218A	25p
2N2219	20p
2N2219A	25p
2N2220	25p
2N2221	20p
2N2221A	25p
2N2222	20p
2N2222A	25p
2N2369	15p
2N2369A	15p
2N2646	40p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	25p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2907A	25p
2N2925	15p
2N2926	10p
2N3011	20p
2N3053	20p
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7402	Quad 2-input NOR gates	20p	18p	16p	14p	12p
7403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7404	Hextuple inverters	20p	18p	16p	14p	12p
7405	Hex inverters with open collector outputs	20p	18p	16p	14p	12p
7410	Triple 3-input NAND gates	20p	18p	16p	14p	12p
7413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
7430	Single 8-input NAND gates	20p	18p	16p	14p	12p
7440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
7441	BCD-Decimal decoder/Nixie driver	75p	72p	70p	60p	55p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder TTL outputs	£1·00	95p	90p	80p	70p
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7453	Quad 2-input expand AND-OR-INVERT gates	20p	18p	16p	14p	12p
7454	4-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7460	Dual 4-input expanders	20p	18p	16p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7472	Single J-K flip flop (gated inputs)	30p	27p	25p	22p	20p
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7474	Dual D flip flop	40p	37p	35p	33p	30p
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7495	4-bit up-down shift register	80p	75p	70p	65p	60p
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SC40B	200	6 amps	£1·05
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1N4003	200	8p	7p	6p	5p	4½p
1N4004	400	8p	7p	6p	5p	4½p
1N4005	600	10p	9p	8p	7p	6p
1N4006	800	12p	10p	9p	8p	7p
1N4007	1000	15p	12p	10p	9p	8p

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2002	200	2a	65p	6004	600	4a	80p
4002	400	2a	75p	1006	100	6a	70p
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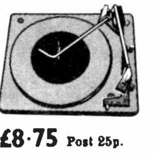

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32/450V	20p	8+8/450V	18p	350+50/325V	50p
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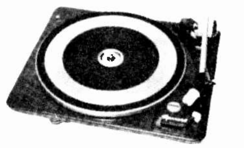

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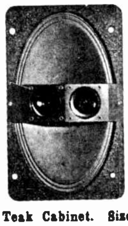

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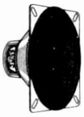
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

GOODMANS 6½in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3¾ × 3¾ × 2in. deep. Rating 10 watt. 3 ohm or 15 ohm models. **£1·90** Post 10p

SPEAKER COVERING MATERIALS. Samples Large S.A.E. Horn Tweeters 2-16Kc/s, 10W 8 ohm or 15 ohm £1·50. De Luxe Horn Tweeters 2-18 Kc/s, 15W, 15 ohm £3. **TWO-WAY 3,000 c.p.s. CROSSOVERS** 3 or 8 or 15 ohm 95p.
SPECIAL OFFER! 80 ohm. 2¾in. 2½in. 35 ohm, 2in.; 3 in. 25 ohm, 2½in. dia.; 3in. dia.; 6 × 4in; 8 × 5in. 15 ohm, 3½in. dia.; 6 · 4in; 7 × 4in; 3 ohm, 2½in. 3in. 5in, 5 × 3in. **£1** EACH TYPE
LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8 × 2½in. £1·50; 8in. £1·75; 10 × 6in. £1·90.
RICHARD ALLAN TWIN CONE LOUDSPEAKERS 8in. dia. 4 watt; 10in. dia. 5 watt; 12 in. dia. 6 watt, 3 or 8 or 15 ohm models £2 each. Post 15p.
VALVE OUTPUT TRANS. 25p. **MIKE TRANS.** 50:1 25p.
5 WATT MULTI RATIO, 3, 8 and 15 ohms 80p.

BAKER 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

4 inputs speech and music. Mixing facilities. Response 10–30,000 cps. Matches all loudspeakers. A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£39** Post Free

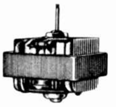
BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4·50**

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. Stereo version of above £4·50. **£3·50**

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt. Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4 inch **£12·50**
BARGAIN FM TUNER as above. Chassis only, less cabinet. **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3·50**

COAXIAL PLUG 6p, **PANEL SOCKETS** 6p. **LINE** 18p. **OUTLET BOXES. SURFACE OR FLUSH** 25p. **BALANCED TWIN FEEDERS** 5p yd. 80 ohms or 300 ohms. **JACK SOCKET** Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p, Phono Socket 5p. **JACK PLUGS** Std. Chrome 15p; 3·5mm Chrome 14p. **DIN SOCKETS** Chassis 3-pin 10p; 5-pin 10p. **DIN SOCKETS** Lead 3-pin 18p; 5-pin 15p. **DIN PLUGS** 3-pin 18p; 5-pin 25p. **VALVE HOLDERS,** 5p; **CERAMIC** 8p; **CANS** 5p.



E.M.I. TAPE MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3¾ × 2¾ × 2¼in. (illustrated). Post 15p. **£1·25**

BALFOUR GRAM. MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 50mA. Spindle ¾ × 3/20. Size. 2¾ × 2¾ × 1¼in. **85p** Post 15p

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NEWS BRIEFS

SOLID-STATE EYE

A SMALL research model of a black-and-white camera employing a solid-state "eye" that could make possible future TV cameras as small as a wristwatch was demonstrated recently by RCA.

The camera's imaging sensor is a silicon integrated circuit in contrast to the vacuum tubes of conventional TV systems.

The camera's integrated circuit "eye" consists of 32 rows of photo-sensitive elements, with 44 elements in each row. When an image strikes the array, an electrical charge proportional to the light intensity is produced in each element. The rows are read out very rapidly in sequence to produce a black-and-white television-type picture.

A model of the camera, developed at RCA Laboratories in Princeton, America, has been delivered for evaluation to the Air Force Avionics Laboratory in Ohio, which sponsored research on the system.

LASAR DRILLS FOR DIAMONDS

MINUTE flaws and other imperfections in diamond gemstones can now be removed by use of a laser developed by the Raytheon Company of America.

In a series of experiments on natural diamonds, light energy from the laser was focused to extremely small areas and tiny holes "drilled" to the imperfections. The imperfections are then removed by a variety of methods and the small-diameter holes cleaned.

The holes pierced by the laser are about two-thousandths of an inch in diameter—about the diameter of a human hair. These holes are not generally visible without magnification, and because of their small diameters, they do not change the stone's natural reflections.

SPACEWATCH

THE International Telecommunication Union has made a proposal that a satellite communications system should be set up to provide aid following natural disasters such as earthquakes and floods.

The ITU proposes the setting up of an organization in Geneva from where the coverage using two geo-stationary satellites over the Equator would be world-wide. Communications links required with this scheme include walkie-talkie radios, medium distance multi-channel voice links and a mobile earth station. All this equipment would be air transportable with self-contained power sources.

DOLBY SOUND IN THE CINEMA

RANK Audio Visual Ltd., in agreement with Dolby Laboratories, are now making Dolby noise reduction units available to cinemas on a rental basis. The new unit (Model 364) is a modification of the now well known Dolby "A" system. This reduces noise levels by boosting low level signals at all stages of recording until playback when they are reduced to their original level.

Cinema film sound is usually read from an optical track which is characteristically noisy, grain and dirt being the main offenders. The h.f. range of cinema sound is thus severely limited. By reducing noise the h.f. response can be greatly improved, for instance by using a better quality speaker system.

The full potential of the playback unit will not be realised until Dolbied films are available, but Rank demonstrations have shown that in use with existing films the 364 unit gives a healthy though not dramatic improvement. At only £2·74 per week, many cinema owners should soon be taking advantage of this chance to improve the weak link in the film projection system.

charger-unit

BY C.MARSHALL

An inexpensive 9V supply and Deac battery charger combined

If you use your transistor portable at home, this power supply unit will be a worthwhile investment. It will replace a 9V battery, the most common of supply voltages, by simply connecting the radio battery terminals to the output of the unit. Although this is a constant current device the power available is more than adequate for the majority of good quality transistor radios.

A built in bonus is the facility for charging nickel cadmium or Deac batteries. As any user of secondary cells knows, regular charging is the only way to get the best out of these.

DROPPING THE VOLTAGE

The circuit of Fig. 1 is unusual in that the normal mains voltage dropping transformer is missing, in this a capacitor (C1 or C2) is used to fulfil this function. One of the great advantages of using a reactance whether it be capacitive or inductive, is the fact that very little power is consumed although a voltage is dropped and a current passed.

For the capacitors used the reactance presented to the mains input is $1/(2\pi fC)$ ohms. This is, of course, an idealised figure since the capacitor diode bridge and load have resistance so the formula should be modified to $Z = \sqrt{(X_c^2 + R^2)}$ where X_c is the reactance and R the total circuit resistance. If comparative measurements were made it would be found that the reactance figure would be far in excess of the resistance figure so that we can say that the circuit is constant current device, the value being dependent on the series capacitance as the load presented plays little part in modifying the total impedance.

CROSSING THE BRIDGE

With the mains voltage applied and dropped it only remains for it to be rectified and smoothed. In this circuit the diodes D1–D4 afford rectification and the capacitor C3, smoothing. By rectification is meant the conversion of a.c. to d.c. However, when there is conversion there is normally some ripple present, so the capacitor C3 attempts to smooth this before it is passed on to the load.

ZENER PROTECTION

The diode D5 has the unique function of deciding the output voltage. In the condition of no load, the voltage at the output would approach that of mains potential which could be dangerous. With the Zener diode D5 in circuit the voltage will drop to 9·1V. Obviously any low voltage diodes would be destroyed without this protective influence, so the diode serves as protection to the bridge and to supplying an output voltage on load of about 9V.

BATTERY CHARGING

Up to now we have only dealt with the unit in its power supply role at 9V. As a flexible secondary cell

COMPONENTS . . .

Resistors
R1 680kΩ ½watt carbon

Capacitors
C1 0·68μF 400V
C2 0·33μF 400V
C3 5,000μF elect. 25V

Diodes
D1–D4 1S100 or any silicon diodes of 50 p.i.v. and current capacity greater than 100mA
D5 ZS9·1 Zener (see text)

Switches
S1 Double-pole mains on/off toggle
S2 Single-pole, double throw

Miscellaneous
LP1 Mains neon, FS1-500mA fuse, 2in × 1½in Veroboard 0·15in matrix

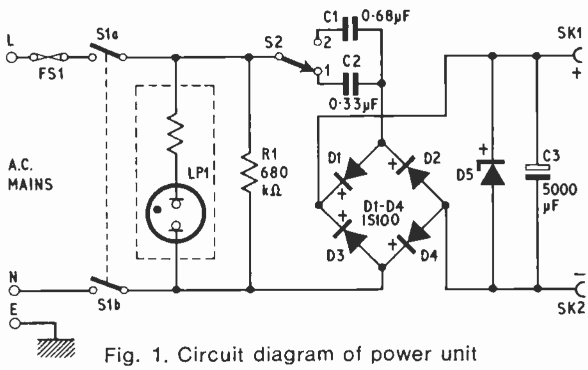


Fig. 1. Circuit diagram of power unit

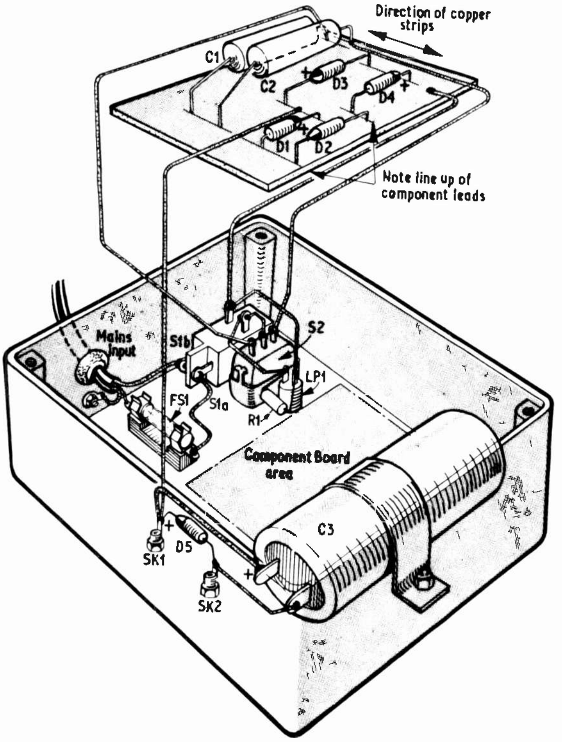


Fig. 2. Veroboard layout and interwiring details of power unit

charger there are a number of other points to be considered.

When charging a nickel cadmium cell it should be remembered that the charging current should not exceed the 10 hour rate. By this is meant that for a 200mAH cell, the charge current should be 200/10 = 20mA and at 225mAH, the current is 225/10 = 22·5mA.

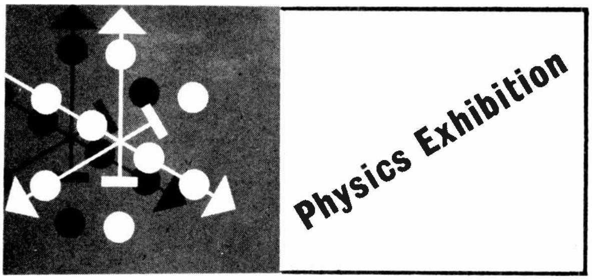
To recharge a totally discharged battery the total charge time should be the charging rate times 1·4. For example, if current is being replaced at the 10 hour rate the total time for recharge would be 10 × 1·4 = 14 hours.

With the circuit shown, in position 1 of the function switch S2, the unit will provide 25mA with Zener protection, for up to five Deac cells. This follows since the maximum charging voltage per cell is 1·5V, so that in the circuit given the output voltage will be around 9V with the cells disconnected. With a battery connected this will start to charge and the Zener diode will be cut off.

While the Zener diode will prove adequate for charging up to five cells, two ZS9·1 diodes connected in series should be used for six to ten cells, that is, for charging a 9 to 15V battery.

UNIT ASSEMBLY

The small components are assembled on a 2in × 1½in piece of 0·15in matrix Veroboard, as in Fig. 2. Also given here are the complete interwiring details for the unit. The actual box dimensions for the prototype was 6in × 4in × 1½in but since any rearrangement of the components will not adversely affect performance, other housings can be tried. ★



THE poor level of participation at this year's, the fifty-sixth, Physics Exhibition, was particularly evident by the large area of unused floor space in the Great Hall of Alexandra Palace. Earlier this year (March 13–16) this showcase of scientific instruments and apparatus seems to have been a sufferer of the same economic exigencies that have been denuding commercial exhibitions, particularly on the electronic scene.

With a reduction of nearly fifty per cent of last year's exhibitor count, the translation of the venue and amalgamation with another exhibition would seem inevitable. This, in fact, is what will happen next year when this will combine under the joint title of Labex and Physics Exhibition and be held at Earls Court. This Mecca will no doubt assure the future viability of this high quality scientific exhibition, but for me its "Ally-Pally" situation seemed in tune with its not too commercial, academic tenor.

This year the special features included exhibits arranged by the Electronics, Optical and Spectroscopy Group, to mark the occasion of the 1971 Nobel Prizes for both physics and chemistry to Professor Gabor for his developments of holography and Dr Herzberg for his work on the electronic structure and geometrics of molecules.

With man's desire for faster travel comes an awareness of the limitations of the existing systems. Conventional steel wheel-on-rail suspensions are limited to about 200 m.p.h. In overcoming this barrier two avenues have been explored; air suspension (hovercraft) and magnetic levitation (linear motors). While the former is commercially viable and a 250 m.p.h. tracked hovercraft will soon be starting test trials in this country, the linear motor has not yet enjoyed the same emergence.

The Department of Engineering at the University of Warwick demonstrated a linear motor model using superconducting magnets for the suspension and guidance of high speed vehicles with a conducting track.

In the same vein, a fascinating exhibit on the Decca Radar stand was a piezo-electric transducer in disc form made to act as a linear motor when subjected to ultrasonic vibrations at its resonant frequency. When excited this disc propelled itself silently along an inclined surface at speeds which were infinitely controllable up to 10cm/s: Possible research applications for this are tape and chart recorder drives and conveyor belts.

Ultrasonics also have applications in medicine as was shown by the Medical Research Council. The exhibit demonstrated that instantaneous blood velocity in the human aorta could be measured by Doppler analysis without involving the patient in chest surgery so enabling a quick assessment of heart pumping action.

A recent development from Mullard is a channel image intensifier which is fitted to the front of a television camera and can provide a gain of up to a hundred thousand so enabling the camera to produce bright clear pictures even in starlight.

Other Mullard exhibits included a fruit machine and a digital clock both specially devised for their educational service.

It is this sort of diversity that makes the Physics Exhibition so appealing and we can only hope that in its move to Central London that it manages to retain its particular identity. ★

Readout—
A SELECTION FROM OUR POSTBAG

Correspondents wishing to have a reply must enclose a stamped addressed envelope. We regret we are unable to guarantee a reply on matters not relating to articles published in the magazine. Technical queries cannot be dealt with on the telephone.

Wrong formula

Sir—I have been teaching Physics, not pure Nuffield but with a slant that way, for only 10 years, but I share Mr. Cozens' concern, see "Paradoxical Stage" April *Readout*.

Perhaps he will be glad to know that the Association for Science Education, the Institute of Physics, and the numerous "new Maths" authorities are also aware and worried. The incompetence of pupils trained by some of the experimental methods is very obvious, and Mr. Cozens is quite right in saying that Physics teachers have to do their own traditional Maths teaching.

At an earlier stage, a colleague of mine who teaches both trad and modern Maths finds he has to teach 14 year olds that, say, 4·18 on a scale lies between 4·10 and 4·20. And at a higher level, some University entrance authorities are less than happy about the mathematical incompetence of many applicants who hold Maths and Physics Highers and A levels.

Incidentally, it's probably a traditional printer's error, but Mr. Cozens has the Wheatstone Bridge formula wrong. And very few pupils with a modern Physics Higher would know what a Wheatstone Bridge is, although they would know what to do with a collection of gates and a 5V supply.

It's sad that the same blind concern with change and trendiness affects the attitudes of some modern teachers to things like not hurting other people's feelings unless you really want to (manners), and sometimes getting on with something when you want to do something else (discipline). Luckily, most of these educational experiments are rethought before too much harm has been done.

W. H. Jarvis, M.A., A.Inst.P.,
Perthshire,
Scotland.

I hope Mr. Jarvis is right in saying that educational experiments are usually put right before too much harm is done, but I am afraid I do not share his optimism, I think that this particular experiment with the "New Maths" should be left until the student has safely passed C.S.E. or G.C.E. in traditional maths.

About my error in the Wheatstone Bridge formula Mr. Jarvis is right. I will try to make it clear.

When the bridge is balanced

$$\frac{R1}{R2} = \frac{R3}{R4}$$

If R1 is unknown resistance and R2 is the standard known resistance then

$$R1 = \frac{R3}{R4} \times$$

G. A. Cozens.

Better performance

Sir—As your Ferranti boys' *Scorpio* ignition looked the most sophisticated circuit yet published I purchased a set of components and assembled it for my Rover 2000 SC. The result is a distinctly brighter performance.

From the photograph enclosed you will notice that I have transposed the transformer and circuit connector block to suit the Rover. I have also clamped down the two large discharge capacitors by means of a hard Dural bridge-piece and a stainless steel rod screwed 6B.A. This rod passes through a clearance hole in the circuit board and is secured to the case by a couple of nuts. This is a more secure fixing than anchoring to the board which could distort in time and allow the clamp to loosen.

Recently I went with a stop-watch to my favourite testing stretch of level road (there are six miles of it) and got the following results.

Top gear: 30-50m.p.h. 11·4 secs. Scorpio 10·0 secs.
Top gear: 50-70m.p.h. 14·8 secs. Scorpio 11·2 secs.
3rd gear: 30-50m.p.h. 7·5 secs. Scorpio 7·0 secs.
3rd gear: 50-70m.p.h. 9·7 secs. Scorpio 8·6 secs.

The above results with brand new contact points, once they were burnt down a bit the discrepancy would be greater as I had previously found that after about 4,000 miles the engine got rough over 5,000 revs due to erratic ignition timing with the points pitted.

Please convey my congratulations to Messrs. Gibbs and Shaw.

G. A. Turner,
Airdrie, Lanarkshire.

Mumbo-jumbo

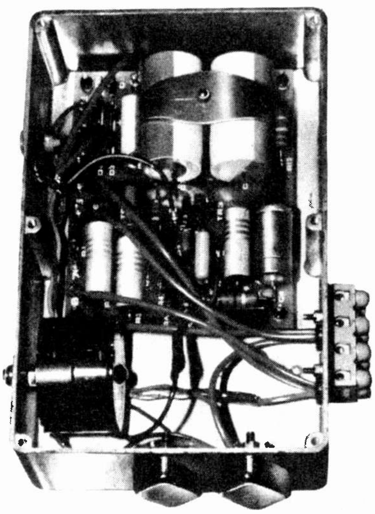
Sir—I resumed buying P.E. last December especially for the articles on "Logical Radio Control" and like Mr. W. G. Jones, (Letters, March issue), I found the whole thing almost unintelligible. I should like to make it clear that I have worked as a technician for a number of years in various types of laboratories and am used to unravelling the intricacies of strange systems.

This is England, I am English and your magazine prints articles in English for me to understand. Of course Electronics has its own slice of language to be understood, but surely all the bits of electronic language have to be joined by clear, simple English. If you like, try printing your magazine using only an Electronic Dictionary and see how far you get!

Needless to say, I have not built any of the radio control circuits described (?) in the articles and feel disappointed about them. No doubt if I built them up just as shown and connected them all together it would all work, but I wouldn't know why and would have learnt nothing—and what if something went wrong? I was going to complain before now but let it slide until I read your Editorial in the April issue in which you seem to be defending the type of bad technical writing under discussion; your attitude being that it is our fault if we don't understand the mumbo-jumbo.

If your motives are good I can only assume that you don't realise how difficult it is to be a teacher and pass on information in a clear manner. If on the other hand, your intentions are less honourable I suppose it is in order to maintain some sort of superior position by withholding information.

C. F. Hughes,
Bedford.



Sinclair Project 60

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.
Performance characteristics are so good they hold their own with any other available system irrespective of price or size.
Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
12 W. RMS continuous sine wave stereo amp for average needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag P.U., F.M. Tuner, etc	**£23.90**
25 W. RMS continuous sine wave stereo amp using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60 W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60 PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

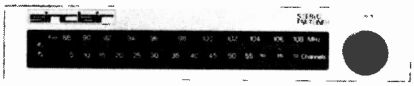
F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

sinclair

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

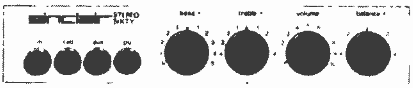


The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** 20μV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz ($\pm$1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC.
Indicators: Stereo on; tuning. **Size:** 93 x 40 x 207mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**

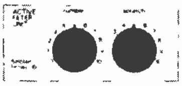


Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation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

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve $\pm$1dB: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV; Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 12 to —12dB at 10 KHz: BASS + 12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

A.F.U. High & Low Pass Filter Unit

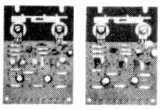
Built tested and guaranteed. **£5.98**



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (—3dB) variable from 28KHz to 5KHz. L.F. cut-off (—3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) 0.02% at rated output. **Size:** 66 x 40 x 90 mm.

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. **Z.30 £4.48** **Z.50 £5.48**



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).***

Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts. 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
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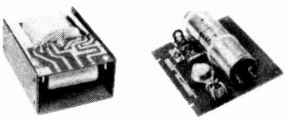

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2N1307	0·25	ASY28	0·25		0·75	OA70	0·10	OC205	0·75
2N1308	0·25	ASY29	0·30	BTY42	0·92	OA71	0·10	OC206	0·90
2N1309	0·25	ASY36	0·25	BTY79/100R		OA73	0·10	OC207	0·90
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ASY50	25p
ASY51	32½p
ASY54	25p
ASY86	32½p
ASZ21	42½p
AU103	£1·25
BC107	10p
BC108	10p
BC109	10p
BC113	15p
BC115	15p
BC116A	15p
BC118	10p
BC121	20p
BC122	20p
BC125	20p
BC126	20p
BC140	37½p
BC147	10p
BC148	10p
BC149	12p
BC152	17½p
BC157	20p
BC158	11p
BC159	12p
BC160	62½p
BC167	11p
BC168B	10p
BC168C	11p
BC169B	11p
BC169C	12p
BC170	12½p
BC171	15p

BC172	15p
BC175	22½p
BC182	10p
BC183	9p
BC184	11p
BC212L	13p
BCY30	27½p
BCY31	30p
BCY32	50p
BCY33	25p
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BCY38	40p
BCY39	60p
BCY40	50p
BCY42	15p
BCY43	15p
BCY54	32½p
BCY58	22½p
BCY59	22½p
BCY60	97½p
BCY70	20p
BCY71	25p
BCY72	17½p
BCZ10	27½p
BCZ11	42½p
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BD132	85p
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BDY11	£1·62½
BDY17	£1·50
BDY18	£1·75
BDY19	£1·97½
BDY20	£1·12½
BDY38	97½p
BDY60	£1·25
BDY61	£1·25
BDY62	£1
BF115	25p
BF117	47½p
BF163	37½p
BF167	18p
BF173	19p
BF177	30p
BF178	30p
BF179	30p
BF180	35p
BF181	32½p
BF184	25p
BF185	42½p
BF194	17½p
BF195	15p
BF196	42½p
BF197	42½p
BF198	42½p
BF200	52½p
BF224	14p
BF225	19p
BF237	23p
BF238	23p
BF244	23p
BFW58	27½p
BFW59	25p
BFW60	25p
BFW61	47½p
BFX12	22½p
BFX13	22½p
BFX29	30p
BFX30	30p
BFX43	37½p
BFX44	37½p
BFX68	67½p
BFX84	25p
BFX85	32½p
BFX86	25p
BFX87	27½p
BFX88	25p
BFX89	62½p
BFX93A	70p
BFY10	32½p
BFY11	42½p
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BFY24	45p
BFY25	25p
BFY26	20p
BFY29	50p
BFY30	50p
BFY41	50p
BFY43	62½p
BFY50	23p
BFY51	20p
BFY52	23p
BFY53	17½p
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BFY75	30p
BFY76	42½p
BFY77	57½p
BFY90	67½p
BPX25	£1·85
BPX29	£1·80
BPY10	£1·45
BRY39	47½p
BSW41	42½p

BSW70	27½p
BSX19	17½p
BSX20	17½p
BSX21	37½p
BSX26	45p
BSX27	47½p
BSX28	32½p
BSX60	82½p
BSX61	62½p
BSX76	22½p
BSX77	27½p
BSX78	27½p
BSX78	27½p
BSY10	27½p
BSY11	27½p
BSY24	15p
BSY25	15p
BSY26	17½p
BSY27	17½p
BSY28	17½p
BSY29	17½p
BSY32	25p
BSY36	25p
BSY37	25p
BSY38	22½p
BSY39	22½p
BSY51	32½p
BSY52	32½p
BSY53	37½p
BSY54	40p
BSY56	90p
BSY78	47½p
BSY79	45p
BSY82	52½p
BSY90	57½p
BSY95A	12½p
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C424	27½p
C425	55p
C426	40p
C428	37½p
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D16P2	40p
D16P3	37½p
D16P4	40p
D40N1	75p
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GET113	20p
GET114	20p
GET118	20p
GET119	20p
GET120	52½p
GET873	12½p
GET880	30p
GET887	20p
GET889	22½p
GET890	22½p
GET896	22½p
GET897	22½p
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MJ420	£1·12½
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MJE3055	87½p
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NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	22½p
NKT215	22½p
NKT216	37½p
NKT217	42½p
NKT219	30p
NKT223	27½p
NKT224	25p
NKT225	22½p
NKT229	30p
NKT237	35p

NKT238	25p
NKT240	27½p
NKT241	27½p
NKT242	20p
NKT243	62½p
NKT244	17½p
NKT245	20p
NKT261	20p
NKT262	30p
NKT264	20p
NKT271	20p
NKT272	20p
NKT274	20p
NKT275	20p
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NKT402	90p
NKT403	75p
NKT404	62½p
NKT405	75p
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NKT613F	32½p
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NKT677F	30p
NKT713	25p
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NKT20339	37½p
NKT80111	77½p
NTK80112	97½p
NKT80113	£1·12½
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OC23	60p
OC24	60p
OC25	50p
OC26	27½p
OC28	62½p
OC29	62½p
OC35	50p
OC36	62½p
OC41	22½p
OC42	25p
OC44	20p
OC45	12½p
OC46	15p
OC70	15p
OC71	12½p
OC72	12½p
OC74	32½p
OC75	22½p
OC76	22½p
OC77	30p
OC81	20p
OC81D	22½p
OC83	25p
OC84	25p
OC139	32½p
OC140	32½p
OC170	30p
OC171	30p
OC200	40p
OC201	60p
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2	200	41p	6	50	62p
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			6	400	£1·10

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¼ watt 5%. 1p.
½ watt 5%. 1½p.
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1 watt 10%. 2½p.
2 watt 10%. 6p.

⅛W & ¼W are E24 series.
½W, 1W, & 2W are E12 series.

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0·01, 0·022, 0·033, 0·047, 3p; 0·068, 0·1, 4p each.
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74 Series T.T.L. I.C's

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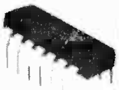

Check our 74 Series List before you by any I.C's. Our prices are the lowest possible. All devices ex-stock. Full spec. guaranteed.

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP00=SN7400	0·15	0·14	0·12
BP01=SN7401	0·15	0·14	0·12
BP02=SN7402	0·15	0·14	0·12
BP03=SN7403	0·15	0·14	0·12
BP04=SN7404	0·15	0·14	0·12
BP05=SN7405	0·15	0·14	0·12
BP07=SN7407	0·18	0·17	0·16
BP08=SN7408	0·18	0·17	0·16
BP09=SN7409	0·18	0·17	0·16
BP10=SN7410	0·15	0·14	0·12
BP13=SN7413	0·29	0·26	0·24
BP16=SN7416	0·43	0·40	0·38
BP17=SN7417	0·43	0·40	0·38
BP20=SN7420	0·15	0·14	0·12
BP30=SN7430	0·15	0·14	0·12
BP40=SN7440	0·15	0·14	0·12
BP41=SN7441	0·67	0·64	0·58
BP42=SN7442	0·67	0·64	0·58
BP43=SN7443	1·95	1·85	1·75
BP44=SN7444	1·95	1·85	1·75
BP45=SN7445	1·95	1·85	1·75
BP46=SN7446	0·97	0·94	0·88
BP47=SN7447	0·97	0·94	0·88
BP48=SN7448	0·97	0·94	0·88
BP50=SN7450	0·15	0·14	0·12
BP51=SN7451	0·15	0·14	0·12
BP53=SN7453	0·15	0·14	0·12
BP54=SN7454	0·15	0·14	0·12
BP60=SN7460	0·15	0·14	0·12
BP70=SN7470	0·29	0·26	0·24
BP72=SN7472	0·29	0·26	0·24
BP73=SN7473	0·37	0·35	0·32
BP74=SN7474	0·37	0·35	0·32
BP75=SN7475	0·47	0·45	0·42
BP76=SN7476	0·43	0·40	0·38
BP80=SN7480	0·67	0·64	0·58
BP81=SN7481	0·97	0·94	0·88
BP82=SN7482	0·97	0·94	0·88
BP83=SN7483	1·10	1·05	0·95

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP86=SN7486	0·32	0·30	0·28
BP90=SN7490	0·67	0·64	0·58
BP91=SN7491AN	0·87	0·84	0·78
BP92=SN7492	0·67	0·64	0·58
BP93=SN7493	0·67	0·64	0·58
BP94=SN7494	0·77	0·74	0·68
BP95=SN7495	0·77	0·74	0·68
BP96=SN7496	0·77	0·74	0·68
BP100=SN74100	1·75	1·65	1·55
BP104=SN74104	0·97	0·94	0·88
BP105=SN74105	0·97	0·94	0·88
BP107=SN74107	0·40	0·38	0·36
BP110=SN74110	0·55	0·53	0·50
BP111=SN74111	1·25	1·15	1·00
BP118=SN74118	1·00	0·95	0·90
BP119=SN74119	1·35	1·25	1·10
BP121=SN74121	0·67	0·64	0·58
BP141=SN74141	0·67	0·64	0·58
BP145=SN74145	1·50	1·40	1·30
BP150=SN74150	1·80	1·70	1·60
BP151=SN74151	1·00	0·95	0·90
BP153=SN74153	1·20	1·10	0·95
BP154=SN74154	1·80	1·70	1·60
BP155=SN74155	1·40	1·30	1·20
BP156=SN74156	1·40	1·30	1·20
BP160=SN74160	1·80	1·70	1·60
BP161=SN74161	1·80	1·70	1·60
BP164=SN74164	2·00	1·90	1·80
BP165=SN74165	2·00	1·90	1·80
BP181=SN74181	2·75	2·60	2·40
BP182=SN74182	0·97	0·94	0·88
BP190=SN74190	3·50	3·25	3·00
BP191=SN74191	3·50	3·25	3·00
BP192=SN74192	2·10	1·95	1·75
BP193=SN74193	2·10	1·95	1·75
BP125=SN74195	1·10	1·05	0·95
BP196=SN74196	1·80	1·70	1·60
BP197=SN74197	1·80	1·70	1·60
BP198=SN74198	5·50	5·00	4·00
BP199=SN74199	5·50	5·00	4·00

PRICE-MIX. Devices may be mixed to qualify for quantity prices.

PRICES for quantities in excess of 500 pieces mixed, on application.

Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

LINEAR I.C's—FULL SPEC.

Type No.	Price 1-24	25-99	100 up
BP 201C—SL201C	63p	58p	45p
BP 701C—SL701C	63p	50p	45p
BP 702C—SL702C	63p	50p	45p
BP 702—72702	53p	45p	40p
BP 709—72709	53p	45p	40p
BP 709P—μA709C	53p	45p	40p
BP 710—72710	53p	45p	40p
BP 711—μA711	58p	50p	45p
BP 741—72741	75p	60p	50p
μA 703C—μA703C	43p	35p	27p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350	170p	158p	150p

S.G.S. EA 1000 £2·63.

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

Type No.	Price 1-24	25-99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

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

NUMERICAL INDICATOR TUBES

MODEL	CD66	GR116	3015F
Anode voltage (Vdc)	170 min	175 min	5 min
Cathode current (mA)	2·3	14	8
Numeral height (mm)	16	13	9
Tube height (mm)	47	32	22
Tube diameter (mm)	19	13	12 wide
I.C. driver rec.	BP41 or 141	BP41 or 141	BP47
Price each	£1·70	£1·55	£1·90

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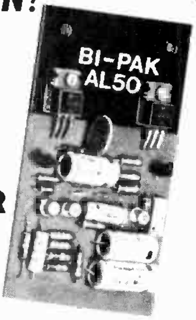

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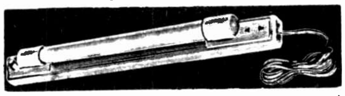

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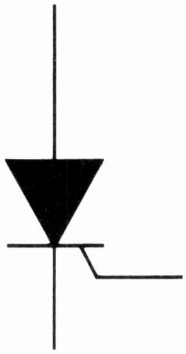

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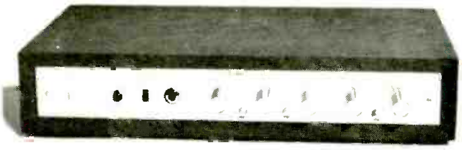

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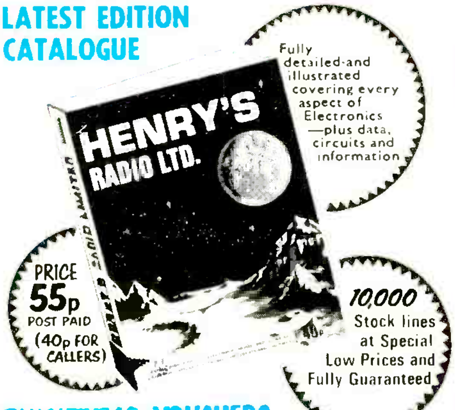

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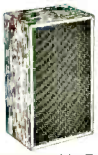

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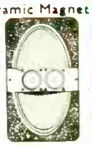

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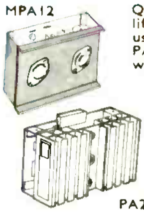

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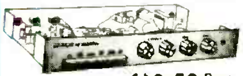

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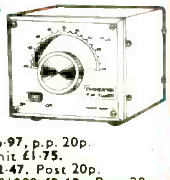

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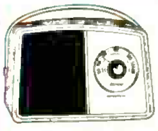

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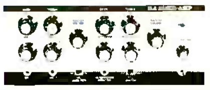

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