

PRACTICAL ELECTRONICS

MARCH 1967

PRICE 2/6



PROXIMITY DETECTOR ALARM

Also

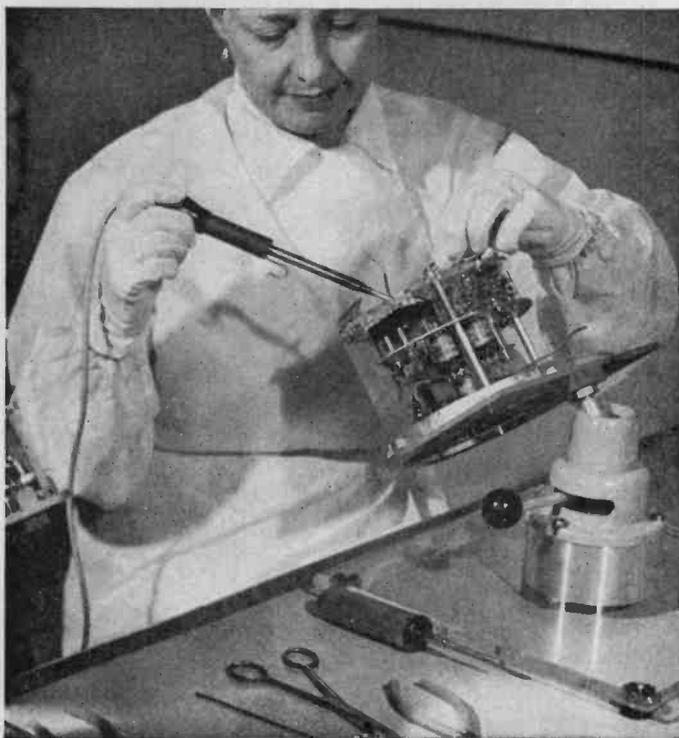
SPECIAL
IN THIS ISSUE!

RADIATION COUNTER
PHOTOFLASH SLAVE UNIT
THE OSCILLOSCOPE -
AND ITS APPLICATIONS

ADCOLA
PRODUCTS LIMITED
(Regd. Trade Mark)

**SOLDERING
EQUIPMENT**

Preferred by Experts



Photograph by the courtesy of Submarine Cables Ltd.

FOR SALES & SERVICE APPLY DIRECT TO:

**ADCOLA PRODUCTS LTD.
ADCOLA HOUSE
GAUDEN ROAD
LONDON, S.W.4**

**TELEPHONE:
MACaulay 0291/3**

**TELEGRAMS:
SOLJOINT, LONDON S.W.4**

LASKY'S RADIO

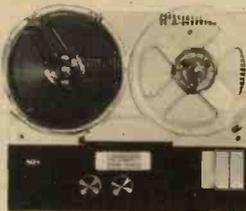
For the Finest Value and Service to HOME CONSTRUCTORS & ELECTRONICS ENTHUSIASTS

We consider our construction parcels to be the finest value on the home constructor market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.

TAPE RECORDERS

MAGNAVOX 363 DECKS

The very latest 3 speed model—1, 3, 7, 1/2 i.p.s. available with either 1/2 track or 1/4 track head. Features include: pause control; digital counter; fast forward and rewind; new 4 pole fully screened induction motor; interlocking keys. Size of top plate: 13 1/2 x 11 x 3/4 in. deep below unit plate. For 200/250 v. A.C. mains, 50 c.p.s. operation. New unused and fully guaranteed.



LASKY'S PRICE 1/2 track **£10.10.0**
model
LASKY'S PRICE 1/4 track **£13.9.6**
model

Carriage and Packing 7/6 extra.

SPECIAL FOR OVERSEAS CUSTOMERS—the new Magnavox-Collaro 363 Deck for 110/125 v. 50 or 60 c.p.s. mains now available, prices as above. Post to any part of the world 35/-.

MARTIN RECORD/REPLAY TAPE AMPS.

Latest models now available from stock—for use with the Magnavox 363 Tape Deck
1/2 track model **LASKY'S PRICE £14.19.6** Carriage and Packing 4/6 extra
1/4 track model **LASKY'S PRICE £15.19.6**

Optional extra: Control panel escutcheon to take deck and amplifier controls. **LASKY'S PRICE 12/6.** Post and Packing 2/6.

SPECIAL INTEREST ITEMS!

SPECIAL PURCHASE—UHF/VHF T.V. TUNERS

Well known British makers' surplus stocks. Now available for the first time to the Home Constructor. Add 2/6 Post and Packing on each.

VALVE UHF MODEL (illustrated)
In metal case size 4 x 6 x 1 1/2 in. Fully tunable—complete with PCC86 and PCC88 valves. **LASKY'S PRICE 29/6.** Without valves 12/6

TRANSISTORISED UHF MINATURE MODEL I
Shielded metal case only 3 1/2 x 1 1/2 x 3 in. Fully tunable—complete with two AF 139 transistors. **LASKY'S PRICE 39/6**

TRANSISTORISED UHF MODEL 2
Metal case size 3 1/2 (plus spindle) x 2 1/2 x 1 1/2 in. Fully tunable with slow motion drive. Comp. with two AF186 transistors and leads. **LASKY'S PRICE 25/6**

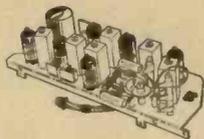
TRANSISTORISED VHF TUNER
Sub-minature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors
In metal case size 3 x 1 1/2 x 2 1/2 in. **LASKY'S PRICE 37/6**

Add 2/6 Post and Packing on each.

MAKERS' SURPLUS TELEVISION IF AMPLIFIERS

38 Mc/s. Contains a large number of components, 1F transformers, resistors, capacitors, etc., and the following valves: 2XPCF80, 1XB91, EF80, EF183 and EF184. Overall size 11 1/2 x 3 1/2 x 4" deep. Ideal for servicemen and experimenters. This IF amp. when used with the Valve model UHF Tuner (above) provides a suitable conversion for B.B.C.2. Circuit supplied.

LASKY'S PRICE 29/6 Post 2/6



SPECIAL PACKAGE OFFER

Free standing table cabinet, size 17 1/2 x 9 x 5 1/2 in., finished in medium Mahogany. Scale marked 23 to 68 (UHF band). Designed to accept the above IF Amplifier with space for a Valve UHF Tuner. Cabinet only 27/6 Post 3/6



Special Package Offer IF Amplifier, UHF Tuner with valves and Table Cabinet. **PACKAGE PRICE, 59/6,** Post 6/6.

WATER TEMP. THERMOSTATS

British made—orig. for use in high quality washing machine. range adjustable between 114°F and 230°F. Rating 200/250 V.A.C., 20 amps (also D.C. up to 125 V.A.). Size 2 1/2 x 1 1/2 x 1 1/2 in. with 18 in. capillary tube and 6 in. bulb. single hole fixing—3/16 in. spindle.

LASKY'S PRICE 15/- Post 2/6.

207 EDGWARE ROAD, LONDON, W.2 Tel: PAD 3271
118 EDGWARE ROAD, LONDON, W.2 Tel: PAD 9789
33 TOTTENHAM CT. ROAD, LONDON, W.1 Tel: MUS 2605

The above branches open all day Saturday. Early closing Thursday.

Please address all Mail Orders and Correspondence to 3-15 Cavell Street, Tower Hamlets, London, E.1.

CONSTRUCTORS BARGAINS

The "Sixteen" Multirange METER KIT

This outstanding meter was featured by *Practical Wireless* in the Jan. '64 issue. Lasky's are able to offer the complete kit of parts as specified by the designer.
RANGE SPECIFICATION: D.C. volts: 0-2.5-5-25-50-250-500 at 20,000 Ω/V. A.C. volts: 0-25-50-250-500 at 1,000 Ω/V. D.C. current: 0-50 μA, 0-2.5-50-250 mA. Resistance: 0-2,000 Ω, 0-200 kΩ, 0-20 MΩ. Basic movement: 40 μA i.s.d. moving coil. With universal shunt full scale deflection current is 50 μA. Black plastic case—3 1/2 x 5 1/2 x 1 1/2 in. Controls: 12 position range switch; separate slide switch for A.C. volts—D.C. ohms; ohms zero adjustment pot, meter, meter zero. Power requirements: One 1.5v. and one 1.5v. bats. Complete with all parts and full construction details. H.P. Terms available.

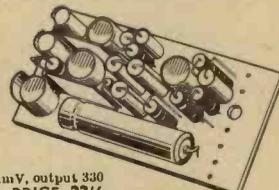


Data and circuit available separately, 2/6; refunded if all parts bought. Pair of batteries 2/- extra.

LASKY'S PRICE £5.19.6. P. & P. 3/-

NEW—LASKY'S MINIATURE TRANSISTOR AMPLIFIER MODULES

Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extreme small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9v. miniature battery. Add 1/- on each for post & packing



TYPE LRPC 1. 3 transistor. Input sens. 50 mV, output 150 mV, output imp. 40 Ω, size 2 x 1 x 1 1/2 in. **PRICE 27/6**
TYPE LRPC 2. 5 transistor. Input sens. 1mV, output 330 mV, output imp. 15 Ω, size 2 1/2 x 1 1/2 x 2 in. **PRICE 22/6**
TYPE LRPC 3. 5 transistor. Input sens. 5 mV, output 400 mV, output imp. 15 Ω, size 2 1/2 x 1 1/2 x 2 in. **PRICE 25/6**
TYPE LRPC 4. 5 transistor. Input sens. 150 mV, output 330 mV, output imp. 15 Ω, size 2 1/2 x 1 1/2 x 2 in. **PRICE 22/6**
TYPE LRPC 5. 6 transistor. Input sens. 8mV, output 3W, output imp. 3 Ω, size 5 1/2 x 1 1/2 x 1 in. **PRICE 59/6**
TYPE LRPC 6. Tape record/play back amp. (for use with self oscillating erase head). Output 750mW, output imp. 8 Ω. Size 4 1/2 x 2 x 1 in. **LASKY'S PRICE 39/6**

FULLY ENCAPSULATED MODULES

Special function modules — all one size 1 1/2 x 1 x 1 1/2 in. Complete with detailed function and installation instructions. Send S.A.E. for data.

TYPE PA-1. Public address amp. for use with carbon, crystal or Dynamic microphones. 3 Ω output imp. **PRICE 30/-**
TYPE GR-1. Gramophone amplifier—provides sufficient power to fill average room. 3 Ω output imp. **PRICE 30/-**
TYPE CO-1. Morse code practice oscillator — for use with morse key and 3 Ω speaker. **PRICE 20/-**
TYPE MT-1. Metronome module—provides audible and visual beat from 30 to 240 beats per minute (for use with 3 Ω speaker or incl. lamp) **PRICE 22/6**

SINCLAIR SUPER MINIATURE KITS

We stock the complete range. Write for details of package deals.
THE MICRO-6 miniature radio only 1 1/2 x 1 1/2 x 1 1/2 in. **£2 19 6**
THE MICRO-FM. (tuner/receiver) **£5 19 6**
THE X-20 20 watt P.W.M. amplifier Kit **£7.19.6.** Fully built **£9 19 6**
STEREO 25 pre-amp control unit fully built. **£9 19 6**
THE Z-12 12 watt amplifier and pre-amplifier. Fully built and tested **£4 9 6**
PZ-3 power pack for Z-12 **£8 19 6**

VEROBOARD — High grade laminated board with copper strips bonded to it and pierced with holes.

Boards
42/1503 2 1/2 x 5 in. **3/11**
43/1504 2 1/2 x 3 1/2 in. **3/3**
45/1507 3 1/2 x 5 in. **5/8**
46/1508 3 1/2 x 3 1/2 in. **3/11**
44/1505 3 1/2 x 17 in. **15/8**

Accessories
Terminal pins — pkt. of 50 **3/-**
Spot face cutter tool **7/3**
Pin inserting tool **9/8**
Post 6d. per item extra.
Orders of 10/- and over post free.

TRANSISTORS ALL BRAND NEW AND GUARANTEED

GET 81, GET 85, GET 86 2/6; 873A, 874P 3/6; OC45, OC71, OC81D 4/6; OO 44, OC 70, OC 76, OC 81 5/6; pair (10/6); AF 117, OC 200 5/6; OO 42, OO 43, OC 73, OC 82D 7/6; OC 201, OC 204 15/-; OO 205, OO 206 19/6; OC28 24/6; OC 75 8/-.

TRANSFILTERS By BRUSH CRYSTAL CO. Available from stock.

TO-01B 465 kc/s. ± 2 kc/s. TO-02D 470 kc/s. ± 1 kc/s. **9/6 EACH**
TO-01D 470 kc/s. ± 2 kc/s. TF-01B 465 kc/s. ± 2 kc/s.
TO-02B 465 kc/s. ± 1 kc/s. TF-01D 470 kc/s. ± 2 kc/s. Post 6d.

42 TOTTENHAM CT. ROAD, LONDON, W.1 Tel: LAN 2573
152/3 FLEET STREET, LONDON, E.C.4 Tel: FLE 2833

Both open all day Thursday. Early closing Saturday.

3-15 Cavell Street, Tower Hamlets, London, E.1. Tel: STE 4821/2

LASKY'S FOR SPEEDY MAIL ORDER SERVICE



MODEL 1052 — DOUBLE BEAM OSCILLOGRAPH

With similar amplifiers having continuously variable gain controls. Sensitivities of 9, 33 and 180 mV peak-to-peak/cm. Frequency response 15 c/s to 5 Mc/s (—6 dB). Time Base for either triggered or repetitive operation. Sweep duration 5 microseconds to 200 milliseconds. 4-in. dia. flat screen tube operates at 1kV. Power units designed for operation from all services and domestic supplies. C-core transformer, canned and oil-filled.

PRICE £25. Carriage 20/-

COSSOR SCOPES AVAILABLE NOW

Type 1035MK2 as illustrated	£27	Carr. 20/-
.. 1035MK4 late version	£45	Carr. 20/-
.. 1049MK2 DC Scope	£30	Carr. 20/-
.. 1049MK4 late version	£50	Carr. 20/-
.. 1052 Portable general purpose	£25	Carr. 20/-

SOLARTRON SCOPES

- CD614 Bandwidth 1 c/s—9 Mc/s; for 3 db down Time Base 10 c/s to 200 Kc/s. Trigger for TV frame block in as new condition... £50 Carr. 20/-
- CD518 Bandwidth DC ... 5 Mc/s ... £20 Carr. 17/6
- CD513 Bandwidth DC ... 10 Mc/s ... £50 Carr. 20/-



AVOMETER MODEL 7
Ready for use. Fully guaranteed
£12.5.0 Post 7/-

MODEL 1050A—OSCILLOGRAPH TROLLEY

Strongly constructed of steel tubing and fitted with rubber-tyred swivel castors, this trolley provides a very convenient mobile stand for Cossor Oscillographs, enabling them to be wheeled easily to any location in laboratory or factory.
Price inclusive of Carriage £8



**P. F. RALFE, 423 GREEN LANES,
HARRINGAY, LONDON, N.4
MOUNTVIEW 6939 (WORKS) ENTERPRISE 3192**

AN/APR4 VHF COMMUNICATIONS AND SEARCH RECEIVERS



For the first time offered in new boxed condition. Frequency Range 38-1,000 Mc/s. Accuracy 1%. Five I.F. stages. Output impedance 600 or 4,000 ohms. Power supply 115 v. A.C. (internal). Price complete with three tuning units. NEW £90.

FATIGUE METERS MK. 1B

This extremely light self-contained instrument measures and records g forces from an accelerometer in the ranges of 0.05g to 1.95g on the six high speed counters, all counters are clearly marked with the relative g forces enabling a permanent record to be kept. The only power required is 12 or 24 v. D.C. for relay operation. Size 6 X 6 X 4 in., weight 4 lb. Price £9.19.6.

MARCONI POWER OUTPUT METERS TYPE TF340

Measures 5 mW-5 watts F.S.D. A small portable instrument in excellent condition. Only £12.10.0. P.P. 7/6.

SIGNAL GENERATOR TYPE 804 BY GENERAL RADIO

Frequency Range in six switched bands 7.5 to 300 Mc/s. R.F. Monitored R.F. and modulation percentage on two separate panel meters. Highly suitable for TV work etc. In excellent condition and working order. Price £23/10/0. Carr. 10/-.

MARCONI VALVE VOLT METERS TF428B

AC Voltage range 0.1—150v. DC Voltage range 0.2—300v. Frequency range 20 c/s—400 Mc/s. C/W with probe for R.F. measurements in good working order. £7. Carr. 10/-.

CRYSTAL TEST SET MODEL TS-268/U

This small modern portable instrument will measure the FWD RES, BKWD RES and BACK CUR of all 1N21, 1N23, 1N23A, etc. crystals. Completely self-contained with battery and full operating instructions. £8.10.0.

The SUPER 6
LONG AND MEDIUM WAVE
TRANSISTOR RADIO



★ 6 transistors and diode. ★ 350mW. ★ Superhet, Ferrite rod aerial. ★ Component positions and references printed on back of board ★ Wooden cabinet, 11 x 7 1/2 x 3 1/2 in. ★ Vinyl covered ★ 6 x 4 in. speaker. ★ Booklet 2/- Free with kit. ★ Lining up service. ★ All parts supplied separately. Write for list. S.A.E. please. VT9 or P.P.9. (3/9 with kit).

COMPLETE SET OF PARTS ONLY **£4.0.0**

OR FULLY BUILT £8.7.6 Tax & Carr. Paid (PLUS 5/- POST)

AUTOCHANGERS AND PLAYER DECKS. (All 7/6 post). With Mono Cartridges. Stereo 10/- extra. AT6 £8.17.6; 1000 £6; 2000 £6.5.0; 3000 £8; AT60 £10; UA16 £5.17.6; UA20 £5.19.6; SRP12 £4.5.0; LAB80 (less cart.) £24.

AMERICAN TAPE. POLYESTER. 7" 1200 ft. 12/6; 7" 1800 ft. 19/6; 5" 1200 ft. 15/-; 5 1/2" 1800 ft. 22/6; 7" 2400 ft. 25/-; 5" 1800 ft. 35/-; 7" 3600 ft. 58/6. **ACETATE.** 5" 600 ft. 8/-; 5" 900 ft. 10/-; 5 1/2" 1200 ft. 12/6; 7" 1200 ft. 11/-; 7" 1800 ft. 15/-. **MESSAGE.** 3" 150 ft. 3/6; 3" 225 ft. 4/11; 3" 300 ft. 7/-.

POST. MESSAGE TAPES 6d. each. **OTHERWISE** 1/6 (1); 2/6 (2); 3/6 (3 or more).

GLADSTONE RADIO

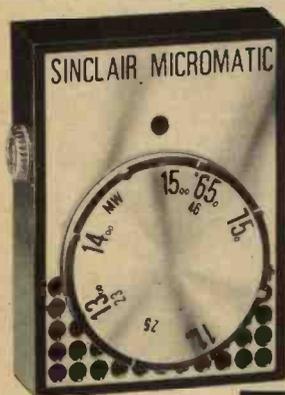
66 ELMS ROAD, ALDERSHOT, Hants.
(2 mins. from Station and Buses.) Akershot 22420
CLOSED WEDNESDAY AFTERNOON CATALOGUE 6d.
BULK ENQUIRIES INVITED FOR EXPORT

R.S.T. VALVE MAIL ORDER 144-146 WELLFIELD ROAD, S.W.16 24-HOUR EXPRESS SERVICE

AC/TH18/8	EC81	9/-	KT33C	6/-	PX25	18/6	354	4/9	7C8	8/-	
AC/VP12/6	ECC81	3/9	KT36	22/6	PY31	6/8	3V4	5/9	7H7	5/6	
(5 & 7 pin)	ECC82	4/9	KT61	17/8	PY32	8/8	4THA	17/8	7K7	19/6	
AC/VP215/-	ECC83	5/9	KT88	20/-	PY33	8/6	5R4GY	8/9	7S7	17/9	
AC2/PEN	EC84	5/8	KT81(702)	10/-	PY80	4/9	6U6	4/-	7Y4	7/8	
	EC804	9/9		10/-	PY81	6/-	5V4G	8/-	10C1	9/9	
AZ31	ECF80	7/-	KT88	27/6	PY82	5/6	5Y3GT	5/-	10F9	9/9	
B36	ECF82	7/-	KTW61	4/3	PY83	6/-	5Z4G	8/-	10L1	10/9	
C1	ECH21	19/-	MHW2	5/-	R10	15/6	5Z4GT	10/-	10P14	15/-	
C1C	ECH35	11/-	MHL4	8/-	R16	15/6	630L2	11/3	11E3	27/8	
CB11	ECH42	6/9	N78	15/6	R19	7/-	6A5	15/-	12AT6	4/8	
CB13	ECH51	5/3	NL4	17/6	S130	25/-	6AC7	3/-	12AT7	3/9	
CCB35	ECR83	7/-	MS/PEN		S130P	25/-	6AK5	4/6	12BA6	6/9	
OL4	ECL80	6/8		10/-	SP41	1/6	6AK6	6/6	12BE6	5/3	
CL33	ECL82	6/8	MU12	4/-	SP41	1/6	6AL5	3/-	12E1	18/6	
CY10	ECL86	6/9	N37	15/6	T41	9/-	6AR5	5/6	12TGT	7/8	
DAC32	EF9	20/-	N78	15/6	U10	7/-	6B4G	10/-	12XGT	3/-	
DAF91	EF36	3/-	N329	6/6	U24	24/-	6B8G	2/-	12K9GT	8/-	
DAP92	EF37A	7/6	OA2	5/3	U25	10/6	6BA8	4/8	12Q7GT	3/-	
DAP96	EF39	6/8	OB2	8/-	U26	10/6	6BE8	4/8	12S17GT	5/-	
DF91	EF42	3/9	OM4	9/-	U33	13/-	6B66G	12/8	14B7	9/-	
DF92	EF50	2/-	OM6	6/-	U35	14/-	6B7A	7/-	14S7	13/-	
DF96	EF80	5/-	OM10	12/6	U37	15/6	6B7T	10/8	19AQ5	7/6	
DK32	EF86	6/3	OZ4	4/-	U251	12/6	6B7W	7/6	19BGG	19/6	
DK91	EF89	5/6	PAC80	6/9	U301	13/-	6B7W	8/8	20L1	15/6	
DK92	EF91	3/3	PC88	9/-	U404	6/-	6C4	2/9	20P1	10/-	
DK96	EF183	6/6	PC88	9/-	U901	18/6	6C6DG	22/6	20P3	17/-	
DL33	EL32	8/-	PC84	9/-	UAB80	5/8	6C6	2/9	20P4	12/-	
DL86	EL33	17/6	PC189	10/-	UAF24	9/9	6F6G	4/-	25L6GT	4/8	
DL81	EL34	9/8	PCC189	10/-	UAC21	21/-	6F14	12/6	25U4GT	12/6	
DL84	EL36	10/-	PCC82	10/6	UCL83	8/9	6F16	9/-	25Z5GT	7/-	
DM70	EL38	15/8	PCF80	6/6	UF89	6/-	6F18	8/8	27S9	20/-	
DM74-350	EL41	8/6	PCF82	6/-	UL41	9/9	6F23	11/-	30FL1	13/6	
	EL53	6/-	PCF84	8/-	UL44	20/-	6F28	2/8	30FL12	13/6	
DY86	EL86	7/6	PCF88	8/-	UL84	8/-	6HGG	GT1/3	30FL14	12/8	
DY87	ELL80	20/-	PCL82	7/-	U08	13/8	6J5M	6/6	30L1	5/6	
EB0F	EM80	7/-	PCL83	8/8	U07	13/8	6K7G	1/3	30L15	12/6	
EB8CC	EM84	7/-	PCL84	7/3	UY41	8/8	6K8G	3/-	30P4	14/-	
EB1H	EM87	7/-	PLC85	8/8	UY85	5/-	6K25	20/-	30P12	10/-	
EB30C	EY81	7/-	PEN44	20/-	VM49	17/-	6S17	9/8	30P19	14/-	
EB10F	EY86	6/8	PEN84	20/-	VU110	8/-	6L6G	7/-	30P114	12/8	
EB18C	EY87	6/6	PEN45	6/-	VU120	12/6	6L18	7/6	35L6GT	5/9	
EB12CC	EZ35	4/9	PEN45DD		VU120A12	8	6N72T	6/9	35W4	4/9	
EABC80	EZ40	7/-		11/-	VU508	30/-	6P28	10/-	35Z4GT	3/6	
EAF42	EZ41	8/-	PEN45DD	W81	5/-	6Q7G	5/8	50C5	5/8		
EBF1	EZ80	5/-		W149	7/-	6S47	7/-	50C6G	32/6		
EB33	EZ81	5/-	PL33	10/-		6S17	2/6	30L8GT	6/-		
EB34	EZ81	5/-	PL36	9/-	X79	41/-	6S17GT	4/9	58KU	12/6	
EB31	EZ90	3/6	PL38	15/-	X81	18/8	6SN7GT	4/8	80	5/-	
EB30	GZ32	9/6	PL81	6/6	Z88	17/8	6U4GT	10/-	85A2	8/8	
EBP80	GZ34	10/-	PL82	6/6	1R5	5/-	6V6G	3/8	90AG	52/8	
EBP98	H63	5/-	PL83	6/6	1S4	5/-	6X4	3/8	90AV	22/8	
EBL1	17/6	HABC80	PL84	6/6	1T4	2/8	6X5G	4/9	90C1	15/-	
EBL2	10/8	HBL23DD	PL500	14/8	2828	12/6	7B8	11/9	90CV	52/8	
EBL31	27/8	IW4-350	5/-	PX4	18/8	2C34	3/6	7B7	7/-	185BT	30/-

S.A.E. for list of 4,000 types. Postage 6d. per valve.

NEW!



THE WORLD'S SMALLEST RADIO

Photograph shows actual size

SINCLAIR MICROMATIC

PROFESSIONALLY RIGHT IN EVERY DETAIL

- ★ ONLY ONE CONTROL
- ★ CALIBRATED DIAL
- ★ SIZE — $1\frac{1}{2} \times 1\frac{1}{8} \times \frac{1}{2}$ "
- ★ POLISHED ALUMINIUM FRONT PANEL WITH SPUN ALUMINIUM DIAL
- ★ AMAZING RANGE POWER & SENSITIVITY
- ★ NEW CIRCUITRY
- ★ BANDSPREAD FOR EASY RECEPTION OF 'POP' STATIONS
- ★ A.G.C.
- ★ IN KIT FORM OR READY BUILT
- ★ 5 YEAR GUARANTEE

THE SINCLAIR MICROMATIC is a brand new design from an organisation world-famous for its production of micro-electronic equipment for constructors. It has behind it the Sinclair tradition of specialisation in micro-radio circuitry which, in the MICROMATIC, reaches fantastically high levels of performance. We have combined new circuitry with new elegance to make the SINCLAIR MICROMATIC professionally right in every detail whether you build it yourself or buy it complete in presentation case.

This makes the perfect personal radio, ready to serve wherever and whenever required. Its minutely proportioned

case houses transistors, ferrite rod aerial and batteries and yet is considerably smaller than an ordinary matchbox. The MICROMATIC has an elegantly designed aluminium front panel with matching calibrated slow motion dial. New circuitry assures reception from a wide range of stations over the medium waveband, with excellent selectivity and quality. Here is a new set you will be proud to be seen using; you will also find it an ideal gift to give anyone. **YET THIS BRILLIANT NEW DESIGN IS THE EASIEST OF ALL SINCLAIR RADIO SETS TO BUILD—AND IT IS BRITISH!**

TECHNICAL DESCRIPTION

The Sinclair Micromatic is housed in a neat plastic case with attractive aluminium front panel and aluminium tuning dial to match, calibrated in Kc/s and metres. Three special Sinclair transistors are employed in a six stage circuit of exceptional power and sensitivity. Two stages of powerful R.F. amplification are followed by a double diode detector from which the signal tuned in is passed to a high gain three stage audio amplifier. Automatic Gain Control counteracts fading from distant stations and maintains signal strength. The set is powered by two Mallory Mercury Cells Type ZM.312 which are readily obtainable from radio shops, Boots Chemists, Stores, etc., and cost 1/7 each. The cells will give approximately 70 hrs. continuous working life. Inserting the earpiece plug switches the set on, withdrawing it switches off.

Complete kit of parts to build Sinclair Micromatic including lightweight earpiece, case and instructions

59/6

Sinclair Micromatic ready built with lightweight earpiece, in presentation case,

79/6

FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

sinclair

SINCLAIR RADIONICS LTD., 22 Newmarket Rd., CAMBRIDGE

Telephone 52996 (STD Code OCA3)

Order form and more Sinclair designs on pages following



SINCLAIR STEREO 25 DE-LUXE PRE-AMP CONTROL UNIT

THE SINCLAIR STEREO 25 has been designed specially to ensure the highest possible standards of reproduction when used with two Z.12s or any other first class stereo power amplifier. Best possible components are used in the construction of this superb unit, whilst its appearance reflects the professional elegance characteristic of all Sinclair designs in hi-fi, radio and TV. The front panel of the Stereo 25 is in solid brushed and polished aluminium with beautifully styled solid aluminium control knobs. Mounting the unit is simple, and power is conveniently obtainable from the Sinclair PZ.3 which can also be used to supply two Z.12s to make a complete stereo assembly. Hi-fi enthusiasts seeking the ultimate in domestic listening will find all they want from this combination of Sinclair units. With a Micro FM for tuner, they will have an installation to compare favourably with anything costing from four to five times as much.

FOR USE WITH ANY GOOD STEREO SYSTEM

TECHNICAL SPECIFICATIONS

Performance figures obtained using Stereo 25, two Z.12s and a PZ.3.

- **SENSITIVITY** for 10 watts into 1.5 ohms load per channel. Mic.—2 mV into 50K ohms. Pick-up—3 mV into 50K ohms. Radió—20 mV into 4.7K ohms.
- **FREQUENCY RESPONSE** (Mic. and Radió)—25 c/s to 30 kc/s \pm 1dB extending to 100 kc/s \pm 3dB.
- **EQUALISATION** — Correct to within \pm 1dB on RIAA curve from 50 c/s to 20 kc/s.

TONE CONTROLS

- Treble +12dB to —10dB at 10 kc/s. Bass +15dB to —12dB at 100 c/s.
- **SIZE**—6in.x2in.x2in. overall, plus knobs.
- **FINISH**—Front panel sectioned in brushed and polished solid aluminium with solid aluminium knobs. Black figuring on front panel.

BUILT, TESTED AND GUARANTEED

£9.19.6

"Although a complete novice to radio I was able to assemble it (Micro-FM) without undue difficulty thanks to your clear and lucid instructions. I receive all B.B.C. programmes and local.....very strongly." H.T., Warrington, Lancs.

"Far more sensitive (Micro-FM) than many commercial models."

M.M. New Romney, Kent
"Z.12 received in perfect order. It is wonderful to hear records properly."

J. de H.S., London, N.2
"I consider your after sales service is excellent. I wish very much that other suppliers treated their customers in the way you do. I have tried out the Micro-FM with the Z.12 and my Quad speaker and am very pleased with the results."

H.A., London, N.6

SINCLAIR MICRO-FM COMBINED FM TUNER AND POCKET FM RECEIVER

7 TRANSISTORS

NO ALIGNING

PULSE COUNTING DISCRIMINATOR

A.F.C.

TUNES 88-108 Mc/s

SIZE—less than 3" x 1½" x 1"

FM superhet using 7 transistors and 2 diodes. The R.F. amplifier is followed by a self-oscillating mixer and three stages of I.F. amplification which dispense with I.F. transformers and all problems of alignment. The final I.F. amplifier produces a square wave which is converted to produce the original modulation exactly. A pulse-counting discriminator ensures better audio quality. One output is for feeding to amplifier or recorder and the other enables the Micro-FM to be used as an independent self-contained pocket portable. A.F.C. "locks" the programme tuned in.

Complete kit, including transistors, case, aerial, earpiece, etc.

£5.19.6



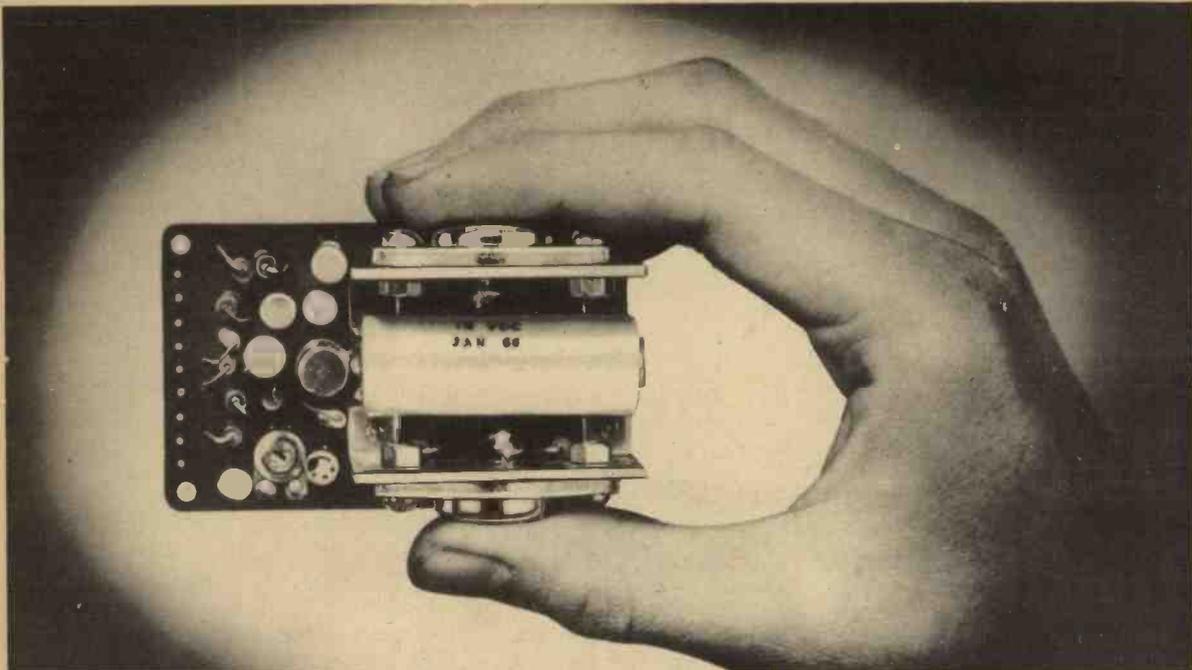
ANYONE CAN BUILD IT

FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

sinclair

SINCLAIR RADIONICS LTD., 22 Newmarket Rd., CAMBRIDGE

Telephone 52996 (STD Code OCA3)



SINCLAIR Z.12

COMBINED 12 WATT HIGH-FIDELITY
AMPLIFIER AND PRE-AMP

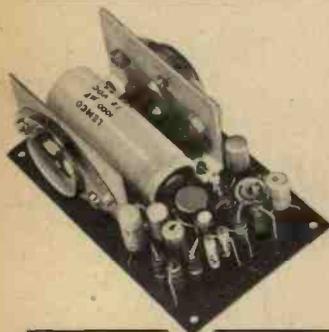
12 WATTS R.M.S. OUTPUT
CONTINUOUS SINE WAVE (24W. PEAK)

**8 TRANSISTOR CIRCUIT WITH
CLASS B ULTRALINEAR OUTPUT**

IDEAL FOR HI-FI (STEREO OR MONO)
CAR RADIO, ELECTRIC GUITAR, P.A.,
INTERCOM, ETC.

The amazing adaptability and rugged construction of this very powerful and exceptionally compact amplifier make it possible to use just one type of unit with outstanding success in an unusually wide variety of applications. Eight special H.F. transistors are used in a highly original circuit to achieve the characteristics demanded of any quality amplifier irrespective of price, yet this Sinclair unit costs well under £5, including its own integrated pre-amplifier. The Z.12 accepts radio, microphone and pick-up inputs. Detailed instructions for connecting

these in mono and stereo are given in the manual supplied with every unit. A number of different control networks are also shown. The Z.12 will operate efficiently from any supply between 6 and 20 V. d.c, making it very convenient to run the amplifier from a car battery. Where it is required to run the Z.12 from mains supply, the PZ.3 is recommended. Those wishing to have a ready made pre-amp control unit can feed inputs via the Stereo 25, which, with two Z.12s will provide the finest stereophonic hi-fi possible—and the saving in cost is fantastic.



TECHNICAL SPECIFICATIONS

- Size 3 in. × 1½ in. × 1½ in.
- Class "B" ultralinear output
- **RESPONSE** 15-50,000 c/s ± 1 dB.
- Suitable for 3, 7.5 or 15Ω speakers. Two 3Ω speakers may be used in parallel
- **INPUT**—2mV into 2kΩ
- **OUTPUT**—12 watts R.M.S. continuous sine wave (24 w. peak); 15 watts music power (30 w. peak)
- Signal to noise ratio better than 60dB.
- Quiescent current consumption—15mA.

Built, tested and
guaranteed.
Ready for
immediate use.
With Z.12
manual.

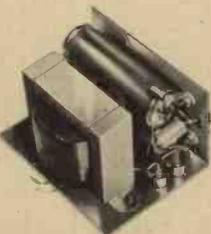
89/6

YOUR SINCLAIR GUARANTEE
If you are not completely satisfied when you receive your purchase from us, your money will be refunded at once in full and without question.

If you prefer not to cut this page, please mention PE.367 when writing your order.

PZ.3 MAINS POWER SUPPLY UNIT

This special power supply unit uses advanced transistorised circuitry to achieve exceptionally good smoothing. Ripple is a barely measurable 0.05 v. The PZ.3 will power two Z.12s and a Stereo 25 with ease.



79/6

A new Sinclair Set—see page 163



SINCLAIR RADIONICS LTD.
22 Newmarket Road, Cambridge 52996

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Please send items detailed below:

NAME.....

ADDRESS.....

For which I enclose cash/cheque/money order

PE.367

FULLY GUARANTEED INDIVIDUALLY PACKED VALVES

AC/HL 4/6	EBC41 8/6	EL37 10/-
ACP4 8/6	EBC80 5/-	EL38 17/6
ACSPEN 6/-	EBF80 6/6	EL41 8/-
AL50 6/-	EBF83 7/6	EL42 8/-
AR3 6/-	EBF89 6/6	EL50 8/-
ARP3 3/-	EEL31 20/-	EL1 8/-
ARP12 2/6	EC62 4/-	EL83 6/3
ARP24 10/-	EC63 12/6	EL84 4/3
ATP4 2/3	EC70 4/-	EL85 7/6
ATP7 5/6	EC90 2/-	EL91 4/6
AU7 55/-	EC91 4/-	EL95 5/-
AZ31 9/-	ECC81 4/-	EM80 6/3
B6H 15/-	ECC82 5/-	EM81 7/3
BD78 40/-	ECC83 6/-	EM84 6/3
BL63 10/-	ECC84 5/6	EN31 10/-
BR4 8/-	ECC85 8/6	ESU74 80/-
BR5 20/-	ECC89 4/-	ESU208 6/-
BS84 47/6	ECC89 9/6	EY81 5/6
BU134 16/-	ECF90 7/-	EY86 6/6
CCSL 2/-	ECH82 7/-	EY91 3/-
CF23 10/6	ECH82 9/-	EZ40 6/6
CL33 9/-	ECH81 5/-	EZ41 6/6
CY31 6/6	ECH83 7/6	EZ80 5/6
D1 1/8	ECL80 6/-	EZ81 4/6
D41 3/3	ECL81 10/-	F6057 8/-
D61 9/-	ECL83 10/-	F6061 5/-
D77 3/3	ECL86 9/-	F6063 4/-
DA30 12/6	EP36 3/6	FW4500 6/6
DAF96 6/-	EP37A 7/-	FW4800 8/6
DD41 4/-	EP40 8/-	GI236G29/-
DF73 5/-	EP41 6/-	GO2G 5/-
DF81 3/-	EP50 2/6	G44 45/-
DF92 3/-	EP52 6/-	G232 10/-
DF96 6/-	EP53 4/6	G234 10/-
DE63 5/-	EP55 8/-	HK54 22/6
DK96 5/6	EP71 7/6	HL2K 2/6
DL92 4/-	EP72 5/-	HL23 6/6
DL93 4/-	EP73 5/-	HL23DD 5/-
DL94 5/3	EP74 4/-	HL4 4/-
DL96 7/-	EP80 5/-	HVR2 9/-
DL910 8/-	EP85 4/6	K3A 30/-
DR66 7/6	EP86 6/6	KT32 8/-
EB6F 23/-	EP89 5/-	KT33C 6/-
EB8CC 12/-	EP91 3/6	KT44 5/6
EB9CC 10/-	EP92 2/-	KT63 4/-
EA50 1/-	EP95 5/-	KT66 18/-
EA73 7/-	EP95 5/-	KT67 25/-
EAC80 5/6	EP183 6/6	KT76 8/6
EAC91 3/6	EP184 6/6	KT88 22/-
EAF42 8/-	EBI90 7/6	KTW61 4/6
EB34 1/8	EL32 8/6	KTW63 5/-
EB91 5/-	EL34 10/-	KTZ41 6/-
EBC33 6/-	EL35 5/-	KTZ63 5/-

MH4 5/-	311E12 10/-	UP89 6/-	118GT 6/-	3V4 5/9	6AM5 2/6	6K8M 8/6	12AU7 5/-	50CD6G 27/6
ML6 6/-	SP2 8/6	UL41 7/6	1E7G 7/6	4C27 35/-	6AM6 4/-	6L6C 5/-	12AV6 5/6	50L6GT 8/-
N78 15/-	SP41 1/8	UL84 5/6	IF2 3/-	4D1 4/-	6AQ5 7/-	6L6GA 7/6	12AX7 6/-	50L6GT 8/-
NE17 7/-	SP61 4/-	ULU 7/6	1G6GT 7/-	6/-	6AQ5G 9/-	6L7G 4/-	12AY7 10/-	58A 7/6
OA2 5/8	SP210 3/6	UT9 8/6	1LA 2/6	5A173G 5/-	6A86 4/-	6L94 3/-	12BA6 5/6	57 6/6
OB2 6/-	T41 12/6	UY21 7/6	1LA6 6/-	5B/251M 5/-	6A86V 9/-	6LD20 5/8	12BB8 7/6	58 6/6
OB3 7/-	TP22 5/-	UY85 5/-	1LCC 7/-	6/-	6A87G 15/-	6N7 6/-	12BH7 7/6	59 6/6
OC3 5/-	TP23 15/-	VZ23 3/-	1LH4 4/-	5B/253M 40/-	6AT6 4/-	6N7G 5/9	12C8 3/6	75 5/6
OC5 8/6	TT11 8/6	VP33 3/-	1LH1B 15/-	6A88 4/-	6A88 4/-	6P26 12/-	12DKT 2/6	75 6/6
OZAA 5/-	TT15 35/-	VR99 8/-	1N43 4/-	6A88 4/-	6AX4 8/-	6R7 5/6	12JKT 6/6	77 6/6
PC66 9/-	TRR31 45/-	VR106/30 18/6	1N70 4/-	6A88 4/-	6B4G 17/-	6R7 5/6	12JKT 6/6	80 5/6
PC88 9/-	TZ20 16/-	6/-	1RA 5/-	5B/255M 40/-	6B7 8/-	6SA7 7/-	12K7GT 2/6	80 5/6
PC97 9/-	U81 8/-	VR150/30 18/6	1R5 3/6	6/-	6B8G 2/6	6SA7GT 6/6	12K8M 10/-	81 9/6
PC900 12/-	U12/14 8/-	6/-	1R4 5/-	5R4G 9/-	6BA5 5/6	6SK7GT 4/-	12QGT 3/8	82 8/6
PC884 5/8	U17 6/-	V133A 4/-	1R5 4/6	5TR 7/-	6BA7 5/-	6SCT 7/-	12R47 4/6	84 8/6
PC889 10/-	U18 6/-	V133 3/-	1R4 3/-	5U4G 4/6	6BB6 4/8	6SCTG 5/-	12SCT 4/6	84A 8/6
PC882 6/6	U25 13/-	VX3208 5/-	2A3 5/-	5V4G 8/-	6B16 7/8	6SFGT 7/6	12SOT 7/6	85 8/6

TRANSISTORS

OC16 20/-	OC1D 12/6	OC201 12/6	XC141 10/-
OC22 23/-	OC81M 5/-	OC202 12/6	XC142 15/-
OC25 9/6	OC82 10/6	OC203 12/6	XC155 20/-
OC35 12/6	OC82DM 5/-	OC204 17/6	XC156 22/6
OC44 6/-	OC83 5/-	OC206 22/6	2N247 9/6
OC45 5/-	OC83B 5/-	AAZ12 6/-	2N412 7/6
OC71 4/6	OC122 5/-	AC128 7/6	2N592 47/6
OC72 5/-	OC170 6/-	BCZ11 7/6	2N1090 20/6
OC73 9/-	OC200 10/6	BY38 7/6	2N1091 29/-

U26 13/-	W21 5/-	2B26 8/-	5X4G 8/6	6F6 4/-	6Y3GT 5/-
U27 8/-	W118 8/-	2C26 7/-	5Y3GT 5/-	6F7 6/-	6-30L2 8/6
U22 4/6	W119 8/-	2C26A 3/-	5Y3WGTB 6/-	6F7 5/-	6Z4 7/-
U191 11/6	X66 7/6	2C34 7/-	5Z4G 6/6	6F8G 6/6	7B7 7/6
U801 17/-	X81M 18/-	2C45 22/6	6AB7 4/6	6F12 4/6	7C5 10/-
UABC80 8/-	X118 8/-	2C46 30/-	6AC7 3/-	6F13 5/-	7C6 7/-
UAF42 9/-	X146 8/-	2C51 12/-	6AG7 8/-	6F32 4/-	7C7 6/-
UBC41 6/-	YF 1/-	2D21 5/-	6AG5 2/6	6F33 20/-	7H7 7/3
UBF80 5/6	Y63 5/-	2X2 3/-	6AG7 8/-	6GG2 2/6	7Q7 7/-
UBF89 6/6	Y65 4/-	3A4 4/-	6AH6 10/-	6H6M 1/8	7V7 8/-
UBL21 10/-	Y66 8/-	3B7 5/-	6AJ7 3/-	6J4W 10/-	7Y4 4/6
UCC85 6/6	Z800U 20/-	3B24 9/-	6AK5 5/-	6J5G 2/6	7Z4 4/6
UCH42 8/-	Z801U 10/-	3D6 4/-	6AK6 6/-	6J6 3/6	8D2 2/8
UCH81 6/-	LA3 3/-	3E29 50/-	6AK7 6/-	6J6 3/6	9D2 3/-
UCL82 8/-	LA6GT 5/-	3G4 8/-	6AK8 5/8	6J6G 6/-	9D6 2/-
UCL83 9/-	LB22 3/-	3Q3GT 7/6	6AL5 3/-	6J7G 5/-	10P9 9/-
UF41 8/6	IC5GT 6/-	384 4/-	6AL5W 7/-	6J7M 8/-	12A6 2/6

P.G. RADIO LTD

170 GOLDHAWK ROAD, W.12
Shepherds Bush 4946
Open 9-5.30 p.m. Thursday 9-1 p.m.

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. Orders below £1 P. & P. 1/-; over £1, 2/-; over £3, P. & P. free. C.O.D. 2/6 extra. Overseas Postage extra at cost.

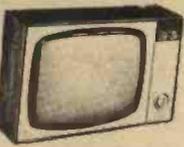
TWO-YEAR GUARANTEE EX-RENTAL TELEVISIONS

★ Tube
★ Valves
★ Components

17 in. £11.10.0
3 star Guarantee Channels for all areas Insured Carriage 30/-

FREE ILLUSTRATED LIST

Slim line models
17" — 19" — 21" — 23"
A wide range of sizes, models and prices.
Demonstrations daily



RADIOGRAM CABINETS 19 Gns.



An elegant Stereogram Cabinet in modern Veneered Mahogany and Cloth covered Front Panel
BLACK LEATHERETTE SIDE PANELS
Dimensions: 52 x 17 1/2 x 12
Speaker positions for Twin 10" x 5" Speakers
OTHER MODELS—SEND FOR LIST

TRANSISTOR CASES 7/6. 9 1/2" x 6 1/2" x 4 1/2" P. & P. 3/6.

TRANSISTOR CASES 19/6. Cloth covered, many colours. Size 9 1/2" x 6 1/2" x 3 1/2" P. & P. 3/6. Similar cases in plastic 7/6.

RECORD PLAYER CABINETS 49/6. Latest designed covered cabinets. Takes any modern Autochanger. P. & P. 7/6.
SINGLE PLAYER CABINETS 19/6. P. & P. 7/6.



T.V. TURRET TUNERS 2/6.
New Less Valves. Slim Models 5/-, Press Button Models 19/6. P. & P. 2/6.

the WyndSOR Vanguard ... the most versatile recorder at its price offering so many outstanding features ...

- 4 track-3 speeds — 7 in. spools
- Separate Record and replay amplifiers
- Double play
- Sound-on-Sound
- Detachable lid fitted 8" speaker
- Tape Monitoring facility



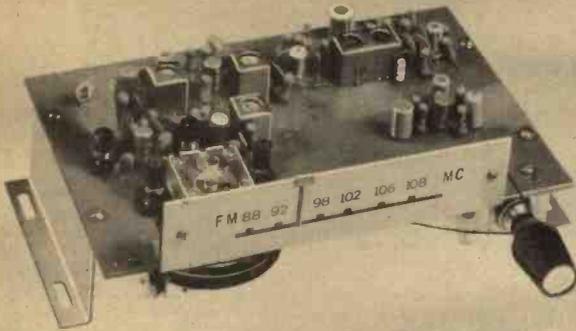
- Push button controls
- Recording meter and Playback indicator
- Straight through amplifier facility
- Bass, treble, volume and record gain controls
- Many other features

Before you buy an ordinary tape recorder write for full details of the Vanguard and other models.

* All British and full value for money at only 59 gns, inc. 1800 ft. LP tape and Tape manual. (less mlke).

WYNDSOR RECORDING CO. LTD. (Dept. PE2)
WyndSOR Works, Bellevue Road, Friern Barnet, London, N.11. ENT. 2226

FMT41 Transistorised
FM Tuner



have
you...

W12. Transistorised
Wireless Intercom

seen
the



complete range of

PEA.400. Photo Electric
Relay System



EAGLE
products

When the "Eagle" Brand was launched 10 years ago it was impossible to foresee that in such a short time the range would grow to cover over 500 items, all carrying the "Eagle" name. Whether you are interested in Hi-Fi, Amateur Radio, Do-it Yourself projects or any field of Electronics, "Eagle" offer you the widest choice of sensibly priced products and by the end of the year we plan to increase our range to cover the formidable total of 700 items.

If you would like to study our entire range in the leisure of your home we will be delighted to send you our catalogue free of charge or why not ask your local dealer (there are over 6,000 "Eagle" stockists) to show you the latest "Eagle" Products today!

To: EAGLE PRODUCTS, Dept. P.E.3,
Coptic Street, London, W.C.1.

Please send me catalogue of the entire "Eagle"
range.

Name

Address

PEAK SOUND



From stockists everywhere. In case of difficulty, direct from Peak Sound.

Think what it means to be able to have just ONE printed circuit to the design you want and you will see immediately just how wonderfully CIR-KIT more than fills that long felt need. CIR-KIT is quick—you simply lay the self-adhesive copper strip on the board, drill holes for mounting the components and you are ready to solder them in at once. CIR-KIT is clean—there are no chemicals, acids or etching processes involved. CIR-KIT is adaptable—you can amend a circuit again and

again quickly and easily. Ideal for experimenters, this. CIR-KIT is economical—No. 3 Kit contains enough material to make up about 10 circuits and components may be closely mounted if desired. You can also repair damaged conventional printed circuits; you can experiment quickly and cheaply. In fact, CIR-KIT is the most revolutionary advance in circuit techniques since the printed circuit itself was invented and is already widely used by many of the most famous houses in electronics.

makes better circuits quicker and cheaper

- ★ INSTANTLY APPLICABLE, INSTANTLY ADAPTABLE
- ★ NO CHEMICALS, NO ETCHING, NO HEAT
- ★ AS USED IN LABORATORIES, INDUSTRY, ETC.

CIR-KIT KIT No. 3 contains 12in. x 6in. mounting board, 4in. x 6in. CIR-KIT adhesive copper sheet for land areas and special shapes and approx. 15ft. of 1/2in. CIR-KIT adhesive copper strip. The heat-resistant adhesive used will last indefinitely with normal use. With instructions.

15/-

“Cir-Kit” shows the way to economical hi-fi stereo



PEAK SOUND SA. 8-8 Kit complete with instructions £12. 19. 6

PEAK SOUND POWER PACK 75/-

PEAK SOUND combined 16 watt stereo amplifier and pre-amp for only £12.19.6 is made possible entirely due to using “Cir-Kit”. 14 matched transistors are used in this superb hi-fi kit for crystal and ceramic pick-ups. Over 16 watts output into two 5-ohm speakers in stereo. 8 and 15Ω speakers may be used. This Peak Sound Kit is complete down to last piece of wire.

PEAK SOUND (HARROW) LTD. 10 ASHER DRIVE, MILL RIDE, ASCOT, BERKS.
Distributors to the Radio Trade. T.S.L., 63 GOLDHAWK ROAD, W.12. (01-603 2581)

Phone: WINKFIELD ROW (OE47) 3217



YOURS FREE FOR 7 DAYS

The New 'Picture - Book' way of learning

- ## BASIC
- ELECTRICITY (5 Vols)
 - ELECTRONICS (6 Vols)
 - ELECTRONIC CIRCUITS (2 Vols)
 - INDUSTRIAL ELECTRICITY (2 Vols)
 - SYNCHROS & SERVOMECHANISMS (2 Vols)

You'll find it easy to learn with this outstandingly successful new pictorial method—the essential facts are explained in the simplest language, one at a time; and each is illustrated by an accurate cartoon-type drawing.

The books are based on the latest research into simplified learning techniques. This has proved that the Pictorial Approach to learning is the quickest and soundest way of gaining mastery over these subjects.

The series will be of exceptional value in training mechanics and technicians in electricity, Radio and Electronics.

WHAT THIS MONTH'S ENTHUSIASTIC READERS SAY

- ... Your books are just the job ... Sgt. R.B., B.F.P.O. 46
- ... Thank you for your excellent books they are everything you said they would be ... T.T., LONDONDERRY
- ... A really silent efficient instructor ... A.W., HARROW

TO SELRAY BOOK CO.
60 HAYES HILL, HAYES, BROMLEY, KENT

Please send me Without Obligation to Purchase, one of the above sets on 7 Days Free Trial. I will either return set, carriage paid, in good condition within 7 days or send the following amounts. Basic Electricity 70/- Cash price or Down Payment of 15/- followed by 4 fortnightly payments of 15/- each. Basic Electronics 82/- Cash Price or Down Payment of 15/- followed by 5 fortnightly payments of 15/- each. This offer applies to U.K. only. Overseas customers cash with order.

Tick set required (only ONE set allowed on free trial)

- BASIC ELECTRICITY 70/-
 - BASIC ELECTRONIC CIRCUITS 40/-
 - BASIC INDUSTRIAL ELECTRICITY 40/-
 - BASIC SYNCHROS & SERVOMECHANISMS 38/-
 - BASIC ELECTRONICS 82/-
- ALL PRICES INCLUDE POSTAGE

PE 3

Signature (If under 21, signature of parent or guardian)

NAME.....
BLOCK LETTERS BELOW

FULL POSTAL ADDRESS.....

POST NOW FOR THIS OFFER!

Build Your Own Heathkit Electronics

A Kit for every interest — Home Workshop — Hi-Fi — Radio — Test — "Amateur"

Treat yourself to superb LW, MW entertainment with the
High-Performance Car Radio Kit, CR-1



Complete your motoring pleasure with this small, compact, high-performance car radio. It can be fitted to any make of car having 12 volt positive or negative earth system. Tastefully styled in neutral grey with matching black knobs and chrome trim to harmonise with any car colour scheme.

Features include: Six-transistor, 2-diode circuit. Completely pre-assembled and aligned tuning unit. High sensitivity, combined with wide range automatic gain control (AGC), minimises fading under weak reception conditions. Easy-tune dial. Push button Long, Medium and Tone selection.

The car radio is available for your convenience, in two separate units; RF Amplifier Kit CR-1T £1 . 13 . 6 incl. P.T., IF/AF Amplifier Kit CR-1A £11 . 3 . 6.

TOTAL PRICE KIT (excluding Loudspeaker) £12 . 17 . 0 incl. P.T.
8" x 5" Loudspeaker Pt. No. 401-505 £1 . 16 . 1 incl. P.T.

The Transistor Amplifier you have been looking for!



Low-cost Stereo Amplifier Kit, TS-23
Breaks the price barrier in quality
Transistor Amplifier cost

Incorporates all the essential features for good quality reproduction from gramophone records, radio and other sources.

Its many features include: 3 watts rms (15Ω) each channel. Good frequency response for outstanding fidelity. Compact slim-line styling. Ganged BASS, TREBLE and VOL. controls, 6-position SELECTOR switch for programme sources. Attractive perspex two-tone front panel. 16 transistor, 4 diode circuit. Handsome fully-finished walnut veneered cabinet. Outputs for 8 or

15 ohm loudspeakers. Printed circuit boards. For free-standing or cabinet mounting. Size 3 1/2" x 13" x 8" deep.

PRICES: Amplifier Kit £17 . 15 . 0
Amplifier Kit and Cabinet £18 . 19 . 0

Walnut Veneered Cabinet
separate £2 . 0 . 0

Hi-Fi performance from a "Mini"
Speaker Kit
with the
"AVON"
BOOKSHELF
SPEAKER
SYSTEM



The challenge to our acoustic engineers was to design a speaker occupying the minimum space consistent with first class reproduction. The results of our efforts was this "AVON" compact unit of exceptional quality. Features: Two special speakers 6 1/2" BASS, 3 1/2" HF unit and crossover network. Good frequency response. Beautiful fully-finished walnut veneered cabinet, size only 7 1/2" x 13 1/4" x 8 1/2" deep.

Supplied in two units. Can be built for a total price.

Kit £13 . 16 . 0 incl. P.T.

A 3" Service Oscilloscope Kit with outstanding
features. Model OS-2

The attractively styled OS-2 is a compact, lightweight, portable oscilloscope that fulfills many of the general requirements in Laboratories, Service Departments and Educational Training. It is ideal for use in production line testing where otherwise expensive equipment would be tied up on ordinary routine tests. The bandwidth of the OS-2 is from 2 c/s-3 Mc/s ± 3dB, this 'scope can therefore be used in applications ranging through audio, ultrasonic and radio frequencies. The time base operates from 20 c/s to 200 kc/s in four ranges. Size 5" x 7 1/2" x 12" deep. Weight 9 1/2 lb.



Kit £23 . 18 . 0. Assembled £31 . 18 . 0
Optional extra L/Cap Probe Kit, PK-1 Kit £3 . 12 . 6

Many other models in wide range.

Prices quoted are Mail Order, Retail Prices in general 5% extra.

Full specification sheets of any model available upon request.

FREE
BRITAIN'S LARGEST FREE
ELECTRONIC KIT CATALOGUE
GET YOUR LATEST COPY NOW →

WHEN IN LONDON visit our
HEATHKIT CENTRE
233 Tottenham Court Road, W.1
Tel. : MUSEUM 7349

See a full range of British models and a selection of American Heathkit models

HEATHKIT

To:—
DAYSTROM LTD., Dept. P.E.3
GLOUCESTER, ENGLAND. Tel. : Glos. 20217

Please send me model(s)

for which I enclose £ s. d. post paid

Please send me FREE British Heathkit Catalogue

NAME

ADDRESS

P.E.3

Why

NOT BUILD ONE OF OUR PORTABLE TRANSISTOR RADIOS...

FIRST FOR PERFORMANCE, QUALITY AND PRICE!

BACKED BY OUR SUPER AFTER SALES SERVICE

"A wonderful range of transistor radios using first grade components for guaranteed results"

NEW ROAMER SEVEN Mk IV

Amazing performance and specification
FULLY TUNABLE ON ALL WAVEBANDS

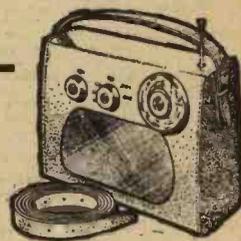
Covers Medium and Long Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room filling volume from rich toned 7" x 4" speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M & L Waves and telescopic aerial for S Waves. Real leather-look case with gilt trim and shoulder and hand straps. Size 9" x 7" x 4" approx.

★ EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, etc.

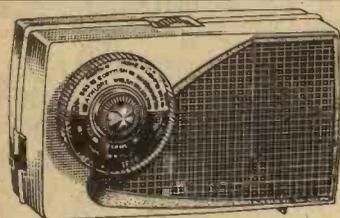
7 WAVEBAND PORTABLE OR CAR RADIO
Now with PHILCO MICRO-ALLOY R.F. TRANSISTORS

● 9 stages—7 transistors and 2 diodes

Total cost of parts now only **£5.19.6** P. & P. 5/6



Parts Price List and easy build plans 3/- (Free with kit)



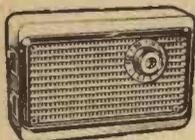
NEW MELODY MAKER SIX

3 WAVEBAND PORTABLE. ● 8 stages. Six transistors and two diodes.

Covers Medium and Long Waves and extra Band for easier tuning of Luxembourg, etc. Top quality 3" Loudspeaker for quality output. Two RF stages for extra boost. High 'Q' 6" Ferrite Rod Aerial. Approx. 350 Milliwatts push pull output. Handsome pocket size case with gilt fittings. Size 6½ x 3½ x 1½ in. (Uses long-life PP6 battery). Carrying strap 1/6 extra.

This amazing receiver may be built for only

£3.9.6 P. & P. 3/6 Parts Price List and easy build plans 2/- (Free with kit)



NEW TRANSONA FIVE

"Home, Light, A.F.N. Lux. all at good volume"
G.P., Durham

● 7 stages—5 transistors and 2 diodes

Fully tunable over Medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new

type fine tone super dynamic 2½ in. speaker, etc. Attractive case. Size 6½ x 4½ x 1½ in. with red speaker grille. (Uses 1289 battery available anywhere.)

Total cost of all parts now only **42/6** P. & P. 3/6 Parts Price List and easy build plans 2/- (Free with kit)

POCKET FIVE

● 7 stages—5 transistors and 2 diodes.

Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½ in. moving coil speaker, built into attractive black and gold case. Size 5½ x 1½ x 3½ in. (Uses 1289 battery, available anywhere.)

Total cost of all parts now only **42/6** P. & P. 3/6

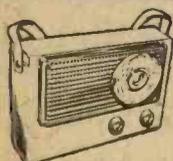
Parts Price List and easy build plans 1/6 (FREE with Kit)



STOP PRESS!

Pocket 5 Med and Long wave version with miniature speaker

29/6 P. & P. 3/-



NEW ROAMER SIX

NOW WITH PHILCO MICRO-ALLOY R.F. TRANSISTORS

● 6 WAVEBAND !!
● 8 stages—6 transistors and 2 diodes

Listen to stations half a world away with this 6 waveband portable. Tunable on Medium and Long Waves, Trawler Band and two Short Waves. Sensitive Ferrite rod aerial and telescopic aerial for short waves. Top grade transistors. 3-inch speaker, handsome case with gilt fittings. Size 7½ x 5½ x 1½ in. (Carrying Strap 1/6 extra.)

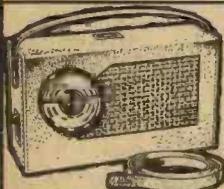
★ EXTRA BAND FOR EASIER TUNING OF LUX, ETC. Total cost of all parts now only **£3.19.6** P. & P. 3/6 Parts Price List and easy build plans 2/- (Free with kit)

TRANSONA SIX

● 8 stages—6 transistors and 2 diodes

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade 3 in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6½ x 4½ x 1½ in. (Uses PP4 battery available anywhere.) Carrying Strap 1/- extra.

Total cost of all parts now only **59/6** P. & P. 3/6 Parts Price List and easy build plans 1/6 (Free with kit)



MELODY SIX

● 8 stages—6 transistors and 2 diodes

Our latest completely portable transistor radio covering Medium and Long Waves. Incorporates pre-tagged circuit board, 3 in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6 in. Ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6½ x 3½ x 1½ in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

Total cost of all parts now only **£3.9.6** P. & P. 3/6 Parts Price List and easy build plans 2/- (Free with kit)



SUPER SEVEN

● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car, or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 RF Stages, push-pull output, 3 in. speaker (will drive large speaker). Size 7½ x 5½ x 1½ in. (Uses 9v battery, available anywhere.)

Total cost of all parts now only **£3.19.6** P. & P. 3/6 Parts Price List and easy build plans 2/- (Free with kit)

Callers side entrance
Barratts Shoe Shop.

RADIO EXCHANGE Ltd

Open 9-5 p.m.
Saturdays 9-12.30 p.m.

61a HIGH STREET, BEDFORD. Phone: 52367

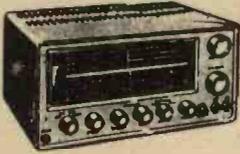


HA-43A COMMUNICATION RECEIVER OUTSTANDING VALUE

High class receiver covering 650 kc/s.-31 Mc/s. on 4 bands. Incorporates 7 valves plus rectifier, RF stage. Illuminated '8' meter, 1.5μV sensitivity, electrical bandspread on the 80/40/20/15 and 10 metre bands, slide rule dial, aerial trimmer, B.F.O., noise limiter. Output for phones or speaker. Operates on 115/230/240 v. A.C. Supplied brand new and guaranteed with manual. 24 gns. Carr. 10/-.

LAFAYETTE KT-340 COMMUNICATION RECEIVER SEMI-KIT

Build this wonderful receiver and save Pounds! Supplied semi-completed, main components ready mounted, R.F. Section already wired and aligned. Full and precise instructions supplied. Specification: 8 valves + rectifier, 4 bands covering 550 kc/s.-30 Mc/s. Incorporates 1 R.F. and 2 I.F. stages, "Q" multiplier, B.F.O., A.N.L. "8" meter, bandspread, aerial trimmer, etc. Operation 115/230v. A.C. Price 25 GNS. Carr. 10/-



HAM-I. 4 BAND COMMUNICATION RECEIVER

4 wavebands covering 535 kc/s.-30 Mc/s 5-valve superhet circuit. Incorporates 8 meter, B.F.O., BANDSPREAD TUNING, BUILT-IN 4in. SPEAKER, FERRITE AERIAL AND EXTERNAL TELESCOPIC AERIAL. Operation 220/240v. A.C. Supplied brand new with handbook. £16/10/0. Carr. 10/-.

GARRARD RECORD PLAYERS BRAND NEW AND GUARANTEED

SRP-12 Player, mono £4 4 0
1600 Changer, mono or stereo £5 5 0
2000 Changer, mono or stereo £5 5 0
A50 Changer, mono or stereo £7 10 0
3000 Changer—Stereo £7 7 0

AT6 Mark II £8 19 6
SP25 Player, mono or stereo... £9 19 6
AT 60 Changer mono or stereo £9 19 6
LAB (less cart.)..... £19 19 0
A780 £25 0 0
401 Transcription £27 6 0

All plus P. & P. 5/-.

MAIN LONDON AGENTS FOR CODAR EQUIPMENT

All items available as advertised

SINCLAIR TRANSISTOR AMPLIFIERS

Z12 Amplifier 89/8; Z12 Power Pack 79/8; Stereo 25 Amplifier 49.19.8; Micro FM Radio Kits 45.19.8; Micro G Radio Kit 59/8; Micro Amp Kit 28/8. Post Paid.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM.

Operative over amazingly long distances. Separate call and press to talk buttons. 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. 26.10.0 pair. P. & P. 3/6.



2-WAY RADIOS

Superb quality. Brand new and guaranteed. 3 Transistor 26.15.0 pr. 4 Transistor 27.19.8 pr. 4 Transistor 29.19.8 pr. 6 Trans. De Luxe 41.10.0 pr. 10 Transistor 222.10.0 pr. 13 Trans. 500MW 231.10.0 pr. 13 Trans. IW 235.0.0 pr. Post extra. These cannot be operated in U.K.

MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0.7-0.9987; B: 5-200; Ico: 0-50 microamps, 0-5 mA. Resistance for diode 200Ω. 1 MEG. Supplied complete with instructions, battery and leads. 26/19/8. P. & P. 2/6.



VARIABLE VOLTAGE TRANSFORMERS

Brand New—Fully Shrouded. Input 230v. 50/60 c/s. Output 0-260 Volts.
1 Amp. £4.10.0
2.5 Amp. £5.17.8
5 Amp. £8.0.0
8 Amp. £13.10.0
10 Amp. £17.0.0
12 Amp. £19.10.0
20 Amp. £32.10.0
2.5 Amp Portable—Metal Case with Meters, Fuses, etc. 29/17/8.

SILICON RECTIFIERS

200 v. P.I.V. 300mA 2/8
200 v. P.I.V. 8 amp. 5/8
400 v. P.I.V. 3 amp. (M.C.R.) 10/-
400 v. P.I.V. 3 amp. 7/8
1,000 v. P.I.V. 650 mA 6/6
800 v. P.I.V. 500mA 5/8
800 v. P.I.V. 5 amp. 7/8
400 v. P.I.V. 500mA 3/8
70 v. P.I.V. 1 amp. 1/6
150 v. P.I.V. 150mA 1/6
150 v. P.I.V. 25 amp. 19/8
700 v. P.I.V. 100 amp. 49/8
Discounts for quantities. Post extra.

TEST EQUIPMENT

PORTABLE OSCILLOSCOPE CT.52

A compact (9"×8"×16") general purpose 'scope. T/8 10 c/s-40 kc/s. Band width 1 Mc/s. Mullard DG 7/5 24 CRT. For operation on 200/250 v. A.C. Supplied complete with metal transit case, strap, test leads, and visor hood. Brand new. 222/10.0. Carr. 10/- Complete with instructions



F.M. WIRELESS MICROPHONE



94-104 Mc/s. Transistorised. Operates from 9 v. battery. Complete with additional secret clip microphone. List £12.10.0. ONLY 27.10.0. P. & P. 2/6.
These cannot be operated in U.K.

ERSKINE TYPE 13 DOUBLE BEAM OSCILLOSCOPE

Time base 2 c/s-750 kc/s. Calibrators at 100 kc/s and 1 Mc/s. Separate Y1 and Y2 amplifiers up to 6.5 Meg. Operation 110/230 volt A.C. Supplied in perfect working order. 222/10/- Carriage 20/-.

TE-20 RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 kc/s.-250 Mc/s on 6 Bands. Directly calibrated. Variable B.F. attenuator. Operation 200/240 v. A.C. Brand new with instructions. 212.10.0. P. & P. 7/6. S.A.E. for details.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYZER

2 PF—2,000 MFD. 2 ohms—200 Megohms. Also checks impedance, turns ratio, insulation 200/250v. A.C. Brand New £15. Carr. 7/6.

TE-900 20,000 Ω/VOLT GIANT MULTI-METER 6 in. full view meter. 2 colour scale. 0/2.5/10/250/1,000/5,000 V. A.C. 0/25/12.5/10/50/250/1,000/5,000 V. D.C. 0/50μA/10/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £12/19/8. P. & P. 5/-.

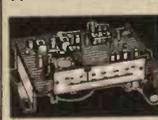


TE22 SINE SQUARE WAVE AUDIO GENERATORS

Size 20 cps to 200 kc/s. on 4 bands. Square: 20 cps to 20 kc/s. Output impedance 6,000 ohms. 200/240 v. A.C. operation. Supplied Brand New and Guaranteed with instruction manual and leads. £15. Carr. 7/6.



★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER SIZE ONLY 6in.×4in.×2 1/2in. 3 I.F. stages, Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 volt battery. Coverage 88-108 Mc/s. Ready built ready for use. Fantastic value for money. 26.19.6. P.P. 2/6.

CLEAR PLASTIC PANEL METERS

First grade quality. Moving Coil panel meters, available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Available as follows: Type MR. 38P. 1/21/32in. square fronts.

100-0-100μA	27/8	200mA	22/8	100V D.C.	22/8
500-0-500μA	22/8	300mA	22/8	150V D.C.	22/8
1-0-1mA	22/8	500mA	22/8	300V D.C.	22/8
1mA	22/8	750mA	22/8	300V D.C.	22/8
5mA	22/8	1A D.C.	22/8	750V D.C.	22/8
10mA	22/8	2A D.C.	22/8	15V A.C.	22/8
20mA	22/8	5A D.C.	22/8	50V A.C.	22/8
30mA	22/8	3V D.C.	22/8	150V A.C.	22/8
50mA	22/8	10V D.C.	22/8	300V A.C.	22/8
100mA	22/8	20V D.C.	22/8	500V A.C.	22/8
150mA	22/8	50V D.C.	22/8	750V A.C.	22/8

POST EXTRA. Larger sizes available—send for lists.

TE-51 NEW 20,000Ω/VOLT MULTIMETER

0 / 6 80 / 120 / 1,200V. A.C.
0 / 3 / 30 / 60 / 300 / 600 / 3,000V. D.C.
0 / 60μA / 12 / 300 MA. D.C.
0 / 60K / 6 Meg. Ω
85/- P. & P. 2/6.



MODEL TE-12

20,000 O.P.V. 0/0.8 / 0/30/120/600/1,200 / 3,000/6,000 V. D.C. 0 / 8 / 30 / 120 / 600. 1,200 V. A.C. 0 / 60μA/6/60/600 MA. 0/6K/60K/6 Meg. Ω 60 Meg. Ω 60 PF. .2 MFD. 25.19.8. P. & P. 3/6.



MODEL U50D. WITH METER PROTECTION.

20,000 o.p.v. 0/1.5/5/50/250/1,000 v. D.C. 0/2.5/10/50/250 1,000 v. A.C. 0/1.05/5/50/50/250 mA. 0/5K/50K/500K/3 meg. Ω .0001—2 mid.—20 —22 db. 45.19.8. P. & P. 3/-.



MODEL 500. 30,000 o.p.v. 0/1.5/12.5/10/25/100/250/500/1,000 v. D.C. 0 / 2.5 / 10 / 25 / 100 / 250 500 V. A.C. 0 / 50μA / 5 / 50 / 300mA. 12 amp. D.C. 0 / 60K / 6 Meg. Ω 60 Meg. Ω 25/17/8 Post Paid.

AMERICAN TAPE

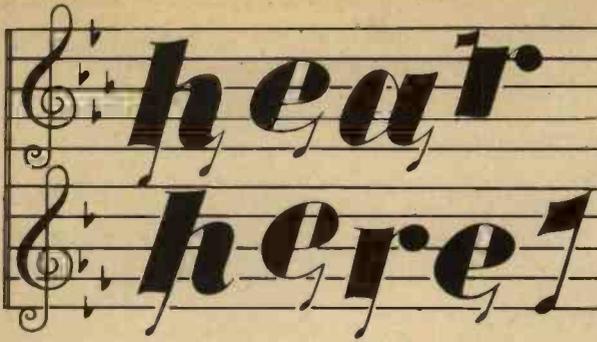
First grade quality American tapes. Brand new. Discounts for quantities.
3in., 225ft. L.P. acetate 4/-
3 1/2in., 600ft. T.P. mylar 10/-
5in., 600ft. std. plastic 8/6
5in., 900ft. L.P. acetate 10/-
5in., 1,200ft. L.P. mylar 15/-
7in., 1,800ft. T.P. mylar 35/-
5 1/2in., 1,200ft. L.P. acetate 12/8
5 1/2in., 1,800ft. D.P. mylar 22/8
5in., 2,400ft. T.P. mylar 45/-
7in., 1,200ft. std. mylar 12/6
7in., 1,800ft. L.P. acetate 15/-
7in., 1,800ft. D.P. mylar 20/-
7in., 2,400ft. D.P. mylar 25/-
7in., 3,600ft. T.P. mylar 35/8
Postage 2/- Over £3 post paid.

CALLERS WELCOME!

Open 9 a.m. to 8 p.m. every day Monday to Saturday. Trade supplied.

GW. SMITH & CO. (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2



the world's
finest sound
equipment at the

INTERNATIONAL audio

Festival & Fair
March 30-31st April 1st-2nd
11 a.m. — 9 p.m.

... held over the week-end in the heart of London's West End this is acknowledged to be the finest exhibition of its kind in the WORLD. Famous international manufacturers give demonstrations all day long of microphones, Pick-ups, stylis, turn-tables, amplifiers, speakers, tapes, tape recorders and many many accessories. Musicians, technicians, professionals, amateurs—all will find something new to interest them.

★ Here hear the best Sounds in the world.

to obtain
complimentary tickets:

Just ask at your nearest
Audio, Record, Radio
or Music Shop, or
write direct
(enclosing
stamped and
addressed
envelope) to:

AUDIO HOUSE,
42 MANCHESTER ST.,
LONDON W.1.

HOTEL RUSSELL
Russell Square,
London W.C.1.

OLRUS ELECTRONICS LTD.

PADDINGTON 1515
9 NORFOLK PLACE (off Praed St.) LONDON, W.2

FACTORY NEW VALVES FULLY GUARANTEED TRANSISTORS - DIODES - ZENER

DAF91 4/8	PCF80 7/-	AC107 10/-	GET113 5/-	OA2210 8/8	OC70 4/-
DAF96 8/8	PCF86 8/8	AC126 8/8	GET114 4/-	OA2211 8/8	OC71 4/-
DF91 3/-	PCL82 7/-	AC127 7/6	GET115 9/-	OA2212 8/8	OC72 5/-
DF96 7/6	PCL83 8/8	AC127Z 9/8	GET116	OA2213 8/8	OC73 7/6
DK91 5/8	PCL84 7/8	AC128 8/8		OA2222 9/8	OC75 8/-
DK92 8/-	PCL85 9/-	AC176 7/8	NKT213 8/-	OA2242 4/8	OC76 5/-
DK96 7/-	PCL86 8/8	ACX17 8/8	NKT216 7/8	OA2245 4/8	OC77 7/-
DL92 5/-	PL36 9/-	ACX18 5/8	NKT251 5/-	OA2246 4/8	OC78 5/-
DL94 5/9	PL81 7/-	ACX19 6/8	NKT255 8/8	OA2247 4/8	OC78D 5/-
DL96 7/-	PL82 6/8	ACX20 5/-	NKT304 8/-	OA2290 9/8	OC81 5/-
DY86 6/4	PL83 6/8	ACX21 8/-	NKT403	OA2291 9/8	OC81D 5/-
EBC41 7/6	PL84 6/8	AD140 16/-		OA2292 9/8	OC81M 5/-
EBC81 6/3	PL500 13/6	AD149 18/-	OA5 4/-	OC16 20/-	OC81DM 9/-
EBC90 4/3	PY32 8/6	AD161 11/-	OA7 4/-	OC19 7/8	OC81Z 5/-
EBF80 8/8	PY81 6/-	AD162 11/-	OA10 3/-	OC22 10/-	OC82 8/-
ECC81 4/-	PY82 5/6	ADT140	OA47 3/-	OC23 12/8	OC82D 5/-
ECC82 5/-	PY83 8/-		OA70 2/-	OC24 17/8	OC83 9/8
ECC83 5/8	PY88 7/3	AF102 18/-	OA73 2/6	OC25 9/8	OC84 8/-
ECC85 5/-	UBC41 7/6	AF114 8/8	OA79 2/8	OC26 7/8	OC122 15/-
ECP80 7/-	UBC81 7/8	AF115 8/-	OA81 2/8	OC28 12/8	OC139 7/8
ECH35 10/8	UCH25 8/8	AF116 8/8	OA85 3/-	OC29 15/-	OC140 9/8
ECH42 9/-	UCH42 8/8	AF117 5/-	OA86 4/-	OC35 12/8	OC169 5/-
ECH81 5/2	UCH81 6/3	AF118 12/6	OA90 2/8	OC36 12/8	OC176 5/-
ECH84 8/10	UCL82 7/3	AF124 9/-	OA91 2/8	OC41 6/-	OC171 6/-
ECL80 7/-	UL41 8/6	AF125 8/6	OA95 3/8	OC42 5/-	OC200 7/8
ECL82 8/3	UL84 8/3	AF126 8/-	OA200 3/3	OC43 9/-	OC201 11/8
ECL86 9/-	UY85 8/8	AF129 8/-	OA202 4/3	OC44 5/-	OC202 13/8
EF80 5/-	U25 9/8	AF139 15/-	OA210 7/8	OC44M 5/8	OC203 10/8
EF86 6/8	U26 8/8	AF186 19/8	OA211 9/8	OC45 4/-	OC204 15/-
EF183 6/4	5U40B 6/8	AFY19 22/8	OA220011-	OC45M 4/-	OC205 15/-
EF184 6/4	5Y30T 5/-	AFZ11 17/-	OA220110-	OC46 5/8	OC206 22/8
EL34 9/6	5Z4GT 8/-	APZ12 12/8	OA2202 8/8	OC47 7/8	ORP12 8/8
EL41 8/8	6P23 10/-	ASX26 6/8	OA2203 8/8	OC57 16/8	ORP60 5/-
EL84 4/9	6L6GC 7/8	ASX28 6/8	OA2204 8/8	OC58 17/8	18202 4/8
EM84 7/-	6SN7GT17E	ASZ20 7/8	OA2205 8/8	OC59 18/8	28012 20/-
EY51 7/-	6V6GT 6/8	GET20 7/8	OA2206 8/8	OC60 17/8	28012A 25/-
EY86 6/8	6X5GT 6/-	GET102 6/-	OA2207 9/8	OC65 22/8	28013 20/-
EZ40 7/6	25L6GT 8/8	GET103 4/8	OA2208 8/8	OC66 25/-	
EZ80 8/-	30C15 10/-	GET105 8/8	OA2209 8/8		
EZ81 5/-	30FL1 10/8				
EZ90 4/-	30FL14 11/-				
GZ32 10/-	30L15 11/-				
GZ34 10/-	30P12 9/-				
PC86 11/-	30P19 13/-				
PC88 11/-	30PL1 10/8				
PC97 7/8	30PL13 12/-				
PCC84 6/-	35L6GT 6/-				
PCC89 11/-	35ZGT 5/8				
PCC189 11/-	50L6GT 6/8				

C.W.O. ONLY

P.P. 2/- in £

1/- Minimum

METAL WORK — PANELS — CHASSIS
FOR P.W. P.E.
CONSTRUCTIONAL PROJECTS

For quick, easy faultless soldering



Easy to use and economical. Containing 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required. Ersin Multicore Savbit Alloy reduces wear of copper soldering iron bits.



**SIZE 5
HANDY SOLDER
DISPENSER**

Contains 12 ft. of
coil 18 s.w.g.
Ersin Multicore
Savbit Alloy. Quick
and easy to use.
2/6 each



NEW SIZE 15
21 ft coil of 60/40
Alloy, 22 s.w.g. in
a dispenser. Ideal
for small compon-
ents, transistors,
diodes, etc.
3/- each



SIZE 12
Ideal for home
constructors.
Contains 102 ft.
of 18 s.w.g. Ersin
Multicore Savbit
Alloy on a plastic
reel. 15/- each
(Also available
in other sizes)



**BIB MODEL 8
WIRE STRIPPER
AND CUTTER**
Strips insulation
without nicking the
wire, cuts wire
and splits
plastic twin flex.
Plastic cushioned
handles. 8/6 each

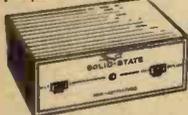
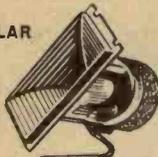
From Electrical or Hardware shops. If unobtainable write 40:
MULTICORE SOLDERS LTD., Hemel Hempstead, Herts. M29 B

RADIO • HI-FI • COMPONENTS • TEST EQUIPMENT

ALL ITEMS SENT POST FREE

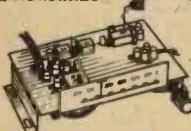
HT.20 RECTANGULAR HORN TWEETER

Ideal for 2-way and 3-way speaker systems ensuring smooth and clean reproduction. Output 20 watts. Impedance 16 ohms. Response 1,500-18,000 cps. £4.2.6
CROSSOVER NETWORKS CN.23—3 ohm, 2-way 1/4/6. CN.216—16 ohm, 2-way 1/4/8.

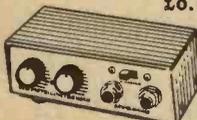


ALL TRANSISTOR MONO & STEREO PRE AMPLIFIERS

Provide extra stage of amplification for use with magnetic cartridges, tape and microphone inputs. Both models feature wide band pass range, 20-20,000 cps. PRE 301 MONO £4.12.6
PRE 302 STEREO £5.15.0



EAGLE FM41. FM TUNER
Sub-miniature 6 transistor 3 diode F.M. Tuner. Covers 88-108 Mc. Operates from 9-volt battery, micro miniature circuit giving brilliant FM reception. Ready to use, simply connect to your Hi-Fi amplifier. Instructions supplied. £8.10.0



REMOTE CONTROL STEREO HEADPHONE STATION LS.2

A Junction box for connecting stereo headphones to a stereo or monaural system. Separate controls for each channel. On/off switch. Stereo sockets allow two sets of headphones to be used. With instructions and 20 ft. of 5 conductor cable. £3.5.0



EEK28. 28 PROJECT CONSTRUCTIONAL KIT
This advanced educational kit is excellent for beginners as well as the more advanced experimenter. Not even a soldering iron is needed! Complete with 60-page booklet giving full details of suggested circuits. £6.10.0



LA9P. AC ELIMINATOR
with a double wound step down transformer to operate 9v Radios, etc., from AC Mains. £1.8.6



TAPE HEAD DEMAGNETIZER MODEL TD.79

Compact, easy to handle. Will remove magnetism from tape heads permitting improved recordings. Reduces harmonic distortion and noise level. 35/6
Also Two Probe version TD.109, 38/6



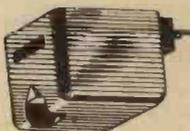
AIWA. TP. 712 2-SPEED 5" REEL MAINS AND BATTERY TAPE RECORDER

Loaded with features hitherto only found in more expensive tape recorders: AVC system adjusts recording volume level. TWO-WAY OPERATION: AC mains or batteries. TWO HOURS OF RECORDING TIME: using 1.5 mil 600 ft. REMOTE CONTROL: TONE CONTROL: LEVEL METER: indicates recording and battery levels. Other features include 1 1/2 and 3 1/2 ips speeds, 3 motor operating push-button keyboard, input for radio, record player, TV, etc., socket for an external speaker. Complete with Dynamic microphone, earphone, 5' 600' tape, 5' empty reel, batteries and AC lead. 25 1/2 gns.

EAGLE PRODUCTS. MAGNETIC STEREO CARTRIDGES

As reviewed in Hi-Fi News, Sept. 1966.

M1007G. GOLD Response 20-20,000cps Output: 5MV at 1Kc/5cm/Sec. Stylus: 0.5 Millidiamond Tracking Pressure 1-2.5 grams. £6.12.6
M1007F. SILVER Response 20-18,000cps Output: 10MV at 1Kc/5cm/Sec. Stylus: 0.7 Millidiamond Tracking Pressure 2-4 grams. £5.14.6



Both feature singularly smooth reproduction and lucid separation of stereo channels

EAGLE SA100. 10W INTEGRATED STEREO AMPLIFIER

A compact, versatile integrated unit for monaural or stereophonic reproduction from record player, tape recorder and tuner. Power output 3 watts per channel. Frequency response 40-20,000 c.p.s. £18.0.0

EAGLE AFM100. AM-FM TUNER

Combines a host of advanced features that easily make it the finest AM-FM tuner in its class. A tuned RF stage on FM, AFC circuit and a heavy flywheel giving smooth but effortless tuning, built in AM Ferrite aerial. FM.88-108Mc. £29.0.0
AM 535-1605 K/s.

MS80. 20W ROSEWOOD SPEAKER SYSTEM

The perfect answer for the music lover who wants full range fidelity in a compact system. Features an 8in. full range high compliance speaker with an output capacity of 20 watts R.M.S. Frequency response: 30-20,000 c.p.s. Resonant frequency: 30-40 c.p.s. Sensitivity: 97 db/w. Flux density: Over 12,000. Impedance: 16 ohm. Size 14 1/2in. high x 10 1/2in. wide x 8in. deep. £14.14.0

As well as this beautifully designed speaker there are two other models M445. 10 watts R.M.S. at £12.12.0 and M440 5 watts R.M.S. £8.10.0. All three speakers are finished in magnificent rosewood and the entire cabinet filled with neomine damping material.

UD40H CARDIOID DYNAMIC MICROPHONE

Features a pop-proof diaphragm and superior anti-feedback properties, reduces feedback and room reverberation. Output: -42 db. Response: 40-12,000 cps. 30K ohm impedance £8.8.0



DM31C CARDIOID DYNAMIC MICROPHONE

Superb quality with bull head for distributed cardioid front-angled pick-up. Output: -52db. Response: 40-13,000 cps. Impedance 60K ohm. £7.7.0



DM24HL

A goose-neck, dual impedance microphone 600 ohm. Response: 50-11,000 cps. £8.8.0

27 other microphones available.



SR165. ALL BAND COMMUNICATION RECEIVER

This entirely new professional type communication receiver features frequency coverage of 35 Kcs-30 Mc/s for complete general coverage. In particular ham bands are arranged in the same callibration scale, so that the band switching can be accomplished rapidly. £48.0.0

FOR FULL DETAILS OF THESE AND MANY OTHER ITEMS SEND FOR FREE COMPREHENSIVE CATALOGUE, EAGLE NEWS AND ORDER FORM. ALL ITEMS AVAILABLE POST FREE AND COVERED BY 12 MONTHS' GUARANTEE.

CALLERS WELCOME AT OUR HI-FI SHOWROOM

TT.144. Dynamic Transistor Tester

Tests in-circuit or out of circuit. Identifies PNP and NPN types. Indicates electrode open circuits, short circuits and current drain. Complete with instructions. £4.10.0



TT.145. De luxe Transistor Diode Tester.

£9.7.6

MULTIMETERS

TK.20A 1,000 o.p.v. £2.15.6
TK.25 1,000 o.p.v. £2.15.6
EP.10K 10,000 o.p.v. £4.17.6
EP.10KN 10,000 o.p.v. £5.8.0
EP.20K 20,000 o.p.v. £5.19.6
EP.20KN 20,000 o.p.v. £5.8.0
EP.30K 30,000 o.p.v. £7.19.6
EP.30KN 30,000 o.p.v. £9.0.0
EP.60KN 50,000 o.p.v. £11.19.6
EP.100KN 100,000 o.p.v. £14.19.6



RF.40 RF FIELD INDICATOR

Broad tuning covers 1-250 Mc/s in five calibrated bands. Can also be used as frequency checker. Detects undesired radiation or spurious frequencies. RF is measured on an accurate 200 uA panel meter. £4.10.0



WI-2. TRANSISTORISED WIRELESS INTERCOM

No wires, no installation needed. Simply plug them into AC power point and talk. Units have pressure-talk lock switch and on-off volume control. Ideal Intercom or Baby Alarm for home, office. £14.12.0 Complete.

DP303. DOOR PHONE INTERCOM

Ultra sensitive transistorised intercom designed so that you may answer the door from within for greater convenience and safety. £4.12.6 Other intercoms available.



MCK.2. MORSE CODE KIT

Two station Morse code kit supplied with instructions, 50ft. of connection wire and Morse code charts. £2.2.0

WIRELESS MICROPHONES

WM369 (as illustrated) Pocket FM Wireless transmitter complete with 1/2in. microphone. Transmits clearly up to 100 yds. and is fully tunable over the entire FM band. Simply used with an FM radio or tuner. £14.0.0

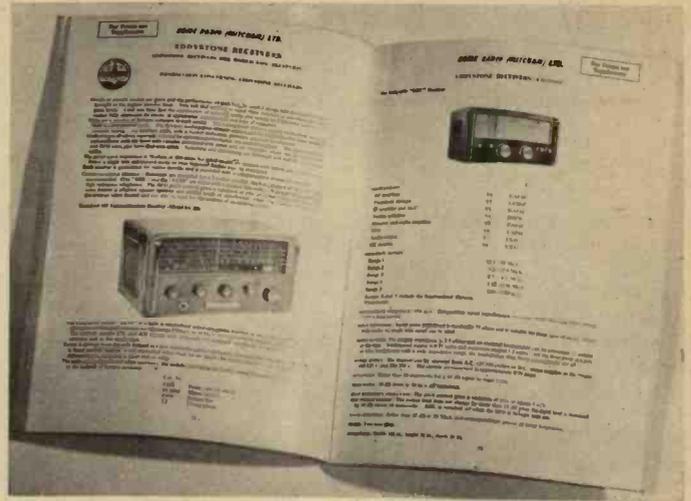
Also available WM368 Professional stick type FM Wireless Microphone. £21.0.0

These cannot be operated in U.K.

REDA RADIO LTD. (Dept. P.E.15), 87 Tottenham Court Road, London, W.1

SIZE VERSUS EXPERTIZE

(or how the knowledgeable catalogue composer takes some beating!)



In the exciting realm of electronics, expansion has been far more rapid than in any other similar field. Already it has reached a point, where to catalogue even a small percentage of all the components associated with the industry would require something approaching the size of the Encyclopaedia Britannica!! Add to this, the extremely fast rate of change (for example, the emphasis from valves to transistors) and you see the difficulties facing the catalogue creator! He has to decide what can be omitted to reduce the publication to a handy size, yet he

must include everything that you the customer are likely to require, not only today but in the future.

Therefore, although we are always emphasizing that our catalogue has 218 pages, lists 6000 items (over 1000 of them illustrated), that by no means tells the whole story of our catalogue.

To compile a components catalogue requires considerable expertize and as we have been composing Electronic Components Catalogues for over 9 years, we admit to having acquired a little of what it takes!

We would like you to judge for yourself, and this you can do for the modest outlay of 9/- (7/6 plus 1/6 p. & p.); and as every catalogue contains 5 vouchers each worth 1/- if used as directed, your total outlay need only amount to 2/6!! Don't delay, send today. We shall be pleased to receive your comments; because we place a very high value on the opinion of all our customers.

Please write your Name and Address in block capitals

Name.....

Address.....

Home Radio Ltd., Dept. PE, 187 London Road, Mitcham, Surrey CR4 2YQ

NEW SYMBOLS

THIS month we introduce "hertz" into our pages as the unit of frequency, in place of the long used and familiar "cycles per second". The symbol Hz replaces c/s. Prefixes k for kilo (10^3) and M for mega (10^6) etc. are used with the new symbol, as with the old.

With this change we come into line with the long standing Continental practice and what now appears about to become also the more general, if not universal, practice.

The U.S. National Bureau of Standards officially adopted hertz in 1964. In the U.K. the "official" position is not entirely clear. Apparently no official recommendation will be issued until some unspecified time in the future when the existing Radio Regulations can be amended by the International Telecommunication Union.

In the meanwhile influential bodies such as the G.P.O. and the B.B.C. have already commenced using hertz, and so there seems little reason to suppose that the U.K. will resist the changeover. Indeed there has been an almost indecent rush on the part of some of our manufacturers to join the hertz band waggon—all in the interest of the export market, of course—we shall no doubt be told.

A slight acerbity in the foregoing paragraph may suggest that we ourselves are not madly enthusiastic about the departure from a time honoured symbol. This is so, but we will not argue the pros and cons here. The commitment appears to have been made and we accept it.

There is another related matter to which it is appropriate to refer at this time. And here it is not too late to join battle.

A new British Standard BS3939 Graphical Symbols for Electrical and Electronics Diagrams was issued in 1966. The introduction to this Standard explains that the intention is to adopt internationally agreed symbols "as soon as practical in the future."

One of the most revolutionary changes proposed is that the well known zig zag for a resistor be replaced by the Continental rectangular box. We join with voices raised in other journals protesting at the stupidity of this move.

What efforts do the British representatives on these International Bodies make in support of *our* symbols? Here surely is an excellent case for the Continent switching over to our symbol—not vice versa.

Why discard a symbol which is the acme of perfection—explicit, simple to draw, and economical in space—for a rectangular nonentity?

We dig our feet in, and will not surrender to this so-called "objective" intruder. And we think readers will have cause to be thankful for being preserved from conglomerations of empty blocks in our circuit diagrams.

THIS MONTH

CONSTRUCTIONAL PROJECTS

PHOTOFLASH SLAVE UNIT	182
PROXIMITY DETECTOR	187
RADIATION COUNTER	195
AUTO CALENDAR	211

SPECIAL SERIES

THE ELECTRONIC ORGAN—4	200
------------------------	-----

GENERAL FEATURES

THE OSCILLOSCOPE AND ITS APPLICATIONS	176
INGENUITY UNLIMITED	192
UNIUNCTION TRANSISTORS	218

NEWS AND COMMENT

EDITORIAL	175
BOOK REVIEW	181
MEETINGS	181
ELECTRONORAMA	204
MARKET PLACE	206
DETACHED PARTICLES	208
AUDIO TRENDS	209
READOUT	229

*Our April issue will be published on
Friday, March 17*

THE OSCILLOSCOPE

and its applications

This is the first of two articles providing an introduction to the oscilloscope and some of the many and varied practical uses to which such an instrument can be applied. The oscilloscope is perhaps the most useful instrument available today to the communications and electronics engineer, both professional and amateur. Its applications not only in the radio and electrical fields, but in physics, mechanical and aeronautical engineering, medical and biological sciences, etc. are immense.

PART ONE

176

By P. Cairns

THE modern oscilloscope (generally abbreviated c.r.o.) appears in almost an infinite number of different types whose specifications vary widely. They can vary greatly in size and cost, weighing anything between a few pounds to over a hundredweight and in price between about thirty pounds and over one thousand pounds. Many of these instruments however are of a very specialised nature and are designed principally to meet particular applications. In this article, therefore, only the general purpose c.r.o. and its applications will be considered.

CHARACTERISTICS

All oscilloscopes have a number of basic characteristics and circuit functions in common. The basic block diagram into which the majority of oscilloscopes could fit is shown in Fig. 1, the differences in size, specification and price being principally in the degree of complexity or otherwise of each of the circuits contained in these blocks.

The heart of the instrument is of course the cathode ray tube. This may have a screen diameter of between three and six inches and the type of phosphor required

can often be selected to suit individual needs. Phosphors ranging from short persistence green or blue, used mostly for photographic purposes, through the various combinations of medium persistence phosphors to the very long persistence orange-yellow grades often used for the display of transient phenomena, are available.

Tubes designed to give a double beam display may be of the split beam or double gun type. Electronic beam switching can also be used for multi-channel display. Most modern oscilloscopes use a p.d.a. tube (post deflection anode). This is a final anode maintained at a high positive potential with respect to the cathode and deflection plates and placed after these plates in the tube structure. The added acceleration given by this anode to the electron beam allows both sharper focus and faster writing speeds to be achieved. Almost without exception all oscilloscope tubes are of the electrostatic deflection type.

The power supplies, both h.t. and e.h.t., are of conventional circuit design. The e.h.t. unit may be of the voltage doubler type with a d.c. output to the final anode of between one and four kV depending upon the

type of tube used. The more expensive types of c.r.o. often have e.h.t. stabilisation, maintained by means of neon discharge tubes. This is a decided advantage as it maintains the sensitivity of the tube at a constant figure and thus the X and Y amplifier calibrations remain constant. A sudden or gradual rise or fall in e.h.t. means a similar decrease or increase in tube sensitivity respectively. R.F. e.h.t. units are seldom used.

The h.t. power unit is again normally a conventional full wave rectifier and smoothing circuit, often with various levels of h.t. voltage being stepped off to suit the h.t. requirements of the various circuits. Electronically stabilised power units are often used and while they are an advantage from the point of view of amplifier and time base, trigger and sync stability, they increase both the cost and size of the oscilloscope.

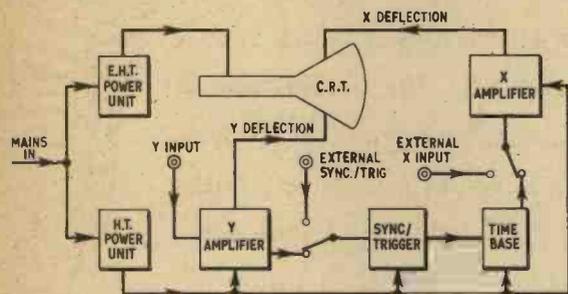


Fig. 1. Block diagram of a typical oscilloscope

Y AMPLIFIER

Few, if any, circuits in an oscilloscope vary so much in type and specification as the Y amplifier. This is the circuit to which the signal under consideration is applied and gives a deflection in the vertical axis. The numerous amplifiers available may be subdivided into a few basic types.

First the general type of d.c. amplifier with selection for a.c. coupling. This can have a frequency response from d.c. to 3MHz or even higher. The less expensive oscilloscopes often have only a.c. coupled amplifiers with a response from about 5Hz to 1 or 2MHz, this being quite adequate for most general applications, though a d.c. amplifier is always preferable.

The maximum sensitivity of these general types of amplifier may be anything between about 10 to 250 mV/cm. Such amplifiers have numerous applications in radio, television, servo and computer work, electrical engineering, etc.

Rather more specialised types of amplifier are the high gain low bandwidth d.c. amplifier and the differential type of d.c. amplifier. These may have an upper bandwidth limit of 1 to 100kHz and a sensitivity down to 1mV/cm. A high common mode rejection figure is desirable with these types of differential amplifier, a figure of 10,000:1 being reasonable. This type of amplifier is much used in electromechanical, medical and biological applications.

Another class of amplifier often met with in practice, particularly in the electro-acoustic and magnetic recording fields, is the very high gain a.c. amplifier. A frequency response of 5Hz to 100kHz or more being quite average while they may often have a sensitivity as high as 10 μ V/cm.

Many modern oscilloscopes have facilities for plug in amplifiers, a whole range of different amplifiers being available. To have a range of three or four such

amplifiers is a decided advantage, particularly in research work though the initial cost is rather large. The majority of good oscilloscopes have an adjustable stepped attenuator preceding the Y amplifier, this being frequency compensated if necessary.

TIME BASE

Time bases and X amplifiers tend to vary rather less widely than Y amplifiers. The purpose of the time base is to generate a saw-tooth waveform having an extremely linear slope, and the time duration of this waveform must be variable over a very wide range while maintaining this linear rate of rise. The flyback period must be as fast as possible over this range.

This waveform is fed into the X amplifier before being applied to the tube horizontal deflection plates. While the smaller oscilloscopes may have only five or six time base ranges, the larger instruments have up to 18 ranges. The sweep speeds available may lie between 100ms/cm–10 μ s/cm with the smaller instruments to 1s/cm–0.5 μ s/cm on the larger instruments.

The X amplifier can be either a.c. or d.c. coupled, the latter being preferable. Facilities are also available to allow the input of the X amplifier to be switched to an input terminal on the front panel, thus allowing external signals to be applied to the X deflection system. In this position the time base and sync/trigger circuits are muted to prevent possible interference and interaction between the time base circuit and the applied signal.

The gain control on the X amplifier controls the amplitude of the external signal in the normal way. With the time base running the gain control gives a trace expansion of many times the screen diameter; trace expansions of up to 5 or 10 times being normal. This facility can be extremely useful when it is required to examine a small part of a complex waveform. Generally speaking the X amplifier has a smaller bandwidth and lower sensitivity than the Y amplifier.

SYNC/TRIGGER CIRCUIT

The purpose of the sync/trigger circuit is to synchronise the signal being applied to the Y amplifier to the time base scan. When these two are locked together a steady picture or trace is the result; an unsynchronised signal "free runs" across the tube face.

A signal is synchronised when a portion of the Y signal is applied to the time base to lock them together. In the case of a triggered circuit the time base is not free running and the spot remains stationary (usually blanked out) until the trigger pulse "fires" the time base. The time base then sweeps once across the tube face, returns, then waits for the next trigger pulse to fire it again.

Sync/trigger circuits vary greatly in complexity and reliability, often being extremely susceptible to voltage changes, valve or component ageing, etc. Internal-external switching controls are often available for trigger or sync on both positive or negative waveforms and in many cases television line and frame sync separator circuits are included in the c.r.o.

Other facilities which increase the usefulness of an oscilloscope are an internal calibration source and an input point for Z or intensity modulation. The simpler forms of calibration signal are usually square waves derived from the mains supply and having a constant amplitude. This can be used for calibrating Y deflection sensitivity and also, within limits, for time base calibration.

The Z or intensity modulation access point is a.c. coupled to the c.r.t. grid or cathode. An external alternating signal applied to this point allows the trace to be blanked out (or brightened up) during either the negative or positive half cycle. This method, when used in conjunction with a phase shift circuit or Lissajous figures, allows spot wheel patterns to be obtained. This can make frequency comparison measurements much simpler.

CALIBRATION

Before commencing work with an oscilloscope a calibration check should be carried out on both X and Y amplifier sensitivities and time base accuracy. While the more elaborate oscilloscopes have attenuator and shift controls (besides normal X and Y shifts) which are calibrated in terms of amplifier sensitivity in centimetres per voltage input (V/cm), many oscilloscopes depend upon visual measurement on the screen graticule. In many such amplifiers the gain control is calibrated in terms of V/cm, say from 0 to 10, while a stepped attenuator gives various increases in this sensitivity scale (X3, X10, etc.).

Graticules are normally divided into 1cm squares, all measurements, both voltage and time, being given in terms of this unit. To check the Y calibration a signal source of known amplitude, the internal calibration signal being used if available, is connected into the Y input, the time base being adjusted to give a few cycles of the signal across the tube face. The gain and attenuator are set to give a definite vertical deflection. This peak to peak deflection is then measured on the graticule and can be expressed in terms of the signal input.

Signal levels are normally expressed in terms of peak to peak voltage though if the signal is a sine wave it can be simply converted to r.m.s. value by dividing by $2\sqrt{2}$. For example, if a 0.5V peak to peak calibration source is available and the Y gain is adjusted until the signal occupies exactly 4cm in the vertical plane, the calibration at that point is 0.125V/cm, or in general:

$$\text{Calibration in V/cm} = \frac{\text{Input peak to peak voltage}}{\text{Vertical deflection in cm}}$$

By this method either a full calibration scale can be made or the existing scale may be checked. The same calibration checks can be carried out on the X amplifier, this being switched to the external input position. In this case the signal will appear as a horizontal line as there will be no signal deflection in the vertical axis.

Having checked the sensitivity calibrations of both amplifiers, the time base sweep speeds can be checked. Assuming that the calibration signal is 50Hz, if the time base is adjusted until one cycle occupies exactly 2cm the sweep speed at this point is 10ms/cm (1 cycle of 50Hz equals 20ms). While using only 50Hz obviously limits the range of time calibration (about 2 to 150ms on a three inch tube), if an audio signal generator is available the complete range of time base speeds may be calibrated. For example, with a signal of 1,000Hz, 1 cycle equals 1ms, therefore if the time base is adjusted until one cycle occupies say, 4cm, the sweep speed is then 0.25ms/cm or 250 μ s/cm, or in general:

$$\text{Time per cm} = \frac{\text{Period of signal}}{\text{Horizontal deflection in cm}}$$

and the time duration of a signal can be found from the period of one cycle equals $1/f$ seconds. Where f is the frequency in hertz of the applied signal.

The calibrations described above are extremely important if any accurate work of an experimental nature or work requiring reasonably reliable results are required. The accuracy of oscilloscope measurements depend in the first instance upon the accuracy of the initial calibration and while good commercial instruments achieve accuracies of 5% or even 3%, a figure of 10% is a more realistic target in the case of most home constructed oscilloscopes.

MEASUREMENTS

The three basic units which normally have to be measured in practice are voltage, current and power; all of these can be measured on an oscilloscope. In the case of reactive circuits the phase angle can also be measured. To measure the voltage level of a signal it is simply applied to the Y input, the time base adjusted to suit the frequency of the signal and then the signal level is read off the calibrated Y gain scale.

Current is measured in a similar manner except that a shunt is connected in series with the circuit under test, the Y input being connected across the shunt. The shunt should be of a non-reactive type (carbon resistors meet this requirement), be of low ohmic value compared with the circuit in which it is to be connected and also be of known value.

Typical shunt values are 100, 10, 1, 0.1 ohms, and as the voltage drop across the shunt will be small the Y amplifier will have to be set to a high sensitivity level. The shunt should be chosen to have negligible effect on the circuit under test, e.g. a 10 ohm shunt connected in a 10 kilohm circuit will affect the circuit by only 1 part in 1,000 or 0.1 per cent. This ability to view and measure current waveforms can be very useful when working with transistors, these being current operated devices.

POWER FACTOR VALUES

By combining the two measurements just described, power may be measured. The circuit is connected as shown in Fig. 2a, the voltage across the series shunt being applied to the Y input, this normally having the greater sensitivity. The X amplifier is switched to external input, the time base being switched off. The X and Y gain controls are adjusted to give a similar deflection in each axis.

The resultant trace will be as in Fig. 2b. That is, a straight line (assuming a purely resistive circuit) at an angle across the tube face. The power can be calculated by dropping a vertical line from each end of the trace to the horizontal axis and measuring the area of the resultant triangles, see Fig. 2b.

Should the circuit be reactive, instead of a straight line, an ellipse will appear (Fig. 2c). The ellipse may be used to determine the phase angle or power factor of the circuit. The straight line represents a resistive circuit (unity power factor) and the greater the reactive component or phase angle, the wider the ellipse will become. A 90 degree phase shift appears as a circle, this representing zero power factor. The value of the phase angle represented by an ellipse can be calculated by either of the methods shown in Figs. 2d and e.

Large power factor values can be rather difficult to measure due to the negligible width of the ellipse. This can be overcome by shifting one of the deflecting voltages by 90 degrees, i.e. putting it through a phase shift circuit before applying it to the oscilloscope. A suitable variable phase shift unit that can be used in a number of applications is described in Part 2 next month. If the above procedure is carried out a straight

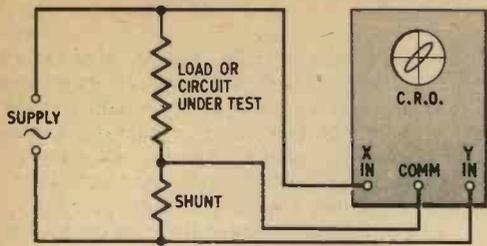
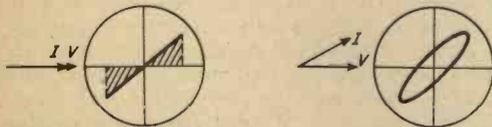


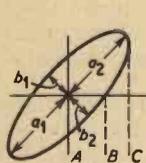
Fig. 2a. Test set-up for power factor measurements



RESISTIVE LOAD. POWER=AREA OF BOTH TRIANGLES (SHADED) ADDED TOGETHER

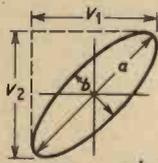
REACTIVE LOAD

Figs. 2b and c. Oscillograms for resistive and reactive power factor measurements



$$\sin \theta = \frac{AB}{AC}$$

$$a_1 = a_2 \quad b_1 = b_2$$



PHASE ANGLE $\sin \theta = \frac{a b}{V_1 V_2}$
 $V_1 V_2$ ARE THE PEAK/PEAK VALUES OF THE DEFLECTING VOLTAGES.
 $a b$ ARE THE MAJOR & MINOR AXIS OF THE ELLIPSE.

Figs. 2d and e. Two methods of calculating phase angle

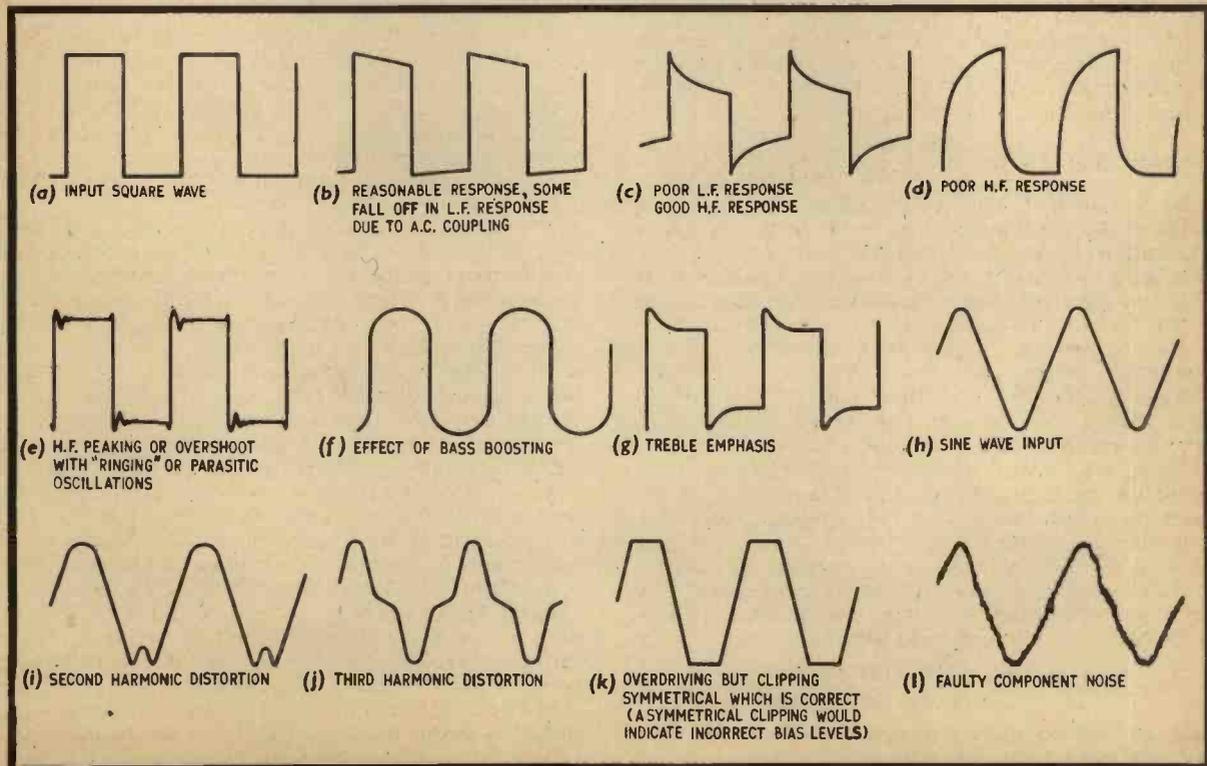
line will then represent zero power factor and a circle unity power factor, thus making the measurement of small angles much easier. Due to the artificial phase shift of 90 degrees the intercept of the ellipse on the horizontal axis now gives $\cos \theta$ direct from the ratio AB/AC , Fig. 2d. It may be of interest to note also that the area of the ellipse represents the energy used per cycle and can represent either "wattless" or "watt" power depending upon whether an artificial phase shift of 90 degrees has been introduced into the circuit or not.

When carrying out measurements on an ellipse care must be taken to ensure there are no phase shifts in the test circuit, test leads, or oscilloscope itself. Such phase shifts can always be measured first by connecting the test circuit to a purely resistive load and the resultant phase shift, if any, measured and taken into account when carrying out tests on a reactive circuit.

Another interesting feature is that if the current waveform is applied to the Y input and the time base is switched on, the quantity of electricity can be estimated. Any waveform can be regarded as an area traced on a screen having a magnitude proportional to the product of the two deflecting quantities. Thus, if the current waveform is drawn on a time scale, the area of the trace will be proportional to the quantity of electricity in coulombs.

One of the advantages of using an oscilloscope for voltage or current measurements is that an actual picture of the waveform is given besides its peak or peak to peak value. Conventional measuring instruments using a moving coil or moving iron meter are generally only calibrated in r.m.s. values and thus any

Fig. 3. (below). Typical deficiencies in an audio amplifier are shown by these waveforms when using a square wave input (a to g) and sine wave input (h to l)



waveform other than a sine wave will result in an incorrect reading.

If the waveform present in the circuit under test is not known, such readings taken on a meter may not be a true representation of conditions present in the circuit and in many cases can be extremely misleading. The only method of obtaining the accurate phase relationships and values of an irregular voltage and current waveform is by means of an oscilloscope.

AUDIO ANALYSIS

The performance of audio amplifiers, high quality or otherwise, can be quickly checked by injecting a square wave of suitable level into the amplifier and using the oscilloscope to examine the waveforms at various points in turn throughout the amplifier. Many defects which would not show up if a sine wave signal were used quickly come to light if a good square wave signal with a fast rise time and negligible overshoot is used.

Some of the various waveforms which may be encountered are shown in Fig. 3. By such tests many so called "hi fi" amplifiers have been shown to be of a much lower quality than was previously thought. If the signal levels into and out of each stage are measured when carrying out such tests the effective stage gains throughout the amplifier can be found. The effects on overall gain and quality by increasing or decreasing the amount of negative feedback can also be measured. The effectiveness or otherwise of bass and treble tone controls can also be checked by observing their effect on the output waveform.

If a variable audio signal generator is connected to the amplifier input, a complete frequency response curve of the amplifier can be taken. The input signal should be kept constant in amplitude over the complete frequency range (about 10Hz to 20kHz), the output level being measured on the oscilloscope. A typical response curve is shown in Fig. 4.

The total phase shift in the amplifier can also be found by applying the input signal to one deflection system and the output to the other deflection system,

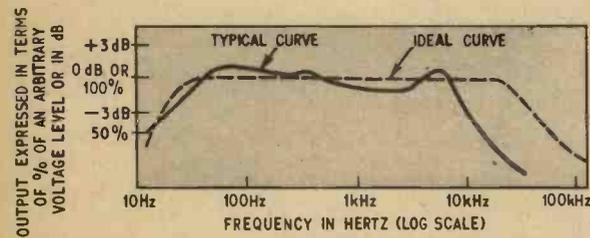


Fig. 4. Typical frequency response curve, determined by using an oscilloscope, compared with a desired ideal curve (shown dotted)

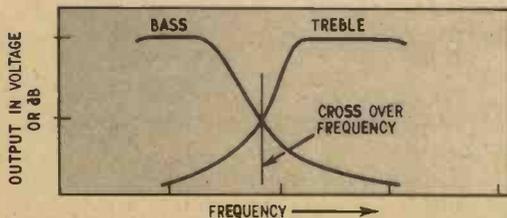


Fig. 5. By using the frequency response technique, cross-over filters can be measured

the time base being switched off. Any phase shift will result in an ellipse which can be measured as previously described. If this test is carried out at various audio frequencies, a complete phase shift characteristic over the audio range can be plotted. Thus the optimum values of phase shift compensation components can be easily found by observing the changes in the ellipse when altering the components in question.

When using a variable frequency audio generator the cross-over point and efficiency of cross-over networks in multi-speaker systems can also be found. The output levels of both bass and treble output points are measured in turn over the audio range for a constant value of input signal. A curve similar to that in Fig. 5 can then be plotted. If the constant input signal level is also measured on the oscilloscope the attenuation factor of the network in dB can be calculated for both curves and a further set of curves drawn showing the loss characteristics.

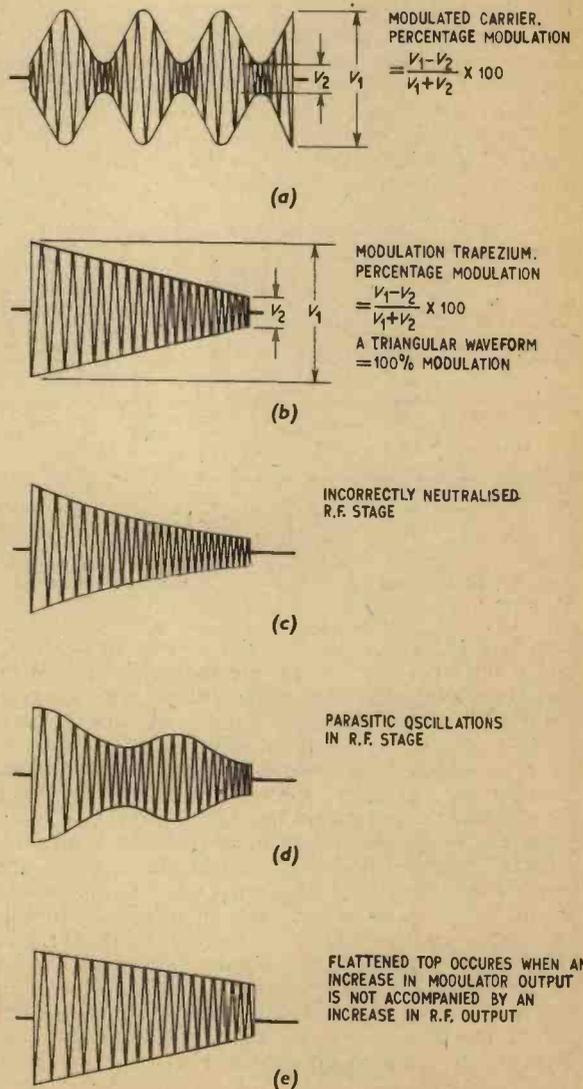


Fig. 6. Typical oscillograms showing amplitude modulation and various distortion characteristics

By a few such simple tests as have been described the principle characteristics of an amplifier can be quickly tabulated and any improvements or modifications can be quickly and visually carried out.

It must be remembered when carrying out such tests not to overload the amplifier, the input signal being kept below the maximum input level. If necessary the pre-amplifier and main amplifier stages can be tested individually. If the loudspeaker or speakers are disconnected during the tests a dummy load resistance of the correct impedance and wattage value should be connected across the secondary of the output transformer.

MODULATION MONITOR

Another useful oscilloscope application is the measurement of amplitude modulation depths in transmitters. For the experimental amateur transmitter the oscilloscope can often prove invaluable. A typical amplitude modulated carrier waveform is shown in Fig. 6a, the percentage of modulation being calculated as shown.

This shows the modulated carrier applied to the Y input and displayed on a linear time base. Modulation patterns are very often displayed in the form of a trapezium, such displays having a number of advantages. To achieve this pattern the modulated carrier is applied to the Y deflection system and the modulation signal only, to the X deflection system.

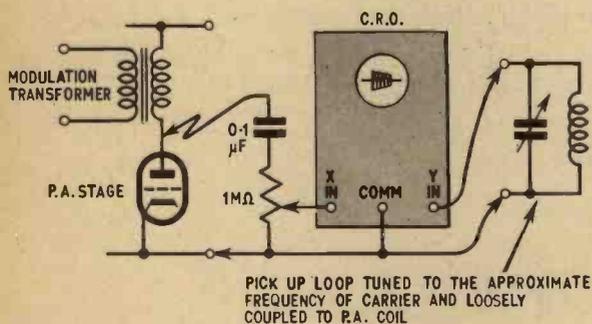


Fig. 7. Test set-up for transmitter amplitude modulation measurement

A typical test set up is shown in Fig. 7. Various forms of trapezium patterns are shown in Figs. 6b to 6e. Providing no phase change takes place between the modulator and the stage from which the carrier is taken, the sloping edges of the trapezium will be straight. Thus, both linearity and percentage modulation can be checked as shown in Fig. 6b. To check for the presence of second harmonic in the modulated voltage, reduce the modulation input to zero, this leaving a vertical line of carrier on the screen. The modulation input is then increased gradually, an unequal expansion on each side of this line indicates even or second harmonic content. The presence of third or odd harmonics is generally indicated by a line of increased brilliance across the trace. Should a phase difference be present between modulation and carrier the sloping lines bounding the trapezium will form an ellipse and the figure will appear to be wrapped round a cylinder.

Next month: Television servicing, Lissajous figures, Z modulation, and phase shift network.

Book review

ITV 1967

Published by the Independent Television Authority
224 pages, 7in × 9in. Price 7s 6d

THIS well established year book which has proved increasingly popular since its first edition in 1963 as a guide and work of reference, now appears completely restyled primarily to make its 250 pictures as large as possible.

It contains such visual information as viewing audience charts and TAM pictograms showing growth over the last 10 years and a comprehensive coverage of the U.K. network of transmitting stations and programme companies. These chapters provide technical information on channel frequencies, radiation power, patterns and site topography which includes contour maps, and a great deal of general company information.

A third of this guide is devoted to programme categories each of which are supported by a profusion of representative photographs and programme lists for 1966.

G.G.

Meetings . . .

SOCIETY OF ELECTRONIC AND RADIO TECHNICIANS

SALISBURY

Date: February 23
Title: Microwave Techniques and Applications to Radar
S. V. Judd
Time: 7 p.m.
Address: Salisbury College of Further Education, The Friary, Salisbury.

INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS

LONDON

Date: February 22
Title: Dual Standard Colour Television Receiver
P. L. Mothersole, D. S. Hobbs and D. J. King
Time: 6 p.m.
Address: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

BOURNEMOUTH

Date: February 22
Title: Development of Satellite Communications
J. K. S. Jowett
Time: 7 p.m.
Address: Bournemouth College of Technology, Bournemouth.

SLOUGH

Date: February 21
Title: Pulse Code Modulation
J. R. Jarvis
Time: 7.30 p.m.
Address: Lecture Theatre, Slough College, Slough.

TORQUAY

Date: February 21
Title: Automatic Landing Systems
R. A. Bailey and J. Meadows
Time: 7 p.m.
Address: South Devon Technical College, Torquay.

Photoflash SLAVE UNIT

By B. MUNCASTER

In recent years the photographer, professional or amateur, has come more and more to rely on electronics for assistance in the production of his photographs. The slave unit about to be described is yet another instance where the electronic device gives more freedom and versatility to the photographer.

**What is a
slave unit?**

- In short . . . it is a device which will fire one or more flash guns from the light emitted by a single flash gun connected to the camera.
- It does away with the need for interconnecting wires, but enables as many flash guns as required to be synchronised from the camera shutter.
- It makes possible the use of additional flash lights with the consequent improvement in the quality of the resulting photographs.
- Furthermore, it enables friends and clubs to pool their equipment making possible photographs approaching professional studio quality.

HAVING acquired, over a period of years, some half a dozen flash guns of the electronic type the writer found the need for a synchronising device which would permit the use of multiple flash lighting. Since all the flash guns were not of the same type it was not possible to effect synchronisation simply by connecting all the trigger leads in parallel. In any case this practice would be very detrimental to the shutter contacts within the camera. As most readers will know, an electronic flash gun is triggered by discharging a

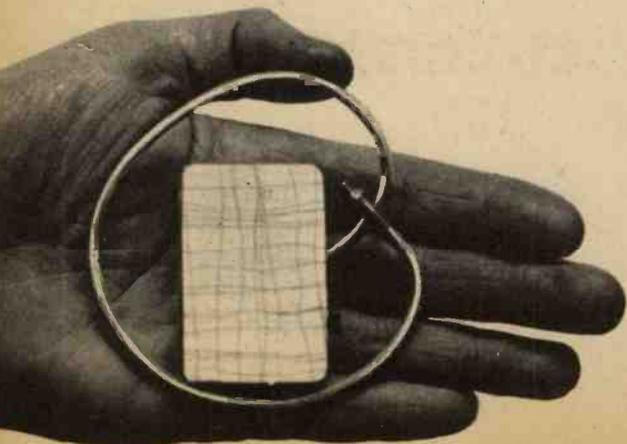
capacitor which may be at a potential of up to 250 volts and although the usual trigger capacitor is between $0.1\mu\text{F}$ and $0.25\mu\text{F}$, when several are connected in parallel quite a hefty spark can result when contact is made.

The unit which is the subject of this article will function from the light of either an expendable bulb flash or an electronic flash, and it will also fire both types. It can be built using all new components for a good deal less than half the price of the commercial units, and by taking note of the advertisers in PRACTICAL ELECTRONICS it is possible to get the cost down to about 50s per unit.

CIRCUIT DESCRIPTION

Fig. 1 shows the theoretical circuit of the slave unit. The photo-sensitive device is the phototransistor OCP71 (TR1). When the primary flash (i.e. the one fired from the camera) is set off, the light impinging on the OCP71 causes a momentary increase in the current through it, the capacitor C1 then charges and draws current through the base of TR2; the latter switches on and passes a pulse of current through the gate terminal of a thyristor SCR1, the thyristor is itself turned on and fires the slave flash gun.

In the quiescent state the current taken by the unit is in the order of 150 to 200 microamps and only at the



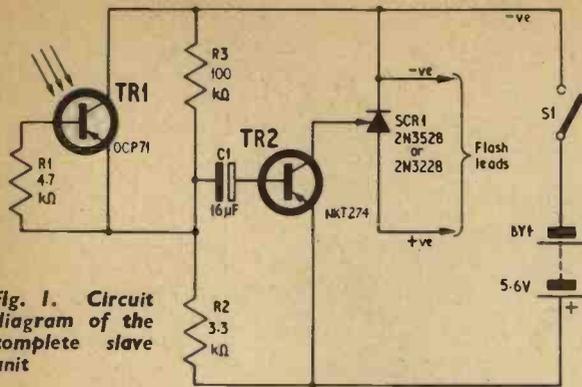


Fig. 1. Circuit diagram of the complete slave unit

moment of the flash does the current taken rise into the milliamp range. This low consumption means that a very small battery may be used to power the unit and battery life is reckonable in terms of the shelf life of the battery.

SELECTION OF COMPONENTS

All the resistors are miniature types, as is the capacitor.

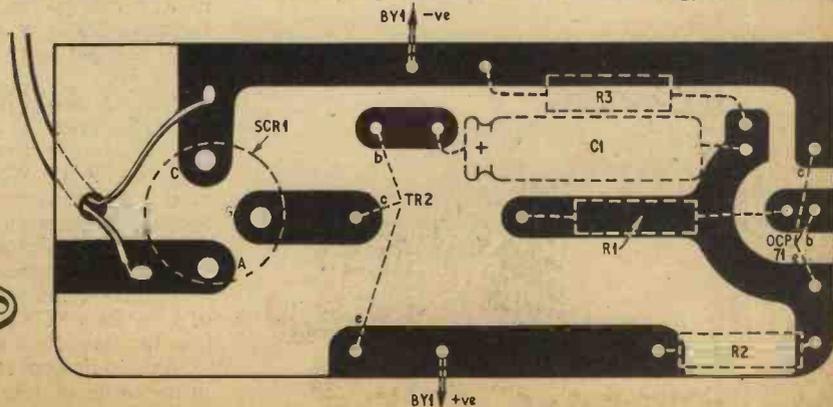
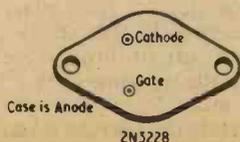
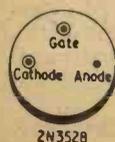
The second transistor TR2 is an NKT274, although OC72, OC81, and NKT224 have also been used successfully by the author, the difference in overall sensitivity being marginal.

The thyristor is the most important item and several factors govern the actual type to be used.

When used with electronic flash guns the voltage rating of the thyristor needs to be quite high, at least 300 volts, and the leakage through the device in the "off" state must be very, very low indeed. Trigger circuits of electronic flash units are supplied through very high value resistors and any leakage more than a few microamps drains current from the circuit faster than it can be supplied. The consequence is that there is insufficient power in the trigger circuit of the flash gun to fire the tube. The gate sensitivity of the thyristor must be quite high to obviate the need for a multistage amplifier after the OCP71, and finally the cost of the thyristor must be low enough to make the construction of the slave unit worthwhile.

The writer finally settled on the R.C.A. thyristor type 2N3228 which cost about 15s and fulfilled the other requirements ideally. In fact, since making the first few slave units R.C.A. have introduced a further thyristor under type number 2N3528. This latter type is supplied with a separate heat sink base which is not necessary in this particular application and which allows the slave unit itself to be made even more

Fig. 2. Layout of components (shown dotted) on the reverse side of the printed circuit board



compact. The current rating of this type is 1.3A average with a maximum single cycle limit of 60A. This means that the slave unit is capable of accepting several flash guns connected to it without fear of overloading. There is no heat dissipation problem since the thyristor is in the "on" state for only a fraction of a second in several minutes.

As readers will know, once a thyristor has been switched on the gate has no further control over the conduction through the device, and in order to turn it off the anode circuit has to be broken or the current reduced to a very low value.

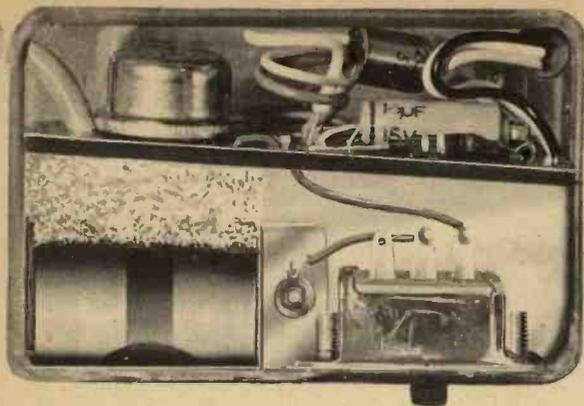
In the slave unit this switching off is done automatically when the flash trigger capacitor has discharged: the thyristor switches "off" and is then ready for the next cycle of operation.

One other fact that will be of interest is that thyristors must not be subjected to high voltage transients in the reverse direction. In practice the transients which might be expected from the trigger coil in the flash gun seem to be effectively suppressed by the trigger capacitor itself. One absolute requirement of the thyristor is that the anode must be connected to the positive flash lead and this matter is dealt with in the paragraphs on construction.

NO SENSITIVITY CONTROL

The writer would emphasise that this circuit is not the most sensitive one which can be devised, but from the photographer's point of view it is very practical. There are no adjustments to make and the slave will function in the presence of a fair amount of ambient lighting so that it is possible to make use of modelling lamps when setting up the flash guns.

Sensitivity would be increased enormously if d.c. coupling was used in the slave unit but other considerations preclude this. For one thing, it would be



necessary to have some form of sensitivity control to take care of differing lighting conditions, and when used in this application the gate current must either be fully off, or at a level which will trigger the thyristor.

It is an unfortunate characteristic of thyristors that as the gate current approaches the level at which triggering takes place, so is there an increase in the forward leakage current through the junction. Since this must be prevented for reasons already given, capacitor coupling is the only method which will avoid the addition of some form of control.

With the present circuit the slave is switched on, coupled to its flash gun and it is then immediately ready for action. Experience will soon indicate to the photographer when it is necessary to point the slave at the primary flash and when it is quite sufficient to point it in the general direction of the scene being photographed.

The sensitivity is such that in a room 30 feet long the slave unit will trigger when another flash is set off anywhere in the room even if the primary flash and the slave are pointed away from each other. When used with electronic flash guns the slaved flash is only microseconds behind the primary flash and for all practical

purposes this delay may be discounted. With expendable bulbs the photographer must allow for the burning time of the foil in the bulb (typically 25 milliseconds from contact to peak light) and the shutter must be set at a speed which will allow the light from both primary and slaved flashes to be utilised.

CONSTRUCTION

The layout of the photoflash slave unit is in no way critical and the physical size of the unit is dependent to some extent on the skill of the constructor. The writer has used plastic boxes which appear to be a stock item at most radio shops and which measure $2\frac{1}{2}$ in \times $1\frac{1}{2}$ in \times $\frac{7}{8}$ in overall, but as can be seen from the photograph of the internal layout, there is still plenty of room to spare and the unit could be tucked into a smaller space.

The photograph shows a unit which incorporates a 2N3528 thyristor, but Fig. 2 shows the pin connections of both this and the 2N3228 types.

A word of warning here. The case of both types of thyristor is at the same potential as the anode. Depending on the flash gun being used, the thyristor case may be at a potential of up to 250V with respect to the negative side of the slave unit supply. SCR1 must therefore be insulated with the appropriate mica washers, and the layout should be such that there can be no accidental touching of SCR1 case or any other components.

The prototype units are each built on a small piece of printed circuit board cut to fit into the case. Fig. 3 is a diagram of the printed circuit board using a 2N3528, and if this is followed the various components fit in with ease.

The usual precautions should be taken when soldering the semiconductors into place and the leadout wires should not be cut short. When soldered in, the OCP71 should be carefully positioned so that the active side of the junction faces out of the case. The photosensitive side of the OCP71 is towards you when the stripe indicating the collector lead is on the left.

continued on page 226

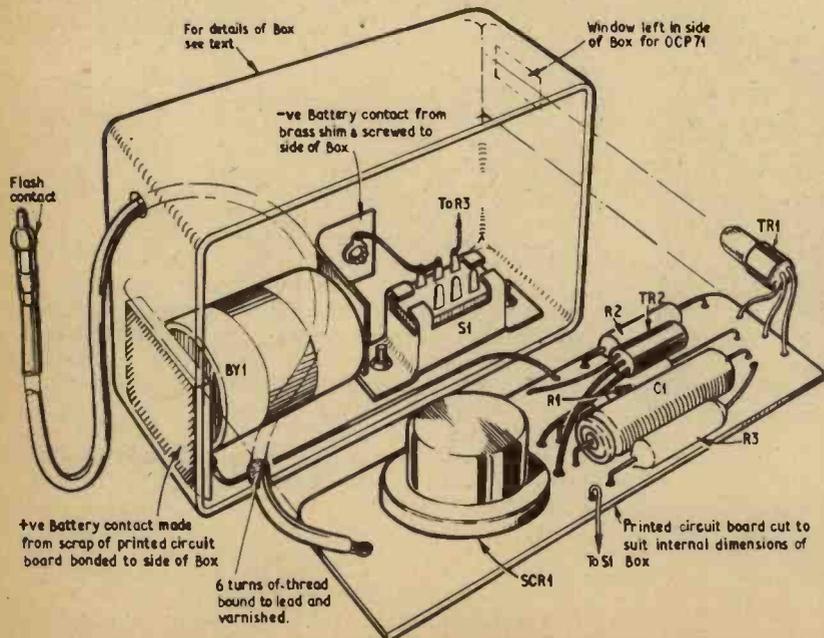


Fig. 3. Complete pictorial layout of the slave unit

COMPONENTS . . .

Resistors

R1 4.7k Ω R3 100k Ω
R2 3.3k Ω All $\frac{1}{8}$ W carbon

Capacitor

C1 16 μ F miniature elect. 10V

Transistors

TR1 OCP71
TR2 NKT274 (see text)

Thyristor

SCR1 2N3528 or 2N3228 (R.C.A.)

Switch

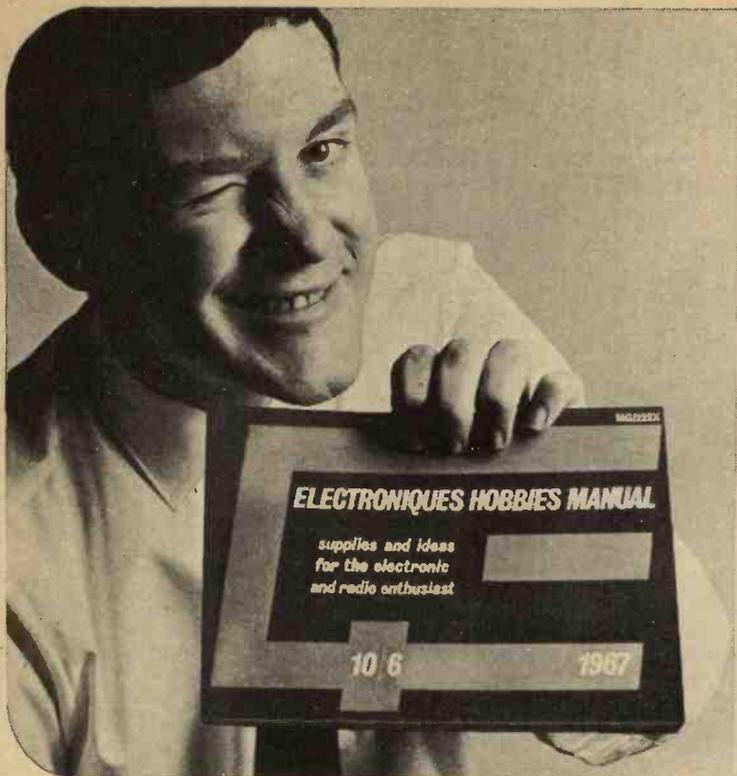
S1 Miniature slide on/off switch

Battery

BY1 5-6V battery (Mallory PX23)

Miscellaneous

Plastics box, $2\frac{1}{2}$ in \times $1\frac{1}{2}$ in \times $\frac{7}{8}$ in.
Small piece of laminated plastics board. Flash extension lead.



I should like a copy of the *Electroniques Hobbies Manual*.
Enclosed is a cheque/P.O. for 10/6.

NAME

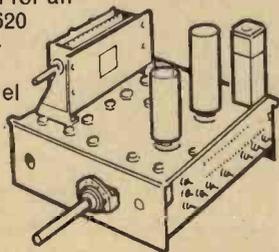
ADDRESS

P.I.E.3.

Two items from the *Electroniques Manual*...

Brilliant Valved 'QOILPAX'

● Highly sensitive ($1\mu\text{V}$ for 15dB S/N ratio when followed by a normal IF Strip) ● High-sensitivity RF stage is designed around EF 183, connected in a Miller compensating circuit, followed by an ECH81 triode heptode frequency changer, using oscillator circuits. These give optimum mixing conductance on each waveband without any pulling. Each oscillator not in use is shorted out ● General coverage and hamband models available both designed for an IF output of 1620 Kc/s ● Exceptionally low second channel



interference ● Units are completely wired, tested and aligned.

Both Models: £12.12.0 each complete. p.p. 4/-.

Today's most advanced aerial rotator

● Aims within ONE DEGREE of transmitter location ● Twin synchronised motors ● No guesswork, no irritating gear clicks. Precise fine adjustment through 365° location ● Continuous Instant Direction Indication—even when motor is not in use ● Accurate repeatability—aerial position can always be pinpointed ● Turns the heaviest arrays easily under ALL weather conditions.

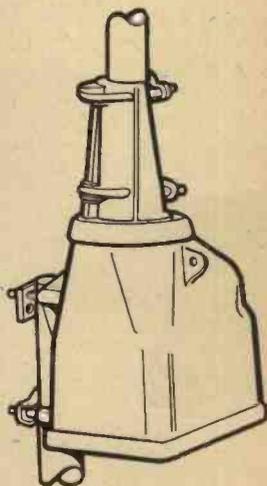
Price Automatic Model: £17.17.0.

Compass Model: £12.12.0 + p.p. 3/6.

Electroniques (Prop. STC Ltd.)

Edinburgh Way, Harlow, Essex.

Telephone: Harlow 26771.



High-grade components for amateur communications

electroniques



Armstrong

MONO TUNER-AMPLIFIERS



- | | |
|------------------------------------|----------|
| 227M MONO TUNER-AMPLIFIER | £39.10.0 |
| (illustrated) | |
| 127M MONO TUNER-AMPLIFIER | £29.10.0 |
| 127 STEREO TUNER-AMPLIFIER | £39.10.0 |
| OPTIONAL CASE, teak and vinyl hide | £3.10.0 |

Three tuner-amplifiers, identical in size and similar in styling, each with the same high performance AM-FM Tuner incorporated. The 227M provides 10 watts power output whilst the 127M, with 5 watts output, is designed for those whose power requirements are more modest. The 127 is the stereo version of 127M, having two amplifiers, each of 5 watts output. All three have similar facilities; pickup and tape inputs, tape recording output, bass and treble tone controls.

For full details and technical specifications of all models, plus list of stockists, post coupon or write mentioning 3PE67.

ARMSTRONG AUDIO LTD.
WARLTERS ROAD, N.7
Telephone: North 3213

Name.....

Address.....

3PE67

RECORD HOUSING



Does your hi-fi cause disharmony in the home? Does it clutter up the room? Does it irritate your wife? Why not bring harmony into the home with Record Housing? Our New Maestro Equipment Cabinet (£32.10.0) with matching Folded Horn Loudspeaker Enclosures (£10.19.0 each) will blend harmoniously into any setting. Whatever your set up there's a Record Housing Cabinet to meet your needs. Amplifiers, tuners, turntables, loudspeakers, records, tapes, tape decks — and even a complete tape recorder—you name it—we'll house it! Send for fully illustrated catalogue describing over 20 different cabinets and U.K. stockists' list.

FREE HI-FI HOUSING ADVISORY SERVICE
RECORD HOUSING (Dept. P.E.3)
Brook Road, London, N.22. Tel.: BOWes Park 7487



GOODMANS HIGH FIDELITY MANUAL A Guide to full listening enjoyment

The Manual is much more than a catalogue of Goodmans High Fidelity Loudspeakers—it contains informative articles, including advice on stereo, special beginners page, and full cabinet drawings. You'll find it interesting as well as informative.

NEW MAXAMP30 HIGH FIDELITY AMPLIFIER

MAXAMP 30 is a fully transistorised stereophonic High Fidelity Amplifier using Silicon Transistors throughout. It is precision engineered and fullest use is made of printed circuits. It will deliver continuously up to 15 watts of power on each channel and it looks as good as it is. 10½" x 5½" x 7¼" £49.10s.0d.

Full specification of the Maxamp 30 is given in the High Fidelity Manual - send the coupon for your FREE copy - or pay an early visit to your Goodmans dealer

FREE Please send Hi-Fi Manual together with name and address of my nearest Goodmans dealer.

Name

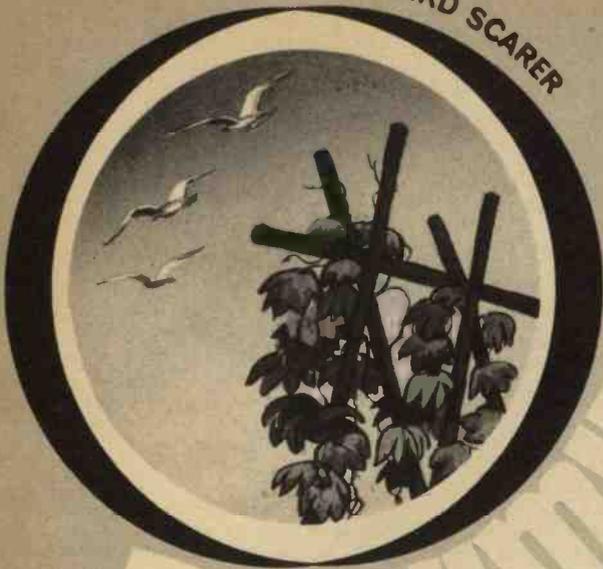
Address

PE 3

GOODMANS INDUSTRIES

AXIOM WORKS · WEMBLEY · MIDDLESEX Tel: WEM 1200
A Division of Radio Rentaset Products Ltd.

BIRD SCARER



PROXIMITY DETECTOR



SECURITY GUARD

GARAGE DOOR OPENER



By D. BOLLEN

PROXIMITY detectors are often used to guard property and can be used to prevent operators of machines from coming into contact with lethal moving parts. The usefulness of a device which responds to movement of a nearby human body is not restricted to purely industrial applications, however. In the home, a proximity detector can function as an automatic doorbell, a near infallible burglar alarm, garden bird scarer, and garage door opener, to mention only a few possibilities.

Optical proximity detectors are among the simplest to use and set up, and they can be highly sensitive. When a photocell, or similar light-sensitive cell, is arranged to "view" an illuminated space, then a person or object moving across that space will cause minute

fluctuations of current in the cell, which may be amplified to operate a relay.

In turn, the relay can be made to ring a bell, open doors, and operate machinery in direct response to the approach of a human being.

The device described here exploits this principle and, with a quiescent battery consumption of only 3mA, will detect a person moving at distances in excess of 6ft in ordinary daylight without the need for mirrors, pencil beams of light, or lenses.

TIME CONTROL

When a selenium cell is exposed to light it will generate a steady d.c. current, proportional to the light intensity. If the light reaching the cell is momentarily

increased or reduced, even by quite a small amount, the selenium cell will emit a pulse. Depending on how the light fluctuates, the pulse will be of a certain duration; the secret of success here lies in the correct selection of a suitable amplifier RC time constant.

If the time constant is too slow, a cloud obscuring the sun will cause the unit to trigger; if too fast it will fail to respond to the relatively slow movement of a human body. Assuming that a bell is to be operated by the unit, it must ring for several seconds to be effective, even though the trigger pulse from the selenium cell may last for only a fraction of a second.

There must therefore be a built-in time delay to keep the bell ringing. On the other hand, for burglar alarm applications, the bell will be required to ring continuously after the initiating event.

The circuit of Fig. 1 shows how these different requirements are met. A positive going pulse from the selenium cell, produced when the light to the cell suddenly diminishes, is amplified and inverted by the pulse amplifier TR1. C1 and C2 values are selected to give the appropriate time constant.

TR2 and TR3 form a Schmitt trigger, which is noted for its stability and freedom from drift. VR1 is so adjusted that TR2 is normally off and TR3 is on. As the pulse arrives from the collector of TR1, the Schmitt "flips" and TR3 is switched off. The Zener diode D1 performs the useful function of isolating the base of TR4 when TR3 is conducting, but it allows a heavy current to pass to TR4 base when the voltage at the collector of TR3 rises above the Zener turnover potential. C3 assists, at the instant of switching, to give positive relay action.

The feedback link from the collector of TR4 to R1 is responsible for the time delay—typically 15 seconds. When the relay is energised, the collector of TR4 drops to almost positive rail voltage, and bias is removed from the base of TR1, thus isolating R2.

It follows that C2 is then connected to the negative rail via R2 and, until it has charged to the new potential,

will hold the Schmitt hard on. If the delay is not wanted, R1 can be wired directly to the negative rail and the link from TR4 collector can be removed. The circuit will then provide a short output pulse to operate, say, an electromagnetic counter.

When S2 is closed, the relay will hold itself on permanently, after the trigger event, and the bell will continue to ring until BY2 is exhausted. With two 1289 batteries in series for BY1, at a current drain of 3mA, several weeks of continuous operation will be realised.

When setting up the unit, S1 is closed, and the bell will ring for about one minute while C1 and C2 attain equilibrium. VR1 is then adjusted for maximum sensitivity, consistent with reliable operation, while triggering the unit by waving a hand in front of the selenium cell tube opening.

AUTOMATIC DOORBELL

Postmen, milkmen, and advertiser's agents do not always ring the doorbell when they call; it might be that a special letter is expected, or there is some good reason for knowing immediately that somebody is standing at the front door.

The complete board assembly, with its cover, can be placed to view the front porch, and any daytime caller will unknowingly announce his presence. In this case, the bell will be mounted remote from the box, somewhere inside the house, and BY1 would be replaced by a mains powered, low voltage d.c. supply.

There is plenty of room in the box, when BY1 is removed, to take a battery eliminator of the type employed as a direct replacement for PP9 transistor radio batteries. Fig. 2 gives a suggested circuit for those wishing to construct their own eliminator. T1 is any small transformer giving a nominal output of 9 volts, and could well be an inexpensive bell transformer.

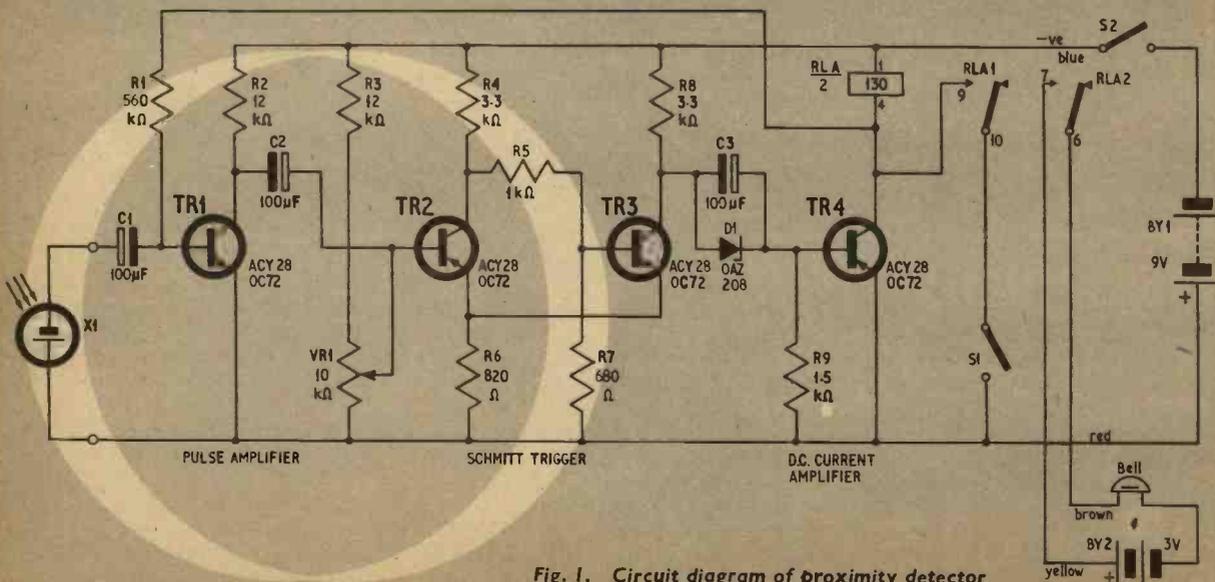


Fig. 1. Circuit diagram of proximity detector

When the automatic doorbell is to supplement an existing doorbell, then contacts 6 and 7 on the relay, see Figs. 1 and 5a, are wired across the bell push. So arranged, the doorbell will ring automatically in daylight, by detecting the caller before he has time to press the bell push, and manually at night.

If 24-hour automatic operation is contemplated, a small, low power lamp could be positioned in the porch, facing the selenium cell, so that the caller will interrupt its light and trigger off the bell.

It is probably better to let the automatic unit work its own bell independently, then one may distinguish between callers who press the button and those who do not, which also gives "fail safe" equipment duplication.

PORTABLE BURGLAR ALARM

There is sometimes a need to protect a sum of money, or documents, for a brief period, where a wall safe is not available. If the temporary hiding place is in the locked drawer of a desk, the warning device could be placed on the desk top so that the intruder must come within its field of view when attempting to open the desk drawer.

If the device is to be successful as a portable burglar alarm, it must be self powered, and tamper-proof. The photograph shows how "secret" switches—taken from old switched potentiometers—were mounted on a thick wooden base, together with batteries, circuit panel, and cell tube. The switches were operated by inserting a slim screwdriver through holes in the cover of the unit (Fig. 3). This, in itself, requires some juggling, and the intruder would take an appreciable time to work out how the switches should be operated.

The burglar therefore finds himself in a room with a featureless box containing a ringing bell, with no way of silencing it, short of dashing the box repeatedly to the floor, or hitting it with an iron bar, thus contributing to the noise already being made by the bell.

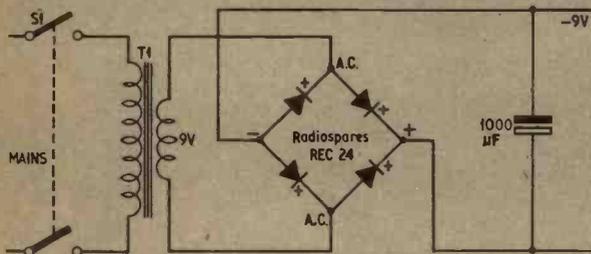


Fig. 2. Suggested battery eliminator power supply circuit for the unit when used as a "doorbell"

Obviously, publication of any secret switch system renders it no longer secret, but a simple solution to this is a key switch, such as the Bulgin type S321. The constructor might like to devise his own form of secret switching, however.

A suitable cover, designed to fit the wooden mounting board, is given in Fig. 3. When used as a burglar alarm, the bell is mounted internally, shown dotted, and small holes should be drilled to allow the sound to pass out of the box.

Ideally, the cover should be as stout as possible, preferably fabricated from sheet steel, with a steel panel bonded to the back of the wooden mounting board. This is not to say that a hardboard box is useless, in fact it will take considerable force to break open if the epoxy glue has been liberally applied.

At night, a small table lamp could be used to provide enough light to sensitize the selenium cell, but the light from a burglar's torch, as it falls on the unit, would be enough to set off the alarm.

If, in daytime, it is not convenient to site the desk close to a window, a white wall may provide enough ambient light to give correct functioning of the alarm. Optimum positioning of the alarm must be found by experiment, but is usually far from critical.

GARAGE DOOR OPENER

With the early warning device mounted close to a garage door, it will detect flashing headlamps at a considerable range, and the car may be driven straight into its garage, without the need for the driver getting out, when a door motor is activated by the unit.

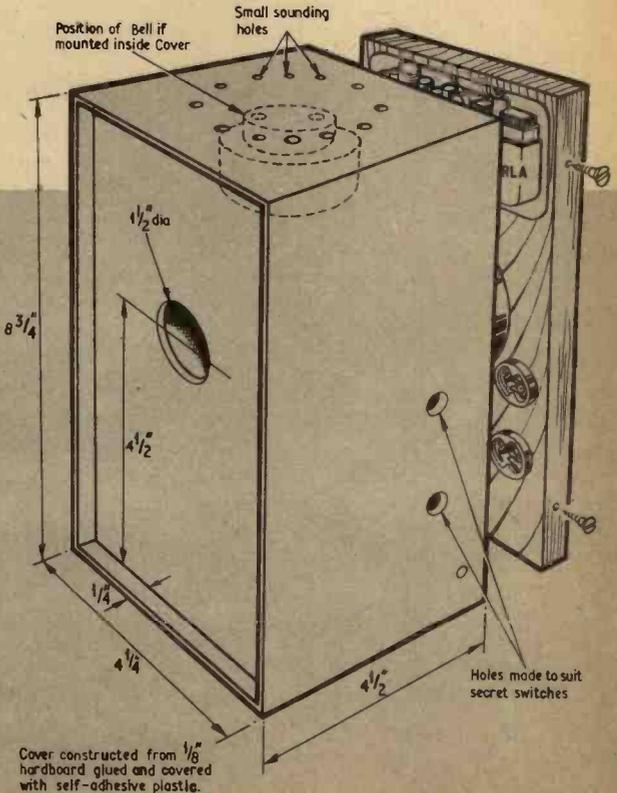


Fig. 3 (right). Case construction details. Note the switches on the baseboard and the related access holes

COMPONENTS . . .

Resistors

R1	560k Ω	R6	820 Ω
R2	12k Ω	R7	680 Ω
R3	12k Ω	R8	3.3k Ω
R4	3.3k Ω	R9	1.5k Ω
R5	1k Ω		

All 10%, $\frac{1}{4}$ watt carbon

Potentiometer

VR1 10k Ω log. carbon miniature skeleton pre-set

Capacitors

C1	100 μ F elect. 12V
C2	100 μ F elect. 12V
C3	100 μ F elect. 12V

Transistors

TR1, TR2, TR3, TR4 } ACY 28 or OC 72 (Mullard).

Diode

DI OAZ 208 (Mullard)

Relay

RLA 130 Ω four changeover contacts (S.T.C. type 25)

Photo Cell

X1 Selenium cell type B3M (International Rectifier Co.)

Batteries

BY1 9V (2 \times 4 $\frac{1}{2}$ V type 1289)
BY2 3V (type 800)

Switches

S1, S2 single pole, on/off (see text)

Miscellaneous

Relay socket, 3-8V bell
Laminated plastics board 2 $\frac{3}{4}$ in \times 4in
Baseboard, Cardboard tube and tin

If the sensitivity control VR1 is backed off, fluctuations of ambient light produced by a person walking in front of the garage door will not cause spurious operation, but there will still be a response to the intense glare of headlamps.

Contacts 6 and 7 on the relay will not carry sufficient current to switch a garage door motor, but a supplementary power relay can be installed, working from contacts 6 and 7, to control the motor. Switching circuits will vary, and depend on the type of motor used. The time delay previously discussed may not be required if only a brief switching pulse is necessary, to start the motor sequence.

The selenium cell connections to the amplifier should be reversed if triggering is to commence at the instant headlamps are switched on. In the normal mode, as shown in Fig. 1, the unit will only trigger when ambient light is reduced, when the headlamps are turned off.

GARDEN BIRD SCARER

The unit can be used in the garden. Rapidly fluttering wings will generate a good signal in the selenium cell. The ringing bell will disconcert birds as well as announce that the garden is under attack. In

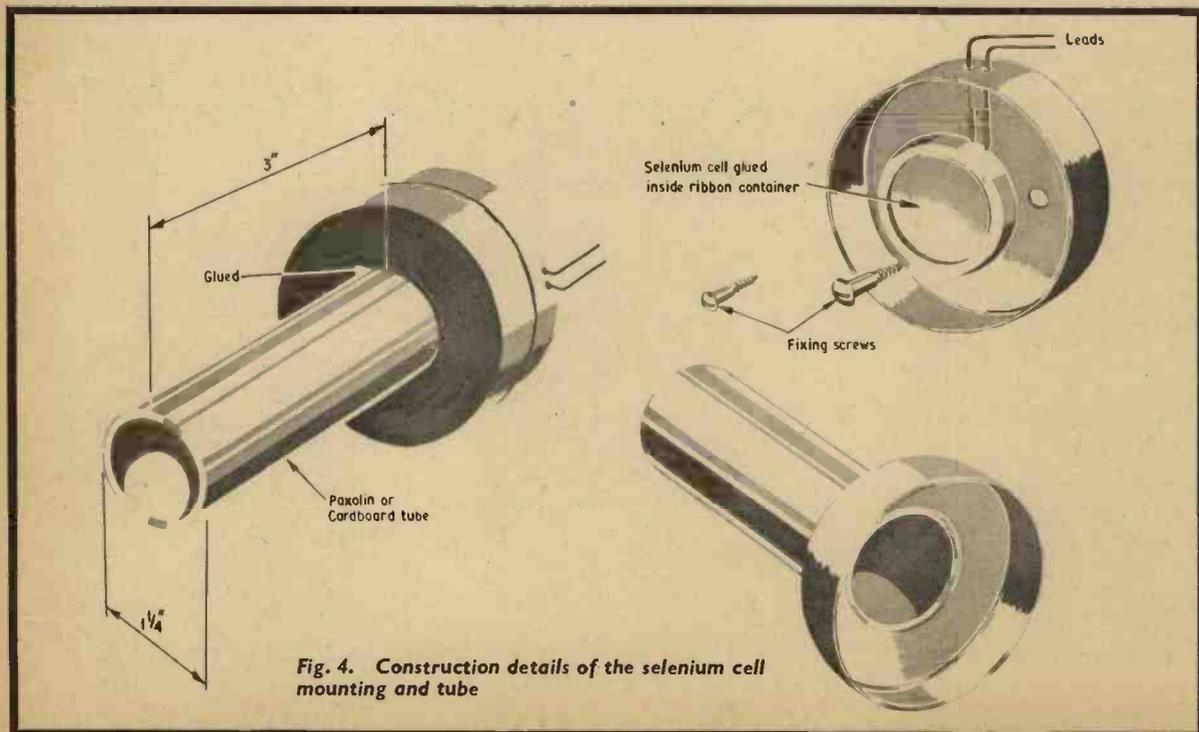


Fig. 4. Construction details of the selenium cell mounting and tube

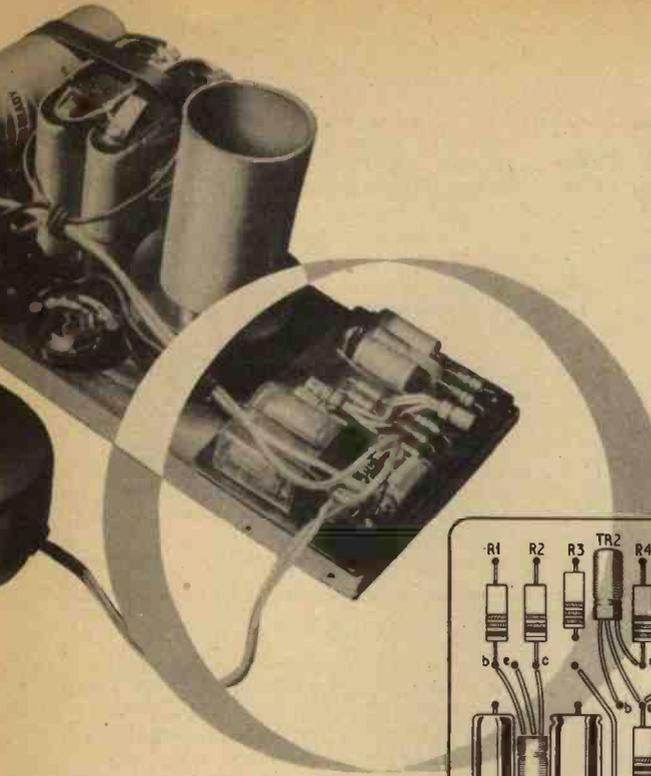
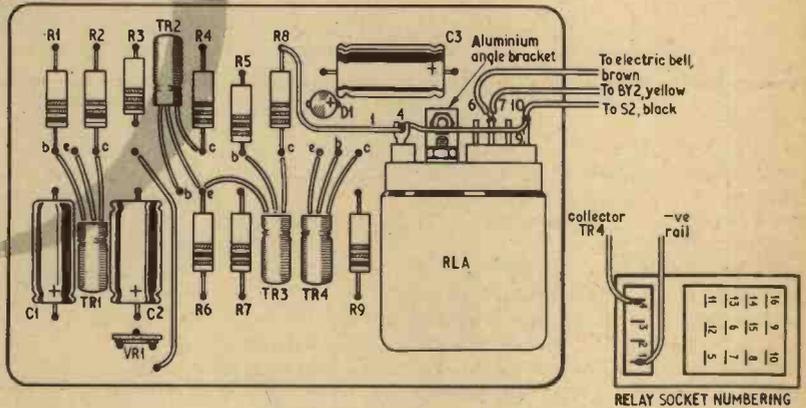


Fig. 5a (right). Component layout and relay socket numbering

Fig. 5b (below right). Wiring on the reverse side of the panel



fact, any marauding creature of sufficient size, such as hens or cats, will be quickly discovered.

FLAME DETECTOR

The early warning device will make a very efficient flame detector. For example, when pointed at flames in a small domestic fireplace, the bell will function reliably, and repeatedly, at distances of around 12ft. The flickering action of the flames provides an a.c. signal. No modifications to the circuit are necessary for this application and, indeed, the portable burglar alarm already described will also serve as a fire alarm.

CELL TUBE CONSTRUCTION

Details of the selenium cell mounting are given in Fig. 4. A plastics or cardboard tube is employed to enhance directional response and increase sensitivity. The hole to take the tube can be cut in the lid of a typewriter ribbon container with a fretsaw.

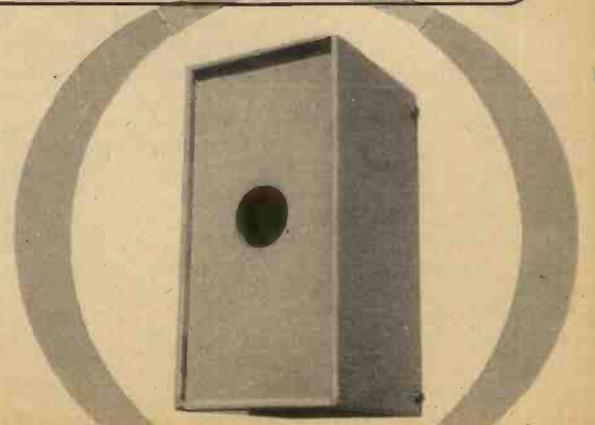
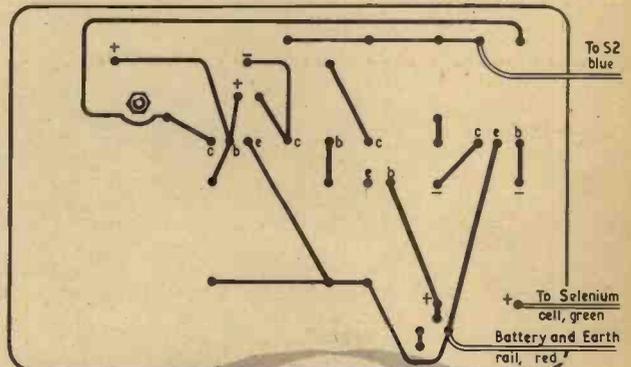
The selenium cell need not be circular, the more usual rectangular cell wafers are quite suitable, but the largest available cell is to be preferred if sensitivity is the prime requirement. The cell is glued to the back of the ribbon container and holes are drilled for cell leads, as shown. Holes are also drilled and counter-sunk to take woodscrews, for mounting the cell tube on a baseboard.

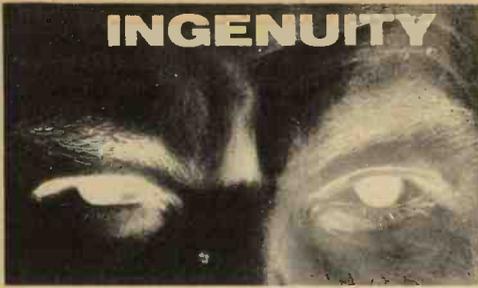
PANEL CONSTRUCTION

All the components of Fig. 1, with the exception of the selenium cell, power supply, and switched circuits, are mounted on a laminated plastics panel measuring

4in x 2½in, as a module for installation in different types of equipment. The diagram (Fig. 5) shows positioning of components and drilling plan. Although components were wired underneath on the original, the diagram of Fig. 5b could be copied directly on to copper covered laminated board to make an etched circuit.

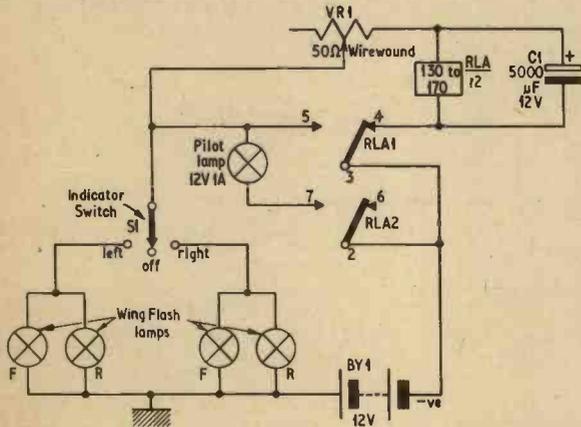
Almost any relay of 6 to 9 volts, operating at currents of 100mA or less, could be employed with the circuit of Fig. 1, but the type specified will fit neatly with other components on the module panel, mounted by means of a small aluminium bracket. The S.T.C. type 25 relay has four complete sets of changeover contacts, and plugs into a special socket. It is convenient to have these spare sets of contacts available if function lights are incorporated, and other circuits are to be added at a later date. Transistors are laid flat on the panel with their leads insulated by thin sleeving. ★





IN THIS feature we hope, from time to time, to be able to publish suggestions submitted by some of our readers on the possible improvement of projects previously described in PRACTICAL ELECTRONICS; short contributions on other subjects may be included. The aim is not to find fault or undermine the abilities or knowledge of our contributors. It may well be that the original article is *par excellence* but it could be improved or adapted to suit individual requirements. The views expressed by readers are not necessarily those of the Editor.

DIRECTION INDICATOR



THE circuit shown in the May 1966 issue seems to be fairly complex for the job. The circuit I am enclosing is simple and inexpensive, and has been working successfully for many years.

The capacitor is the only component that needs reversing for positive or negative earth systems. The circuit is switched on by the indicator switch which passes current via the flasher lamps (right or left hand) through RLA1 (4) to RLA coil and C1, the contacts of RLA1 (5) and RLA2 (7) are then closed which lights the wing flasher lamps and pilot lamp (on dash). C2 holds RLA in this position until discharged through the relay coil. RLA1 and RLA2 return to contacts four and six and the cycle repeats again, the speed of flash is set by VR1.

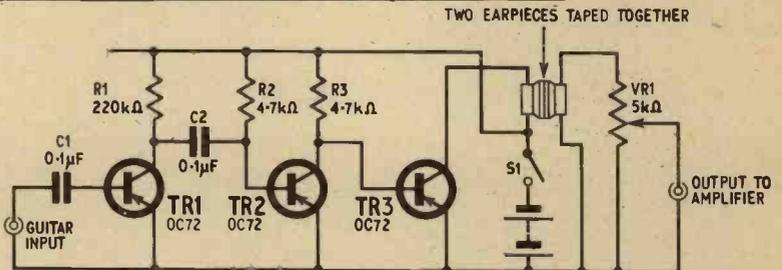
C. Caton,
Thaxted,
Essex.

SIMPLE SITAR

FROM an ordinary electric guitar a sound very similar to the sitar, can be produced by the circuit shown here.

It consists of a three transistor amplifier which amplifies the guitar sound and is connected to one of a pair of earphones which are taped together. The second 'phone is connected to the guitar amplifier input; the volume control is not essential.

The earphones should be wrapped in some material, for example foam rubber, when the unit is mounted in a box, to prevent acoustic feedback to the guitar.



M. P. Hamer,
Bath,
Somerset.

SECRET SAFEGUARD

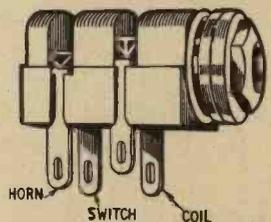
SINCE published car alarm systems can be studied by the best brains in the thieving industry, it is better to suggest ways which can be adapted according to the ingenuity of the owner, so that only *he* knows the key.

The ordinary jack-socket with shorting contacts can be connected in the ignition circuit, starter switch (relay type only), lighting circuits, etc. so that switching on will sound the horn but not start the engine.

Sockets can be obtained with both contacts short-circuited, so that it can be used with the chassis connection to the plug body (sleeve). The plug can be short-circuited, left open-circuit, or replaced by a rod of insulating material.

So there is scope for a range of ideas such as three sockets in a row, one as in the sketch, the other two with HORN instead of COIL. Only the right plug in right socket will start the engine. The plugs are numbered 1,2,3, but only *you* know which socket no. 1 plug goes into safely. If pushed into the wrong one, the alarm would sound at once.

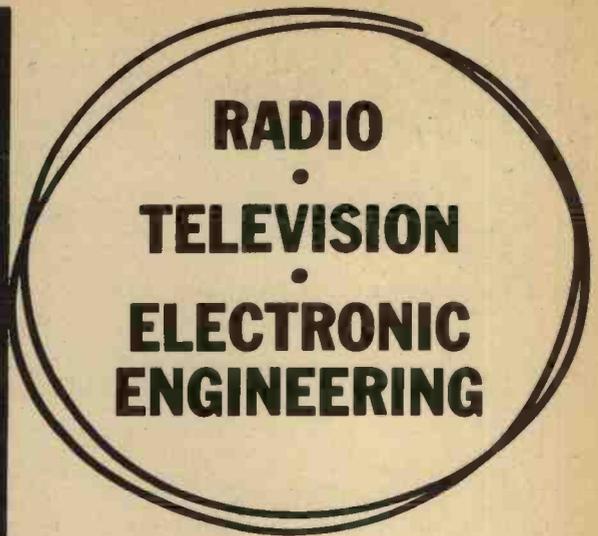
This guards against starting. Protection against entry could be similar, the socket being connected to door switches and boot and bonnet switches.



A jack plug with short-circuited contacts will disconnect the horn and connect the switch to the coil.

E. W. Baigent,
High Wycombe,
Bucks.

INCREASE YOUR KNOWLEDGE



MEMBER OF THE ASSOCIATION
OF BRITISH CORRESPONDENCE COLLEGES

CHOOSE THE RIGHT COURSE FROM
RADIO AND TELEVISION ENGINEERING,
INDUSTRIAL TELEVISION, RADIO AND
TELEVISION SERVICING, ELECTRONICS,
COMPUTERS AND PROGRAMMING,
ELECTRONIC TECHNICIANS, SERVOMECH-
ANISMS, TELEMTRY, CLOSED CIRCUIT TV,
INSTRUMENTATION, AND PRINCIPLES OF
AUTOMATION.

ALSO EXAMINATION COURSES FOR:

Inst. of Electronic and Radio Engineers
C. & G. Telecommunication Techns'. Cert.
C. & G. Supplementary Studies
R.T.E.B. Radio/TV Servicing Cert.
P.M.G. Certificates.
Radio Amateurs' Exam.

LEARN AS YOU BUILD

Practical Radio Courses: Gain a sound knowledge of Radio as you build YOUR OWN 5-valve superhet Receiver and Transistor, Portable Signal Generator and High Quality Multitester. At the end of the course you have valuable practical equipment and a fund of personal knowledge and skill. ICS Practical Radio Courses open a new world to the keen amateur.

THERE IS AN ICS COURSE FOR YOU

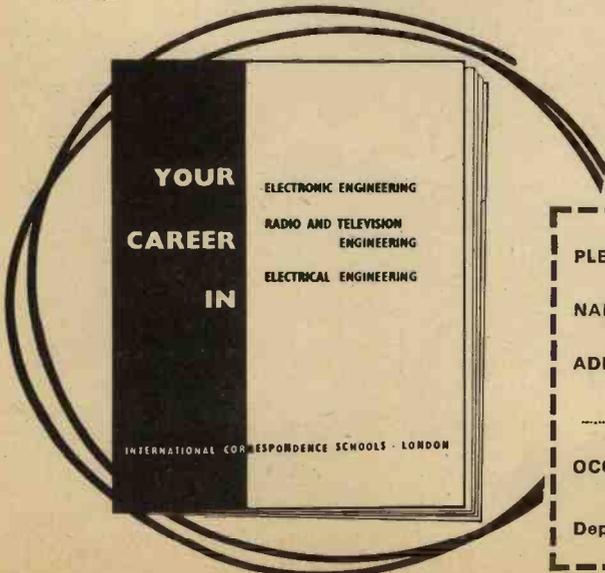
Whether you need a basic grounding, tuition to complete your technical qualifications, or further specialized knowledge, ICS can help you with a course individually adapted to your requirements.

There is a place for you among the fully-trained men. They are the highly paid men—the men of the future. If you want to get to the top, or to succeed in your own business, put your technical training in our experienced hands.

ICS Courses are written in clear, simple and direct language, fully illustrated and specially edited to facilitate individual home study. You will learn in the comfort of your own home—at your own speed. The unique ICS teaching method embodies the teacher in the text; it combines expert practical experience with clearly explained theoretical training. Let ICS help you to develop your ambitions and ensure a successful future. Invest in your own capabilities.

FILL IN AND POST THIS COUPON TODAY

You will receive the FREE ICS Prospectus listing the examinations and ICS technical courses in radio, television and electronics. PLUS details of over 150 specialised subjects.



PLEASE SEND FREE BOOK ON.....

NAME

ADDRESS

.....

OCCUPATION..... AGE.....

INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 150, INTERTEXT HOUSE, PARKGATE ROAD, London, SW11
3/67

DE LUXE PLAYERS

4-Speed Players 2-tone Cabinets 17x15x8 1/2 in. High flux loudspeaker and High Quality Amplifiers ready built. Quality output. Volume and Bass controls. Special instructions enable assembly in 30 minutes, only 5 wires to join. 12 months' guarantee.



TO BUILD YOURSELF

PORTABLE CABINET As illustrated. To fit standard player or autochanger. **69/6**
RCS AMPLIFIER 3 WATT. Ready made and tested with UCL82 triode pentode valve. **59/6**
SINGLE PLAY UNITS
BSR GUT £4.19.6
 Garrard SRP12 £4.19.6
 Garrard SP25 £10.19.6
 Philips AG1016 £12.9.6
 Garrard A70 £18.19.6
 Garrard LAB80 £24.19.6
 Garrard 401 £29.19.6

SUPERIOR AMPLIFIER. Ready made and tested. Guaranteed better sound. Fully isolated AC Mains Transformer. 4 watt output. ECL82 triode pentode valve. Volume and tone controls with knobs. Quality Loudspeaker. **89/6**
AUTOCHANGE UNITS
 BSR Superslim £5.19.6
 Garrard 1000 £5.19.6
 Garrard 2000 £6.19.6
 Garrard 3000 £8.9.6
 Garrard AT60 with discust turntable £10.19.6

GARRARD TEAKWOOD BASE WB1 Ready cut for mounting 1000, 2000, 3000. SP25. AT60. **72/6**

INTEGRATED STEREO AMPLIFIER 4 watt per channel. A splendid example of functional design and value. Grey Silver Chassis cabinet size 10 x 6 x 3 in. 200-250v. A.C. Separate Gram and Tuner inputs. Self contained pre-amp. and all controls. **£10.10.0**

Q MAX CHASSIS CUTTER

Complete: 3 die, a punch, an Allen screw and key
 1 in. 14.6 in. 15.9 in. 18 in. 18 in. 20.6 in. 22 in. 37.9 in.
 14.9 in. 18 in. 1 in. 18 in. 22.6 in. 2 in. 44.3 in.
 15.6 in. 1.1 in. 18 in. 2 in. 34.3 in. sq. 31.8

BARGAIN XTAL PICK-UP ARM Complete with ACOX LP-75 Turnover Head and Stylus 20/-; Stereo 30/-; SPEAKER FREET Tyanan various colours, 32in. wide, from 10/-; 26in. wide, from 5/-; H. SAMPLES S.A.E.
EXPANDED METAL GOLD or Silver 12 x 12 in. 6/-
NEW GARRARD GRAM MOTORS 100-130v. A.C. 15/- pair for 200/250v. (in series), or 10/- each Post Free.

FULL WAVE BRIDGE SELENIUM RECTIFIERS: 2, 6 or 12 v. outputs. 1 1/2 amp. 8/9; 2 a. 11/3; 4 a. 17/6.
CHARGER TRANSFORMERS. Tapped input 200, 250 v. for charging at 2, 6 or 12 v. 1 amp. 17/8; 2 amp. 21/-; 4 amp. 25/-; P. & P. 2.6. Circuit free. Meter 5 amp. 10/6.

MOVING COIL MULTIMETER TK 25. 0-1,000v. A.C./D.C., ohms 0 to 100k. etc. **47/6**
MOVING COIL MULTIMETER EPIOK. 7/6
 0-1,000v. A.C./D.C., ohms 0 to 3 meg. etc.
MOVING COIL MULTIMETER EP20K. 99/6
 0-2,500v. D.C. 20,000 ohms per volt. 0-1,000v. A.C. Ohms 0 to 6 meg. 50 Microamps full scale.

NEW MULLARD TRANSISTORS
 OC71 6/-; OC72 7/6; OC81D 9/-; OC81 6/-; AF115 8/-; AF114 8/6; OC44 8/-; OC45 8/-; OC171 9/-; OC170 8/6; AF117 7/-; OC25 12/6; AD140 15/-; OC35 15/- Holders 1/3.

ARDENTE TRANSISTOR TRANSFORMERS
 RD3035, 7.3 CT. 1 Push Pull to 3 ohms for OC72, OC81. 11/-
 RD3034, 1.75 1 CT. Push Pull Driver for OC72, OC81. 11/-
 RD3058, 11.5 1 Output to 3 ohms for OC72, OC81. 11/-

TRANSISTOR MAINS ELIMINATORS. FAMOUS "POWER MITE". 9-VOLT. SAME SIZE AS PP9 BATTERY. 45/- FULLY SMOOTHED. 150mA. FULL WAVE CIRCUIT.

WEYRAD P50 - Transistor Coils
 RA2W 6 in. Ferrite Arched Spare Cores. 6/6
 with car aerial coil. 12/8
 Driver Trans. LFDT4. 9/6
 Osc. P50/AC1. 5/4
 J.B. Tuning Circuit, PCAL. 8/6
 I.F. 200/470 kc/s. 5/7
 P.T. Tuning Gear. 10/6
 3rd I.F. P50/3CC. 6/-
 Weyrad Booklet. 2/-

Volume Controls
 80 Ohm Coax 6d. vd
 Long spindles. Midget Size 3k. ohms to 2 Meg. LG or LIN. L3 3". D.P. 5".
 STEREO LS 10/6, D.P. 14.6.

COAXIAL PLUG 1/4" PANEL SOCKETS 1/4" LINE SOCKETS 2" OUTLET BOXES SURFACE OR FLUSH 4.6.
BALANCED TWIN FEEDERS 6d. 4d. or 30d. ohms.
TELESCOPIC CHROME AERIALS. 6in. extends to 23in. 6.8 each. CAR AERIAL PLUGS 1/6. Sockets 1/3.

TV REMOTE CONTROL

For PHILIPS 197G111A, 121A, 125A, 142A, 23TG111A, 113A, 121A, 131A, STELLA ST1033A 39A, 45A, 53A, COSSOR CT1810A, 21A, CT2310A, 21A, 31A
PHILIPS Price 2 gns.
 Our **12/6** Post Free
 Brand New. Includes 11ft. 7-way cable, MULLARD OA81 2 pots., 3 switches, 5 resistors



RETURN OF POST DESPATCH Minimum P.P. Charge 1/6 unless otherwise stated. C.O.D. 5/- extra. Full List 1/-.

RADIO COMPONENT SPECIALISTS

Written guarantee with every purchase. (Export: Send remittance and extra postage, no C.O.D.) Buses 133, 68 pass door, S.R. Stn. Selhurst. Tel: THO 1665

STELLA RECORD PLAYER AMPLIFIER

4 watt. 2 stage. 3 to 7 ohm. Neg. feed back. UCL82. UY85. 200-250v. A.C. tapped input. Chassis size 8 x 2 x 4 in. High. Gold Walnut knobs. Volume and Tone controls on separate Polished Wood Panel 6 x 2 in. Brand new with makers' guarantee. **BARGAIN PRICE P. & P. 1/6. 78/6**

NEW TUBULAR ELECTROLYTICS	CAN TYPES
2/350 v. 2/3 100/25 v. 2/6	8/800 v. 9/6
4/350 v. 2/3 250/25 v. 2/6	16/800 v. 12/6
8/450 v. 2/3 500/15 v. 3/-	16-16/500 v. 7/6
16/450 v. 3/- 8-8/450 v. 3/6	32-32/450 v. 6/-
32/450 v. 3/9 16-16/450 v. 3/9	50-50/350 v. 7/-
50/25 v. 1/9 8-8-16/450 v. 4/3	80-100/350 v. 11/6
50/50 v. 2/- 32-32/350 v. 4/6	100-200/275 v. 12/6

PAPER TUBULARS
 350v.-0.1 9d., 0.5 2/6; 1 mfd. 3/-; 2 mfd. 150c. 3/-; 500v.-0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.5 3/6; 1.000v.-0.001, 0.0022, 0.0047, 0.01, 0.02, 1/6; 0.047, 0.1 2/6.
E.H.T. CONDENSERS. 0.01mfd. 7kV, 6/6; 20kV, 10/6

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250 mfd. 15v. 2/6; 500, 1000 mfd. 15v. 3/6; 2000 mfd. 25v. 7/-; CERAMIC 500 v. 1 pF. to 0.01 mfd. 9d.
SILVER MICA. Close tolerance (plus or minus 1 pF.). 5 to 47 pF. 1/-; ditto 15 to 50 to 800 pF. 1/-; 1,000 to 5,000 pF. 2/-; TWIN GANG "0-0" 208 pF. 1/7. 375 pF. 10/6; 365 pF. miniature 10/-; 500 pF. standard with trimmers. 9/-; 500pF. midget less trimmers. 7/6; 500 pF. slow motion, standard 9/-; small 3-gang 500 pF. 18/8. Single "0" 365 pF. 7/6. Twin 10/-; SHORT WAVE. Single 10 pF., 25 pF., 50 pF., 75 pF., 100 pF., 160 pF., 5/6 each. Can be ranged. Couplers 9d. each. TUNING. Solid dielectric. 100 pF., 300 pF., 500 pF., 3/6 each. TRIMMERS. Compression ceramic 30, 50, 70 pF. 3/6; 100 pF., 150 pF., 1/3; 250 pF., 1/8; 600 pF., 750 pF., 1/9.
 250v. RECTIFIERS. Selenium 1 watt 100mA 5/-; BY100 10/-; CONTACT COOLED 1/2 wave 80mA 7/6; 85mA 9/6. Full wave 75mA 10/-; 150mA. 19/6; T.V. rectis. 10/-.

SPECIAL OFFER! NEW B.A.S.F. TAPE

7 in. L.P. 1,800 ft. (Cat. LGS35) 45/-
 7 in. D.P. 2,400 ft. (Cat. LGS26) 70/-
 Spare Spools 2/6. Tape Splicer 1/-. Leader Tape 4/6.
 Tape Heads: Collaro 2 track 28/6 pair. B.S.R. 4 track 99/6

MAINS TRANSFORMERS

E.M.I. 250-0-250, 100 mA. 6.3 v. 4 a. 8.3 v. 2 a. 19/6
 250-0-250, 80 mA. 6.3 v. 3.5 a. Rectifier 8.3 v. 25/-; 1 a. or 5 v. 2 a.; Ditto 350-0-350, 29/6.
 MT. 510/300-0-300 v. 120 mA. 6.3 v. 4 a. 29/6
 MINIATURE 200 v. 20 mA. 6.3 v. 1 a. 10/6
 MIDGET 220 v. 45 mA. 6.3 v. 2 a. 15/6
 SMALL 300-0-300 v. 70 mA. 6.3 v. 4 a. 19/6
 HEATER TRANS. 6.3 v. 15 a. 7/6; 6.3 v. 4 a. 10/6
 Ditto tapped sec. 1.4 v., 2.3 v., 4.5 v., 8.3 v. 11 amp. 10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a. 25/-
 1 amp., 5, 10, 15, 20, 25, 30, 35, 40, 55, 60, 29/6; 2 a., 47/6
 Sub-Min. Mains to 9 v. 80 mA. 1 1/2 1 1/2 1 1/2 1 1/2 1 1/2 7/6
AUTO TRANSFORMERS 0-115-230 v. Input, Output, 60w. 18/6; 150w. 29/1; 500w. 82/6

CRYSTAL MIKE INSERTS

1 1/2 x 3 in. 6/6; BM3 1 1/2 x 3 in. 7/6; ACOS 1 1/2 x 3 in. 8/6
 TANNON CARBON MIKE with Switch. 5/6
 MOVING COIL HEADPHONES 100 ohms (ex. Govt.) 12/6
 H.R. HEADPHONES 2000 ohms. 12/6, 4000 ohms. 15/-
 H.R. HEADPHONES 2000 ohms Super Quality. 25/-

1967 GRAM CHASSIS

Three Wavebands: Five Valves: ECH81, EF89, Lox., Med., Short. Gram. FBCE1, EL84, EZ80.
 12 month guarantee. A.C. 200-250 v. Ferrite Aerial
 5 watts 3 ohm. Chassis 13 1/2 in. x 7 in. x 5 in. dial size
 13 in. x 4 in. Two pilot Lamps. Four Knobs.
 Aligned circuit. Full Chassis isolated from mains
DE LUXE STEREO GRAM CHASSIS V.H.F., MW, SW
 16-50v. SW 60-180m. Magic eye, push buttons. **£19.19**
 9 val. plus rect. Size 15" x 7" x 6" high

HIGH GAIN TV. PRE-AMPLIFIER BAND I B.B.C.
 Tunable channels 1 to 5. Gain 18 dB. ECC84 valve.
 Kit price 32.6 or 55/- with power pack. Details 6d.

BAND III I.T.A. - same prices. Tunable channels 7 to 13.
 Band I or III. Coils and circuit only, 8/6. Chassis 4/9.
B.B.C. 2 SUPER BOOSTER transistor motor. Ready built 75/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2 1/2 in. sides, 7.4 in. 5/6; 9.4 in. 6/6; 11.3 in. 6/6; 11.7 in. 7/6; 13.9 in. 9/6; 14.1 in. 12/6; 15.14 in. 15/-.

ALUMINIUM PANELS 18 s.w.g. 12x12in. 5/6; 14x9in. 4/6; 12x9in. 3/6; 10x7in. 2/9; 8x6in. 2/2; 6x4in. 1/6.

ALL PURPOSE TRANSISTOR PRE-AMPLIFIER
 Gain 14: 1. 250v. or 9v. input. Ready built with Mu Metal input transformer for Mikes, Pick-Ups, Tuners. **15/-**
 Instructions and circuit supplied. Post Free.

THE INSTANT BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

Leaflet S.A.E. 200/250 v. A.C. **35/-**



BAKER 12 in. STANDARD

The Ideal High Fidelity Loudspeaker for high output at home or public address, etc.

Voice Coil Impedance 15 ohms.
 Max. Power 20 watts
 Bass Res. 40/50 cps.
 Flux 14,000 gauss.
 Voice Coil Diameter 1 1/2 in.
 Voice Coil material Copper
 Response 40-14,500 cps.
 Magnet material Alcomax
 Overall dia. 12 in.
 Overall depth 6 in.

Price £8 POST FREE

CATALOGUE S.A.E.

GROUP MODELS FOR VOCALS
 BASS, LEAD and RHYTHM GUITARS
 30-10,000 cps. Voice Coils 15 ohms. Heavy duty

'Group 25' 'Group 35' 'Group 50'

12in. 5gns. 12in. 8 1/2 gns. 15in. 18gns.
 25w. 35w. 50w.

LOUDSPEAKERS 3.5 x 0.8MS. 2 1/2 in., 3 in., 4 in., 5 in., 7 in. x 4 in., 15/6 each; 8 in. 22/6; 6 in. 18/6; 10 in. 30/-; 12 in. 30/-; (15 ohms 35/-; 10 x 6 in. 30/-; 8 x 5 in. 21/-; E.M.I. Double Cone 45/6; 3 in. or 15 ohm models, 45/-; W. B. 10 in. HF1012, £5.10.0; 1 in. HF812, £4.10.0. Crossover W.B. Horn Tweeters 3-18 Kc/s. 10 v. 29/8; 20 v. 20 Kc/s. 99/6.
JACK SOCKETS Std. open-circuit 2/6, closed-circuit 4/6.
Chrome Lead Socket 7/6. DIN 3-pin 1/3; Lead 3/6.
Phono Plug 1/-. Socket 1/-. Banana Plug 1/-. Sockets 1/4-.
JACK PLUGS STANDARD. Chrome 3/-; DIN 3-pin 3/6.
JACK-CHANGE SWITCHES WITH LONG SPINDLES.
 2 p. 2-way, or 2 p. 6-way, or 2 p. 4-way 3/6 each.
 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 3/6 each.
 Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. Prices include click spindles, adjustable tines, spacers, etc. 1 waffer, 10/6; 2 waffer, 15/-; 3 waffer, 19/6.
TOGGLE SWITCHES, s.p. 2/-; s.p. d.t. 3/6; d.p. 3/6; d.p. d.t. 4/-.

DE LUXE TAPE SPLICER

Cuts, trims, joins for editing and repairs. With 3 blades. **14/6**

4 CHANNEL TRANSISTOR MICROPHONE MIXER.

Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. **59/6**

2 WAY INTERCOM and BABY SITTER.

All transistor. 2 way call buzzer. Desk or wall mounting. Very good volume. For home, office or shop. **59/6**
 With long lead, battery, etc.

AM TUNER MEDIUM WAVE.

Three Transistor Superhet. Ready built. Printed Circuit. Ferrite Aerial. Size 5 1/2 x 3 1/2 x 1 1/2. **79/6**
 Ideal for Tape Recorders.

3 WATT QUALITY AMPLIFIER.

4 Transistor Push-Pull Ready built, with volume control **75/-**

NEW MANUFACTURERS SURPLUS UHF BBC 2 AERIALS

BBC 2 Double Gold Ring Set Top Model 22/6
 BBC 2 Five Element Lot Model 32/6; Outdoor 42/6

RADIO BOOKS (Postage 9d.)

Radio, T.V. Valves, Diodes, Transistor equivalents 10/6
 High Fidelity Speaker Enclosures and Plans 5/-
 Transistor Superhet Commercial Receivers 7/6
 Mullard Audio Amplifier Manual 8/6
 Radio Valve Guide, Books 1, 2, 3, 4, or 5 each 5/-
 Practical Radio Inside Out 4/6
 Transistor Audio Amplifier Manual 4/6
 Shortwave Transistor Receivers 5/-
 Transistor Communication Sets 6/-
 International Radio Stations List 2/6
 Modern Transistor Circuits for Beginners 7/6
 Sub-Miniature Transistor Receivers 5/-
 Wireless World Radio Valve Data 9/6
 At a glance valve equivalents 6/-

RESISTORS. Preferred values. 10 ohms to 10 meg. 1 w. 1/2 w. 1 w., 20 w. 4d.; 1/2 w. 8d.; 2 w. 1/-; 1 w. 10/-; 6d. HIGH STABILITY. 1 w. 1/2 w. 2-. Preferred values. 10 ohms to 10 meg. Ditto 5w. 10 ohms to 22 meg., 9d. 5 watt 0.5 to 8.2 ohm 3 w. 1/6
 10 watt 1/6
 15 watt 10 ohms to 6,800 ohms 2 - 2 - 3 -

10K, 15K, 20K, 25K, 10W.
MAINS DROPPERS. Midget. With sliders. 0.3 A., 1 K. 0.2 A., 1.2 K. 0.15 A., 1.5 K. 6/-; each. LINE CORE 100 ohms It. twin plus resistance. 1/- ft.

WIRE-WOUND 3-WATT WIRE-WOUND 4-WATT
 POTS. T.V. Type. Values STANDARD SIZE POTS.
 10 ohms to 90 K, 3, 3, LONG SPINDLE VALUES
 Carbon 30 K to 2 meg., 3-, 50 OHMS to 100 K, 7/-.

VALVE HOLDERS. Int. Oct. 6d. Mazda Oct. 6d.; 8/6. B8A, B8G, B9A. Mounted 9d. Ceramic 1/-; B7G, B9A Cans 1/8-. Valve base plus B7G, B9A, Int. Oct., 2/3.

C.R.T. BOOSTER TRANSFORMERS

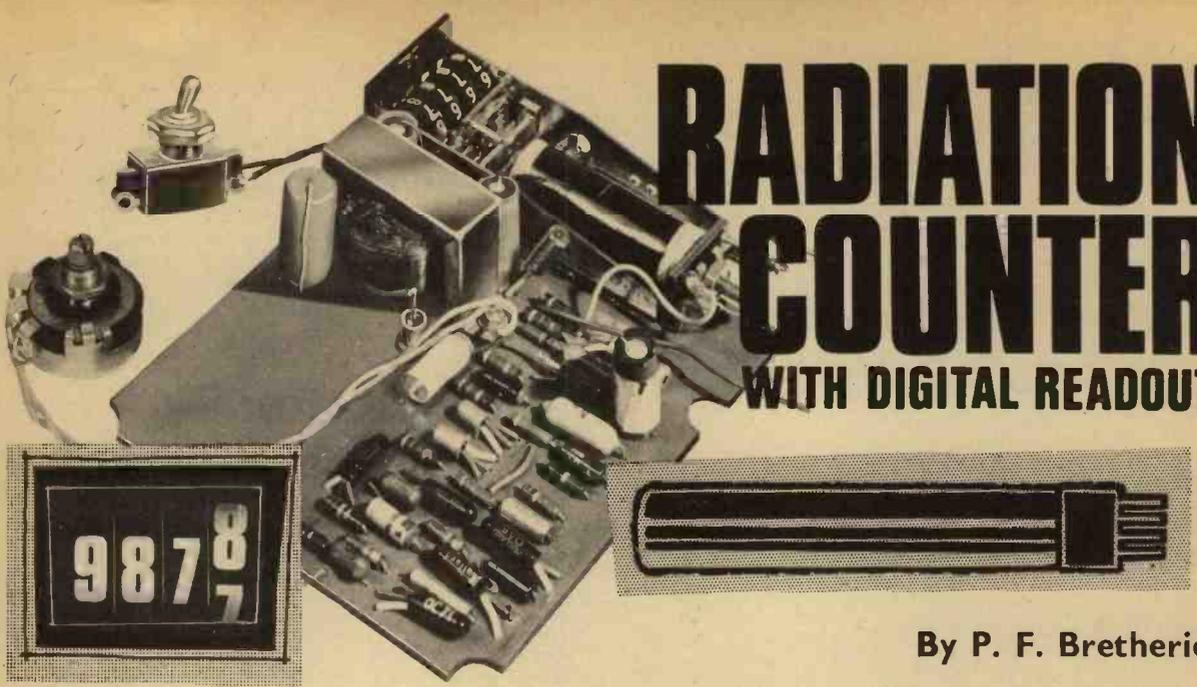
for heater cathode short or falling emission. 25% and 50% optional boost. 200/250v. AC input. State tube voltage required, 2 or 6 or 13 v. **15/6**

BRAND NEW QUALITY EXTENSION LOUSPEAKER

In tough cream plastic cabinet with 20W. lead and amplifier. For any transistor radio, Intercom, mains radio, tape recorder, etc. 3 to 15 ohm matching Size: 7 1/2 x 5 1/2 x 3" **30/-** Post Free



RADIATION COUNTER WITH DIGITAL READOUT



By P. F. Bretherick

THIS unit was designed to display on a digital relay the background count (i.e. counts from two to five hundred per minute) of a modern halogen quenched Geiger-Muller (G.M.) tube. It is suitable for determining the day-to-day change in cosmic radiation or for accurate quantitative analysis of liquid samples using a suitable liquid sampling tube.

The design employs a Post Office type digital relay, which is rewound to suit the circuit, and a binary divider, which enables very high accuracy and counts at more than double the counting speed of the relay to be obtained.

THE CIRCUIT

The principle of operation is best seen by referring to the waveform diagram Fig. 1 in conjunction with the circuit diagram Fig. 2.

The first two transistors TR1, TR2, form a simple pulse amplifier, the gain of which has proved adequate for even the poorest pulse output from any G.M. tube tried by the author. (This stage could also constitute part of a loudspeaker amplifier if one is used with the counter.)

Base current bias is unnecessary for the first transistor, TR1, since the output from the G.M. tube is a negative pulse. When the transistor receives such a pulse it switches on, this causes the collector to go positive. TR2, however, receives this positive pulse from TR1 collector; it must therefore be biased into the conducting condition so that the pulse may switch it off. A negative pulse then appears at TR2 collector which is passed on to the divider circuit.

Transistors in this stage are not critical; any general purpose audio transistors are satisfactory.

THE BINARY DIVIDER

The second part of the circuit is a conventional Eccles-Jordan divider, more commonly known as a bistable multivibrator, and consists of TR3 and TR4.

The divider is triggered by negative pulses, each negative pulse causing a change of state between: TR3 cut off with TR4 hard on, to TR4 cut off with TR3 hard on.

The purpose of the binary divider is to prevent pulses, that occur faster than the operating cycle time of the relay, being missed. The relay is capable of counting at least 600 to the minute and whilst it is not envisaged that it will be used at this speed (an integrating circuit and average value meter is suitable for counting rates higher than this) it is quite possible that, in a background count of as low as 30 per minute, two pulses will occur consecutively in less time than the counting time of the relay (since the output pulses from a G.M. tube are of completely random nature). The binary divider automatically suppresses every alternate pulse no matter how long or short the interval of time between them.

For a pulse to be missed using the divider, three pulses must occur within $\frac{1}{2}$ sec which, although not impossible, is far less likely than the occurrence of two such consecutive pulses. Thus the accuracy of the digital counter is greatly improved using this section of the circuit, the only drawback being that the reading of the digital counter must be doubled.

The circuit may, of course, be used without the divider, at the expense of accuracy, by coupling the output of TR2 directly to the monostable multivibrator via C6.

Transistors in this part of the circuit are more critical. They should be both of the same type and preferably of low leakage. Silicon transistors are ideal but OC71, OC75, XA101, etc. all function quite well. Most germanium diodes are satisfactory in the pulse steering circuits.

THE MONOSTABLE MULTIVIBRATOR

As can be seen from the waveform diagram Fig. 1c, only half the number of negative trigger edges are now present at TR4 collector. These are passed on to the monostable multivibrator where they trigger TR5 into conduction. C7 in series with R13 is tied across the supply: the capacitor thus charges up with time constant $C \times R$ seconds, until the charge on the capacitor is sufficient to switch TR6 back on, i.e. after time $0.7CR$ seconds, and this again is the stable state of the multivibrator. In this way TR6 collector is made negative,

due to TR6 being switched off for $0.7CR$ sec, and a pulse of this duration is passed to the output stage.

The digital relay is capable of counting up to 10 impulses per second and it therefore requires a pulse of $\frac{1}{10}$ sec on and $\frac{1}{10}$ sec off at its maximum resolving time. Thus CR is designed to give $\frac{1}{10}$ sec pulse at TR6 collector, i.e. $0.7CR = 50\text{msec}$. If C is chosen as $8\mu\text{F}$ then R must be 9.1 kilohms, or to be on the safe side 10 kilohms, plus or minus 10 per cent.

In the author's circuit it was found necessary to introduce a diode D3 to prevent the positive pulse from TR4 collector triggering the monostable back to its stable state when a second pulse from the G.M. tube occurred before the $\frac{1}{10}$ sec negative pulse had finished.

The transistors used here again are more critical than those for the first stage. They should be of similar type and of low leakage. OC71, OC75, XA101, etc. are all quite satisfactory. Both multivibrators employ fairly high collector load resistors (4.7 kilohms) to reduce the battery consumption to a minimum.

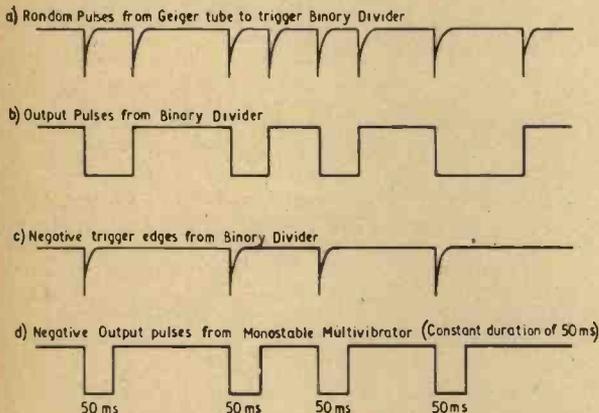


Fig. 1. Function of pulse counting circuit. Timings and amplitudes are not to scale

THE OUTPUT STAGE

The output stage is just a single transistor TR7 switching on and off as it receives its negative pulse from TR6 collector. This final stage is powered from a separate 4.5V battery, since it draws about 110mA per pulse, and a sudden current pulse drawn from the main h.t. rail is likely, to say the least, to upset the pulse divider circuit. This arrangement also makes direct coupling extremely simple. A diode D4 reverse biased is placed across the relay coil to prevent the back e.m.f. destroying the transistor when the relay de-energises.

The output transistor must be capable of passing the current, i.e. 110mA. It is, however, switched on and off, so when it is passing current no voltage exists across it and when it is cut off no current passes through it; its power dissipation is not, therefore, very large. It is advisable, however, to use a transistor of fairly generous rating, say, OC81, OC83, OC84, although OC72 and OC76 will do.

THE DIGITAL RELAY

The digital relay RLA employed by the author is a reset-zero type, but non-resettable types are just as good provided one remembers to take the reading before as well as after the recording time. In either case, however, the relay coil has to be rewound, since these components usually have 1 kilohm coils, although some have 2.3 kilohm and 500 ohm coils.

First remove the relay coil and former completely by unscrewing the retaining nut at the bottom of the relay. The old wire must be completely cut off (a sharp razor blade serves very well for this) and a new coil wound using 34 s.w.g. enamel covered wire. This should be layer-wound to approximately the same thickness as the original coil. However, it is quite satisfactory pile wound with about 4,000 turns, although this takes up more room on the former than the original coil.

The rewind operation is not as tedious as it seems; it can be done easily in half-an-hour on a lathe or a

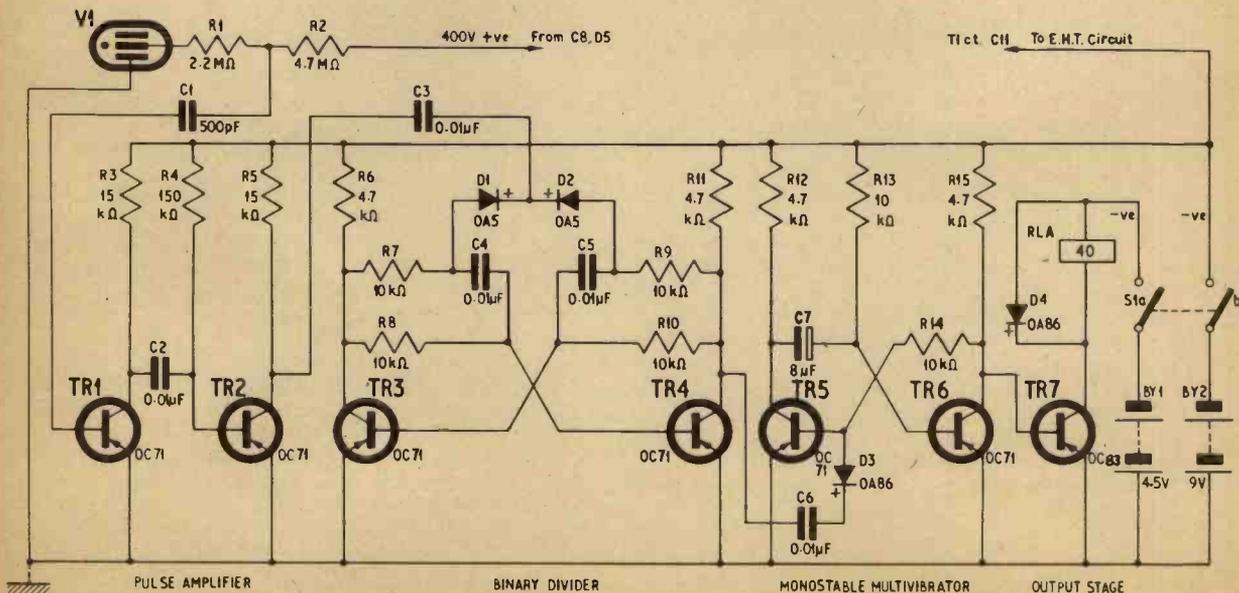


Fig. 2. Circuit diagram of the transistorised pulse counter

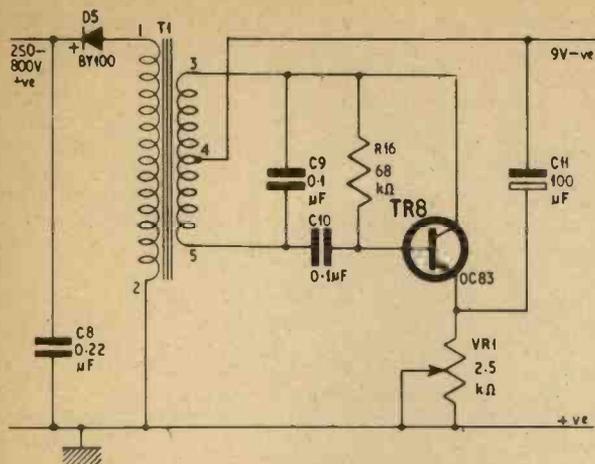


Fig. 3. Circuit diagram of the e.h.t. supply

coil winding machine or even a hand drill held in a vice. Alternatively, it can be wound by hand without much trouble in an evening.

A good policy to follow when winding the coil is to attempt to layer wind it and when it gets a bit "messy" wind a layer of Sellotape on and start layer winding again. The Sellotape also helps to insulate sections of the coil and prevent breakdown due to back e.m.f. The completed coil is, of course, soldered to the original tags on the former. When completed a layer of tape should be wound on the coil to protect it and the counter then re-assembled.

The coil resistance should now be around 40 ohms and it should energise quite satisfactorily on 4.5 volts.

E.H.T. SUPPLY

Considerable thought was given to the design of a suitable e.h.t. supply for the G.M. tube, battery economy being the main consideration. The supply may, of course, be mains-derived, using a suitable transformer, but this would defeat the object of having a battery operated counter. Several types of oscillator were tried, using various step-up transformers. The most reliable and economical was found to be the series fed Hartley oscillator shown in Fig. 3.

This is a very conventional circuit oscillating at about 500Hz and it draws only a modest 2mA from the 9V supply when providing about 3-4μA of e.h.t. Since the G.M. tube is virtually electrostatic in operation, this low current is quite sufficient and if a voltage doubling circuit were employed on the secondary, the supply could operate an organic quenched tube. The only disadvantage is that the e.h.t. cannot be measured on anything but an electrostatic meter or very high resistance valve voltmeter, on which the supply should be set up.

The transformer T1 is a converted battery pentode output transformer, ratio 90:1. The secondary winding is removed and rewound with a centre tap. This does not present much of a problem, since the secondary (now the primary) usually consists of only 40-50 turns wound in two layers on the outside. The core must, of course, be dismantled beforehand, but the whole operation takes little more than twenty minutes. Alternatively, a centre tapped heater transformer or an output transformer with a centre tap already on the secondary, if obtainable, is quite satisfactory. In fact, almost any transformer with a ratio within 50 per cent of that stated above will work.

VR1 is the set e.h.t. control. This potentiometer controls the d.c. supply to TR8 and is decoupled by C11.

COMPONENTS . . .

Resistors

R1 2.2MΩ	R7 10kΩ	R13 10kΩ
R2 4.7MΩ	R8 10kΩ	R14 10kΩ
R3 15kΩ	R9 10kΩ	R15 4.7kΩ
R4 150kΩ	R10 10kΩ	R16 68kΩ
R5 15kΩ	R11 4.7kΩ	
R6 4.7kΩ	R12 4.7kΩ	

All 10%, ¼W carbon, unless otherwise stated

Potentiometer

VR1 2.5kΩ

Capacitors

C1 500pF 1,000V	C7 8μF elect. 12V
C2 0.01μF	C8 0.22μF 1,000V
C3 0.01μF	C9 0.1μF
C4 0.01μF	C10 0.1μF
C5 0.01μF	C11 100μF elect. 12V
C6 0.01μF	

All miniature ceramics or paper, unless otherwise stated

Transistors

TR1-TR6 OC71 (6 off)
TR7-TR8 OC83 (2 off)

Diodes

D1-D2 OA5 (2 off)
D3-D4 OA86 (2 off)
D5 BY100

Transformer

T1 Battery pentode O.P. transformer, ratio 90:1 (modified as per text)

Relay

RLA Digital relay. Sodeco type TCeZ4E (available from P.C. Radio, 170 Goldhawk Road, London W.12), or Post Office equivalent (see text)

Batteries

BY1 4.5V Flat flash lamp battery
BY2 9V Layer type battery, PP7

Switch

S1 Double pole, on/off toggle switch

G.M. Tube

VI B6H, B12H (available from P.C. Radio, 170 Goldhawk Road, London W.12)
CV2886 Liquid sampling tube (Henry's Radio, 303 Edgware Road, London W2)

Miscellaneous

Laminated plastics board 4½ in. × 5 in. Coaxial plug and socket. ¼lb 34 s.w.g. enamelled wire. Battery connectors. Material for case. Socket B2A or octal to suit G.M. tube

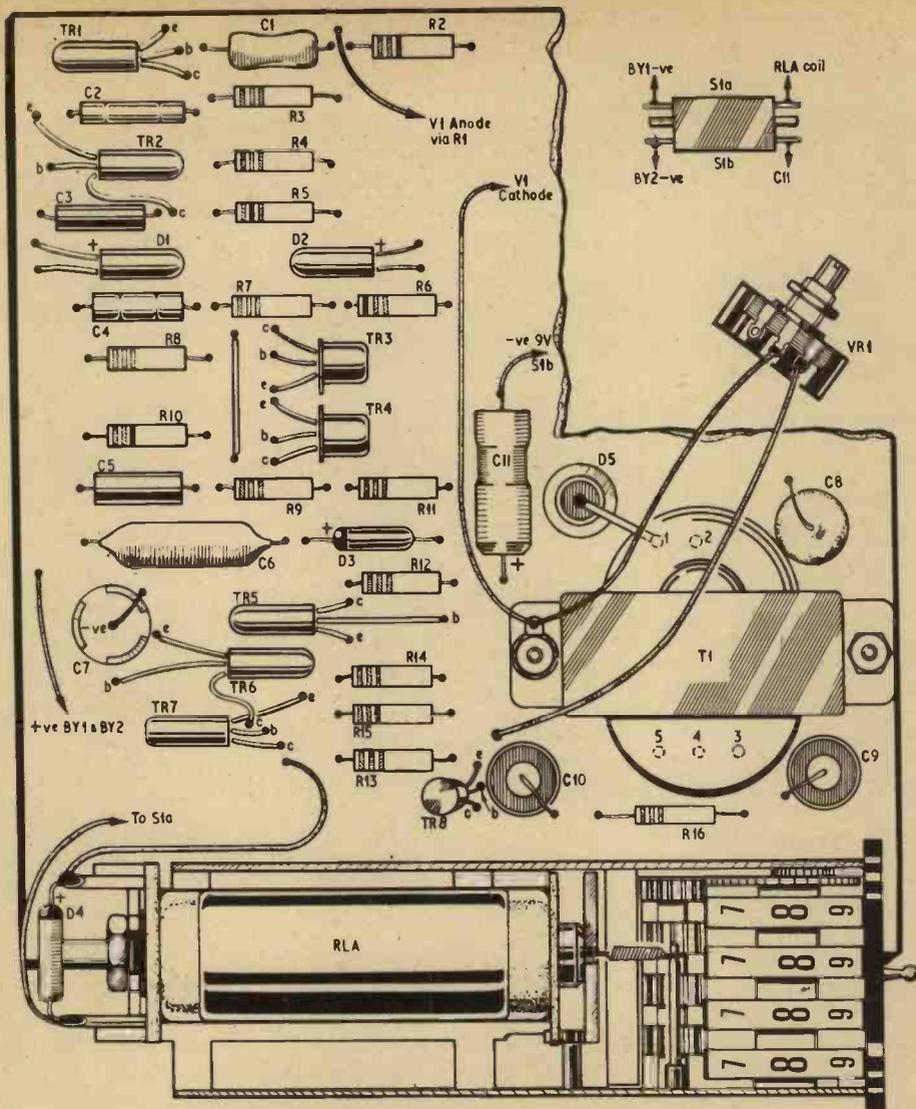


Fig. 4. Component layout on laminated plastics board

The only critical component of the circuit is the diode D5 which must have an extremely high back resistance in the order of 1,000 megohms. BY100's are the most suitable but some specimens tried by the author gave far less e.h.t. voltage and it may be advantageous, therefore, to use two silicon diodes in series.

Many a.f. type transistors were tried in the e.h.t. circuit and they all worked; the best results, however, were obtained from an OC83.

CONSTRUCTIONAL DETAILS

The circuit is built up on a small piece of laminated plastics board, measuring 5in by 4½in. The arrangement of the components is shown in Fig. 4, while the underside wiring is given in Fig. 5.

Flying leads are required to connect up the components not mounted on the board, these being as follows: The G.M. tube socket, the set e.h.t. control VR1, the battery supply switch S1, and the two batteries BY1, BY2. There are in all a total of seven flying leads and they are clearly shown in Fig. 4.

The two leads for the G.M. tube should be connected to a coaxial socket, so that the external connec-

tion to the tube itself can be made by coaxial cable. Note that R1 must be mounted on the G.M. base (see final paragraph of this article).

The completed assembly can be housed in a wooden or metal box with the on/off switch, set e.h.t. control, and the coaxial socket mounted on the front panel. A suitable aperture should be cut in this panel so as to expose the end of the digital relay.

The top of the box or cabinet should be made removable, thus allowing access to the batteries which can be installed in the unused corner of the component board.

In this way a neat, compact and self-contained piece of equipment is achieved.

USE OF THE COUNTER

The pulse counter is admirably suitable for determining the background count of different tubes or the day-to-day change in cosmic radiation. Measurements are made by leaving the counter running continually for about half-an-hour and dividing the reading by exactly half (since the binary divider is used) the number of minutes.

If used with a liquid sampling tube a reading of background radiation must be taken before the tube is filled with the liquid sample. The two results are then compared. All liquid samples, such as rainwater, tap water, etc. should be concentrated and then acidified to prevent contamination of the tube by solid deposits. This is best done by boiling about half-litre of the sample to dryness (or almost to dryness) and swilling out the residue with about 5cc of dilute nitric acid. This will give a concentration of 100 times, which is quite suitable. Some interesting comparative experiments can also be done by filling the tube with unprepared freshly fallen rain.

For most purposes a count of half-an-hour is sufficient, but for more exact work or when very low background count tubes are used, counts overnight may be done. There is little fear of running the batteries down, since the 9V battery consumption is only around 7mA and the digital relay only demands 110mA for $\frac{1}{2}$ sec per pulse which for an actual count of 30 per minute (registered count 15 per minute) is equivalent to 0.3A torch bulb in use for only three minutes when counting for a period of 12 hours.

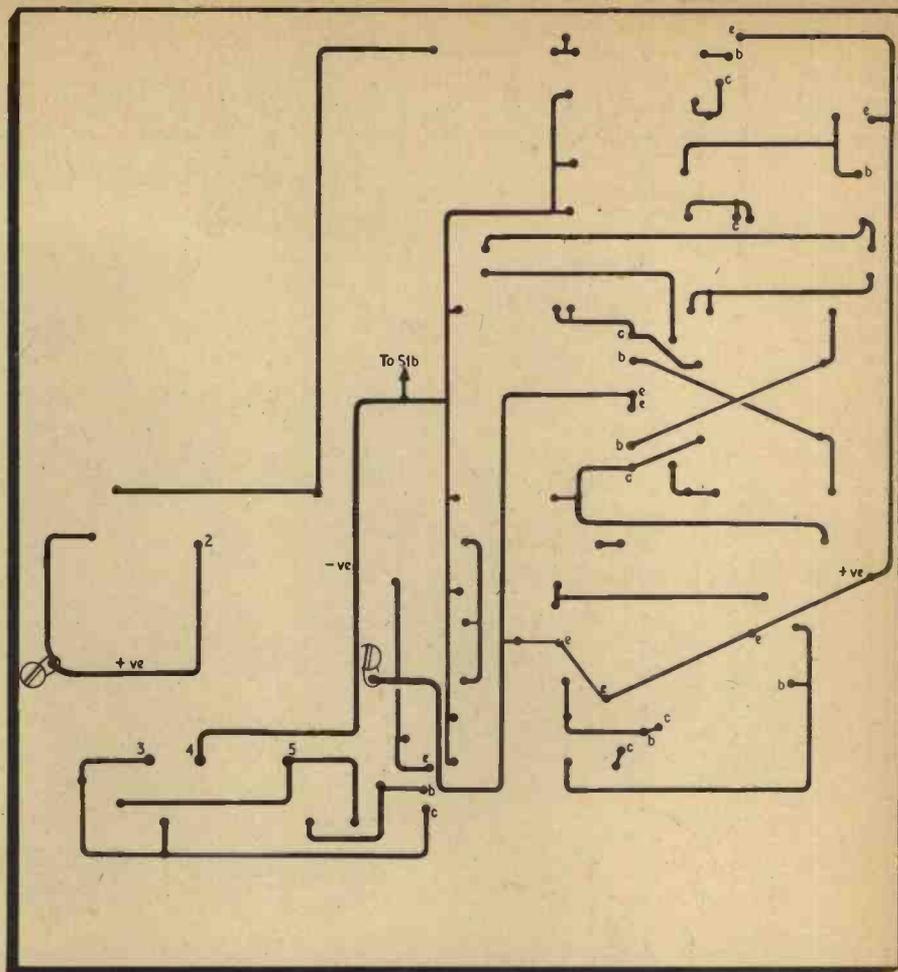


Fig. 5. Wiring on underside of component board

GEIGER-MULLER TUBES

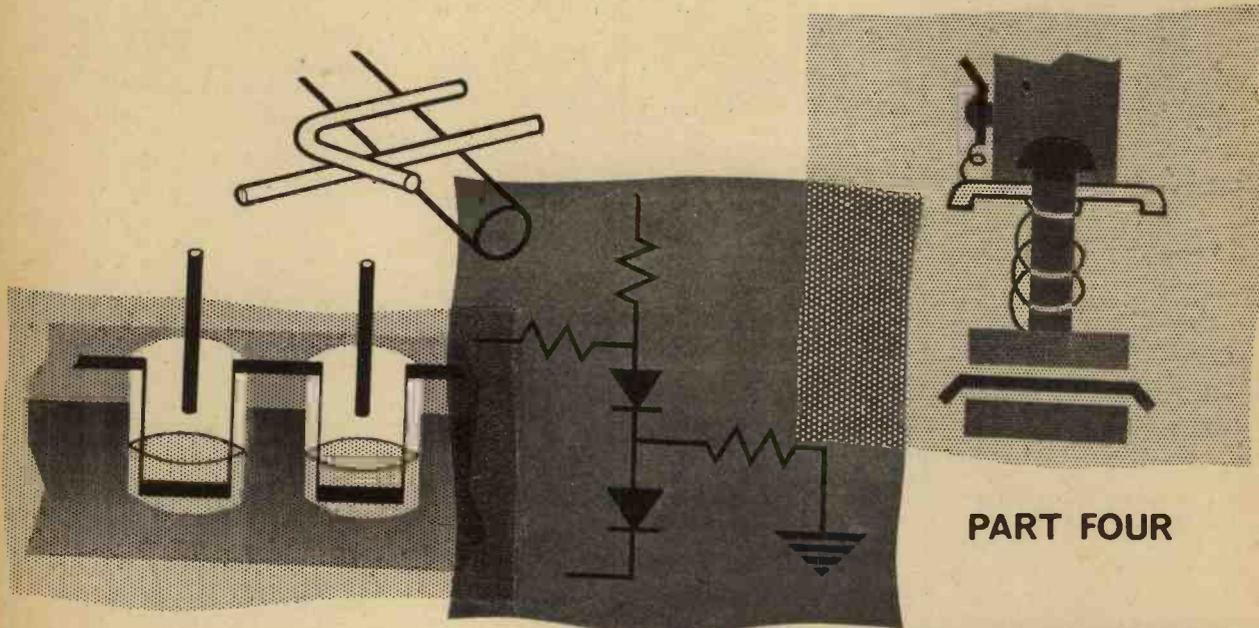
The author used 20th Century Electronics G.M. tube types B12H and B6H, which have an octal base and may in fact be immersed in liquid samples. However, almost any halogen-quenched tube is satisfactory and it is quite advantageous to hunt around the surplus component shops where they should be obtainable for about £1. For constructors wishing to do research into radiation of liquid samples, a very good tube type CV2886 is available for £1 2s 6d from Messrs. Henry's Radio, 303 Edgware Road, London, W.2. Alternatively, the Mullard types MX142 and MX124/01 may be used.

Care must be taken when handling the G.M. tubes, since the glass walls are usually made very thin to allow ease of penetration by beta rays and will break if handled roughly. Also, to conserve the life of the tube, it should be fed into a high impedance non-capacitive load. To avoid excess capacitance across the tube, which should not exceed 5-10pF, the anode resistor R1 must be mounted directly at the anode connection on the tube socket before the outlet lead to the counter unit.



THE ELECTRONIC ORGAN

By ALAN DOUGLAS, Sen. Mem. I.E.E.E.



PART FOUR

KEYING ARRANGEMENTS

WE still have two very important matters to consider in general terms—since they apply to all electronic instruments—before we can start on a specific organ design. The first is the method of keying the signal. It is here that a major difference arises between pipes and electronics. Even if the synthesised waveform is perfect, the sound will not be the same. But is this very significant? Perhaps it is, in the case of very large instruments; but again, it is one of the attributes of such circuits that they can speak far more quickly than pipes. So for some purposes, this is a great advantage. Why, then, do we find keying a difficulty?

INDEPENDENT OSCILLATOR SYSTEM

In the case of an organ having separately tuned oscillators for each note, no sound is available until one or more of these circuits are energised. Since this can be done by connecting the h.t. line, which is d.c., then a form of charging network can be incorporated just to take the edge off the starting transient. Such oscillators can be made frequency stable over a change in h.t. of some 40V, or if transistorised, a change of perhaps 9V. So a quite appreciable delay can be introduced before the oscillator goes off pitch. Fig. 4.1 shows two ways of doing this—valve and transistor techniques. Organs using this method include Miller, Allen, Gregorian, Conn, and my own circuit which is tolerably well known. No problem arises with such independent tone sources.

But the independent oscillator system is very costly and, moreover, requires a separate set of oscillators for

each pitch; so one could soon absorb a couple of hundred generators. Although of course the results are far superior to any other system, this is only true to the extent that one is capable of, or wishes to, develop the kind of tonal spectrum associated with the pipe organ.

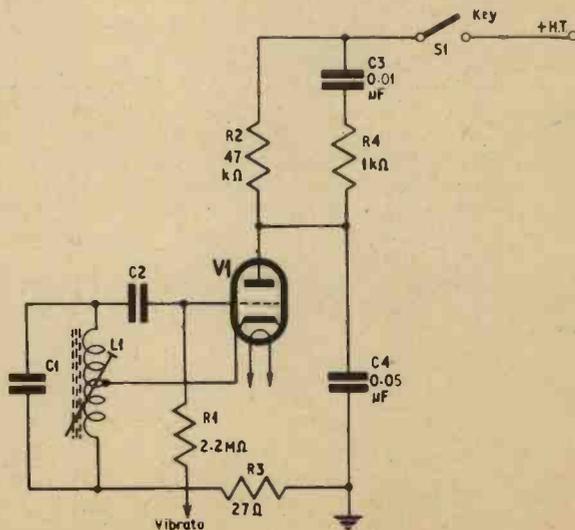


Fig. 4.1a. A method of delayed keying for a valve oscillator

FREQUENCY DIVIDER SYSTEM

Today, the concept of organ tone veers more towards the synthetic quality popularised by Hammond, and if one studies current commercial design it is soon apparent that all modern circuits are directed towards trying to fill out the meagre resources of the frequency divider instrument by such methods as keying compound waveforms, sustain and phase shift devices, multiple vibratos (including the mechanical systems such as the Leslie speakers), and in fact anything which will give the effect of there being more generators than actually exist. In short, the limitations of the frequency divider cannot be improved upon, and secondary circuits have been evolved to pad these out.

A simple example of a compound waveform produced from the one and only wave available from most dividers is shown in Fig. 4.2. Here, the fundamental is mixed with the octave above, which is attenuated to half its normal level. The two waves, each square originally, add to form the staircase waveform which is keyed; thus, a simulation of a sawtooth is obtained at no extra cost, and from this can be formed sounds not possible with a simple square wave. Sounds which consist entirely of square waves having no even harmonics tend to be discordant and "edgy"; even harmonics are always consonant and agreeable. Therefore a good organ would provide both waveforms.

REDUCING TRANSIENTS

If we decide that a frequency division method is the more economic proposition, then we are faced with the fact that all dividers must run continuously whether in use or not; otherwise, one could not drive the next. This being so, the a.c. signal will have to be keyed.

Now if the waveform is square, there is only one instant at which it could be keyed to avoid transients, see Fig. 4.3a. But this is a chance in a million. If then we close the circuit at some other instant of time, the transient will always be large. Should the dividers provide a sawtooth, the case is not quite so bad in theory (Fig. 4.3b), since the amplitude can change with time; but in practice the effect is just as objectionable. Even if it was a sine wave, we would not obtain any advantage as is evident from Fig. 4.3c.

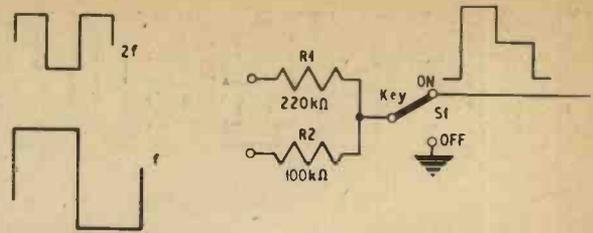


Fig. 4.2. Production of a compound (staircase) waveform by addition of two separate square waves

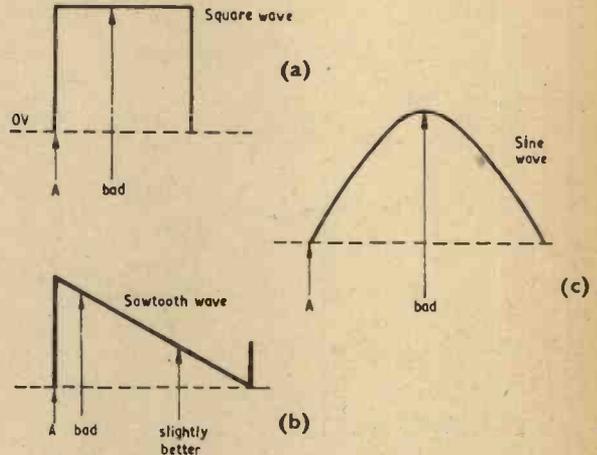


Fig. 4.3. The only possible keying position to avoid transients for these three different waveforms is indicated by "A"

Therefore the transient must be reduced by some means. A delay of perhaps 10–50 millisecond would be satisfactory. How can we do this?

The first thing to bear in mind is that there will not be much room for whatever means of keying we decide on, since the width (or length inside the frame) of a playing key must accommodate the contacts for all pitches. Then we have to remember that clicks due to transients will be most noticeable on high pitched notes since they can be removed by filters on lower pitches. Lastly, of course, is there something we can make without too much precision or the use of difficult materials?

POSSIBLE KEYING METHODS

Let us look at the alternatives available for providing this most necessary delayed action switching or keying.

The simple case is a pair of plain gold wire contacts. A non-tarnishing surface is essential, so a thin gold coat rolled onto a bronze wire is commonly used. Fig. 4.4a shows such a contact for one pitch. The divider output is earthed to a common busbar through a resistor of 100 kilohms to 1 megohm; this prevents crosstalk which is prone to occur by capacitive coupling in the British type of contact block where all the wires for all the pitches (for any one note) are side by side in a bakelite block $\frac{1}{2}$ in wide.

The American vertical contact block, see Fig. 4.4 b, is much superior but harder to assemble since it calls for precision mounting. Considerable saving in gold is possible here, since only the tips of the wires need be precious metal. It is usual to make the earthing rod rhodium plated because of mechanical abrasion, yet a gold plated rod is better from a contact point of view.

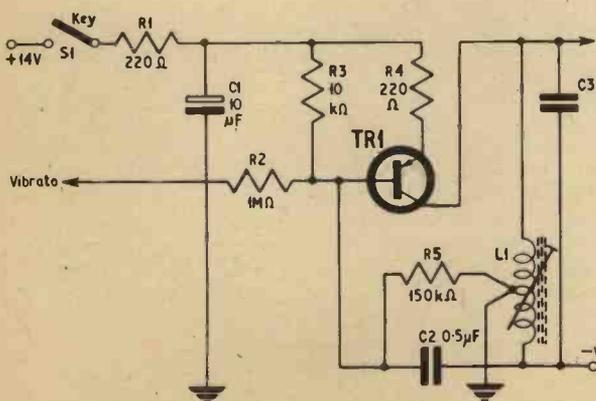


Fig. 4.1b. Keying delay circuit for a transistor oscillator

It will be understood that the methods described in this section are only representative of alternatives, and would be added to in the case of most organs having more than one pitch available. Consequently, in the illustrations of Fig. 4.4a, the busbar is not accepting a tone signal but is used for earthing the unwanted tone sources. The actual tone busbars would consist of extra wires which are closed by the key in the manner of the one example shown.

In the illustration of Fig. 4.4b, the unwanted tone sources are *not* earthed, so the busbars shown are actual tone outlets; in other words, since there is one

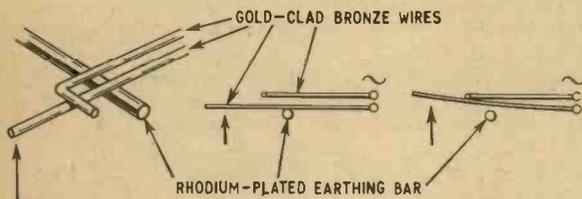


Fig. 4.4a. Conventional key contact

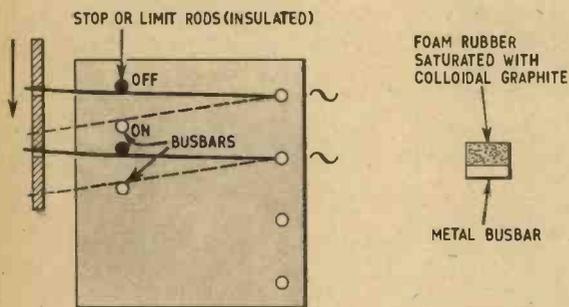


Fig. 4.4b. American type vertical contact assembly

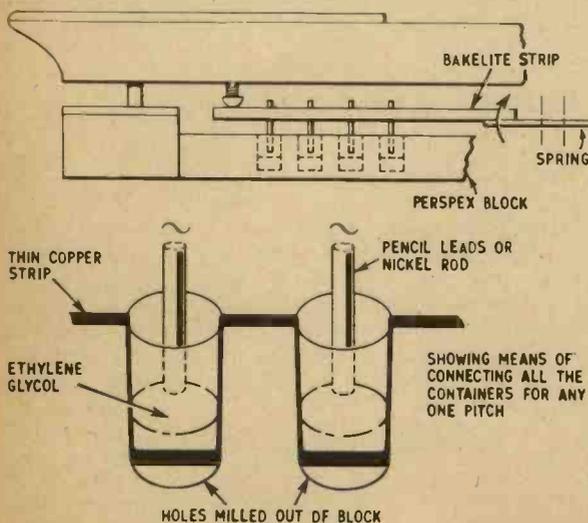


Fig. 4.4c. A liquid resistive keying system

assembly like that shown for every playing key, depression of a key would make the flexible wires touch as many busbars as there are pitches. So all the 8ft pitch sources would contact one bus, all the 4ft another, etc.

All such simple contacts can give rise to clicks, but many organs use them and adjust their amplifiers to cut off at about 8kHz. This does much to reduce the transient, but of course also reduces the fidelity of strings and reeds.

RESISTIVE KEYING

It is possible to apply resistive keying in many forms, and if the busbars of Fig. 4.4b are covered with very thin foam draught excluder, well soaked in colloidal graphite, thoroughly dried and all loose graphite shaken out, some excellent results can be obtained. Although the foam strip must be glued to the busbar, this can only be done with spots of cement between notes, so that when the contact wire is depressed, it forces the graphite-loaded strip down on to the metal busbar and not on to the glue. See small diagram at right-hand side of Fig. 4.4b. This method of keying has been developed by E. A. Heywood.

Another alternative is to use ethylene glycol as a liquid keyer as in Fig. 4.4c. This calls for a more complex contact arrangement as shown, but this system has been highly developed by A. Le Boutillier (founder of the Electronic Organ Constructors Society). Liquid keying has been used in some German instruments for nearly 40 years with success.

Another way to make resistive contacts is to use one of the conductive silastomers (artificial silicone rubber) available from the British Bakelite Company at Birmingham. These, if tried, should be *clipped* to the busbar between each contact wire. This method is used by Baldwin, Thomas, and other American makes. An advantage is that plain bronze contact wire can be used, but a great improvement results from Nichrome V wire. This has been used by Wurlitzer and Gulbransen for many years.

All of the above methods require one contact wire and one busbar for every pitch of every note. There is no control over the time constant after the proportions have been fixed initially. Nevertheless, when correctly designed such contacts can operate for several million cycles without deterioration.

DIODE KEYING

As knowledge of tone forming methods increased, it was found possible to key the signal through diodes with little loss of fidelity, even though rectification of the waveform might take place. The diode method is costly, but has the advantage that a time constant can be introduced. Thus, not only can the transient be abolished, but in fact a sustain effect can be provided; and it is possible to key any number of pitches per note with only one contact per note. The mechanics are thus greatly reduced. An example of this method is shown in Fig. 4.5a.

With the key open, the diodes D2, D4, D6, etc. are biased off, and so the generator outputs are prevented from reaching the busbars.

When the key is depressed, +15V is applied through R1 to capacitor C1. Initially the whole 15V is dropped across R1, but as C1 becomes charged the lower end of R1 reaches +15V and so the diodes D2, D4, D6 become forward biased. Current flows through the path provided by these diodes and the resistors R5, R8, R11.

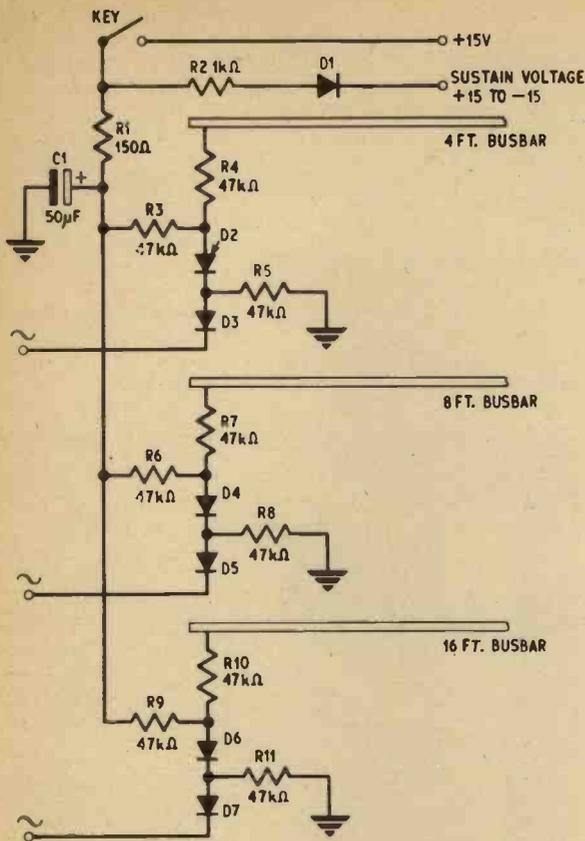


Fig. 4.5a. A diode keying system

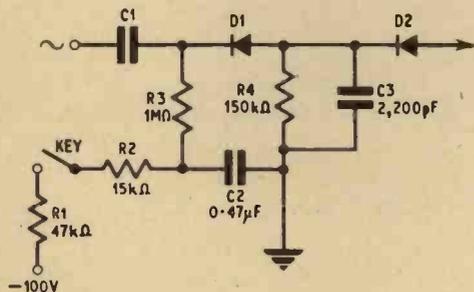


Fig. 4.5b. A diode sustain circuit

These methods of course require many diodes but they could be applied to 4ft and 2ft pitches only where the clicks are most irritating.

In the days when valves predominated, there were many such control circuits, some of which were much more effective than their semiconductor equivalents. But then the complete absence of leakage and the closer gain or slope tolerances together with the very high input impedances (where triodes were used) weighed heavily in their favour. Transistors have still some way to catch up, the most promising device for this application so far being the field effect transistor.

CAPACITIVE KEYER

The last device to be considered is the capacitive coupling. Whilst originally intended to confer some measure of touch sensitivity to an organ, it has been highly developed by Dr H. Le Caine in Canada and Dr Rainer Böhm in Germany. The latter arrangement is the easier to make, and will now be described.

In Fig. 4.6 we see a brass busbar covered with a film of 0.0025in thick Mylar or equivalent insulator. Above this is located a small metal plate, about 11 × 13mm, held by a coil spring so that when it is depressed by the key to touch the Mylar, it assumes a parallel position and the spring, taking up the remainder of the key motion, retains the alignment of the system. Although a certain amount of screening is desirable, this method is excellent for very high frequencies—and in his organs, Dr Böhm uses up to 16kHz.

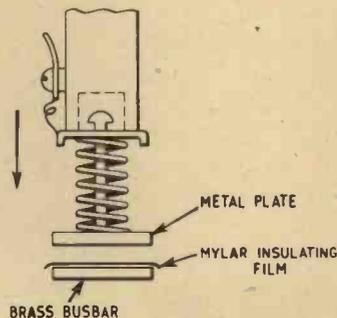


Fig. 4.6. A capacitive keyer

The voltage developed across each resistor forward biases the associated diodes D3, D5, D7 and so the generator signal is applied to the busbar.

When the key is released, the charge on C1 dissipates itself through this same circuit and the diodes remain conductive until the voltage drops below the diode cut-off value.

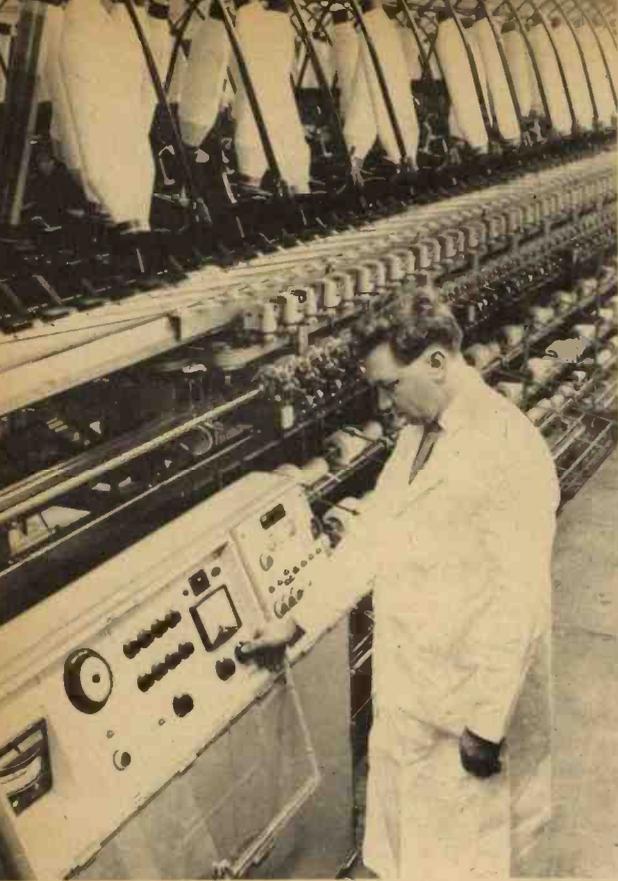
A bias voltage of from +15V to -15V can be applied via D1 and R2, in order to alter the sustain time. Thus we can have -4V applied for a fairly fast release of the note; -4V for a longer time, and if the sustain supply is +15V then the sustain diode D1 is cut off and capacitor C1 can only discharge through the keyed circuits giving a long delay time.

Another way of sustaining the sound and avoiding an abrupt attack is shown in Fig. 4.5b.

MAKING A CHOICE

From the foregoing brief account of some of the many and varied systems that have been developed, it will be apparent that the individual constructor must try to form his own conclusions with regard to the kind of keying system to adopt for his own instrument.

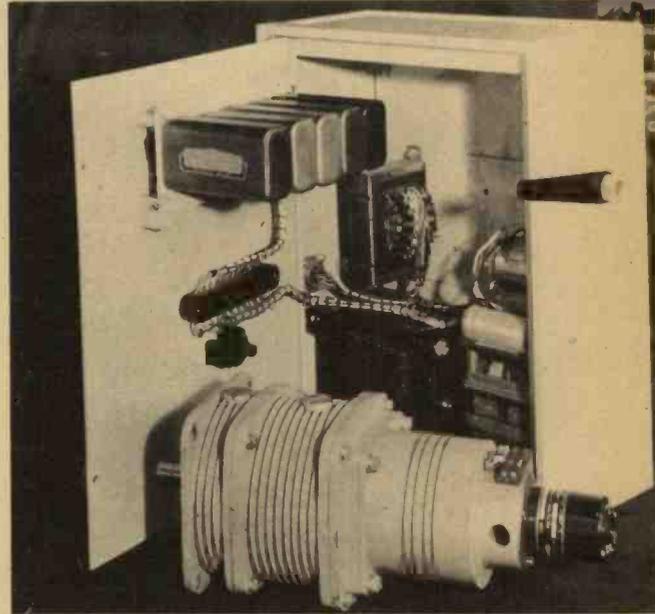
In practise, the obvious approach is to set up the highest required frequency on a variable oscillator, preferably giving a square wave output; adjust the signal level to 0.5 to 1V, and try the effect of one method of keying at a time. But bear in mind that it is *not* desirable in domestic organ systems to exceed 8 to 10kHz at the upper end of the spectrum. When we have a look at tone forming methods in the next article, it may become possible to find, with a single note, the highest frequency required for realism.



◀ High Speed Fibre Control

ELECTRONIC control of industrial processes spreads rapidly. Another example is in the man-made fibre industry where, at the Klinger Organisation plant at Margate, a world speed record was recently set up with a speed revolving at a million revolutions per minute.

The picture here shows the AMI twist crimping machine and control console designed by Abbey Electronics and Automation. The electronics controls temperature, turns per linear inch, and time lapse before doff and the condition of ancillary services.



'Concorde' Fatigue Testing

AN ADVANCED computer-controlled industrial automation system which will help to ensure greater safety for airline passengers of the future is now being installed at the Royal Aircraft Establishment, Farnborough, by English Electric.

A rig is being built at Farnborough in which the forward section of the fuselage of the Anglo-French Concorde supersonic airliner will be structurally proved.

The rig will be able to carry out a new type of fatigue test which not only takes into account mechanical stresses, but the effect on the air-frame of the severe heating and cooling encountered in supersonic operation. During the next four and a half years or more, the fuselage will be subjected to many thousands of test cycles. Each test cycle simulates a typical flight covering taxi-ing, climb, cruise and descent but to an accelerated scale.

It is expected that the tests will continue day and night with brief stops every month or so for a physical inspection of the fuselage.

Two English Electric Leo Marconi KDF7 computers are used. One will control the tests, and the other will be used as a monitor to establish the integrity of the test programme. The system will simulate flight conditions more accurately than has been possible before, and will give more precise knowledge of fatigue life at supersonic speeds.

Marine Servo System

A NEW a.c. servo unit for control and power actuation has been developed by Vosper Electric.

This unit consists of a synchro-transmitter coupled to the lever or other operating device, with a corresponding synchro-receiver coupled to the final output of a geared a.c. servo-motor. When an error signal is generated at the synchro-transmitter it passes to a phase discriminator which will sense the angular displacement and actuates one or other of the trigger control circuit amplifiers, which in turn feeds control pulses to the phase commutator unit containing Triac power circuitry. Appropriate rotation of the servo-motor will reduce the error in a proportional manner until a null error is reached. A d.c. tachogenerator feedback loop controls the speed and damping of the system.

ELECTRONORAMA

Power Pulse Ignition

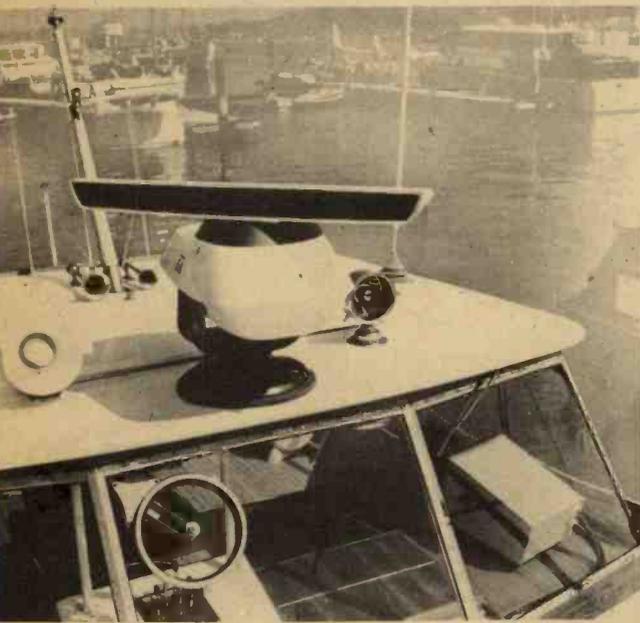
AN EXAMPLE where capacitor discharge ignition systems are used is in the 100 h.p. outboard motors made by an American firm Johnson. These systems deliver a high voltage to the sparking plugs in $5\mu\text{s}$, twenty times faster than conventional systems. The encapsulated power pack steps up the 12 volts from the battery to a pulse of 20,000 volts at the plug.

These systems are imported by E. P. Barrus (Concessionaires) Ltd., 12-16 Brunel Road, London, W.3.

Radar for Small Boats

THE WORLD'S first high-quality marine radar specially designed for small boats was on display at the International Boat Show in London. Known as the Decca 101, it has a maximum range of 15 nautical miles and can also be set to cover $\frac{1}{2}$, $1\frac{1}{2}$ or 5 miles; it is suitable for 12, 24, 32, 110, 220 volts d.c. and 115 or 230V a.c. 50 or 60Hz single-phase operation.

The scanner unit shown below combines both the aerial and the transceiver. The aerial is 3ft wide and rotates at the high rate of 36 revolutions per min. The transceiver has a peak power of 3kW. The display unit houses a cathode ray tube with a diameter of 7in (178mm).



Operational features include range rings on the screen at equally spaced intervals representing $\frac{1}{2}$ or 2 miles, depending on the range in use.



L/S Telephone with a Difference

LOUSPEAKING telephones have taken some time to be accepted as a normal piece of office equipment, but are now looking ahead with this futuristic design (below) from Gustav A. Ring of Norway. This "Triphone" combines optical, acoustic, and "pocket" paging from any other station in the Triphone network.

The user can have background music from it without disturbing normal services. Any person wishing to have complete privacy can set his Triphone face down (left of picture). Vital calls with still be announced by a short tone signal. Callers also hear an "engaged" tone.

Executives can tilt the instrument to ensure that all incoming calls go to his secretary.



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.

COMPONENTS

Many readers must have experienced at some time the frustration and annoyance when, being engrossed in constructing apparatus, the electric drill suddenly packs up, and on examination it is found that the armature has burnt out. Now a solid state module from STC Components Group, Footscray, Sidcup, Kent, reduces the possibility of overheating due to any form of malfunction or abuse. Operated in conjunction with a thermistor embedded in the motor windings, it automatically cuts off the supply immediately the motor windings exceed a safe temperature.

Still on the problem of heating, the Lektrokit LKU.511 is a cooling unit for electronic equipment. It is designed for improving the efficiency of transistor heatsinks and for lowering the temperature level inside assemblies.

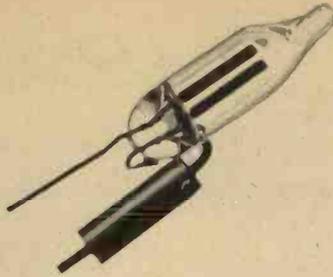
Although the unit is dimensioned to fit into both chassis and rack system constructions, fixing holes being provided to enable it to be used as a replacement for the normal side plate of any Lektrokit assembly, it can be incorporated into the design of any electronic equipment. The price of the LKU.511 is £3 and is available from the Lektrokit Division of A.P.T. Electronic Industries Ltd., Chertsey Road, Byfleet, Surrey.

New high intensity neon/resistor indicators, produced with insulated resistor already welded on and folded ready for assembly, are now available from West Hyde Developments Ltd., 30, High Street, Northwood, Middle-

SOLDERING

A new soldering process that should gain a wide and varied use on the amateur market, once a simple and cheap method of heating has been devised, is the Thermofit Solder Sleeves by Raychem Ltd., Cheney Manor, Swindon, Wiltshire.

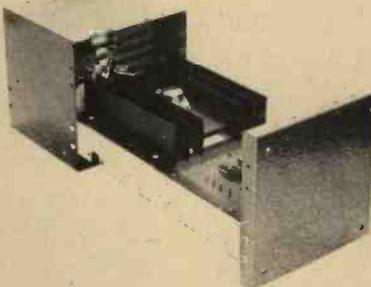
Designed specifically for earthing screened wire and joining equipment wire, the solder sleeves are pre-packaged insulated solder joints. They consist of heat-shrinkable, non-flammable polyvinylidene fluoride (Kynar) sleeves, each containing a preform of fluxed solder at the centre and a thermoplastic sealing ring at each end.



Neon Indicator by West Hyde Developments



Heathkit CR-1 Car Radio



LKU.511 Cooling Unit from Lektrokit



Thermofit Solder Sleeves by Raychem

When placed over a cable screen and earth lead and briefly heated, the outer sleeve shrinks and the solder and thermoplastic inserts melt, forming an insulated encapsulated soldered termination. The melting of the sealing rings controls the solder flow and maintains the wires in contact.

Practical advantages of this method is that inspection of the joint is possible since the entire joint is visible through the transparent sleeve. In this way, improperly stripped or bunched strands can be detected and the solder flow studied.

In many applications the tedious stripping of braid is simply replaced by cutting the insulation and, since there is no inner ferrule, the insertion of screen ends between ferrules is eliminated.

Due to their small size, these solder sleeves may often be installed adjacent to the termination of the wire at a connecting pin, but even where this proves difficult, terminations of adjacent cables may be staggered (see photograph).

Thermofit solder sleeves may be reheated for removal of the insulation and continued heating can then be used to melt the solder so that the earth lead can be removed and replaced as required.

For full details readers should write direct to Raychem Ltd. We understand the Ronson Butane soldering guns make an ideal heat source for the sleeves.

LITERATURE RECEIVED

Readers interested in computers may find a brochure entitled "Staffing a Computer Installation", offering advice on the sort of qualities to look for in selecting staff and discussing the use of aptitude tests, worth obtaining. Copies of the brochure are available from English Electric-Leo-Marconi Computers Ltd., Portland House, Stag Place, London, S.W.1.

A technical bulletin entitled "Magnetising of Permanent Magnets", written by F. Knight, A.M.I.E.E., may interest readers studying magnetism. Copies available from The Permanent Magnet Association, P.O. Box 121, 301, Glossop Road, Sheffield, 10.

A new catalogue from Heathkit has just been issued and amongst its new kits is a car radio type CR-1 with an output of 4 watts, suitable for driving two loudspeakers if required.

LUMOSTAT

Finally, it has been pointed out that the term "Lumostat", which was used for the photographic control unit described in our November, December and January issues, is a trademark of Londex Ltd., and has been applied to their combined push-button switch/indicator lamps. We were unaware of its previous use by Londex and regret any confusion this may have caused.

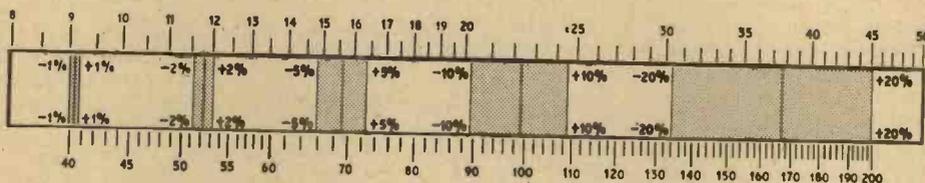
FREE

Inside Next Month's Issue

COMPONENT SELECTION CALCULATOR

PRACTICAL ELECTRONICS

COMPONENT SELECTOR



TOLERANCE CALCULATOR

PRESENTED FREE WITH THE APRIL 1967 ISSUE OF PRACTICAL ELECTRONICS



A double-purpose slide rule for the electronic experimenter. It gives you exact at-a-glance findings on:

Percentage Tolerance Pinpoints the tolerance range for any given nominal value of any component (e.g. resistors and capacitors). Five tolerance ranges are covered on one slide: 1%, 2%, 5%, 10%, 20%.

Values for a CR Circuit Enables you to compute rapidly time constants involving awkward multiples of capacitance and resistance.

ALSO: MILK-O-STAT—novel milk-boiling warning device . . .

DOOR SLAVE—gives visible signal when visitors knock . . .

27MHz FIELD STRENGTH METER

APRIL ISSUE OUT MARCH 17

NAME OF NEWSAGENT

To _____

Please reserve/deliver the April issue of PRACTICAL ELECTRONICS (2/6) and continue until further notice.

NAME _____

ADDRESS _____

MAKE SURE OF YOUR COPY!

Hand this form to your Newsagent

detached particles

JOHN VALENCE

PUBLIC ANNOYANCE

A propos of the editorial comment a short while ago regarding broadcast music, I note that one rail traveller (at least) has been sufficiently provoked by the "noise" emanating from the loudspeaker system at Manchester Piccadilly station to write to the press on this subject. British Rail's well meaning attempt to provide a cheerful atmosphere is not at all appreciated by the customers nor indeed by the station staff—according to an on-the-spot enquiry conducted by this correspondent to a newspaper.

I must admit being a little surprised at the unanimity expressed in this platform poll. Rarely does one find a group of people single-minded on this subject.

The kind of background music I myself find most annoying is the furtive kind: you know—the soft, slinky sound which is always present, although you can never with certainty locate its source. This insidious music pervades the bar, store, or what have you, from decorative *louvres* in the same mysterious manner as the heating and air conditioning enters. Unfortunately it has nowadays become more often than not the custom for such sound distribution systems to be considered as indispensable as these other more essential and desirable services.

FAIR DINKUM

Those of you who have been with us from the start will recall that our first issue included a design for an electronic didjeridoo.

That genial character Rolf Harris who was responsible for introducing the didjeridoo to a wide public has started a new series on BBC-1. It is his intention to bring over to this country two Aborigine didjeridoo players so we all may see and hear the genuine article played by a native expert. A wonderful opportunity too for any reader who has built up the electronic version to compare the synthesised sound with that of the original instrument!

THE OLD ORDER CHANGETH

Of course I should have been prepared for it. After all, I seem to remember mentioning the subject many months ago. Now a curt directive has arrived from the editor that *hertz* is in, real gear, while *c/s* is out—old hat and all that stuff.

I will try to remember, but I reckon my colleagues in the subbing dept. will have to expunge a few inadvertant *c/s* from my notes for a month or so yet.

A suspicion lurks in my mind that the acceptance of Heinrich Rudolf Hertz was all part of a clever scheme to smooth the path of Harold and George on their Grand Tour of European capitals. But as students of the Common Market scene will agree, this would have been more effective if Hertz had been a *Frenchman* and not a German.

With this impending change in mind, I have just been looking through some other periodicals and one interesting thing comes to light.

Hertz, you will recall, established his reputation on account of his discovery of electromagnetic waves. Now, it would appear that support for the adoption of Hz is somewhat tardy in those journals particularly associated with radio. On the other

hand, the audio boys, strangely enough, have been quick off the mark in acceptance of Hertz. "Strangely enough"—for they have no vested interest in electromagnetic waves. Indeed, should they not be rushing to to honour one of the renowned men of science who contributed much to the theory of sound waves; Lord Rayleigh or Hermann von Helmholtz, for example?

Why not *two* separate units for frequency—the distinction between electromagnetic waves and sound pressure waves (audio and ultrasonic) could then be clearly made. NO? ah well, I was only trying to be helpful.

DISTRESS CALL

We have come a long way since H. Hertz discovered the properties of electromagnetic waves. The multiplicity of devices using radio waves for communication, telemetering, or control purposes is immense. Allocation of frequencies to properly authorised users is a major headache for the international and national bodies responsible for this task. However carefully such allocations are made, it seems unlikely that any user can be guaranteed complete immunity from interference of one kind or the other.

Certain patients in a South Coast nursing home can vouch for the truth of the foregoing statement. These elderly gentlemen had been fitted with radio controlled electronic devices to assist the emptying of their bladders. When, on a number of occasions, all devices became operative simultaneously, the medical staff were naturally enough dumbfounded. A little research however soon established the fact that the control frequency was the same as that used by the local lifeboat's radio.

When the lifeboat was launched to provide succour for some ship at sea it was unwittingly responsible for creating a number of distress calls on shore!

I should add that this little story was gleaned from the official journal of H.M. Coastguard.



COMMENTARY ON SOUND REPRODUCING EQUIPMENT BY CLEMENT BROWN



AMPLIFIERS and radio equipment reaching the U.K. market from foreign sources increases in variety and quantity. New units from Sansui have now arrived to join products from other prominent Japanese manufacturers. The distributors are Lasky's Radio, and Londoners wishing to inspect the range at first hand should visit their showroom at 42 Tottenham Court Road, London, W.1.

Examples from Sansui's extensive list are the AU-70 integrated stereo amplifier and the TU-70 stereo tuner. These can be purchased together at a special "package deal" price of 130 gns—a saving of 11 gns. The amplifier is rated at 20 watts r.m.s. per channel and has a full complement of inputs, including a magnetic pick-up input with the high sensitivity of 1.1 mV. The styling of this unit, like others in the range, is crisply modern.

The TU-70 tuner, equipped for stereo, covers the medium wave band as well as f.m. Other Sansui units at present available include four different tuner-amplifiers, and items promised for the near future are speaker systems, stereo headphones and tuner-amplifiers with the lower rating of 10 watts per channel.

SHELF UNITS

Stereo equipment by J. B. Lansing of the U.S.A. was mentioned very briefly on an earlier occasion. An interesting selection of Lansing units now reaches



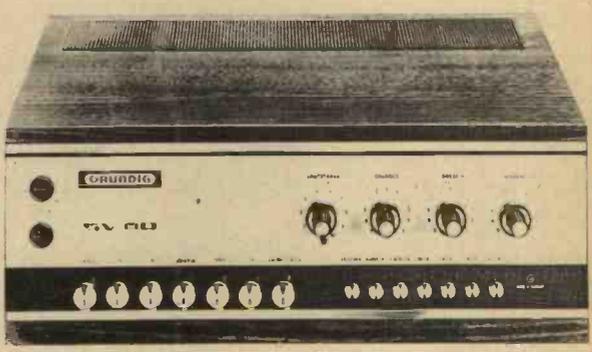
Lansing solid state stereo "energiser"

us via the London agents, Ad Auriema Ltd. Although rather expensive these are claimed to have advanced specifications. They include the SA600 integrated amplifier, which gives an output of 40 watts r.m.s. per channel from silicon transistor circuits. A high performance stereo power amplifier, which Lansing call an "energiser", can be installed in a speaker enclosure and used with a separate control unit.

Other items from this firm include several speaker systems, mostly based on a compact free-standing enclosure incorporating a 15in bass speaker unit with aluminium voice coil. There is also the "Graphic Controller", an elaborate music control centre with a novel display of control functions and pre-amplifier circuits to suit any low output devices.

Still on the subject of shelf units, Grundig's most recent additions to hi fi equipment are the SV80, a transistor stereo amplifier rated at 30 watts per channel, and the matching RT40 a.m./f.m. tuner unit. The amplifier caters for all the usual inputs (pick-up sensitivity is 4mV) and has a 5 ohm output impedance. Suitable speakers are available. No fewer than 44 semiconductor devices of various kinds are used in this amplifier.

Model RT40 radio tuner, like the amplifier, is fully transistorised. It incorporates a stereo decoder, switched automatic frequency control on f.m., and



Grundig SV80 30 + 30 watt transistor stereo amplifier

variable a.m. bandwidth. The tuner and amplifier match in every sense (they have identical dimensions) and there is a choice of wood finishes for the cabinets.

Another shelf unit introduced recently is the Triple-tone Stereo 8-8, claimed to be the first quality transistor model in its price range. It is rated at 8 watts r.m.s. per channel and designed to match other items in this Company's range. The amplifier, which sells at £29 19s 6d, is compact with dimensions 11in x 7½in x 3½in. The pick-up input is for ceramic cartridges, but there is to be a separate "booster" pre-amplifier to match magnetic types.

A small speaker, the Avon, has been introduced by Heathkit at £13 16s in kit form. It measures only 13½in x 8½in x 7½in and is of the sealed type. Drive units are a 3½in tweeter and 6½in bass unit with 2,000Hz crossover unit and 15 ohms impedance. An interesting feature is a metal plate which is fixed in the cabinet to give a rigid mounting for the speaker units. A fully finished walnut veneered cabinet is provided in the kit.

TAPE EQUIPMENT

A new range of semi-professional stereo tape recorders by Ampex—the 2100 Series—have something in

common with the 2000 machines which have been on the market for some time. In particular, simple tape threading and the automatic direction reversal facility are once more in evidence. The recorders can record and replay in either direction of tape travel and thereby give an unusually long programme without the interruption of spool changing.

The transistor Model 2100 is available in three versions—as a portable machine, as a complete recorder in a wooden case, or as a deck with pre-amplifiers. The specifications, instructive for amateurs, are available from Ampex Great Britain Ltd., Acre Road, Reading. Facilities include mixing, three speeds and recording level meters. Recording in either direction is made possible by a fourth head.

Dynatron's new STR1 stereo recorder is fitted in a teak veneered plinth and equipped with a transparent dust cover. Priced at 79 gns, this attractive machine employs the Garrard three-speed deck and the quarter-track system. It is fully transistorised with "advanced modular construction" and, by virtue of separate amplifiers and controls, provides multi-play facilities.

The "Belgravia" by Truvox also has a teak finished cabinet. The deck facilities are identical to those on



Dynatron STR1 stereo recorder

the standard R102 and R104 recorders, and both half-track and quarter-track versions are available. This model employs silicon transistors. Price 93 gns.

A microphone with highly directional characteristics, suitable for amateur use, was introduced by Sennheiser recently. This is the MD411 super-cardioid model, priced at £13 9s and marketed by the London agents, Audio Engineering Ltd. With a design derived from a more expensive professional microphone, the MD411 incorporates a triple impedance transformer giving 200, 800 and 25,000 ohm outputs, the latter being suitable for connection to valve equipment. The price includes a case and stand.

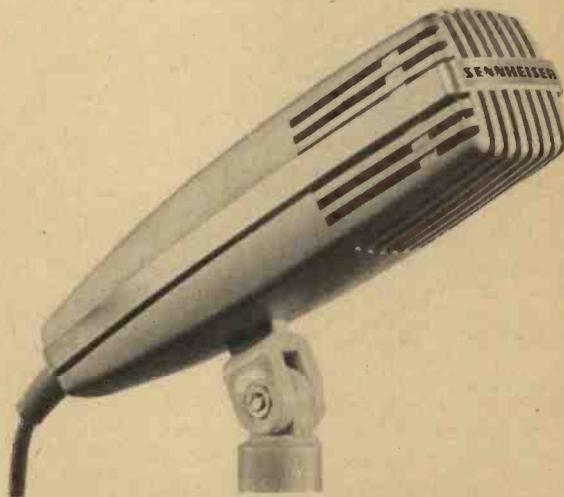
CABINETS

For details of inexpensive hi fi furniture, enthusiasts should write to Medley Musical Ltd., 134 Plumstead Road, London, S.E.18. Products include an equipment cabinet in low-line styling and priced at 18 gns. This model has a Perspex lid over the turntable and a door to cover the control section. It will house numerous alternative assemblies of stereo units.

Then there is the Duo cabinet (also 18 gns) which can be either fitted to a stand or screwed to a wall to isolate the equipment from vibration. Wall mounting is of course the ideal solution for any equipment housing where there is danger of movement due to flexing of floor-boards or where acoustic feedback problems are encountered.

Also made by this firm is the Musette speaker system, measuring 30in × 7½in × 10in and available in 15 ohms or 3 ohms impedance. This system houses a 4in tweeter and 8in bass unit. Teak and walnut are among the finishes offered. Another useful item is a teak finished turntable cabinet for shelf mounting. This is fitted with a transparent lid and is suitable for popular makes of player.

A new 6½in bass speaker unit will be seen in low-cost stereo equipments by leading makers. This ferrite magnet unit, made by Plessey, can be used with the firm's tweeter in small, wide-range systems. Its low nominal resonance (not above 60Hz) is achieved by the use of a flexible bellows-type cone surround of plasticised linen. Standard coil impedances are 15 and 8 ohms and the recommended enclosure is 14in × 9in × 9in minimum, with suitable internal damping.



Sennheiser MD411 super-cardioid microphone

ACCESSORIES

All the usual Metrosound accessories, as well as some new additions, may now be seen on a display rack supplied to retailers. The new products include a spirit level for turntables 6s, and a stylus balance at the unusually low price of 7s 1d. A lubrication kit, selling at 6s, is intended for turntable and tape recorder maintenance. Tape editing aids and a stylus cleaning kit are among the items which are already familiar to amateur enthusiasts.

CUT PRICE

Beocord recorders by Bang and Olufsen were reduced in price not long ago. The Beocord 1500 was 105 gns and is now 97 gns; and the 2000K comes down by 10 gns to 125 gns. Portable radios by Bang and Olufsen, as well as the Sony portable television receiver, are also the subjects of price cuts. Also cutting the cost of good audio equipment are Rectavox, whose Ambi and Omni speaker systems are now considerably cheaper.

AUTO CALENDAR

PART TWO

By D. F. MOODY, B.Sc.

FOLLOWING the theory of the auto-calendar, and the construction and testing of the ring counters on Board 1 (last month), this second part concludes with the construction and testing of the trigger circuitry and assembly of the complete calendar.

CONSTRUCTION OF FACEPLATE

As considerable accuracy is required in drilling the holes in the faceplate, so that they are aligned correctly with the cold cathode tubes mounted on Board 1, a piece of perforated board the same size as Board 1 was used as a drilling template. This provides a convenient way of mounting Board 1 to the back of the faceplate with either wire straps or nuts and bolts.

Using this method, cut a piece of the board to the same size as Board 1 (i.e. 50 holes \times 23 strips). Obtain a piece of sheet aluminium (preferably already painted in a dark grey) with dimensions about $1\frac{1}{2}$ in higher and $\frac{1}{2}$ in wider than this piece of board, and cement the template board to the unpainted side with an impact adhesive.

When completely dry mark the holes to be drilled on the board. The holes to drill will be those directly under the base of each cold cathode tube (i.e. one per tube), for example, holes B4, B8, B12, etc.

Drill the holes with a $\frac{1}{16}$ in drill right through the aluminium. Then turn the faceplate over and drill through the holes again with a $\frac{1}{8}$ in drill. This should leave neat holes. Turn the faceplate over again and clear any burrs from around the holes with a $\frac{1}{16}$ in or $\frac{1}{8}$ in drill.

If the holes have been drilled accurately the faceplate and Board 1 should mate perfectly. If not then the tubes can be tilted slightly. The faceplate should now be labelled with day names, months and day numbers (see photograph).

Board 1 can now be fitted in position and held by means of straps to the perforated board template.

Holding Board 1 in position, feed a piece of tinned copper wire through a vacant hole in Board 1 and locate the end of it in the corresponding hole in the template. Fix it to the template and, keeping a firm pressure on the board, solder the wire to Board 1. Cut off the excess and put in about six straps (three each side). This should hold Board 1 firmly in position.

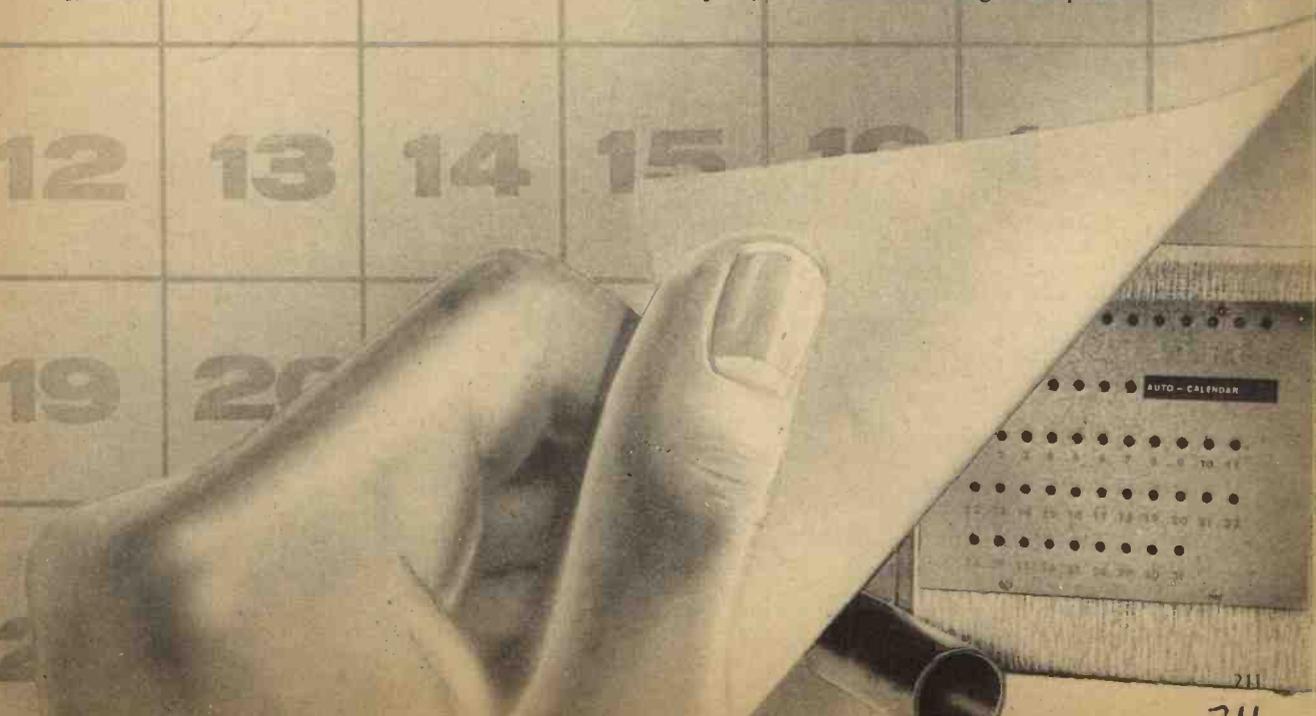
BOARD TWO—CONSTRUCTION

The circuitry for Board 2 is reproduced here in Fig. 5 with a guide to connections to other parts of the circuit. Copper strip code letters are shown in italics.

The layout will depend entirely on the size of the components obtained. Probably the best way to go about planning the layout in detail is to cut a piece of Veroboard the same size as Board 1 (it has to go in the same case) and have all the components in front of you.

Lay the components on the board—starting with the largest, and move them in different configurations until you think you can fit them all on.

Fig. 6 shows a diagram of a suggested layout which will form a rough guide. When you have settled on the layout, fix some of the larger components on to the



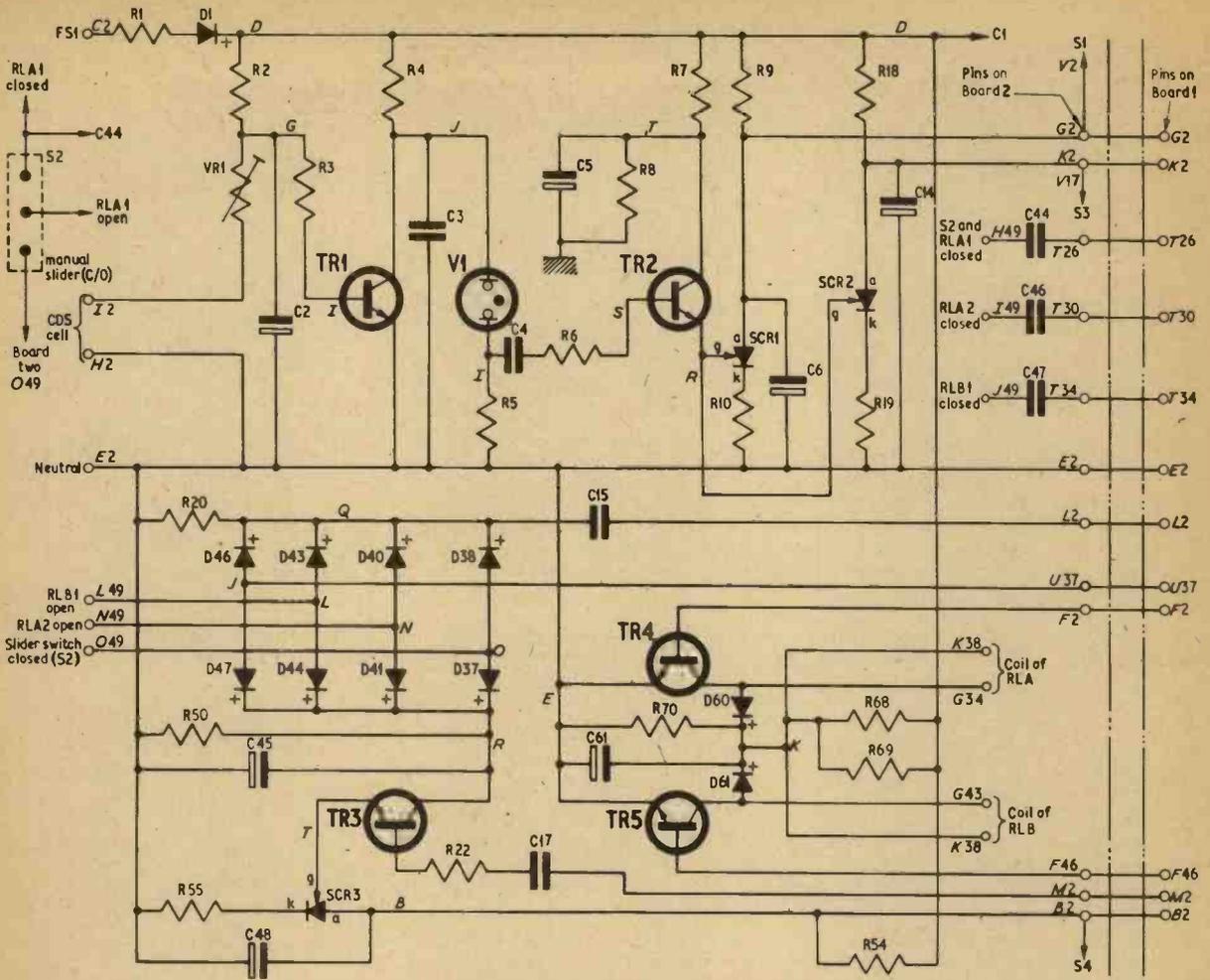


Fig. 5. Circuitry of components mounted on Board 2. *Italic letters, denoting copper strips, are for guidance only. Connections from Board 2 to Board 1 are shown on the right*

board. Insert terminal pins to connect Board 2 to the rest of the circuitry and keep a record of the pin co-ordinates and the point to which the pin must be connected. In this way risks of making wrong connections are avoided.

A line of larger holes is drilled along the top edge of the sheet of Board 2. These should not be cut off as they will serve to mount the board in the case (see section on unit construction).

Provided that you work slowly and carefully, checking all the time with the circuit diagram, then there should be no great difficulty. If necessary, components may be mounted on the copper side of the board, but be sure to put sleeving on component leads and any wire links used. Make sure all necessary copper strip breaks are made as shown in Fig. 6.

Considerable space may be saved if vertical mounting is used wherever possible, for example with small resistors and diodes. Components longer than about $\frac{1}{2}$ in should be mounted flat to keep overall depth small (see unit construction) and to keep component rigidity. The thyristors are fitted to the board by using copper or aluminium brackets screwed down to strips *V* and *W* to make the anode connections. The strip is broken at *V10*.

Nearby copper is cut away to isolate the brackets from these strips. Try to keep all terminals to be wired to a similar location together. This helps to keep wiring much neater, and more compact. Subsequent access for servicing is also possible.

BOARD TWO—TEST

Before completing the construction it is advisable to make a brief test on the operation of Board 2. Mainly of interest is the circuitry around TR1. To protect the remainder of the circuit with h.t. voltage supplied it is essential to make the following connections to Board 1.

Connect pins *B2*, *E2*, *F2*, *G2*, *K2*, *L2*, and *M2* of Board 2 to the appropriate pins on Board 1 and connect pin *E2* to the common line. Connect the CdS cell to *I2* and *H2* with about 3ft of twin flexible wire and the potentiometer VR1 on the copper side of the board. Connect the common line *E2* to the negative pole *Z* of the voltage supply (as shown in Fig. 4 last month for testing Board 1) and connect the positive pole *Y* to the cathode side of diode D1, pin position *D2*. Adjust the supply voltage to 300V and switch on.

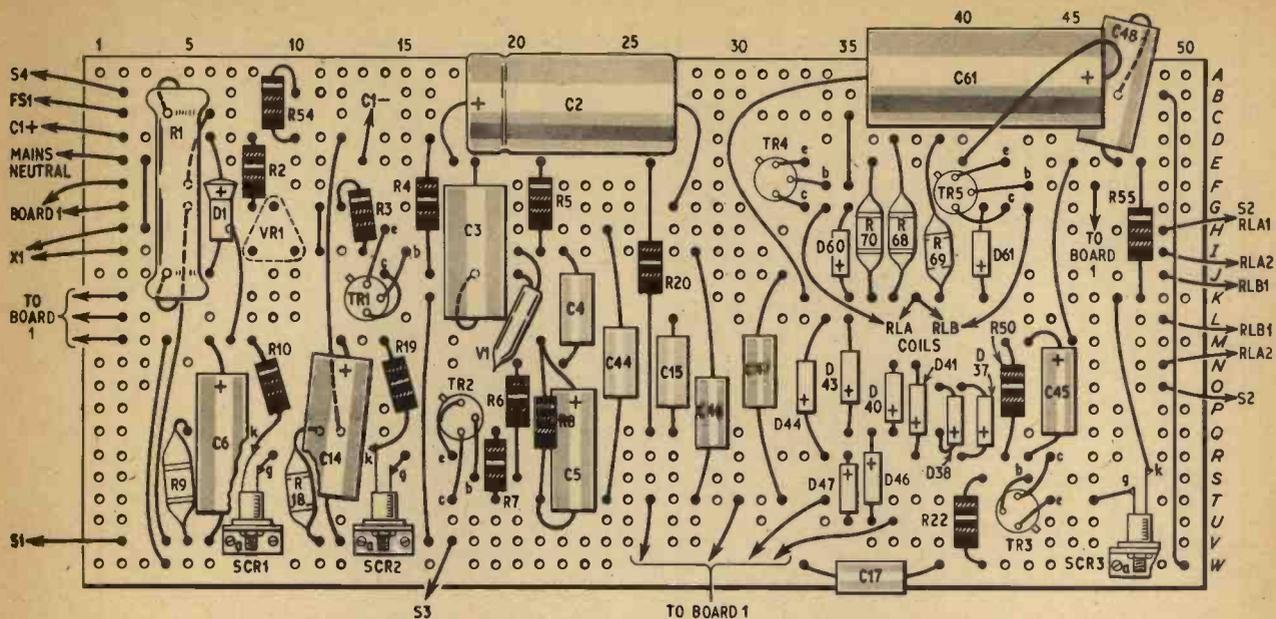


Fig. 6a. Component layout of Board 2. Sizes of components are not necessarily in true proportion so allowance must be made where necessary to alter their positions. The thyristors are mounted on small aluminium brackets (see text)

The following hole positions denote breaks to be made in the copper strips on the reverse side of Board 2:

C5, F7, F14, F38, G7, G31, H23, I9, I12, I17, I27, J7, J31, K17, K46, L28, M5, M31, N36, O36, Q23, R30, S40, T23, T27, T31, T37, U7, U8, U9, U10, U13, U14, U15, U16, V10, V45, V46, V47, V48, W36, W42

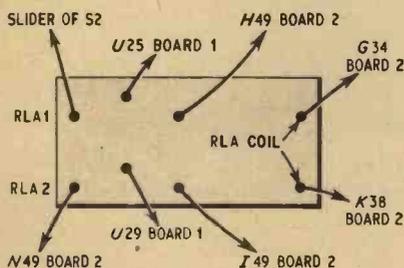


Fig. 6b. Relay connections for RLA

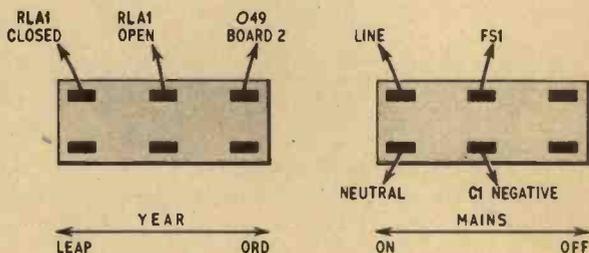


Fig. 6d. Connections to slide switches S2 (left) and S5 (right)

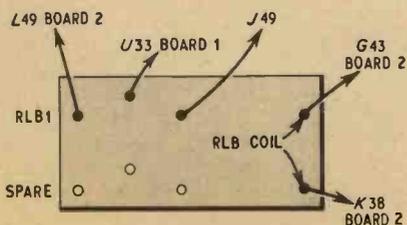


Fig. 6c. Relay connections for RLB

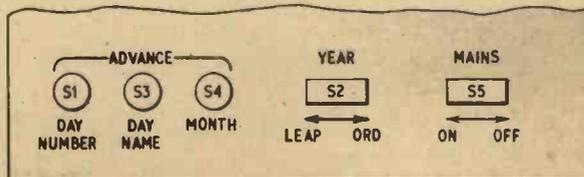


Fig. 6e. Notation of switches on back panel

No doubt many cold cathode tubes will light up—this does not matter at present. Set VR1 to maximum resistance and illuminate the CdS cell. If done during daytime hold the cell pointing towards a window; if at night ordinary room lighting should be sufficient.

If V1 is not glowing reduce VR1 until it does. Now completely mask the CdS cell by wrapping it with some thick, dark cloth. V1 should now extinguish. If it does not then probably TR1 has an extraordinary low gain, when the only solution is to reduce the value of R3. This should not be necessary as in calculating values the gain of TR1 was considered as low as 10.

It should be possible to set VR1 so that V1 ignites when the CdS cell is illuminated with very feeble light after being in darkness for a few seconds.

Every time V1 ignites a change should occur in the day name and day number rings indicating that the thyristors are firing and cutting off correctly. It would be better to disconnect C2 when doing these tests so that the response of the circuit is relatively rapid.

As the feedback path between month and day number rings is not connected, erratic behaviour of the day number ring is to be expected.

R1 ascertained from Table 1. Also as the value of R1 is increased so the rating of fuse FS1 should be reduced to give effective protection.

It should not be thought that the value of R1 is very critical, as the operation of the calendar should not be affected by mains voltage variations of, say, 10 per cent, but nevertheless it is desirable that the nominal working conditions are as favourable as possible. R1 should be a wirewound resistor of about 6 watts so that it can take the high surge current that occurs when switching on, and its value should be greater than 100 ohms to protect the diode from excessive surge currents.

UNIT CONSTRUCTION

With Boards 1 and 2 constructed and tested the complete calendar may be assembled. The prototype was housed in a small loudspeaker cabinet which gives a very handsome finish to the unit. If the reader has constructed Boards 1 and 2 as described then he should allow for the overall size to be bigger to accommodate the larger boards shown here (see Fig. 7). The case should be made in wood and not metal as the calendar is run straight off the mains.

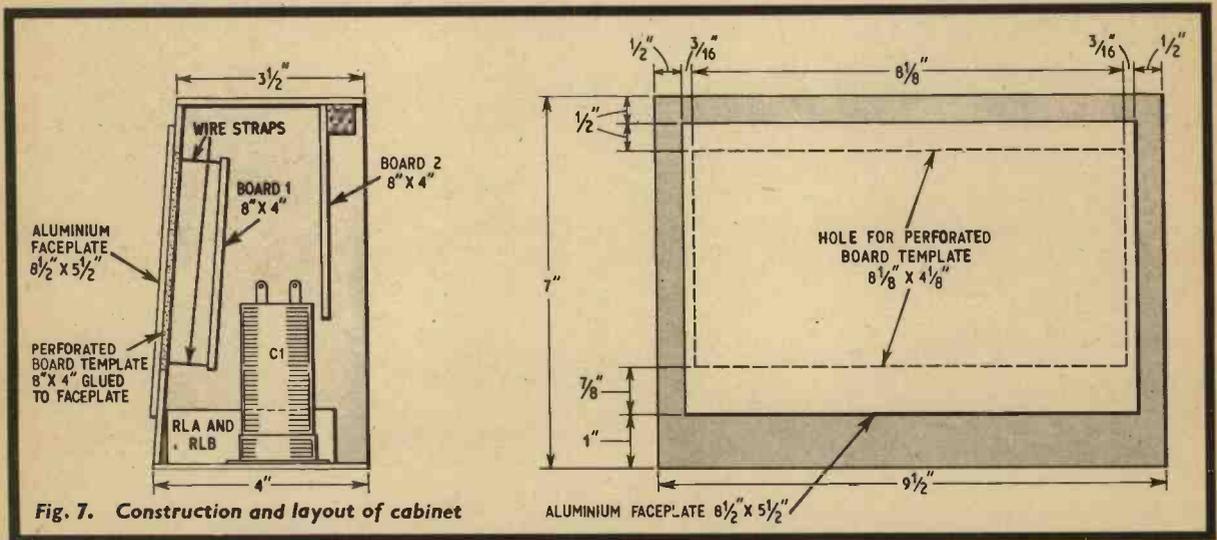


Fig. 7. Construction and layout of cabinet

It should be noted here that the value of R1 should be chosen so that the nominal h.t. voltage is 300V with your local a.c. mains supply voltage at its nominal level. This should be found out or measured and then

Table 1. VALUE OF R1 FOR DIFFERENT A.C. MAINS SUPPLY VOLTAGES

Supply voltage r.m.s.	R1 (ohms)	FS1 rating
250	2,000	250mA
240	1,000	500mA
230	500	700mA
220	200	1A
210	100	1A

Mark out and cut the rectangular opening in the front of the case to accept the perforated board. Mark out on the front the size of rectangle you require which should only be about $\frac{1}{8}$ in larger all round than the actual size of Board 1. If it is made too large there will be difficulty fixing the front-plate screws. The easiest way to cut the hole is to drill a $\frac{1}{4}$ in hole near one of the corners of the rectangle to be cut out, and then using a band saw cut out the rectangular hole.

Check, by holding the face-plate in position, that the relays will fit in without fouling Board 1 (see photograph). At this stage stand the large smoothing capacitor C1 upright in the case (left-hand side), and move it towards the front as far as it will go without touching Board 1. Hold it and mark its position by marking around its base with pencil. The holding clip should now be fixed in using small wood screws.



Take one for 6/11

a genuine
12" LP
or 3 $\frac{3}{4}$ ips tape



22 The Moonlight, Pathétique and Appassionata world's three greatest sonatas played by Joseph Cooper the famous TV pianist.



81 The fabulous Sinatra sings and sings 12 top songs. Don't Worry About Me; Melody of Love; Look over your Shoulder; White Christmas; etc.



1 The complete score from this great musical. With Ian Wallace, Joyce Blair and Chorus.



362 Blue Danube; Empress; Viennese Woods; Voices of Spring; Roses from South - glittering waltzes by Vienna Symphony Orch./Rudel.



32 Famous TV pianist Joseph Cooper plays this triumphant concerto with the Sinfonia under Dodé. Also Saint-Saëns' Rouet d'Orphée.



560 Complete hit parade on one disc - includes Help!; Colours; There But for Fortune; Ticket to Ride; You've Got Your Troubles; plus 7 more smash hits.



70 Band of the Royal Scots Greys plays regimental music. 12 items include Colonel Bogey; Semper Fidelis; El Capitan.



449 Unforgettable songs from the Continent! Romantica; Volare; La Mer; Never on Sunday; Quando, Quando; plus 7.



63 Alexander Jenner in an electrifying performance with the Bavarian State Radio Orch., led by Odd Gruner-Hegge.



44 Covent Garden Ballet, conductor the late John Hollingsworth, in a sparklingly fresh rendering of this lovely ballet.



89 Star cast singing all the greats like Climb Ev'ry Mountain; Do-Re-Mi; Lonely Goats-herd; Favourite Things etc.



443 Chart-topping MORN'ING TOWN RIDE; WE'RE MOVING ON; Blowin' in the wind; 9 more hits.

HERE'S WHY:

We want you to *prove for yourself* that what we say about World Record Club recordings is absolutely true - that for sheer quality they are unsurpassed by *any* other records selling at any price. *Anywhere!*

So choose any one of these magnificent WRC recordings, and actually test it yourself on your own home equipment for 7 days. And read through the fascinating literature we shall send you about WRC, and seriously consider joining Britain's finest record club. You'll find WRC's annual programme of 120 special club releases very tempting! The cream of the World's great Classical, Folk, Jazz, Popular and other music as well - and all offered exclusively to members at special privilege prices.

This offer is strictly limited and is confined to one reply per household.

Available in Stereo & Mono LPs and 3 $\frac{3}{4}$ ips mono tapes. *Electronically reprocessed for stereo reproduction.

SEND NOW! CLAIM YOUR CHOICE HERE!

TO WORLD RECORD CLUB, P.O. BOX 16, HAYES, MIDDLESEX

I want to accept your remarkable invitation and to know all about Britain's brightest Record Club. Please send me, without further obligation, the recording I have indicated below, together with free illustrated brochures about wrc and details of your special Introductory Offer. I understand that even if I take no further interest in the Club, I may still keep my recording and pay you only 6/11 (plus 2/- p & p). Or, if I wish, return my recording in perfect condition and owe you nothing.

IMPORTANT! THIS IS YOUR ADDRESS LABEL - PLEASE PRINT CLEARLY	MY CHOICE IS NO.
MR MRS MISS.....	[]
STREET.....	Enter choice number only in box.
TOWN 383.....	<input type="checkbox"/> Tick for mono 12" LP <input type="checkbox"/> Tick for stereo 12" LP <input type="checkbox"/> Tick for 3 $\frac{3}{4}$ ips mono tape
For office use only	This offer applies to G.B. and N. Ireland only.

COUNTY.....

T.R.S. — BARGAINS IN COMPONENTS & EQUIPMENT

GARRARD UNITS

LM.3000 changer with 9TA stereo cartridge. 8 gns.

AT.60 De-Luxe changer with 12" cast turntable, less cartridge. 9½ gns.

SP.25 De-Luxe single player less cartridge. 9½ gns. Carr. and packing on above 7/6 each.

GARRARD PLINTHS suitable for any of above, with plastic cover 7/5-. Carr. and packing 8/-.
Garrard Mono Cartridges from 15/-. Stereo from 25/-.

TAPE BARGAINS

1500' 7" REEL American professional quality tape. 1½ Br. playing at 3½ r.p.s. Leader and stop foils. In sealed boxes. Ideal for 2 and 4 track machines, mono or stereo. Outstanding value at 17/6 per reel (1½ pf. for first reel, 6½ each after first when ordered at same time).

UNIQUE DOUBLE SIDED TAPE on 6½" reels. Superb quality used in normal way. Ideal for experimenters too. 650' 9½"- 600' 8/6 (1½ pf. per single reel, 6d. for each additional).

MUCH NEEDED ITEMS ALWAYS IN STOCK

RESISTORS
1", HI-STAB.: ½ watt 1/8; 10Ω-100Ω 2/-.
5", HI-STAB.: ½ watt } 100Ω-1 meg. 6d. each.
 } other values 9d.
IN FULL RANGES FROM 10%, Standard ½ watt, each 4d.
10Ω to 1,000 pf. 6d. ea. Dilo ceramics 1 watt 6d., 2 watt 9d.

VOLUME CONTROLS
5/- Centre tapped ½ meg. log/1 meg., less switch 5/-. Twin ganged, 5K to 2 meg. less switch 7/6, with DP switch, 100K-2 meg. each 9/6.
STEREO BALANCE CONTROL. 5K-2 meg. Log/Anti-log each 9/-.

MULLARD DE-CODER COILS, per pair 49/6.
ENAMELLED COPPER WIRE, 2 o/z. reels 14 g.-20 g. 3/6; 22 g.-28 g. 3/6; 30 g.-34 g. 4/3; 36 g.-38 g. 4/6; 39 g.-40 g. 5/-, etc.

WIREWOUND RESISTORS, 25 ohms to 10 K, 5 w. 1/3, 10 w. 1/8, 16 w. 2/-. CONDENSERS Silver Mica. All values 2 pf. to 1,000 pf. 6d. ea. Dilo ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd. to .01 ufd. and .1/350 v. 10d. .02 MF to .01 MF. 500 v. 1/-. .25 T.C.C. 1/9. .5 T.C.C. 2/-.

SINCLAIR KITS. We carry full stocks as advertised and give prompt delivery. MICROMATIC. A new size stage vent-pocket revr. (Kit) 59/6. Built 79/6. MICRO-FM 7 transistor FM tuner-rcvr. (Kit) 25.19.6. Z.12 combined 12w. amp and pre-amp. built 89/6. STEREO 25 de-luxe pre-amp/control unit (stereo) built 29.19.6. PZ.3 Mains Power Unit 79/6.

TINNED COPPER WIRE, 16-22 g. 4/- 2 o/z.
BONDACOST Speaker Cabinet Acoustic Wadding (1" thick approx.) 18" wide, any length cut, 6/- yd.

VEROBOARD—All sizes including 21" x 5", 3/8"; 21" x 31", 3/8"; 31" x 5", 5/2"; 31" x 31", 9/8"; 31" x 17", 12/8. All accessories and tools in stock.

ERSIN MULTICORE SOLDER, 60/40 4d. per yard. Cartons 6d., 1/-, 2/6, etc.

CLOSE TOL. S/MICAS, 10% 5 pf. 500 pf. 9d. 600-5,000 pf. 1/-, 1.5, 2 pf. 100 pf. 11d. 100 pf.-250 pf. 1/2. 270 pf.-800 pf. 1/4, 800 pf.-5,000 pf. 2/-.

7 VALVE AM/FM R.G. CHASSIS 3 wave-band L/M/FM. Permeability tuning on F.M. Large clear dial A.V.C. good neg. feedback. Magic eye. 3 w. output. A.C. 200/250 v. Circuit diagrams available. Aligned, tested and ready for use 13.19.6 (Carr. and Ins. 7/6). S.A.E. brings full details.

STEREO RADIO IS EASY

WITH A T.R.S. MULLARD DECODER

Based on Mullard's proven circuitry, this is a six transistor, printed circuit unit size 6½" x 2½". Two stage transistor Stereo Beacon Indicator is incorporated. Operates from 12 v. supply. Neg. earth. Basic Kit supplied suitable for Transistor equipment. Data supplied with kit for easy adaptation for using with valve equipment. Kit complete with Mullard specified Inductors, Type WF2949, and WF2951 and instructions. Complete kit 10/- With coils tested and pre-assembled 14.19.6 Carriage 2/6. Aligned 15.5.6

WE ARE PEAK SOUND SPECIALISTS

PEAK SOUND "CIR-KIT" for making instant "printed circuit" boards without chemicals, etching or heating. Pack No. 3 with 15" strip, 6" x 4" sheet, 15/- laminated board, etc.

PEAK SOUND STEREO AMPLIFIER, MODEL SA.8-8. Complete with pre-amp. High quality, easy-to-build, using "CIR-KIT". Complete kit with 14 matched transistors and excellent instructions manual. 12.19.6
Peak Sound Power Pack for SA.8-8 75/-.

BUILD TO A T.R.S. PROGRAMME

Example: Garrard LM 3000 changer with stereo cartridge, on plinth with cover 8 gns. Peak Sound SA.8-8 Amp. and Power Pack 18.14.8. T.R.S. Stereo Decoder 25.5.0. Jason FM Tuner 26.5.0 or Sinclair Micro FM 25.19.6. A complete Stereo Hi-Fi/Radio assembly for about 336. Loudspeakers available.

3d. WELL SPENT 3d. stamp brings latest T.R.S. Bargain List (Dec.). 8 large pages packed with bargains.

POSTAL AND PACKING CHARGES

Terms: C.W.O. or C.O.D., post and packing 1/6, 1/1b. 1/9, 3/6, 5/6, 3/9, 8/6, 4/6, etc.

TRANSFORMER MANUFACTURING SERVICE

We manufacture all types Radio Mains, Transf. chokes, Quality O/P Trans., etc. Enquiries invited for specials, prototypes for small production runs. Quotations by return.



RADIO COMPONENT SPECIALISTS

70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY
(A few doors from Thornton Heath Station, Southern Railway)
Telephone: THO 2188. Hours: 9 a.m.—6 p.m. daily. 1 p.m. Wed.

Established 1949

BI-PAK SEMICONDUCTORS

8 RADNOR HOUSE * VALUE PAKS FOR '67
93/97 REGENT STREET * NEW UNTESTED *
LONDON, W.1

LOW COST SILICON CONTROLLED RECTIFIERS (THYRISTORS) FACTORY TESTED	FREE	FREE	FREE																																																																													
1 AMP (TO-5 can) 7 AMP (STUD) 16 AMP (STUD)	One 10/- Pack of your own choice free with orders valued £4 or over	LOGIC MODULES and/or, Gates, Memory Units, Timer Units, etc., details free	UNMARKED, UNTESTED SCR's VOLTAGE RANGE 1 Amp 20/-																																																																													
<table border="0" style="width: 100%;"> <tr> <td>PIV EACH</td> <td>PIV EACH</td> <td>PIV EACH</td> </tr> <tr> <td>50 8/6</td> <td>100 10/6</td> <td>100 16/6</td> </tr> <tr> <td>100 9/6</td> <td>400 30/-</td> <td>400 40/-</td> </tr> <tr> <td>200 12/6</td> <td>600 45/-</td> <td>600 55/-</td> </tr> <tr> <td>400 22/6</td> <td>400 PIV Power SCR 30 Amp. Special Price</td> <td></td> </tr> </table>	PIV EACH	PIV EACH	PIV EACH	50 8/6	100 10/6	100 16/6	100 9/6	400 30/-	400 40/-	200 12/6	600 45/-	600 55/-	400 22/6	400 PIV Power SCR 30 Amp. Special Price				<table border="0" style="width: 100%;"> <tr> <td>3 High vlt. AF Trans. PNP ACY17</td> <td>15/-</td> </tr> <tr> <td>5 Sil. Rect. 750mA 100 PIV TEXAS</td> <td>15/-</td> </tr> <tr> <td>3 BSY95A Sil. Trans. STC</td> <td>15/-</td> </tr> <tr> <td>3 Sil. Trans. OC200 Mullard</td> <td>15/-</td> </tr> <tr> <td>2 Sil. Power Rect. 6 Amp. 200 PIV BYZ13</td> <td>15/-</td> </tr> <tr> <td>1 AF139 GERM. Trans. 1500 M/Cs</td> <td>15/-</td> </tr> <tr> <td>1 Sil. Power Trans. 100 M/Cs TK 201A NPN</td> <td>15/-</td> </tr> <tr> <td>6 Zener Diodes 3-15Vlts. Mixed 400mW</td> <td>15/-</td> </tr> <tr> <td>5 OAS Gold Bonded Diodes Mullard</td> <td>15/-</td> </tr> <tr> <td>1 2N1132 PNP PLANAR Trans. Sil.</td> <td>15/-</td> </tr> <tr> <td>2 2N697 NPN PLANAR Trans. Sil.</td> <td>15/-</td> </tr> <tr> <td>4 GERM. Power Trans. eqvt. OC16 Mullard</td> <td>15/-</td> </tr> <tr> <td>1 UNIJUNCTION Trans. 2N2646 G.E.</td> <td>15/-</td> </tr> <tr> <td>2 Sil. Trans. 60VCB 200 M/Cs. ZT83/84</td> <td>15/-</td> </tr> <tr> <td>1 Sil. PLANAR Trans. BSY25 NPN 100M/Cs</td> <td>15/-</td> </tr> <tr> <td>1 Sil. Trans. IS104 150 M/Cs HFE 200 NPN</td> <td>15/-</td> </tr> <tr> <td>2 SCR's 50 PIV 1 Amp. TO-5 can</td> <td>15/-</td> </tr> <tr> <td>1 Tunnel Diode IN370 (TO-5) G.E.</td> <td>15/-</td> </tr> <tr> <td>1 2N2160 UNIJUNCTION Trans. TO-5 can</td> <td>15/-</td> </tr> <tr> <td>2 Sil. Rect. 5 Amp. 400 PIV Stud</td> <td>15/-</td> </tr> <tr> <td>1 Tunnel Diode AEY II STC. 1050 M/Cs</td> <td>15/-</td> </tr> <tr> <td>2 GERM. Power Trans. OC28/29</td> <td>15/-</td> </tr> <tr> <td>2 Zeners 25 watt 18 and 22 volts</td> <td>15/-</td> </tr> <tr> <td>6 Sil. Rect. Type BY100 800 PIV 550mA</td> <td>20/-</td> </tr> <tr> <td>8 Sil. Rect. 400 PIV 200/500mA</td> <td>20/-</td> </tr> <tr> <td>1 Transistor Manual by G.E. 648 pages</td> <td>30/-</td> </tr> <tr> <td>1 Silicon Controlled Rect. Manual G.E.</td> <td>30/-</td> </tr> <tr> <td>25 Mixed Sil. & GERM. Trans. New Marked</td> <td>30/-</td> </tr> <tr> <td>40 Mixed Semiconductors New Marked</td> <td>40/-</td> </tr> <tr> <td>1 Logic Module Handbook & Catalogue</td> <td>17/6</td> </tr> </table>	3 High vlt. AF Trans. PNP ACY17	15/-	5 Sil. Rect. 750mA 100 PIV TEXAS	15/-	3 BSY95A Sil. Trans. STC	15/-	3 Sil. Trans. OC200 Mullard	15/-	2 Sil. Power Rect. 6 Amp. 200 PIV BYZ13	15/-	1 AF139 GERM. Trans. 1500 M/Cs	15/-	1 Sil. Power Trans. 100 M/Cs TK 201A NPN	15/-	6 Zener Diodes 3-15Vlts. Mixed 400mW	15/-	5 OAS Gold Bonded Diodes Mullard	15/-	1 2N1132 PNP PLANAR Trans. Sil.	15/-	2 2N697 NPN PLANAR Trans. Sil.	15/-	4 GERM. Power Trans. eqvt. OC16 Mullard	15/-	1 UNIJUNCTION Trans. 2N2646 G.E.	15/-	2 Sil. Trans. 60VCB 200 M/Cs. ZT83/84	15/-	1 Sil. PLANAR Trans. BSY25 NPN 100M/Cs	15/-	1 Sil. Trans. IS104 150 M/Cs HFE 200 NPN	15/-	2 SCR's 50 PIV 1 Amp. TO-5 can	15/-	1 Tunnel Diode IN370 (TO-5) G.E.	15/-	1 2N2160 UNIJUNCTION Trans. TO-5 can	15/-	2 Sil. Rect. 5 Amp. 400 PIV Stud	15/-	1 Tunnel Diode AEY II STC. 1050 M/Cs	15/-	2 GERM. Power Trans. OC28/29	15/-	2 Zeners 25 watt 18 and 22 volts	15/-	6 Sil. Rect. Type BY100 800 PIV 550mA	20/-	8 Sil. Rect. 400 PIV 200/500mA	20/-	1 Transistor Manual by G.E. 648 pages	30/-	1 Silicon Controlled Rect. Manual G.E.	30/-	25 Mixed Sil. & GERM. Trans. New Marked	30/-	40 Mixed Semiconductors New Marked	40/-	1 Logic Module Handbook & Catalogue	17/6		
PIV EACH	PIV EACH	PIV EACH																																																																														
50 8/6	100 10/6	100 16/6																																																																														
100 9/6	400 30/-	400 40/-																																																																														
200 12/6	600 45/-	600 55/-																																																																														
400 22/6	400 PIV Power SCR 30 Amp. Special Price																																																																															
3 High vlt. AF Trans. PNP ACY17	15/-																																																																															
5 Sil. Rect. 750mA 100 PIV TEXAS	15/-																																																																															
3 BSY95A Sil. Trans. STC	15/-																																																																															
3 Sil. Trans. OC200 Mullard	15/-																																																																															
2 Sil. Power Rect. 6 Amp. 200 PIV BYZ13	15/-																																																																															
1 AF139 GERM. Trans. 1500 M/Cs	15/-																																																																															
1 Sil. Power Trans. 100 M/Cs TK 201A NPN	15/-																																																																															
6 Zener Diodes 3-15Vlts. Mixed 400mW	15/-																																																																															
5 OAS Gold Bonded Diodes Mullard	15/-																																																																															
1 2N1132 PNP PLANAR Trans. Sil.	15/-																																																																															
2 2N697 NPN PLANAR Trans. Sil.	15/-																																																																															
4 GERM. Power Trans. eqvt. OC16 Mullard	15/-																																																																															
1 UNIJUNCTION Trans. 2N2646 G.E.	15/-																																																																															
2 Sil. Trans. 60VCB 200 M/Cs. ZT83/84	15/-																																																																															
1 Sil. PLANAR Trans. BSY25 NPN 100M/Cs	15/-																																																																															
1 Sil. Trans. IS104 150 M/Cs HFE 200 NPN	15/-																																																																															
2 SCR's 50 PIV 1 Amp. TO-5 can	15/-																																																																															
1 Tunnel Diode IN370 (TO-5) G.E.	15/-																																																																															
1 2N2160 UNIJUNCTION Trans. TO-5 can	15/-																																																																															
2 Sil. Rect. 5 Amp. 400 PIV Stud	15/-																																																																															
1 Tunnel Diode AEY II STC. 1050 M/Cs	15/-																																																																															
2 GERM. Power Trans. OC28/29	15/-																																																																															
2 Zeners 25 watt 18 and 22 volts	15/-																																																																															
6 Sil. Rect. Type BY100 800 PIV 550mA	20/-																																																																															
8 Sil. Rect. 400 PIV 200/500mA	20/-																																																																															
1 Transistor Manual by G.E. 648 pages	30/-																																																																															
1 Silicon Controlled Rect. Manual G.E.	30/-																																																																															
25 Mixed Sil. & GERM. Trans. New Marked	30/-																																																																															
40 Mixed Semiconductors New Marked	40/-																																																																															
1 Logic Module Handbook & Catalogue	17/6																																																																															

Our vast stocks change daily with hundreds of Semiconductor bargains becoming available. Just send 2/6 to cover 3 months mailing of our latest stock lists, eqvt. charts, circuits, etc.

Minimum Order 10/-. CASH WITH ORDER PLEASE. Add 1/- postage and packing per Order. GUARANTEED by return postal service. Overseas add extra for Airmail.

A COMPLETE RANGE OF SILICON RECTIFIERS
750 mA TO 25 Amp. 50-1000 PIV NOW IN STOCK.
ASK FOR PRICE LIST

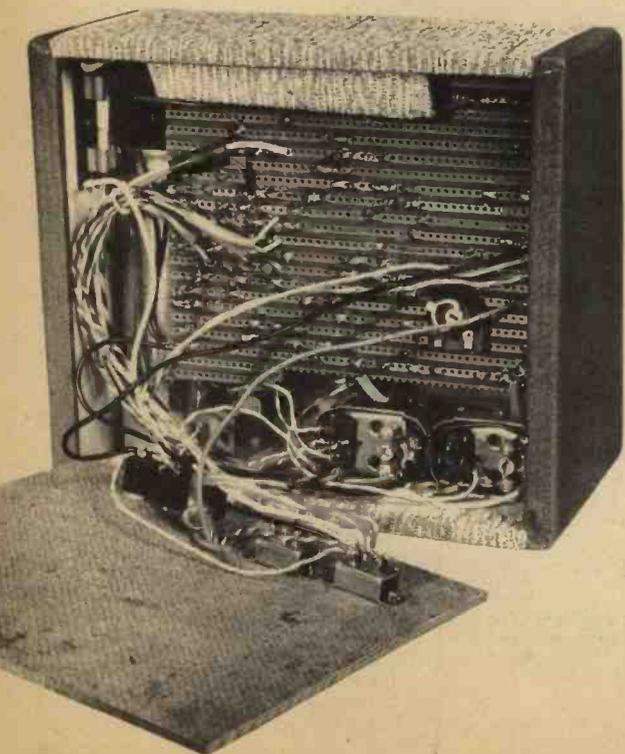
The relays should be fitted next. This can be easily done by removing the dust cover and drilling a $\frac{1}{8}$ in hole through the closed end. Smear one side of the dust cover with impact adhesive. Likewise put some on the wooden cabinet base (right-hand side facing rear). Press the dust covers (side by side) right up into the corner of the case and fix with two small wood screws into the front panel. Before the relays can be inserted into the dust covers remove the aluminium fixing brackets from the base of the relays.

With C1 in position make sure that Board 2 will fit in position. If it does then take it out and solder 8in leads to the pins on the component side of Board 1 which require to be connected to Board 2. There should be 12 connections to make, so colour coding is essential. If a record of each connection and colour is made risks of wrong connections will be avoided.

In the wiring diagram these inter-board connections use corresponding holes (e.g. B2 on Board 1 to B2 on Board 2). All 12 wires can be laced together into a cable form. The pins on Board 1 requiring connections to Board 2 are pins: B2, E2, F2, F46, G2, K2, L2, M2, T26, T30, T34, and U37.

Fix Board 2 in position as shown in diagram taking the leads from it out through the front opening. Now solder leads from pins D2 and E13 on Board 2 to the positive and negative tags respectively on capacitor C1.

The rest of the connecting wires for Board 1 are soldered to pins U25, U29, U33 for relay wiper connections on RLA1, RLA2, and RLB1 respectively. Now place the face-plate in position, pull the three wires to go to the relays through the gap under Board 2, and screw the face-plate in position. Wire up the relays next with the three wires from Board 1 and the other eight leads from Board 2.



Controls to be fitted on the back plate are three push button switches and two changeover slide switches. Holes should also be drilled to accept the mains cable and CdS connecting wire. When fitting the controls on the back plate make sure that their tags do not touch any other components or wiring, especially the relays and Board 2. The fuse is fitted inside the case on the left-hand side (looking at the rear) above the capacitor C1. Connect a few feet of twin mains wire to FS1 and C1 negative (line and neutral mains respectively), or via slider S5 if used. Label each control, especially the slider switch so that you know when the calendar is in leap year mode or ordinary year mode.

INSTALLATION

The finished calendar will be small enough and sufficiently good-looking to be installed in a living room or study. Preferably it should be fitted near a spare mains socket (one provided for an electric clock is ideal) so that there is no chance of it being switched off inadvertently. The CdS cell is required to be mounted near a window or door for maximum light sensitivity.

The CdS cell should be mounted at the end of a short cardboard or metal tube to limit incidental illumination only from the right direction. It should be preferably pointing east or north-east to avoid trouble from a bright full moon, and kept fairly horizontal. In this way the maximum amount of light is detected when it is most required, i.e. in the early morning. If however mounting in this way is impossible, then direct the tube more vertically and more northerly, again to avoid detecting light from the moon.

If horizontal mounting is used Terry clips provide a suitable clamping arrangement especially if the tube is mounted under the eaves of the house. The open end of the tube can be covered with transparent polythene, held by a rubber band. This will protect the tube from the elements.

When the tube and unit have been installed the sensitivity will have to be adjusted. This must be done at night. Switch on the unit, when several tubes will probably light up. By pressing the advance controls it should be possible to get one tube per ring glowing.

In the day name counter a stage may be reached when all tubes try to conduct resulting in oscillation; this is because the number of elements in this ring is small. If this condition develops the only way to remove it is to switch off the mains supply and press the day name advance switch. Due to the high value of C1 the h.t. will drop only slowly.

Keep pressing the day name advance button until only one tube is glowing. Then turn the mains on again. Hence with only one tube glowing in each ring remove the back plate so that you can see whether or not V1 is glowing. This can be seen through Board 2.

Turn VR1 down to the minimum value. If V1 is not glowing then leave VR1 at this value. If V1 is glowing then increase VR1 until it goes out; give it "a little bit more", and then replace the back plate and set up the correct date on the calendar.

If VR1 has been set correctly and the CdS cell mounted in a favourable position then the calendar will change date very early in the morning in the summer and later on winter days.

CORRECTION

In Fig. 1 (last month) R52 should be connected to the common line with R51 and R53, *not* to D40-D43 line.



Unijunction TRANSISTORS



By A. THOMAS

THE unijunction transistor (u.j.t.) was one of the first of the three terminal semiconductor devices to be described. A patent was applied for in France in 1948, by Heinrich Welker, for a unijunction type device. In 1949 Dr W. B. Shockley had written an article describing the operation of the u.j.t. Books published in the 1950s, referred to the u.j.t. as a double base diode.

Fig. 1 shows the symbol for the u.j.t. and it is always presented in this manner to prevent confusion with the bipolar junction transistor and the field effect transistor (f.e.t.). Figs. 2, 3 and 4 show the symbols for these two latter devices.

Referring to Fig. 1, B1 and B2 are Base 1 and Base 2, and E is the emitter. The two base leads are shown at 90 degrees to the base because they are non-rectifying contacts, and the emitter is shown with an arrow because it is a rectifying junction; the direction shows the emitting properties of the junction. The base is *n* type semiconductor material, and the emitter is *p* type. The power supply polarities are the same as for the *npn* junction transistor, and are shown in Fig. 5.

NEGATIVE RESISTANCE REGION

The device exhibits a stable incremental negative resistance region under certain conditions. The negative resistance characteristic is described as being the portion of the characteristic where, as the current through the device increases, so the voltage across the device decreases.

Fig. 6 shows the u.j.t. emitter characteristic. It can be seen from this, that for each specific emitter current there is a unique emitter voltage but as many as three separate values of emitter current may exist for a specified emitter voltage. The negative resistance region is the portion between points A and B, D is the cut-off region, and C is the saturation region. Point A is known as I_{FM} , V_{FM} which is the peak current and voltage, and B as i_{ev} , v_{ev} which is the valley current and voltage.

This negative resistance makes possible the design of circuits which contain fewer components than com-

parable junction transistor circuits. Due to the high input impedance in the off condition, the device may also be used for voltage discriminating circuits.

PARAMETERS AND SYMBOLS

r_{BB} is the static interbase resistance and is measured between the two base terminals with the emitter open circuit. This is simply the resistance of the silicon bar. The parameter is slightly voltage dependent and is specified at a low voltage and current to eliminate self-heating effects.

r_{B1} is the static resistance of the silicon bar from the emitter to the base 1 lead.

r_{B2} is the resistance from the emitter to the base 2 lead. The sum of r_{B1} and r_{B2} is equal to r_{BB} .

I_{FM} and V_{FM} designate the peak current and voltage. The peak is approached as the emitter becomes forward biased causing the device to go into its negative resistance region. V_{FM} is dependent on interbase voltage and η .

i_{ev} and v_{ev} designate the emitter current and voltage at the valley point as shown in Fig. 6. The valley point is dependent on V_{BB} and temperature.

η is the "intrinsic stand off ratio" and is defined in the following formula, $V_{FM} = \eta \cdot V_{BB} + V_D$. Where V_D is the forward volt drop of the emitter to base 1 diode. The ratio η determines the firing voltage of the device for a constant interbase voltage.

$I_{B(mod)}$ gives an indication of the current gain of the device from emitter to base 2. $I_{B2(mod)}$ is specified at a constant V_{B2B1} and emitter current. With a resistor in base 2 and $I_{B2(mod)}$ known, the pulse amplitude at base 2, when the emitter fires, may be calculated.

V_{BB} is the total voltage supplied to the bases.

V_{B2B1} is the voltage between the base leads.

V_{EE} is the emitter supply voltage.

R_{B1} and R_{B2} are the resistors in the base leads.

CIRCUIT SYMBOLS



Fig. 1.
PN u.j.t.

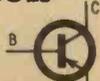


Fig. 2.
PNP junction
transistor



Fig. 3.
NPN junction
transistor

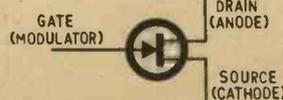


Fig. 4. F.E.T.
(with n-type base)

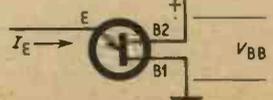
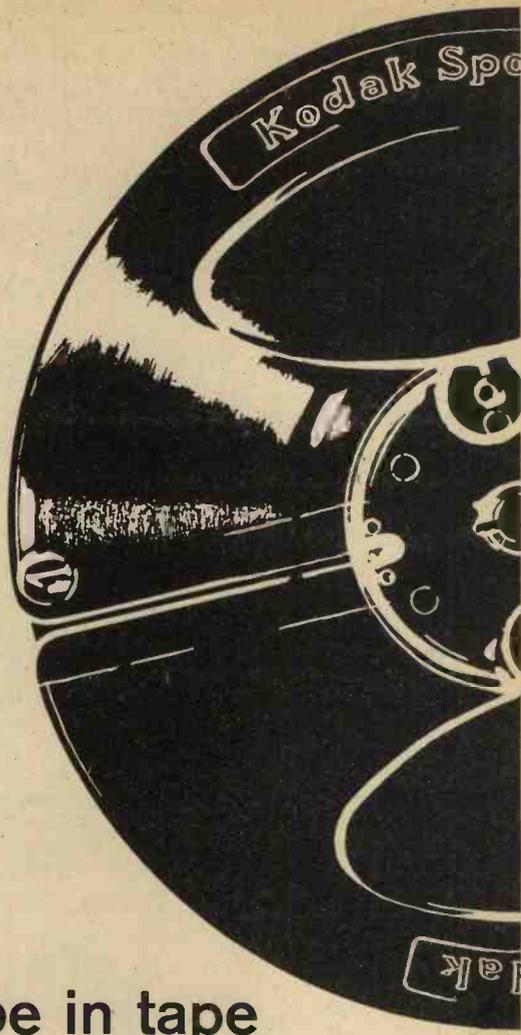
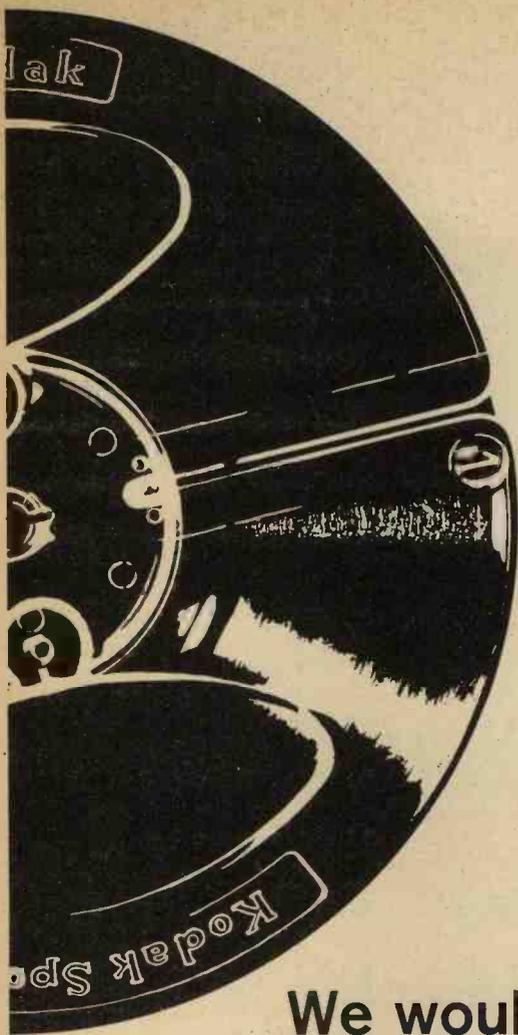


Fig. 5.
PN u.j.t. supply polarities



We wouldn't be in tape if we couldn't make the best

When you're a company whose products are world-famous quality leaders, you can never afford to be 'as good as' in anything.

You **have** to be best.

In entering the tape market, Kodak had to make a tape with a combination of features no other leading tape could match.

We did.

And we can prove it.

So can you, the very next time you buy tape.

Kodak Sound Recording Tapes—Standard, Long, Double, Triple and Quadruple Play—are available through Kodak Photographic Dealers everywhere.

Look for the yellow box, and ask for Kodak Tapes by name.

To Kodak Limited, Dept. 70A,
Kodak House, Kingsway, London, W.C.2.

**Please send me literature on
Kodak Sound Recording Tapes.**

Name.....

Address.....

.....

.....

P.E.

'Kodak' is a registered trade mark

VARIABLE VOLTAGE TRANSFORMERS



4 50 AMPS

INPUT 230/240v. A.C. 50/60—
OUTPUT VARIABLE 0-260v.—
BRAND NEW Carriage Paid.
Buy direct from the importer,
keenest prices in the country.
All Types (and Spares) from
1/2 to 50 amp. from stock.
OPEN TYPE (Panel Mounting)
1/2 amp, £3. 3. 0. 1 amp, £4. 10. 0.
2 1/2 amps, £5. 12. 6.

SHROUDED TYPE

1 amp, £4. 10. 0. 2.5 amps,
£5. 17. 0. 4 amps, £8. 7. 6.
5 amps, £9. 0. 0. 8 amps,
£13. 10. 0. 10 amps, £17. 0. 0.
12 amps, £19. 10. 0. 15 amps,
£22. 0. 0. 20 amps, £32. 10. 0.
37.5 amps, £65. 0. 0. 50 amps,
£85. 0. 0.

1.5 amp. portable fitted metal case
voltmeter lamp, switch, etc. £8.10.0
P. & C. 10/-. Similar to above 2.5
amp. £9.17.6. P. & C. 10/-

PORTABLE TYPE

100 WATT POWER RHEOSTATS (NEW)

AVAILABLE IN THE FOLLOWING VALUES

1 ohm, 10 a.; 5 ohm, 4.7 a.; 10 ohm, 3 a.;
25 ohm, 2 a.; 50 ohm, 1.4 a.; 100 ohm, 1 a.;
250 ohm, .7 a.; 500 ohm, .45 a.; 1,000 ohm,
280 mA; 1,500 ohm, 230 mA; 2,500 ohm, .2 a. Diameter
3 1/2 in. Shaft length 1 1/2 in., dia. 1/4 in. All at 27/6 each.
P. & P. 1/6.



25 WATT POWER RHEOSTATS

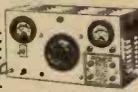
10 ohm, 1.5 a.; 25 ohm, 1 a.; 50 ohm, .75 a.; 100 ohm, .5 a.;
150 ohm, .3 a.; 500 ohm, .2 a.; 1,000 ohm, .15 a.; 1,500 ohm,
120 mA; 2,500 ohm, .1 a.; all at 14/6. P. & P. 1/6.

"CABY" MULTI-RANGE TEST METER

Model B40. D.C. volt, 0-5 V., 2-5 v., at 10,000 ohm per volt. Ideal for transistor circuit testing. A.C. and D.C. volt, 10 v., 50 v., 250 v., 500 v., 1,000 v., at 4,000 ohm per volt. Resistance, 2 K ohm, 200 K ohm, 2 meg., 20 meg. Repair service available. Price includes Test Leads, Battery, Instruction book, Packing and Post (U.K.). £6.2.6. 3 additional models available from 54/- to £14.14.0. Leaflet gladly sent on request.

5 A. AD/DC VARIABLE VOLTAGE OUTPUT UNIT

Input 230v. AC
Output 0-260v. AC
Output 0-240v. DC
Fitted large Scale
Ammeter and Voltmeter, Neon Indicator, Fully Fused. Strong attractive metal case 15" x 8 1/2" x 6". Weight 24lbs. Infinitely Variable, smooth stepless Voltage Variations over full range. Price £30. C. & P. £2.



SENSITIVE GALVANOMETER

Centre Zero 300-0-300. Micro-amp. 90 ohm. approx. Calibrated 30-0-30 in clear divisions. Mounted in sturdy sloping front case with top terminals. Price £4.10.0. P. & P. 2/6. Matching volt meter calibrated 0-3 and 0-15 v. D.C. £4.10.0. P. & P. 2/6. D.C. Ammeter 0-6a and 0-3a. £4.10.0. P. & P. 2/6. Set of 3 matching instruments. £12.19.0. P. & P. 4/6.



CONSTANT VOLTAGE TRANSFORMER

Input 185-250 v. A.C. Output 230 v. A.C. Capacity 250 watt. Attractive metal case. Fitted red signal lamp. Rubber feet. Weight 17 lbs. Price £11.10.0. P. & P. 15/-.



LIGHT SENSITIVE SWITCH

Kit of parts, including ORP12 Cadmium Sulphide PhotoCell, Relay, Transistor and Circuit, etc., 6-12 volt D.C. op. price 23/- plus 2/6 P. & P. ORP 12 including circuit, 10/6 each, plus 1/- P. & P.



A.C. MAINS MODEL

Incorporates Mains Transformer, Rectifier and special relay with 3, 5 amp mains c/o contacts. Price inc. circuit 47/6 plus 2/6 P. & P.

LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with focussible lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP.12 or similar cell, with optic window. Both units are single hole fixing. Price per pair £2.10.0 plus 3/6 P. & P.

UNISELECTOR SWITCHES

75 ohm coil 24 v. D.C.
6 Bank 25 position, 5 non-bridging 1 Bridging Wiper
5 Bank 25 position, 4 non-bridging 1 Bridging Wiper
6 Bank arranged to give 3 bank, 50 positions
8 Bank arranged to give 4 bank, 50 positions
These switches have been carefully removed from equipment.
All at 35/- each. P. & P. 2/6.

BRAND NEW 4 Bank 25

Way Uniselector, 3 Bank + Homing 25 ohm coil. 12-24v. D.C. operation £4.17.6 plus 2/6 P. & P.



230 VOLT A.C. GEARED MOTORS

5 r.p.m. 1-7 lb. inch £2.9.6. P. & P. 2/6
13 r.p.m. 1-45 lb. inch £2.17.6. P. & P. 2/6
80 r.p.m. .26 lb. inch £2.2.0. P. & P. 2/6

METERS 2 1/2" Flush Round A.C. AMMETERS 0-1, 0-5, 0-10, 0-15, 0-20 Amp. All 21/- each, p. & p. extra. A.C. VOLTMETERS 0-25, 0-50, 0-150V. All 21/- each, p. & p. extra. 0-300 V. A.C. m/c Rectifier £19.0

UNIVERSAL DEMONSTRATION TRANSFORMER

A complete composite apparatus, comprising a Transformer and electromagnet with removable coils and pole pieces. Coil tapped for 230v, 220v, 110v, 115v; 6, 12, 36, 110v. A.C. These coils are also used for D.C. experiments. Complete with all accessories as shown. £17 + 15/- carriage. Leaflet on request.

Stenzyl Type



WIMSHURST ELECTROSTATIC GENERATORS
£13/17/6, carr. U.K. (B.R.S.) 10/-. Leaflet on request.

VENNER 14-DAY CLOCKWORK TIMESWITCH

5 amp. 230 v. contact 1 on/off every 24 h. Fitted in metal case with key. Used but guaranteed. 47/- + 3/- P. & P.

BUILD AN EFFICIENT STROBE UNIT

FOR ONLY 37/6. We supply a simple circuit diagram and all electrical parts including the NSP2 Strobe tube which will enable you to easily and quickly construct a unit for infinite variety of speeds, from 1 flash in several seconds to several thousands per minute. 37/6 plus 3/- P. & P.

COMPACT HEAVY DUTY 6 volt DC RELAY

6-9 volt DC operation 30 ohm coil 2 x 10 amp c/o contacts, will handle up to 250 volt A.C. Size 1 1/2" high x 2 1/2" x 1 1/2". Price 7/6 plus 1/6 P. & P. 3 for 20/- post paid.

T. TRANSFORMERS All primaries 220-240 volts.		
Type No.	Sec. Taps	Price Carr.
1	30, 32, 34, 36 v. at 5 amps.	£3.5.0 7/6
2	30, 40, 50 v. at 5 amps.	£5.5.0 9/-
3	10, 17, 18 v. at 10 amps.	£3.10.0 7/6
4	6, 12 v. at 20 amps.	£4.17.6 7/6
5	17, 18, 20 v. at 20 amps.	£5.12.6 10/6
6	6, 12, 20 v. at 20 amps.	£5.5.0 9/-
7	24 v. at 10 amps.	£3.15.0 7/6

CRESCENT RADIO LTD.

40 MAYES ROAD
WOOD GREEN, N.22
BOWES PARK 3206

LONDON'S ELECTRONIC CENTRE
BEST QUALITY — KEEN PRICES

Some more examples from our large selection of transistors

Newmarks		N.K.T. 264	
N.K.T. 217	9/-	N.K.T. 264	3/8
" 218	4/5	" 265	3/8
" 221	5/-	" 272	3/8
" 227	9/-	" 273	3/8
" 228	4/5	" 274	3/8
" 261	3/8	" 275	3/8
" 262	3/8	" 713	6/9
" 263	3/8	" 773	5/3
" 271	3/8	" 774	5/3
" 212	4/9	" 129	5/3
" 676	4/6	" 141	6/2
" 121	9/9	" 142	5/3
" 122	6/8	" 143	5/3
" 123	5/8	" 162	5/-
" 124	8/8	" 163/25	5/-
" 216	9/-	" 164/25	5/-

Special Lines in Transistors, etc.
2G339/A.....4/6 Thyristors (S.C.R.)
OC201 (short 400v @ 3 amp. .6/- ea.
leads).....3/6 ORP12 Photocon-
OC81/M.....1/6 ductive Cell ... 10/- ea.
OC38.....11/6 Sinclair X.20.
V30/30P.....5/- Built.....£9.0.0
Sinclair X.20.
Power Pack ... £4.19.6

Printed Circuit Board
9 X 5 Inch...1/11 ea. 12 X 12 Inch...3/3 ea.
Off Cuts . . .9d. each

Some of our Component Bargains
3.5 m/m Jack Sockets..... 9d. each
Seven Way Group Panels..... 6d. each
8 ohm Ear Pieces..... 1/6 each
65 pf Air Spaced Tuners with Spindles . 1/- each
Single Pole Arrow Toggle Switches with ON/OFF Plates..... 2/- each

E.M.I. Tweeters
2 1/2 inch. 3 ohm. .9/6 ea. 3 inch. 6 ohm. .13/6 ea.

We have large stocks of electronic components and feel that a visit to our premises would be to your advantage. Send 1/- for our Catalogue. Please include postage with orders.

THE MOTOROLA SEMICONDUCTOR DATA BOOK

- lists more than 10,500 semi-conductors.
- includes data sheets for more than 2,800 devices from diodes to integrated circuits.
- has 16 edge referenced sections for fast fact finding.
- 1,500 page hard bound for 40/- including postage.

BASIC ELECTRONICS, by Grob. 36/- Postage 1/6.

BASIC ANALOGUE COMPUTER TECHNIQUES, by Stewart & Atkinson. 21/- Postage 1/-.

RADIO COMMUNICATION, by W. F. Lovering. 70/- Postage 2/-.

TRANSISTOR SPECIFICATIONS & SUBSTITUTION HANDBOOK, 1967, Tech. P. 21/- Postage 1/-.

RADIO VALVE DATA, 8th ed., "W.W." 9/6. Postage 1/-.

TAPE RECORDER SERVICING MANUAL, by H. W. Hellyer. 63/- Postage 2/6.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKISTS
British and American Technical Books
19-21 PRAED STREET
LONDON, W.2
Phone: PADdington 4185

SERVICE TRADING CO

All Mail Orders—Also Callers—Ample Parking Space
57 BRIDGMAN ROAD, LONDON, W.4
Phone 995 1560 CLOSED SATURDAY

Personal callers only
9 LITTLE NEWPORT STREET
LONDON, W.C.2 Tel.: GERrard 0576

BIASING CONDITIONS

Astable Trigger Circuit

A load line, placed as shown in Fig. 7, intersects the negative resistance region of the u.j.t. curve and, together with capacitive reactance at the emitter, produces an astable circuit. Fig. 8 shows a basic circuit of an astable trigger or multivibrator which has a load line as shown in Fig. 7. It can be seen from the waveform of Fig. 9 that the rise time of the emitter waveform is governed by R_E and C of Fig. 8, but the fall time is governed by the value of r_{B2} , r_{B1} and C .

The modified circuit in Fig. 10 enables the rise and fall time of the emitter waveform to be controlled. The circuit operation is as follows. Assume the u.j.t. is in the off condition, C begins to charge to V_{EE} through $D1$ and $R2$. When V_{FM} is reached, the u.j.t. fires lowering the emitter potential and reverse biasing the diode $D1$. The u.j.t. now stays in the on condition, C is isolated by $D1$ from the remainder of the circuit and can only discharge through $R1$. When C has discharged to below the voltage at the emitter, $D1$ conducts. This diverts some of the emitter current into the capacitor, causing the u.j.t. to turn off. C then starts to recharge to V_{EE} through $D1$ and $R2$, and the cycle repeats. The waveforms for the circuit of Fig. 10 are shown in Fig. 11.

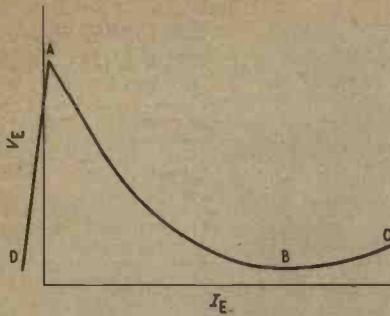


Fig. 6. Emitter characteristic for u.j.t.

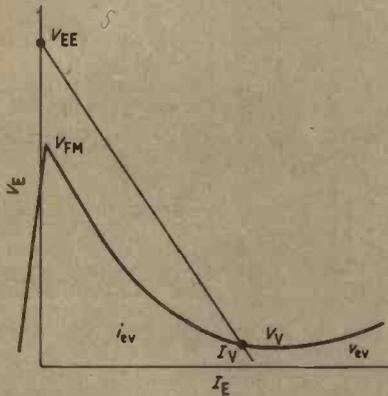


Fig. 7. Load line in negative resistance region

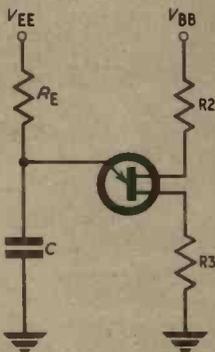


Fig. 8. Basic astable circuit

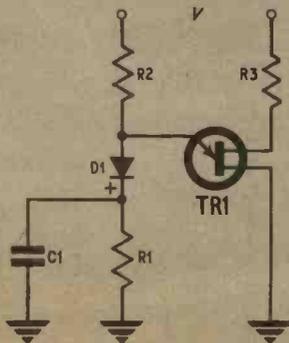


Fig. 10. Modified version of Fig. 8

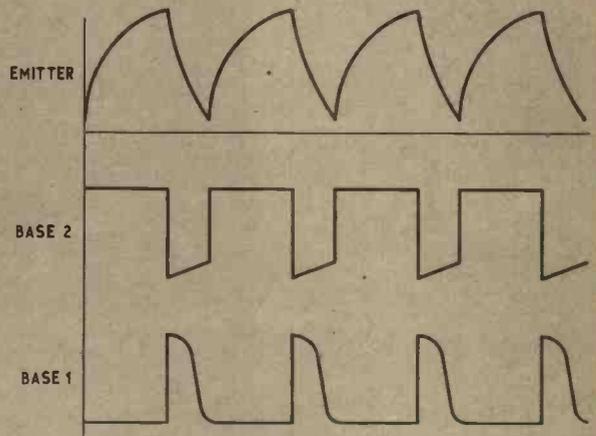


Fig. 9. Waveforms for circuit in Fig. 8

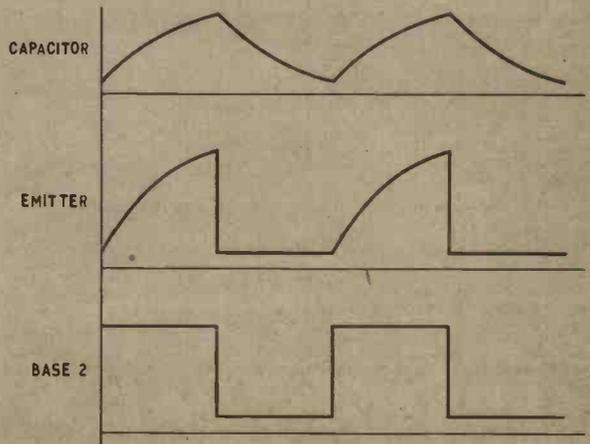


Fig. 11. Waveforms for circuit in Fig. 10

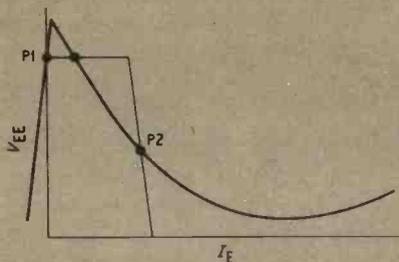


Fig. 12. Load line for bistable trigger

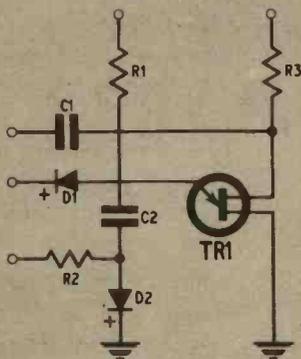


Fig. 13. Bistable trigger

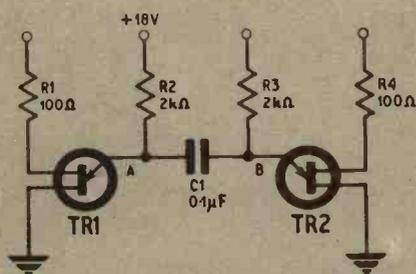


Fig. 14. Practical astable trigger

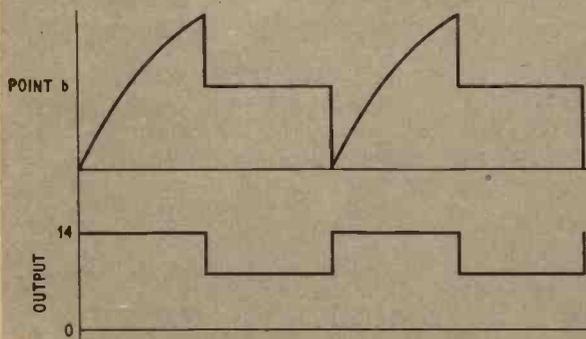


Fig. 15. Waveform of astable trigger

Bistable Trigger Circuit

As in the astable circuit the load line may be shaped by a diode to obtain more useful characteristics. This is shown in Fig. 12, and the actual circuit is shown in Fig. 13.

When the u.j.t. is off, operation is at point P1 (Fig. 12) and the emitter is clamped to V_{EE} by D1. Operation can be shifted to the on condition by the application of a negative pulse at C1. This lowers V_{FM} to below V_{EE} and causes the circuit to switch to P2 in the negative resistance region. If the junction of C2 and D2 is returned to a negative supply via R2, then the diode D2 is reversed biased and C2 isolated from the circuit. If R2 is then made positive, the resistance of D2 decreases. When this is reduced to a certain limit, C2 will cause the circuit to be unstable and flip back to P1.

Monostable Trigger

The circuit of Fig. 10 may be made into a monostable trigger if the load line of Fig. 7 is lowered to cross the voltage axis at a point less than V_{FM} .

The u.j.t. will lock up somewhere in the off condition just below V_{FM} . When a positive trigger pulse is applied to the emitter, the u.j.t. turns on, D1 becomes reversed biased, and C1 begins to charge through R1. The u.j.t. stays on until the voltage across C1 is equal to the emitter voltage, and when D1 becomes forward biased the u.j.t. turns off.

PRACTICAL CIRCUITS

Astable Trigger

The circuit of Fig. 14 shows a practical astable trigger. The circuit operation is as follows. Assume that TR1 is on with point A held at V_{sat} . Point B will be charging towards V_{BB} . When V_{FM} is reached, TR2 will fire, bringing point B to V_{sat} . Because of the voltage on the capacitor, point A is reversed biased and TR1 turns off. Point A then begins to charge towards V_{BB} and the cycle repeats itself. Waveforms are given in Fig. 15.

TECHNICAL DATA FOR THE 2N2160 UNIJUNCTION TRANSISTOR

Emitter-base reverse voltage	30V
Inter base voltage	35V
D.C. emitter current	70mA
Peak emitter current	2A
Total device dissipation at 25°C	450mW

CHARACTERISTICS

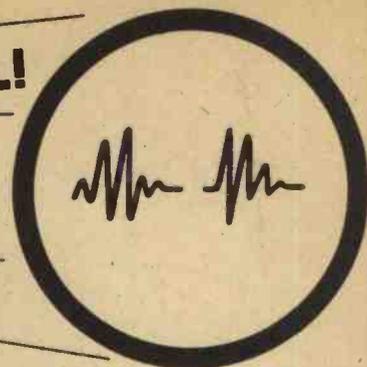
Parameter	Test conditions	Min.	Max.
r_{BB} interbase resistance	$V_{B_2B_1}$ 3V, I_E 0	4kΩ	12kΩ
η Intrinsic stand-off ratio	$V_{B_2B_1}$ 10V	0.47	0.8
$I_{B_2(mod)}$ modulated interbase current	$V_{B_2B_1}$ 10, I_E 50mA	6.8mA	30mA
I_{EB20} emitter reverse current	V_{B_2E} 30, I_{B_1} 0	—	12mA
I_{FM} peak point emitter current	$V_{B_2B_1}$ 25	—	25μA
i_{ev} valley point emitter current	$V_{B_2B_1}$ 20, R_{B_2} 100	—	8mA
V_{0B_1} base 1 peak pulse voltage	V_1 20, R_{B_1} 20Ω	3V	—

LOOK!

PRACTICAL!

VISUAL!

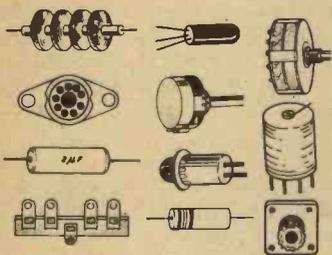
EXCITING!



a new 4-way method of mastering
ELECTRONICS
by doing — and — seeing . . .

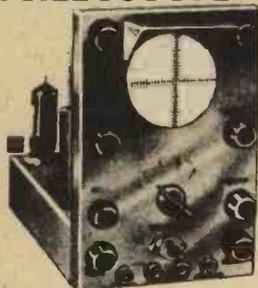
1 ▶ OWN and HANDLE a

complete range of present-day **ELECTRONIC PARTS** and **COMPONENTS**



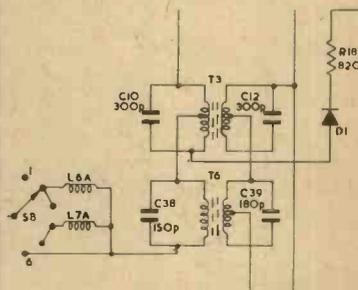
2 ▶ BUILD and USE

a modern and professional **CATHODE RAY OSCILLOSCOPE**



3 ▶ READ and DRAW and

UNDERSTAND
CIRCUIT DIAGRAMS



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

- VALVE EXPERIMENTS
- TRANSISTOR EXPERIMENTS
- AMPLIFIERS
- OSCILLATORS
- SIGNAL TRACER
- PHOTO ELECTRIC CIRCUIT
- COMPUTER CIRCUIT
- BASIC RADIO RECEIVER
- ELECTRONIC SWITCH
- SIMPLE TRANSMITTER
- A.C. EXPERIMENTS
- D.C. EXPERIMENTS
- SIMPLE COUNTER
- TIME DELAY CIRCUIT
- SERVICING PROCEDURES

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

FREE POST NOW
for
BROCHURE

or write if you prefer not to cut page

To: **BRITISH NATIONAL RADIO SCHOOL, READING, BERKS.** Please send your free Brochure, without obligation, to: we do not employ representatives

NAME..... BLOCK CAPS

ADDRESS..... PLEASE PE 3

Be first this year

SEED AND PLANT RAISING

Soil heating wire and transformer. Suitable for standard size garden frame. 19/6 plus 3/6 post and ins.

PP3 ELIMINATOR

Play your pocket radio from the mains! Have it's. Complete component kit comprises 4 rectifiers, mains dropper resistances, smoothing condenser and instructions. Only 8/6 plus 1/- post.

HI-FI SPEAKER BARGAIN

12in. High fidelity loud-speaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 29/6 with built-in tweeter 35/-, plus 3/6 post and insurance.



2kw FAN HEATER

3 heat positions to suit changes in weather: 1kw, 1 1/2kw and 2kw; also blows cold for summer months thermostatically safety cut out. "Proper" price £5.17.6 Yours for only £2.15.0. Plus 7/6 post and insurance.



MAINS TRANSFORMER. Upright mounting with primary tapped 200, 220, 240 v. H.T. secondary is 250-0-250 v. at 100 mA. an. it has two L.T. secondaries of 0-3 v. 1 1/2 amp.—unused (removed from equipment), 15/- plus 3/6 post and insurance.

"C" CORE POTTED OUTPUT TRANSFORMER. Made by the famous "Parneko" company these are the best money can buy—we can offer a bargain 15 watt rating, centre tapped primary with secondary for 3 ohm speaker. Potted and in black stove enamelled case for upright mounting these will make your case for upright mounting these will make your amplifier or rig look perfect at only 12/8 plus 3/6 carriage and insurance—burry for this.

1in. MEG. POTS. By Erie, standard 1in. spindle, 1in. long, 7d. each in doz. lots, otherwise 10d.

1in. MEG. POTS WITH D.P. SWITCH. Again by Eric. Standard size spindle 1in. length. 10d. each in doz. lots, otherwise 1/3 each.

MINIATURE PICK-UP. For pop records—this is made by Cosmocond—has a crystal cartridge and long play sapphire stylus—offered for less than the wholesale price of the stylus only—namely 3/9 each or 36/- doz.

MINIATURE RELAYS with removable covers. Very sensitive (will close on only 20 mA). Coil resistance 10,000 ohms—contacts are three sets; triple set for change over pair to open circuit and the third pair to close circuit—perfect order unused (removed from equipment). 7/6 each.

CAR CHARGER OUTFIT. 3/4 amp transformer and selenium full wave rectifier only 27/6 plus 3/6 post.

FLOUORESCENT LIGHT KITS. Comprising 20k. lampholders, starter and two chrome tube clips. 20 watt 19/6. 40 watt 11/6. 80 watt 17/6. 65 watt 19/6. All 4/6 post.

SEMI-CONDUCTOR BARGAINS

Type No.	Price	Type No.	Price	Type No.	Price
2N1727	15/-	MAT101	8/6	OC71	4/-
2N1728	10/-	MAT120	7/9	OC72	5/-
2N1742	25/-	MAT121	8/6	OC75	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	8/-	OA70	2/-	OC8D	5/-
AC17	8/6	OA79	2/11	OC81	5/-
AC17	8/6	OA81	2/8	OC8D	5/-
AC19	6/6	OA85	3/-	OC82	5/-
AC20	5/6	OA90	2/8	OC83	5/-
AC21	6/-	OA91	2/6	OC84	8/-
AC222	4/6	OA200	3/3	OC139	8/6
AF111	7/-	OC203	6/3	OC140	12/6
AF115	6/6	OC29	15/-	OC12	8/6
AF116	7/-	OC23	17/8	OC171	6/-
AF117	5/-	OC24	22/8	OC200	9/-
AF118	12/6	OC26	7/8	OC201	12/8
AF139	17/8	OC28	15/-	OC202	12/8
AF186	19/8	OC29	17/8	OC203	12/8
AF212	15/-	OC35	12/8	OC271	12/8
AS221	15/-	OC36	15/-	OC312	8/6
BC107	14/6	OC42	6/8	ORP60	5/-
BY100	5/6	OC44	5/-	OR578	6/8
BY213	7/8	OC45	4/-	SB305	8/8
MAT100	7/9	OC70	4/-	SB251	10/-

S.C.R.'s (Thyristors) 100v. 1 amp. 6/8, 3 amp. 7/8, 12 amp. 15/-, 400v. 1 amp. 15/-, 3 amp. 17/6, 5 amp. 22/6, 25 amp. £3, 60v. 1 amp. 6/8, 3 amp. 7/6, 10 amp. 10/-, 25 amp. 30/-.

MINIATURE WAFER SWITCHES. 4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/8 each. 36/- dozen, your assortment.

NEON MAINS TESTER. Good length leads 2/6.

HEAT & LIGHT UNIT

Bring luxury to your bathroom—have comforting heat where you now only have light—all the parts to build a full size (16" diameter) model are now available—you will build it in an hour—12" 750 watt circular silica glass encased element, opal bowl for up to 100 watt lamp—non-rust opun reflector, white enamelled base heat shield, pull switch. Magnificent unit as sold normally at £4.5.0 only 49/6 plus 7/6, post and insurance.

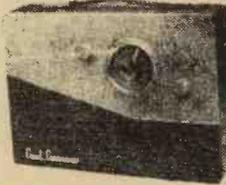


SUPERTONE G.C.V.

Saves you work—It's partly built

Like its predecessors this latest Companion has full performance—such as only a good wooden cabinet and bixid speaker can give, and due to its being partly built you will have it going in an evening. Note these features:

- All Mullard Transistors including 3x AF117.
- Two-tone Cabinet, size 11 x 8 x 3in.
- All circuit requirements, Push-Pull output, A.V.C. and feedback, etc.
- Printed circuit board all wired only connections, e.g. to Volume control—W.C. Switch and Tuning Condenser.
- Pre-aligned IF stages complete with full instructions. Price only £3.19.6 plus 6/6 post and insurance.



THIS MONTH'S SNIPS

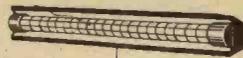
3M SCOTCH TAPE

Brand new, unused and guaranteed perfect and not second in any way—a connoisseur's taste on normal spools.

Standard Play 5in. 800ft. 9/- 5in. 1200ft. 11/6
7in. 1,200ft. 15/- 7in. 1,800ft. 23/-
£3 post free, otherwise add 2/- post and insurance.

INFRA-RED HEATERS

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watts element, all parts, metal casing as illustrated, 21/6, plus 3/6 post and ins. Full switch 3/- extra.



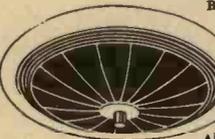
F.M. TUNER

of exceptional quality, giving really fantastic results with virtually no noise. Suitable for mains or battery operation. 6 transistors, three I.F. stages, double tuned discriminator. Complete, new and built up all ready to work on chassis. Size 6" x 4" x 2" with tuning scale and slow motion drive. A £12.12.0 tuner for only £8.10.0.



NOW INSTANT START CIRCULAR FLOUORESCENT

Brings sunshine into your home. 150 watts of light but uses only 40 w. Beautiful fittings with glass, non-plastic centre, fluorescent tube and choke control. Made by Philips. Regular price £4.15.0. Special Bargain price 65/-, plus 8/6 c. and ins. Please state colour of glass centre, white, pink, blue, red, black, yellow or cream. Also whether plug into lamp holder or ceiling mounting model. 80 watt model 99/6 plus 10/- carr. and ins.



FINE RECORD PLAYERS ARE 'GARRARDS'

and because they have been making record players for so long GARRARD are your best choice—big range always in stock.



7/6 for post and insurance.

2000 £8/9/6 SP25 £10/9/0
3000 £7/19/6 LAB80 £25/0/0
AT80 £11/11/0 SEPI2 £3/9/8

Complete with service sheet and transformer

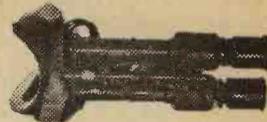
MAINS TRANSISTOR POWER PACK

designed to operate transistor sets and amplifiers. Adjustable output 6v.-9 to 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries, PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers, zener diode and instructions. Real snip at only 14/6, plus 3/6 post.

BATTERY CHARGER—FREE

9v. Nickel Cadmium Battery type PP3 (fits all popular pocket transistors. Can be recharged 800 times. Price with free battery charger, kit only 37/- plus 4/- 1/3. Chargeable replacements also in stock for U7 12/6, U12 32/-.

See in the Dark INFRA-RED BINOCULARS



These infra-red from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses or T.V. cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order, but sold without a guarantee. Price £2/17/6, plus 10/- carr. and ins. Handbook 2/6.

SNIPERSCOPE



Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it.

A golden opportunity for some interesting experiments. 5/- each, post 2/-. Date will be supplied with cells if requested.

TUBULAR HEATERS

New and unused made by G.E.C.—rated at 60 watts per foot—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc.—curtains or papers can scorch them without fear of scorching or fire. Supplied complete with fixing brackets and available in the following sizes. Prices which are about quarter of list price includes carriage by B.R.S.

8ft. 30/-; 10ft. 38/-; 12ft. 42/-
Also in twin assemblies (one pipe above the other):
4ft. 40/-; 5ft. 46/-; 6ft. 52/-.

THERMOSTATS

Type 'A' 15 amp. for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob, nicely adjustable from 30°-80°F. 9/6 plus 1/- post. Suitable box for wall mounting, 5/-, P. & P. 1/-.
Type 'R' 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 30-650°F. Internal screw alters the setting so this could be adjustable over 30° to 1,000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flamestat or fire alarm, 8/6 plus 2/3 post and insurance.

Type 'D'. We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/8, P. & P. 1/1.

Type 'E'. This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, 7/8 plus 1/- P. & P.

Type 'F'. Glass encased for controlling the temp. of liquid particularly those in glass tanks. This thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developed and chemical baths of all types. Adjustable over range 50°F to 150°F. Price 18/- plus 2/- post and ins.

750 mW TRANSISTOR AMP.

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 5 mV.

Post and ins. 2/6

Speakers 3in. 12/6; 5in. 13/6; 8in. x 4in. 14/6.

PHOTO ELECTRIC KIT

All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit, Laminated Boards and chemicals, Latching relay, Infra-red sensitive Photocell and Hood, 2 Transistors, cond., Terminal block. Plastic case. Essential data circuits and P.C. chassis plans of 10 photo electric devices including auto. car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warbling tone electronic alarm—projector lamp stabiliser, etc., etc. Only 39/6 plus 2/- post and insurance.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/6.

ELECTRONICS (CROYDON) LIMITED

(Dept. PE), 102/3 TAMWORTH ROAD, CROYDON, SURREY (Opp. W. Croydon Stn)
also at 266 LONDON ROAD, CROYDON, SURREY

Pulse Generator

The circuit of Fig. 16 shows a free running pulse generator whose frequency and pulse width may be preset. The operation is as follows. Normally TR2 is held in the off state by the 47 ohm resistor from base to emitter. The voltage dropped across this resistor due to V_{BE} and V_{BB} is small. When the voltage on C1 reaches V_{FM} , TR1 fires and C1 discharges. Most of the discharge current passes through the base-emitter junction of TR2, this causes TR2 to turn hard on and bring the collector from 15 volts to almost earth. When the capacitor has discharged sufficiently, TR1 and TR2 turn off and the collector returns to 15 volts. The table of Fig. 17 shows typical frequencies and pulse widths which may be obtained with the circuit.

Step Waveform Generator and Frequency Divider

The circuit shown in Fig. 18 is capable of frequency dividing an input signal by up to 100. The circuit operation is as follows. The signal is applied at point A, and may be sinusoidal or a positive going pulse, the minimum amplitude being 1 volt peak. This turns TR1 hard on and the *pn*p constant current stage TR2 is also turned on. Constant current is applied to C2 for the duration of the input pulse, the capacitor therefore receives a charge for each input pulse, and the voltage across it increases in a series of steps. When the voltage exceeds the product of the intrinsic stand-off ratio η , times the supply voltage V , the u.j.t. will fire and discharge C2 through the base 1 resistor. TR1 is a germanium *npn* transistor and TR2 a silicon *pn*p; the latter is necessary to ensure that C2 does not continue to charge through TR2 in the off condition. As the step waveform approaches the firing potential of the u.j.t., some leakage at the u.j.t. emitter is noticeable on the waveform as shown in Fig. 19.

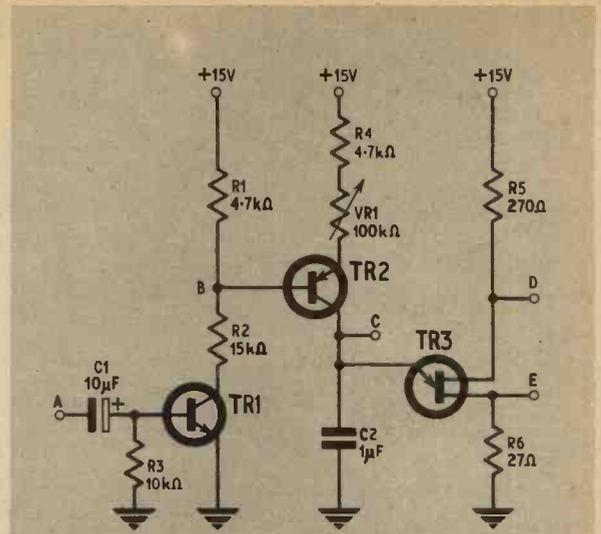


Fig. 18. Step waveform generator

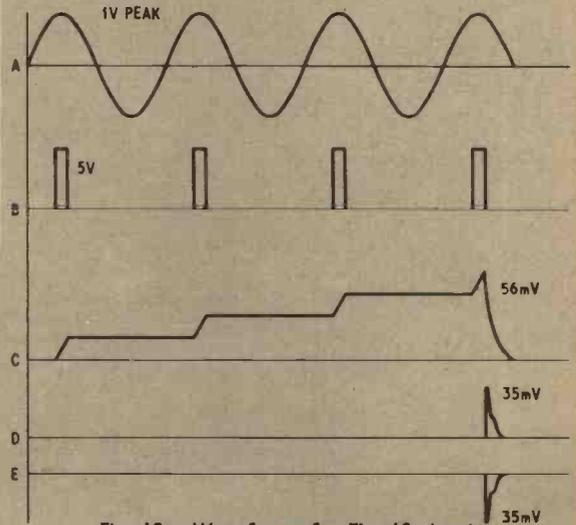


Fig. 19. Waveforms for Fig. 18 circuit

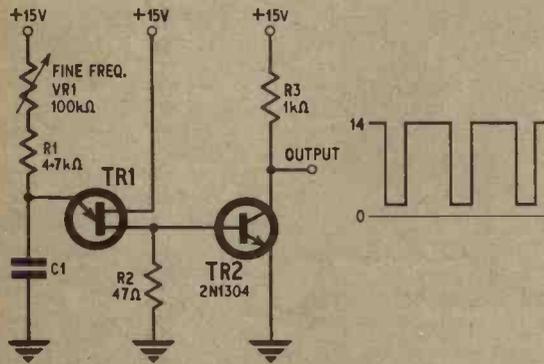


Fig. 16. Pulse generator

C µF	f kHz	PULSE WIDTH µ sec	RISE & FALL TIME µ sec
0.1	120 3	15	0.5
0.047	330 6	10	0.5
0.01	1 20	5	0.5
0.0047	3 40	5	1
0.001	12.5 180	4	1

Fig. 17. Table of capacitor values

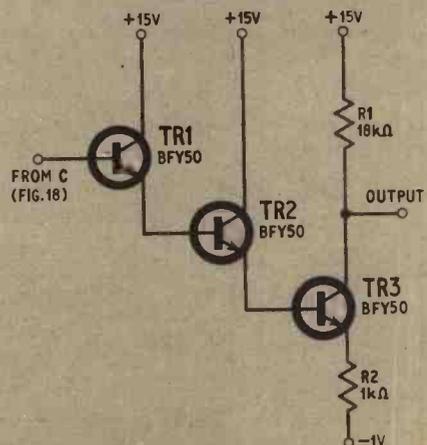


Fig. 20. Compound emitter follower amplifier

Point C is the step waveform output and this may be fed to the circuit of Fig. 20 which provides a high input impedance and amplifies the signal. Points D and E provide antiphase output pulses which may be fed to the circuit of Fig. 21 and amplified.

The potentiometer VR1 in the emitter of TR2 enables the number of steps to be varied from 1 to 100; this means that the output frequency may be up to 100th of the input. A step linearity control may be added between the emitter of TR3 and the 15 volt line. It will be in the order of 10 megohms and enables the increased slope of the step to be compensated for on the last few steps prior to the u.j.t. firing. If a germanium transistor is used for TR2, the circuit will still divide satisfactorily, but the step waveform will have sloping steps.

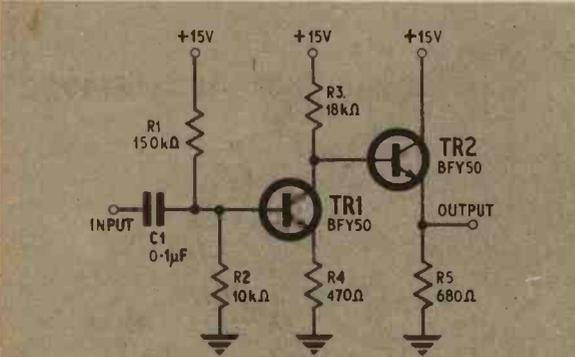


Fig. 21. U.J.T. pulse amplifier

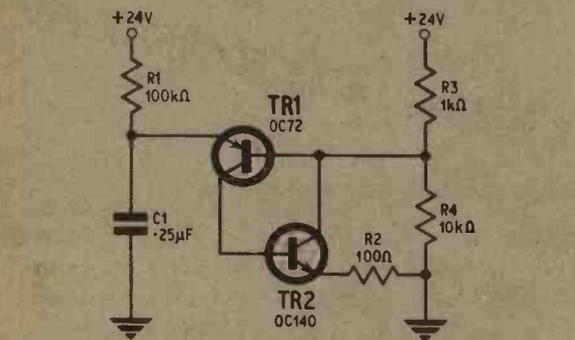


Fig. 22. Simulated u.j.t. astable circuit

SIMULATED U.J.T.

The action of the u.j.t. may be simulated by a *pnp* and an *nnp* transistor connected as in Fig. 22. This may be used by those who would like to try circuits before investing in some unijunction transistors. The characteristics are not the same, but the circuit function is similar.

The u.j.t. is a very useful device for use where a minimum of components and space are necessary. The code of the particular u.j.t. used in the circuits shown here is 2N2160, and the approximate cost is 16s. each. Other codes include 2N489, 2N491, 2N492, 2N494, 2N1671, 2N2646, 2N2647.

Manufacturers of the device 2N2160 are: International Rectifier Co. Ltd., Hurst Green, Oxted, Surrey, and Texas Instruments Ltd., Manton Lane, Bedford. ★

PHOTOFLASH SLAVE UNIT

continued from page 184

The battery is a Mallory mercury type PX23 and the connections are made by cementing a small piece of printed circuit board to the side of the case, using this as one terminal, and bolting into the case a piece of springy brass to make the other terminal. This can be seen in the general assembly diagram Fig. 4.

FLASH GUN LEADS

The flash leads to the slaved flash gun are terminated in the usual 3mm coaxial socket. Note that the connector is a socket similar to the one on the camera. It is possible to purchase these sockets from photographic dealers and make up a lead, but Boots the Chemists sell a flash extension lead at a very modest price and this can be cut to a suitable length and the appropriate end used for the slave unit.

As mentioned before, it is essential that the positive flash trigger lead is connected to the thyristor anode. It is a simple matter to check the polarisation of the trigger leads of the flash gun to be used and arrange that the connections are made correctly. If the constructor is building the slave for use with his own equipment only, it is easy to ensure that the connections are correct. If the slave is required to accept any other flash gun it is necessary to make up a reversing lead consisting of a male and female connector so wired that the centre pin of one connector is wired to the case of the other and vice versa. Here again, it is possible to buy both types of coaxial connectors but it is easier to buy an extension lead, cut it to a suitable length and rejoin the wires the opposite way round. No damage will be done to either the slave unit or to the flash gun if connections are the wrong polarity, but the slave will not function.

The writer has found that there is no accepted standard amongst the manufacturers of flash guns as to which terminal (the centre pin or the case) is positively polarised; indeed, some manufacturers have made different models of their flash guns with the leads differently polarised and one must either check the polarity with a meter or proceed by trial and error. Note that a meter will not measure the actual voltage on the terminals of the flash gun but it will give sufficient indication to determine the polarity. Capacitor flash guns using expendable bulbs have a fairly standard 22½ volts on the leads but electronic flash guns may show voltages up to 250V.

RELIABLE AND EFFICIENT

It may be of interest to relate that a couple of these units have been used during a photo club outing, when reliable triggering was obtained in the open air at 8 p.m. mid July at distances in excess of 50 yards.

Of the half dozen units which the writer made for his own use, in almost two years it has not yet been necessary to change any of the batteries and no snags have arisen in their practical use. Each unit weighs just under 2oz and they are small enough to pack into the pocket or gadget bag without any trouble. On the very few occasions when the slaved flash has failed to trigger it has been found that the reason was always in the actual connector. Unfortunately there is no practical alternative to the standard coaxial connector and it behoves the constructor to ensure that the wiring to the connector is good and that the plugs and sockets are pushed well home. ★

G

GET A GOLDRING HI-FI TURNTABLE UNIT FOR YOUR AMPLIFIER



GOLDRING-LENCO G.99

Incorporates the unique Goldring-Lenco continuously variable speed control and vertical drive features. Machined 8 lb. non-magnetic turntable. Push-button switching. Neon-lit stroboscope. Speed constant within 1% for up to 13% mains voltage change. £21.19.5d.

GOLDRING-LENCO GL 68

Continuously variable speed control with adjustable click-in positions for standard speeds. Arm takes interchangeable head-slides, and is raised and lowered by on/off switch. Wired for mono and stereo. £19.10.7d.



There's a Goldring, or Goldring-Lenco unit to match *any* amplifier—whether you build it or buy it. At the modest end of the scale there's the G.66 integrated hi-fi unit that comes complete with pick-up arm and cartridge for as little as 11 gns. Then there's the highly popular GL 68 (see left) and, for the man who wants the best he can get there's the GL 70 transcription unit with integrated transcription arm at a little under £30, or the sophisticated G 99 without arm, at around £22. Goldring hi-fi equipment includes transcription arms from 7 gns. upwards and a wide choice of cartridges. The coupon will bring you full descriptive leaflets.

GOLDRING HI-FI EQUIPMENT

AUDIO FAIR — BOOTH No. 41 and ROOM No. 334



To: GOLDRING MANUFACTURING CO. (G.B.) LTD., 486-488 High Road, Leytonstone, London, E.11.

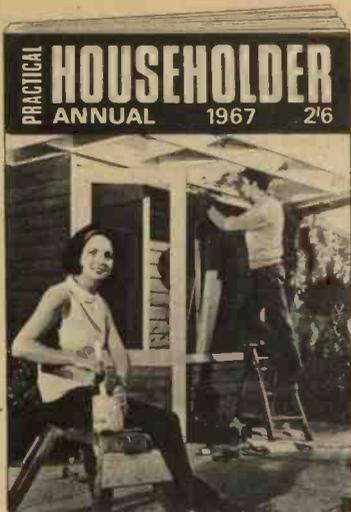
Please send me descriptive leaflets on

- TURNTABLE UNITS TRANSCRIPTION ARMS
 MONO & STEREO CARTRIDGES HI-FI ACCESSORIES

Name _____

Address _____

To: Goldring Manufacturing Co. (G.B.) Ltd., 486 High Road, Leytonstone, London, E.11. Telephone: Leytonstone 8343



Get it Now!

YOUR GUIDE TO MAKING YOUR HOME BETTER, BRIGHTER, MORE EFFICIENT

Don't miss the 1967 PRACTICAL HOUSEHOLDER ANNUAL! It brings you masses of new ideas for making your home more attractive and efficient... with detailed instructions and how-to-do-it illustrations that help you to tackle any job like a professional.

Special Sections on:
HOME HEATING

All the latest developments in hot water central heating, by perimeter heating and unit convectors.

GUIDE TO HOME ELECTRICITY
A complete run-down for the handyman, with diagrams of domestic wiring circuits and how they work.

HANDYMAN TOOLS
Invaluable information on hand and power tools for the enthusiast.

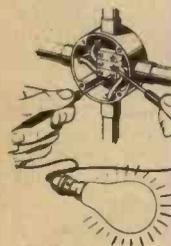
OUTDOOR IMPROVEMENTS
How to build garden furniture—Instructions for building a summer house—Stone, concrete and brickwork around the house.

EASY HOME PLUMBING
How your hot water system works. Information on fittings for modern bathrooms. Install your own shower.

PLAYTIME
Build for the children a complete outdoor play unit of slide, shelter and sandbox and several simple toys.

DECORATING
Advice on long-lasting and attractive decorations for the inside and outside of your home.

PRACTICAL HOUSEHOLDER ANNUAL 2/6



"X"-LINE

MODULES YOU CAN OPEN

Now for the first time, solid state semiconductor modules which you can open. OPEN, to see the high grade components used, OPEN, and modify to your exact requirements, OPEN, to service if needed; (but X-Line has reliability built in right from the design stage). If you would like more information send us a stamped addressed envelope — Trade enquiries welcomed. Phone Brentwood 7904.

X - 161	General purpose amplifier — 2 watts	35/-
X - 191	Guitar amplifier (contact microphone) 2 watts	35/-
X - 141	Record player amplifier — 2 watts	35/-
X - 161	Intercom. Use with 2 speakers and DPDT switch	35/-
X - 461	Audio Booster. Back up your transistor radio	30/-
X - 461	Siren. Upward wailing tone, train sirens, etc.	35/-
X - 471	Burglar alarm. Will wake the soundest sleeper	35/-
X - 661	Metronome. Adjustable 30-240 beats per min.	30/-
X - 761	Morse code practice oscillator	20/-
X - 871	Single high power lamp flasher	32/8
X - 691	Double lamp flasher. Displays, warnings, etc.	30/-

AND: NEVER BEFORE IN THIS COUNTRY:

X - 261	FM microphone transmitter	} 35/-
X - 271	FM telephone transmitter	
X - 241	FM record player transmitter	
X - 291	FM Guitar transmitter	
X - 371	FM Wireless entry	

FIRST GRADE SEMICONDUCTORS — FULLY GUARANTEED

AC128	4/-	NKT121	9/-	NKT271	3/6	OC83	4/-	2N2926	4/-	OC771	19/6
ACY18	7/6	NKT122	6/5	NKT272	3/6	OC123	17/6	2N3707	7/10	equiv.	9/6
AOY20	5/8	NKT123	5/3	NKT273	3/6	OC170	4/-	ORP12	9/6	CR74	27/8
AD161	7/6	NKT124	8/5	NKT274	3/6	OC171	7/8				
AD162	7/6	NKT129	5/1	NKT275	3/6	OC205	10/6				
ADT140	15/-	NKT142	5/11	NKT276	4/4	XA702	6/-				
AF102	18/-	NKT143	6/-	NKT277	5/-	ZT86	25/6				
AF116	4/-	NKT162	5/-	NKT274	5/-	2N897	12/-				
AF116	4/-	NKT212	4/7	OC28	15/-	2N706	5/-				
AF117	4/-	NKT216	8/8	OC29	19/-	2N1302	5/8				
BC107	7/6	NKT217	8/-	OC35	12/6	2N1303	5/6				
BC108	7/6	NKT218	4/4	OC41	3/6	2N1304	6/6				
BC211	13/6	NKT221	5/-	OC44	3/6	2N1305	6/6				
BFY26	22/-	NKT227	8/6	OC45	3/-	2N2646	14/6				
BFY26	7/-	NKT228	4/4	OC71	4/-	2N3819	29/6				
BFY61	9/6	NKT261	3/6	OC72	4/6	2N3820	29/6				
BUY11	29/6	NKT262	3/6	OC73	2/9	1B40K10	8/-				
GET105	4/8	NKT263	8/6	OC76	3/-						
NKT0013		NKT264	8/6	OC81	2/6						
		NKT265	8/6	OC81D	3/-						

BARGAIN PARCELS:
OC76, OC81D, OC81, OC73 any 5 for 10/-
Output set OC81D + 2 OC81 for 7/-
RF set OC44 + 2 OC45 for 8/8
High Current OC83 4 for 10/-
BY100 Mullard Rectifiers 6 for 2L

Special bargains:
Transistors 60 unmarked/untested 10/-

L.S.T. 23 NEW ROAD, BRENTWOOD, ESSEX COMPONENTS

Callers welcome Postage & Packing 9d.

TECHNICAL TRADING Co.

All items previously advertised available, also see items advertised in Practical Wireless. Huge Hi-Fi and Components stocks at all branches.

JASON TAPE Top British mylar/P.V.C.

Standard Play		Double Play	
3"	150ft. 2/3	3"	300ft. 4/-
4"	300ft. 4/8	4"	600ft. 6/-
5"	600ft. 7/8	5"	1200ft. 13/-
6"	900ft. 10/8	6"	1800ft. 19/8
7"	1200ft. 13/8	7"	2400ft. 27/-
Long Play		Triple Play	
3"	225ft. 2/9	4"	900ft. 13/-
4"	450ft. 5/8	5"	1800ft. 25/-
5"	900ft. 10/8	6"	2400ft. 34/-
6"	1200ft. 13/-	7"	3600ft. 44/-
7"	1800ft. 18/8		
Post 1/-		3" Quadruple Play 600ft. 8/-	

ROBOPHONE ORDERS

Your C.O.D. order exceeding £1 can be telephoned to BRIGHTON 680722 at any time day and night

10 TOTTENHAM COURT RD., LONDON, W.1 Tel.: MUS 2639
350/352 FRATTON RD., PORTSMOUTH. Tel: 22034
72 EAST STREET, SOUTHAMPTON. Tel: 25851
132 MONTAGUE STREET, WORTHING. TEL: 2585
ALL MAIL ORDER AND RETAIL SHOP
PARK CRESCENT PLACE, BRIGHTON

BAKER 12 in. DE-LUXE Mk II LOUDSPEAKER

Especially designed to provide full range reproduction at an economical cost. Suitable for use with all high fidelity systems.

Maximum Power 15 watts
Bass Resonance 32-38 c.p.s.
Flux Density 14,000 gauss
Voice coil diameter 1 1/2"
Voice coil impedance 15 ohms
Voice coil material Copper
Useful response 25-16,000 c.p.s.
Cone surround Plastic
Magnet material Alcomax
Overall diameter 12 1/4"

Available from all Radio & Hi-Fi Dealers
£9
Post Free



Send for New catalogue and enclosure plans

Baker Reproducers Ltd

(DEPT. P.E.15)

Bensham Manor Road Passage, Thornton Heath, Surrey. THO 1665

BIG DEMAND! MAKE SURE OF YOURS!

Readout—

A SELECTION FROM OUR POSTBAG

Fluorescent interference

Sir—It is my intention to install fluorescent lighting in a bungalow at present under construction. I am concerned by the interference which can be caused on radio and television receivers by these lights, and I should appreciate your advice as to whether there is any single device which can eliminate the interference.

Having some experience in radio and electrical wiring, I could perhaps construct such a device myself, if there is not one on the market. Any help in the matter would be much appreciated.

W. J. McFerran,
Newtownards,
N. Ireland.

All fluorescent lighting systems of proprietary makes are suppressed against radio and electrical interference to the minimum degree required by law. In the event of any system causing excessive interference due to working in an area of weak signal strength, special precautions can be taken, but each case will need to be investigated on its own merits. The Post Office are glad to help in cases of this kind.—G.J.K.

Stage effect

Sir—Your *Integrated Stereo Amplifier* in the December 1966 issue looks very impressive, and I shall probably decide to build it. Particularly interesting is the use of the field effect transistor in the input stage, which I shall certainly incorporate.

Is the circuit for the f.e.t. stage correct as published? I am puzzled by the resistor R10 value 47k Ω . I would have thought the input impedance of TR3 was about 1 kilohm, in which case the 47k Ω resistor in series with the input would produce a serious loss of signal. I cannot think that this was intended, as the loss would have been better used in more negative feedback, for example by omitting the by-pass capacitor C7.

If 47k Ω for R10 is correct could you please explain its function.

G. W. Waters,
Oxford.

There is considerable attenuation due to the inclusion of R10 in the base of TR3.

The reason for this is that this circuit precedes the volume control circuitry and it is very difficult to cater for the very wide range of transducers that may be used and the output of some of these elements may be in the order of 1V or more, and others in the order of 50mV.

Therefore, there has to be sufficient gain to amplify the lower output units and at the other end of the scale the high output device must not be in a position to overload this circuit. In order to preserve both the d.c. and a.c. parameters it was found necessary to isolate the devices to some degree due to the rather wide variation in the action of the more economical type of f.e.t.

The other problem lies in the lower frequency stability factor where if further feedback is applied over a circuit, when part of a high gain unit that is dissipating large power output, the amplifier tends to oscillate at very low frequencies. The inclusion of C7 reduced the bass response of the amplifier below approximately 5Hz, consequently assisting in the reduction of this type of hazard.—R.H.

The British Amateur Electronics Club

Sir—This club was founded to enable all who are interested in electronics as a hobby to get together, both directly and through the Newsletter, and learn about electronic devices through experiments and technical films. A special scheme has been devised for the benefit of the members in other parts of the country who cannot attend the meetings held in Penarth, so that they can participate in the activities of the club.

The first anniversary dinner and social evening was held at the Queens Hotel, Cardiff on January 21, 1967. It is hoped to hold an anniversary dinner every year so that members and their wives can criticise the past and plan the future of the club.

The membership fee is 10s per year and currently meetings are being held at the Penarth Secondary School, St. Cyres Road, Penarth at 7 p.m. on Thursdays, and all readers who are interested or would like further details should write to me at the following address:

C. Bogod, "Dickens", 26, Forrest Road, Penarth, Glam.

Post-haste, please!

Sir—Among the more brilliant of the ideas thought up by the firms who advertise in PRACTICAL ELECTRONICS are priced lists covering the various construction projects. The object is defeated however if the items priced are not available or competitive in price, and here are two such examples.

Firm number one still owes me a 10 kilohm preset potentiometer—that was three months ago. A reminder from me was ignored, but he is still advertising. Firm number two took two weeks to send me lists and the items I sent for have still not arrived after a further ten days, so there are two firms that I will not deal with in future.

A further complaint concerns prices and their diversity. OC20 transistors cost 50s each from one source, but 10s each from another; 2N2160 u.j.t. 25s from one source, but 15s from another. Why is this?

The cheaper items bought were not listed as substitutes and I find most firms very honest about this, so why this large disparity in price?

Generally speaking, the larger firms are pretty rapid on postal transactions, but there are still too many who nullify their good ideas and ingenuity by poor follow up.

In conclusion I would be glad if you would publish a summary of my "moans", it might wake up some of the culprits and we might all be better off as a result.

H. M. Sherry,
Llanfwrog,
Anglesey.

We understand that quite an enormous amount of business is transacted through the post by these firms and it is not altogether surprising that slip-ups do on occasion occur, although we do agree this is very irksome and disheartening to the individual concerned. Perhaps part of the explanation lies in the fact that these advertisers have to obtain their goods from manufacturers or wholesalers. It well may be that difficulties in supply of particular components are beyond their own control.

We do not pretend to know the complete answer to this question of wide discrepancy in transistor prices. Undoubtedly, there are many different outlets. Sometimes manufacturers have to dispose of surplus stocks and enterprising dealers manage to acquire large quantities at very reasonable prices; some of these they sell direct to individuals at rock bottom prices and some they pass on in bulk to other retailers who naturally have to add their own profit margin before selling these to readers.

NEW!

The safest, quick and handy connector for electrical appliances

MAINS Keynector

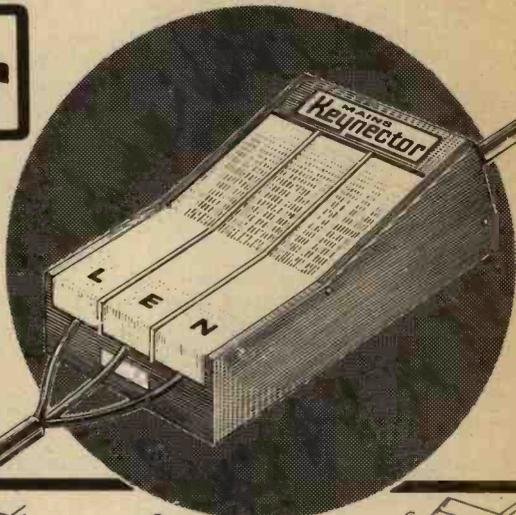
meets an essential need

Measuring only 5" x 3" x 1½" the MAINS KEYNECTOR is made of non-combustible urea-formaldehyde. Designed in modern style and manufactured in attractive two-tone colour. The unit eliminates the need of terminating the mains input lead of any electrical instrument or appliance with a plug. It also enables more than one instrument or appliance to be connected in parallel and used simultaneously. In the workshop, the MAINS KEYNECTOR will prove invaluable to the experimenter and handyman.

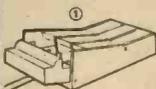
Colour: Duo Green.

British and Foreign Patents applied for.

32/6 inc. p.p.



HOW IT OPERATES



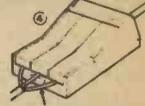
Opening fuse housing cuts off power to keys.



Depress key, clamp bared lead from appliance under appropriate key.

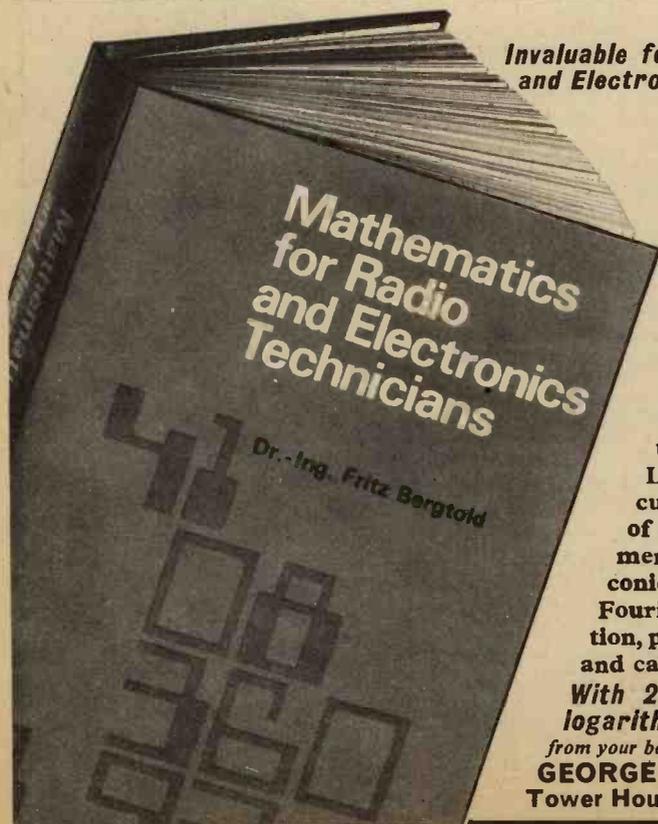


Close fuse housing to supply power to keys.



Neon safety lamp glows when power is applied.

CYBERNAUT CONTROLS LTD. 28-30 Rivington Street, London, E.C.2. Telephone 01 739-2763



Invaluable for all engaged or planning a career in Radio and Electronic Engineering . . .

MATHEMATICS FOR RADIO AND ELECTRONICS TECHNICIANS

Dr. Ing. Fritz Bergtold

Begins with the most simple equations and the basic methods of calculations are reviewed and the compiling of diagrams is demonstrated. Later chapters deal with involution, evolution, curves, arrangement, transformation and solution of equations, the slide rule, logarithms, the treatment of the relationship of measurement results, conic sections, angle and trigonometrical functions, Fourier and other series, differentiation and integration, polar co-ordinates and the Gaussian plane, vectors and calculation with complex values.

With 266 figures, numerous tables and a table of logarithms. 320 pages. 50s.

from your bookseller or by post 52s. from

GEORGE NEWNES LTD.

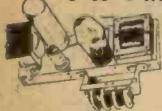
Tower House, Southampton Street, London, W.C.2



POCKET MULTI-METER

Size 3 3/4" x 2 1/4" x 1 1/4". Meter size 2 1/4" x 1 1/4". Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1000. D.C. current 0-150mA. Resistance 0-100k Ohm. Complete with test leads, battery and full instructions, 42/6. P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter

3 to 4 WATT AMPLIFIER



and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6v6. £2.5.0 plus 5/6 P. & P. The above in Kit Form, £1.14.6 plus 5/6 P. & P.

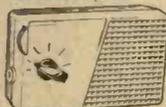
CYLDON U.H.F. TUNER

complete with PC.88 and PC.86 Valves. Full variable tuning. New and unused. Size 4 1/2" x 5 1/2" x 1 1/2". Complete with circuit diagram. 35/- plus 3/6 P. & P.



NEW Transistorised SIGNAL GENERATOR

Size 5 1/2" x 3 1/2" x 1 1/2". For IF and RF alignment and AF output, 700 c/s frequency coverage 460 Kc/s to 2 Mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. 39/6. P. & P. 3/6.



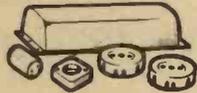
TRANSISTOR INVERTOR

50 v. D.C. Input. Output 240 v. A.C. 40 watts incorporating transformers, choke, condensers and 2C Mullard OC28 in solid 16 gauge Aluminium Case. Size 15" x 6" x 2 1/2" by famous manufacturers. 19/6 plus 7/- P. & P.



40W FLUORESCENT LIGHT KIT

Incorporating GEC Choke size 8 1/2" x 1 1/2" x 1 1/2", 2 bi-pin holders, starter and starter-holder. 11/6. P. & P. 5/6. Similar to above: 80 W. Fluorescent Light Kit incorporating GEC Choke size 11 1/2" x 1 1/2" x 1 1/2", 2 bi-pin holders, starter and starter holder 17/6. P. & P. 6/6. Twin 40 W Choke instant start for 2 x 2 ft. tubes 17/6. P. & P. 5/6.

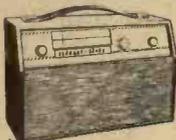


Special offer ELEGANT SEVEN mk IIa

SPECIAL OFFER. 7" x 4" P.M. 8 speaker no extra charge. Power supply kit to purchasers of 'Elegant Seven' parts, incorporating mains transformer, rectifier and smoothing condenser, A.C. mains 200/250 volts. Output 9v. 100 mA. 7/6 extra.

Buy yourself an easy to build 7 transistor radio and save at least £10.0.0. Now you can build this superb 7 transistor superhet radio for under £4.10.0. No one else can offer such a fantastic radio with so many de luxe star features.

★ De luxe grey wooden cabinet size 12 1/2" x 8 1/2" x 3 1/2". ★ Horizontal easy to read tuning scale printed grey with black letters, size 1 1/2" x 2". ★ High 'Q' ferrite rod aerial. ★ I.F. neutralisation on each separate stage. ★ D.C. coupled push pull output stage with separate A.C. negative feedback. ★ Room filling output 350mW. ★ Ready etched and drilled printed circuit board back printed for foolproof construction. ★ Fully comprehensive instructions and point to point wiring diagrams. ★ Car aerial socket. ★ Fully tunable over medium and long wave, 168-535 metres and 1250-2000 metres. ★ All components, ferrite rod and tuning assembly mount on printed board. ★ Full after sales service. ★ Parts list and circuit diagram 2/6, free with parts.



ONLY £4.4.0

Plus 7/6 Post & Packing

BSR Tape deck

AC 200/250 v., tape speed 3 1/2 twin track.

Special price £5.19.6

Post and packing 7/6



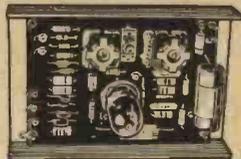
RADIO AND T.V. COMPONENTS (ACTON) LTD.

21D HIGH STREET, ACTON, LONDON, W.3

Shop hours 9 a.m. to 6 p.m. Early closing Wednesday. Goods not despatched outside U.K. All enquiries stamped addressed envelope. Terms C.W.O.

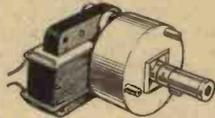
MULTIPLEX DECODER for receiving Stereo FM

Now is your chance to benefit in full from the new B.B.C. stereo transmissions with our Multiplex Decoder. Design features; Highly efficient Mullard vinkor pot cores. Two semiconductor diodes. Double purpose valve. Printed circuit type construction high input impedance. Specification: Cross talk minus 26 dB at 1 kc/s. Input requirements 0.4-1.5 RMS. Stability plus or minus 0.1%. Voltage requirements H.T. 190-250 volts. D.C. at 5 ma. Heaters 6-3 volts A.C. at 300 ma. Self-powered unit shortly available, price to be announced. Size 5 1/2" x 3 1/2" x 1". Fully built and tested, price £4. 4. 0 plus 3/- P. & P. charges.



Type E MOTOR

Small A.C. mains motor 230/250 volts complete with gearbox, 6 r.p.m. Price 15/- plus 4/- P. & P. Similar to above motor but without gearbox. Price 9/6 plus 3/- P. & P.

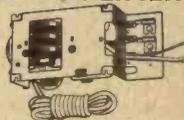


SILICON RECTIFIERS

250 v. P.I.V. 750 milliamps. Six for 7/6. Post paid.

TRANSISTORISED 1 1/2 WATT AMPLIFIER

comprising 2AC 128, 20C 75 and 2 AA129 separate bass and treble volume controls. Complete with Power Supply AC mains 240 v. Size 7 1/2" x 3 1/2" x 2". Price 50/- plus 2/6 P. & P.



POWER SUPPLY KIT

A.C. MAINS 200-250 V Incorporating 'C' core type mains transformer, full wave metal rectification and smoothing condenser. Smooth output 250 v. 250 mA and 6.3v. 4 amp. for Heaters. 25/- P. & P. 9/6.



FIRST QUALITY P.V.C. TAPE



5 1/2" Std. 850ft. ... 9/-	5" L.P. 850ft. ... 10/6
7" Std. 1200ft. ... 11/6	3" T.P. 600ft. ... 10/6
3" L.P. 240ft. ... 4/-	5" T.P. 1800ft. ... 25/6
5 1/2" L.P. 1200ft. ... 11/6	5 1/2" T.P. 2400ft. ... 32/6
7" L.P. 1800ft. ... 18/6	7" T.P. 3600ft. ... 42/6
5 1/2" D.P. 1800ft. ... 18/6	4" T.P. 900ft. ... 15/-

P. & P. on each 1/6, 4 or more post free



EXTRACTOR FAN

AC Mains 230/250v complete with pull switch. Size 6" x 6" x 4". Price 25/- plus 5/- P. & P.

GEC DOORBELL

Complete with mains transformer 240v A.C. and illuminated bell push. Price £2.4.0 plus 5/6 P. & P.



8-WATT 14-VALVE PUSH-PULL AMPLIFIER & Metal RECTIFIER



Size 9" x 6" x 1 1/2". A.C. Mains, 200-250 v. 14 valves. For use with Std. or L.P. records, musical instruments. All makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. £4.4.0. P. & P. 11/- 8" x 5" Speaker to suit. Price 14/6 plus 1/6 P. & P. Crystal Mike to suit 12/6 plus 1/6 P. & P.

GEC KETTLE ELEMENT

3,000W WITH AUTOMATIC EJECTION 200/240 v. List Price 32/-. Our PRICE 15/- P. & P. 1/6.



Our new branch at 323 EDGWARE ROAD, LONDON, W.2 IS NOW OPEN

PERSONAL SHOPPERS ONLY

All orders by post must be sent to our Acton Address

Practical Electronics Classified Advertisements

The pre-paid rate for classified advertisements is 1/- per word (minimum order 12/-), box number 1/6 extra. Semi-displayed setting £3.5.0 per single column inch. All cheques, postal orders, etc., to be made payable to PRACTICAL ELECTRONICS and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Advertisement Manager, PRACTICAL ELECTRONICS, George Newnes Ltd., Tower House, Southampton Street, London, WC2, for insertion in the next available issue.

SERVICE SHEETS

SERVICE SHEETS for all makes Radio, T/V, Tape Recorders, 1925-1966. Prices from 1/-. Catalogue 6,000 models, 2/6. Free fault-finding guide with all sheets. Please send stamped addressed envelope with all orders/enquiries. HAMILTON RADIO, Western Rd., St. Leonards, Sussex.

CIRCUIT, COMP. VALUES, Av0 model 7. 2/6 plus S.A.E. TELRAY, Maudland Bank, Preston.

RADIO TELEVISION, over 8,000 Models. JOHN GILBERT TELEVISION, 1b Shepherds Bush Rd., London, W.6. SHE 8441.

SERVICE SHEETS

4/- each, plus postage.

We have the largest supply of Service Sheets for all makes and types of Radios and Televisions, etc. in the country. Speedy Service.

To obtain the Service Sheet you require, please complete the attached coupon:

From:

Name:

Address:

.....

.....

To: S.P. DISTRIBUTORS

35/36 Great Marlborough Street, London, W.1

Please supply Service Sheets for the following:

Make:

Model No.: Radio/TV

Make:

Model No.: Radio/TV

Make:

Model No.: Radio/TV

I also require the new 1967 list of Service Sheets at 1/6 plus postage. (please delete items not applicable)

I enclose remittance of which includes postage

MAIL ORDERS ONLY Mar. PE

MISCELLANEOUS

ALUMINIUM CHASSIS, PANELS, Etc. Quick service, 'One-offs' welcome. Send sketch for quotation (Stamp please). Trade Supplied. FAIRISGRADES LTD., Barling, Nr. Southend, Essex.

MISCELLANEOUS (continued)

CONVERT ANY TV SET into an Oscilloscope. Diagrams and Instructions, 12/6. REDMOND, 42 Dean Close, Portslade, Sussex.

"PRACTICAL ELECTRONICS". Auto Calendar. Doorbell Repeater. Car Burglar Alarm. Integrated Stereo Amplifier and all construction projects going back to Issue 1. Send s.a.e. for your choice of itemised price lists. AJAX ELECTRONICS, 18a Rumbold Road, Fulham, London S.W.6.

BERRIESOUND (AUDIO ENGINEERS)

Design-Build-Repair-Modify
All types of Electronic Equipment
For estimates write to:-
Mr. Brown, 1 Effie Place, London, S.W.6.

FOR SALE

SEE MY CAT. for this and that. Tools, materials, mechanical and electrical gear—lots of unusual stuff. This Cat. is free for the asking. K. B. WHISTON (Dept. CPE), New Mills, Stockport

COMPUTER CONSTRUCTION KIT

Digi-Comp is a complete mechanical equivalent of a giant electronic brain, designed so that you can see just what it is that makes a computer function. Digi-Comp calculates, solves problems and plays games, and is accompanied by an instruction and programming manual that explains binary methods and elementary logic in terms comprehensible to anyone who can count—primary school to Ph.D! Send 59/11 or for details to:

I-COR SYSTEMS (Plastics Division)
18 STAMFORD HILL, LONDON, N.16

CRACKLE PAINT. Black or Grey, 1/2 pint tins 4/-, post 6d. from the component specialists. SERVIO RADIO, 156-8 Merton Road, Wimbledon, London, S.W.19.

HAMMERITE

HAMMER PATTERN BRUSH PAINT FOR PANELS, METALWORK
3/6 TIN • JUST BRUSH ON •
WITHSTANDS 150°C., OIL, WATER, Etc.
24 oz. tins 3/6 1 gallon 35/-
1 pint 7/6 1 gallon 58/-
1 pint 15/- (* sent by road)
Carriage: Orders up to 5/-, 9d; up to 10/-, 1/9; over 10/-, 3/-. Colours: Blue, Silver, Black or Bronze. Return of post service, Monday to Friday. From your component shop or direct from the manufacturer:
FINNIGAN SPECIALITY PAINTS (PE)
Mickleby Square, Stockfield, Northumberland
Tel. Stockfield 2280

Exciting new illustrated catalogue, no. 17. Government and manufacturers' surplus electronic equipment. Also a large selection of new miniature components and semiconductors. Ready end of January. Send for your copy NOW. 3/- Post Free. ARTHUR BALLIS, Radio Control Ltd., 93 North Road, Brighton.

FOR SALE (continued)

MANUFACTURERS' varied surplus, experimenters send for list. HATFIELD, 7 St. George Bungalow, Hildenborough, Kent.

SEMICONDUCTORS, electrolytics, switches, relays, etc. Also ex G.P.O. and computer gear—relays, selectors, pulse-counters, etc. New or ex-equip. All good stuff! S.A.E. list. D. SMITH (ELECTRONICS), 339 Bath Road, Kettering, Northants.

ELECTRIC SOLDERING IRON



FANTASTIC BARGAIN OFFER ONLY

Lightweight Pistol Grip handle, 40 watt, 240 - 250v. A.C. detachable handle forms cover for iron when not in use. With 4ft. Safety 3-core flex. Indispensable for every home handyman. A boon to model makers and a necessity for every electronics enthusiast. Offered to you at this new amazing price.

10/-

POST FREE

C. H. SERVICE (Dept. PE)
Lusted Hall Lane, Tatsfield, Kent.

TIME SWITCHES reconditioned 14 day clock once on once off every 24 hours, fully guaranteed, Vener, 15 amp. 37/6. 5 amp. with Horstmann clock, 32/6. P. & P. 4/6. A. R. BATCHELOR (P.E. Dept.), 4 Park Road, Bromley, Kent.

FOR SALE. Oscilloscopes — Galvanometers — Evershed & Vignolles Meggers. Also other items and components. Free list. Stamp please. R. & E. MART, Box 9, G.P.O., Tunbridge Wells, Kent.

MORSE EASY!

The Famous RHYTHM RECORDED COURSE cut the practice time down to an absolute minimum. One student, aged 20, took only 13 DAYS, and another, aged 89, took under a week to read 18 wpm. If you wish to read Morse easily and naturally please enclose 8d. in stamps or two international reply coupons for full explanatory leaflet to: G3CHS/H. 45 Green Lane, Purley, Surrey. UPLands 2896

RECEIVERS AND COMPONENTS

Very good general purpose transistors, type GET3, perfect for switching, multi-vibrators, etc. Sample 1/-. Makers sealed pack of 10, 8/6. Silicon rectifiers. 50. p/v. 1.5A. 400. p/v. 0.75A, 2/6. 12V 5%. I.W. zeners, 3/6. J. COOPER, Outwell, Wisbech, Cambs.

RECEIVERS AND COMPONENTS

(continued)

REPANCO Transistor Coils and Transformer. for the Constructor. Send stamp for lists **RADIO EXPERIMENTAL PRODUCTS LTD.**, 33 Much Park Street, Coventry.

R. & R. RADIO & TV SERVICE

Dept. P.E.

44 Market Street, Bacup, Lancs. Tel. 465

Salvage Valves	Good Emission	Guaranteed
EF80 1/6	30P4 7/-	30FL1 5/-
ECC82 3/6	EB91 1/-	U801 7/6
ECL80 3/6	EF85 5/-	PL82 4/6
30F5 5/-	30PL1 5/-	PL36 7/-
PCF80 4/-	EY86 4/-	PCC84 4/6
PL81 5/-	6U4GT 5/-	PY81 3/6
PZ30 5/-	PY33 6/-	U301 6/-

SPEAKERS Ex TV 3 ohm imp, 5" Rnd. and 6" x 4" 3/6. 8" Rnd. 6/- Post 2/6.

BY100, Rectifiers complete with 10 watt var. 6/- Post 6d. Fireball Tuners, less cover cans 9/- post paid.

Video, printed circuit panels, ideal for stripping 5/6. Post 1/6, 5 for £1 post paid.
TV Tubes from £1, callers only.

Line output transformers, Scan coils, tuners, etc. S.A.E. for prompt reply.

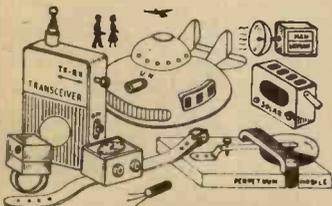
POLYSTYRENE CAPACITORS 350v. 680, 821, 1800, 2200, 2700, 5600, 6800, 0.018, 0.022, 0.033. 125v. 1000, 1200, 1500, 1800, 3300, 3900, 4700, 8200, 0.01, 0.012, 0.015. 2/- doz. any selection. Transistors, 1/6 XA143 pnp germanium 75 megs. 2/- 2N377 npn germanium equiv. OC139. 3/6 planar silicon npn 200-300 megs, 2N706A, 2N743, 2N753, 2N916, BSY18, BSY26, BSY28, BSY29, BSY65, BSY95A. Computer boards, two types average 30 planar epitaxial transistors, 27708 or equiv. 300 megs. 30 diodes, Histab resistors. 19/6 each. Minimum order 5/- Post 1/- **NEW CROSS RADIO**, 6 Oldham Rd., Manchester.

EXPERIMENTER'S PRINTED CIRCUIT KIT

The Kit contains 4 copper laminate boards to suit the designs enclosed and all chemicals required for etching. 16-page Etching Manual "PRINTED CIRCUITS FOR AMATEURS." 2 miniature radio diodes. . . also free with each kit. . . Essential Design Data, Circuits, Layouts, Chassis Plans, etc. for building.

30 SUGGESTED PROJECTS

Latest very efficient electronic designs you probably haven't heard of yet . . .



. . . including 4 crystal sets, 4 Amplifiers, 2 Intercoms, 4 Pocket Loudspeaker Radios, Triple Reflex with self-adjusting regeneration, Bacteria-Resistant Radio, Matchbox Radio, Radio Control Receiver, Control of models by induction (not radio), Human Body Radiation Detector, Efficient Burglar Alarm, Man/Woman Discriminator, Perpetual Motion Machine, 3 **SUBMINIATURE RADIO DESIGNS**, smaller than anything so far published anywhere in the World, Ring Radio, Wrist-Watch Radio, Postage Stamp Radio, Thermal Proximity Fuse, Pocket Transceiver for 10m band (licence required), Transistor Tester, Light-Seeking Robot, etc. etc. Price of kit: 8/6. Post & Packing 1/6. Send S.A.E. for Details, Photographs.

"YORK ELECTRICS"

181a York Rd., London, S.W.11

RECEIVERS AND COMPONENTS

(continued)

ECONOMY SEMICONDUCTORS

New Ceramic Transistors made in U.S.A.
CS2926 red B55-110 3/6. Silicon Planar.
CS2926 orange B90-180 3/9. 120 Mc/s ft. typ.
CS2926 yellow B150-300 4/-. 18V 300mW max
CS2926 green B235-470 4/9. Low noise NPN.

Ultra High Gain Ceramics, U.S.A.

6645 red B250-550 3/6. Silicon Planar.
6645 blue B500-1000 4/3. 15V 300mW NPN.

Medium Power Silicon Planar

2N3053 NPN 60V, 1W max, 100 Mc/s ft. min. 11/6.
40319 PNP 40V, 1W max, 100 Mc/s ft. min. 15/6.
These are 2W max. with heat sinks, 9d. each.

High Power H.F. Silicon Planar, NPN

2N3054 16W @ 100°C case, 90V, 4A, 25 Mc/s ft. typ. 26/-. CP407 15W @ 75°C case, 60V, 10A, 100 Mc/s ft. min. 56/3.

High Power Silicon NPN

2N3055 65W @ 100°C case, 100V, 15A max. 22/9. 40250 16W @ 100°C case. 50V, 4A max. 17/-.

Germanium Low Power

2N1304 NPN } 20V 15W max. high gain
2N1305 NPN } B120 typical 4/3 each.

Germanium High Power PNP

NKT401 90V, 10A max. B15-45 @ 6A, 50W, 17/-.
NKT403 80V, 10A max. B50-150 @ 1A, 50W, 16/3.
2N3731 300Vpk, 6A max. B15 min. @ 6A, 5W, 19/6.

Complementary Matched Pairs

2N1304/2N1305, 9/- 2N2926/2N3702, 9/-
2N3705/2N3702, 11/2 2N3053/40319, 27/6

Reduced prices:

BC107 45V, B125-500 7/-.
BC108 20V, B125-500 6/3.
BC109 20V, B240-900 (low noise) 7/3. Resistors 1W 5% carbon film 2/3 doz. 17/3 100. Skeleton presets 100Ω to 10MΩ.
Horizontal or vertical mounting 1/-. Disc ceramics, 50V, 0.1 5d., 0.2, 0.5 6d.

Clr-Kit, kit including board 15/-

Extra sheet, strip, boards available.
All semiconductor of Texas, IR, Newmarket, SGS Fairchild, Hughes, STC available.
Discount of 10% on orders over £3. Catalogue 6d.

ELECTROVALVE

6 Mansfield Place, Ascot, Berkshire

SPECIAL OFFER

1 Watt S.T.C. 300 MC/S N.P.N. Silicon Planar. Transistors. With data. Limited Stocks. £1 for 6.

3/- each. OC44, OC45, OC70, OC71, OC81, OC81D, OC200, Get 16, Get 20.

4/- each. AF114, AF115, AF116, AF117, OC170, OC171.

5/- each. OC139, OC140, Get 7, Get 8, Get 9, XCI41, BY100, OA211.

ZENER DIODES

3.9v. to 26 volt, 1/4w. 3/6 each, 1.5w. 5/-, 7w. 6/- each.

Send 6d. for full lists: inc. S.C.R. Zeners.

BSY 27, 7/6 each. OC20, 10/- each.

Cursons
78 Broad Street
Canterbury
Kent

RECEIVERS AND COMPONENTS

(continued)

COMPONENTS, VALVES, TRANSISTORS, etc. Call or send 6d. for list. **ROGERS**, 31 Nelson Street, Southport.

FIRST GRADE SEMICONDUCTORS

Silicon F.E.T's N-2N3819 25/-; P-2N3820 25/-
U.J.T. BEN3000/T1543 to trigger SCRs @ 13/-
SCR 2N3529 400PRV.2A.RMS @ Tfr/25C 22/6
SCR 2N3525 400PRV.5A.RMS @ Tfr/75C 25/-
SCR C22D 400PRV.7.4A.RMS @ Tfr/80C 35/-
2N3702 5/6; 2N3704 5/6; 2N1663 12/6; OC83 5/6;
2N2926 ALL TYPES 4/-; 2N1055 22/6

MILLTROCK

1 Ullswater Road, Leverstock Green
Hemel Hempstead, Hertfordshire
C.W.O. Post Free. S.A.E. List Mail Order Only

SPECIALISTS IN ELECTRONIC, professional quality components. Any odd item can be obtained in three days. **VAN BEK ELECTRONICS**, 12 Market Street, Altrincham. ALT 6966.



COMPONENTS

- * ASSORTED TRANSISTORS—6 Tested A.F. Devices 9/6
- * ASSORTED RESISTORS—Hi-Stab. 300 off (5% $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$ watt, worth £3) 15/-
- * SELECTED COMPONENTS—Over 100 Hi-Stabs., Capacitors, Pots, Rectifiers, Switches, etc. 10/-
- * TRANSISTORS—Matched Output Kit: OC81D and 2-OC81 9/6
R.F. Kit: OC44 and 2-OC45 9/6
OC44, 45, 70, 71, 72, 81 and 81D Equivalent, each 3/-
- * GRAMOPHONE AMPLIFIER—Guaranteed, $\frac{1}{2}$ watt, for 8 ohm speaker, 9 v. supply 19/-

(P. & P. 1/6 per order, C.W.O.)

ELMBRIDGE INSTRUMENTS LTD.
Island Farm Avenue, West Molesey, Surrey

FAMOUS TRANS/RECEIVER



Covers 2-4.5, 4.5-8 Mc/s. (150-37 metres) in two bands. 230/250v. A.C. Mains. 11 valve superhet receiver and transmitter designed for voice and C.W. Incorporates test and tuning 500 μ A meter for voltages, aerial loading and current tests.



Panel controls Freq.P.A. Tuning Gain MCW, CW RT. Het Tone, Netting, On/Off Quench, Aerial, AVC, LT-HT Tests. Supplied complete. Fully tested and working. Price £12.10.0. Carr. £1.0.0.

RCA AR88D. RECEIVER (Brand New)
Freq. 540 Kc/s—32 Mc/s. 6 waveband. Mechanical Band spread with Logging scale. Auto and Man. Vol. control, ditto Noise Limiter, EFO, Pitch and Var. HF Tone control, RF & AF Gain, Var. selectivity with Crystal Filter. Complete with Instructions/ Service Manual, £70. USED MODEL Fully tested and working £45. Carr. £2 on each.

NATIONAL H.R.O. SENIOR RECEIVERS 5T MODEL



In excellent tested condition. Complete with 9 coils 50 Kc/s-30 Mc/s and P-wer Unit. £31.10.0. Carr. 30/-.

32 ft. TELESCOPIC AERIAL MASTS
Comprising 20 ft. 4 section tubular steel telescopic mast and 12 ft. folding whip; Can be erected in less than 5 minutes. Closes to 5ft. 9 in. Weight 21 lbs. Must have cost well over £20. Price 67/6. Carr. 7/6.

ROTARY TRANSFORMER. 12v. D.C. input, 250v. D.C. output at 125 mA. Size 3 1/2 x 5 1/2 in. Brand new 17/6. P. & P. 5/-.

ALL 19 SETS AND PARTS AVAILABLE
Complete list of other bargains, 1/- S.A.E. all enquiries. Credit Terms Available.

A. J. THOMPSON (Dept. P.E.)
"EILING LODGE," CODICOTE, HITCHIN, HERTS.
Phone: CODICOTE 242

TAPE RECORDERS, TAPES, ETC.

TAPES TO DISC—using finest professional equipment—45 r.p.m. 18". S.A.E. leaflet. DEROY, High Bank, Hawk Street, Carniforth, Laucs.

BOOKS AND PUBLICATIONS

SURPLUS HANDBOOKS

19 set Circuit and Notes 4/6 P.P. 6d
 1155 set Circuit and Notes 4/6 P.P. 6d
 H.R.O. Technical Instructions ... 3/6 P.P. 6d
 38 set Technical Instructions ... 3/6 P.P. 6d
 46 set Working Instructions ... 3/6 P.P. 6d
 88 set Technical Instructions ... 5/- P.P. 6d
 BC. 221 Circuit and Notes 3/6 P.P. 6d
 Wavemeter Class D Tech. Instr. 3/6 P.P. 6d
 18 set Circuit and Notes 3/6 P.P. 6d
 BC.1000 (31 set) Circuit & Notes 3/6 P.P. 6d
 CR.100/B.28 Circuit and Notes ... 8/6 P.P. 9d
 R.107 Circuit and Notes 5/- P.P. 6d
 A.R.88D. Instruction Manual .. 15/- P.P. 1/6
 52 set Circuit and Notes 4/6 P.P. 6d
 52 set Sender & Receiver Circuits 6/- post free
 Circuit Diagrams 3/- each post free.
 R.1116/A, R.1224/A, R.1355, R.F. 24, 25, & 26.
 A.1134, T.1154, CR.300, BC.342, BC.312.
 BC.348, J.E.M.P. BC.624, 22 set.
 Resistor colour code indicator 1/6 P.P. 6d.
 S.A.E. with all enquiries please.
 Postage rates apply to U.K. only.

Mail order only to:
Instructional Handbook Supplies
Dept. P.E., Talbot House, 28 Talbot Gardens
Leeds 8

EDUCATIONAL

ELECTRONIC EXPERIMENTS. The practical way of mastering electronics. Complete experiment kits with instructions, components, circuits, tabulation and graph sheets, etc. Write for FREE booklet. **ELECTRONIC EXPERIMENTS**, 49 Heath Lane, Brinklow, Rugby.

HOME STUDY COURSES in Practical Electronics. Free Brochure without obligation from: **BRITISH NATIONAL RADIO SCHOOL**, Reading, Berks.

TELEVISION SERVICING RADIOTELEGRAPHY RADAR MAINTENANCE

Full and Part-time Training Courses

Apply:—Director, British School of Telegraphy, 20 Penywern Road, Earls Court, London, S.W.5

ALDERMASTON COURT POSTAL TRAINING for B.Sc. (Eng.) Part 1, A.M.I.E.R.E., A.M.S.E., City & Guilds, G.C.E., etc. prepares you privately for high pay and security as Technician or Technologist. Thousands of passes. For details of Exams and Courses in all branches of Engineering, Building, Electronics, etc. (including latest information on C.Eng.), write for 132-page Handbook—FREE. Please state interest. **BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY**, (Dept. 125K), Aldermaston Court, Aldermaston, Berks.

STUDY RADIO, TELEVISION & ELECTRONICS with the world's largest home-study organisation. I.E.R.E., City & Guilds, R.T.E.B., etc. Also practical courses with equipment. All books supplied. Write for FREE prospectus stating subject to I.C.S. Intertext House, Parkgate Road (Dept. 577), London, S.W.11.

EDUCATIONAL

(continued)

A.M.S.E. (Elec.), City & Guilds, G.C.E., etc., on "Satisfaction or Refund of Fee" terms. Wide range of Home Study Courses in Electronics, Computers, Radio, T.V., etc. 132-page Guide—FREE. Please state subject of interest. **BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY** (Dept. 124K), Aldermaston Court, Aldermaston, Berks.

CHAMBERS GUIDE (New). Details of 293 Careers and spare-time Business, Technical and Examination Courses. A Mine of friendly "know-how" for go-aheads. For free copy write—**CHAMBERS COLLEGE** (Dept. 856K), 148 Holborn, E.C.1.

SITUATIONS VACANT

OPTECH ELECTRONICS

requires keen young men (16-25) to assist with production and test of modern solid state equipment. Instrument fitters also required.

Please contact

Mr. GREENBAUM

OPTECH ELECTRONICS

7a THOROLD RD., BOUNDS GREEN, N.22

Phone 01-889; 1609 (24-hour service)

SITUATIONS VACANT

(continued)

RADIO TECHNICIANS

A number of suitably qualified candidates are required for permanent and pensionable employment (mostly in Cheltenham, but from time to time there are some vacancies in other parts of the U.K. including London). There are also opportunities for service abroad.

Applicants must be 19 or over and be familiar with the use of Test Gear, and have had practical Radio/Electronic workshop experience. Preference will be given to candidates who can offer "O" Level GCE passes in English Language, Maths and/or Physics, or hold the City and Guilds Telecommunications Technician Intermediate Certificate or equivalent technical qualifications.

Pay according to age, e.g. at 19—£747, at 25—£962 (highest age pay on entry) rising by four annual increments to £1,104.

Prospects of promotion to grades in salary range £1,032—£1,691. There are a few posts carrying higher salaries.

Annual Leave allowance of 3 weeks 3 days, rising to 4 weeks 2 days. Normal Civil Service sick leave regulations apply.

Application forms available from:

Recruitment Officer (RT)
Government Communications Headquarters
Oakley
Priors Road
CHELTENHAM, Glos.

TECHNICAL TRAINING by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

First-class opportunities in Radio and Electronics await the ICS trained man. Let ICS train YOU for a well-paid post in this expanding field.

ICS courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

- INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS.
- C. & G. TELECOMMUNICATION TECHNICIANS' CERTS.
- C. & G. SUPPLEMENTARY STUDIES.
- R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.
- RADIO AMATEURS' EXAMINATION.
- P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.

Examination Students Coached until Successful.

NEW SELF-BUILD RADIO COURSES.

Build your own 5-valve receiver, transistor portable, signal generator and multi-meter—all under expert tuition.

POST THIS COUPON TODAY and find out how ICS can help YOU in your career. Full details of ICS courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES.

INTERNATIONAL CORRESPONDENCE SCHOOLS

A WHOLE WORLD
OF KNOWLEDGE
AWAITS YOU!

International Correspondence Schools
(Dept. 152), Intertext House, Parkgate Road,
London, S.W.11.

NAME

Block Capitals Please

ADDRESS

3.67

RADIONIC

RADIO & ELECTRONIC CONSTRUCTION SYSTEM

ABSORBING AND EXCITING!

Unique and brilliantly simple. Hundreds of educational establishments—Universities, Technical Colleges, Schools, the Armed Forces—are already using Radionic for electronic instruction. Enthusiastic owners range from 9 to 82 years of age.

Selected by the Council of Industrial Design for all British Design Centres. Featured in Sound and Television broadcasts.

The system is beautifully engineered from top quality British components. No soldering. No mains. No prior knowledge needed. Simply arrange components on perforated transparent panel, position brass connecting strip underneath, fix with 6BA nuts and circuit works with full efficiency. You can then dismantle and build another circuit. Your results are guaranteed by our Technical Department and News Letter Service. All parts available separately for conversion or expansion of sets.

UNIQUE! Our "No soldering" printed circuit board for superhet portable. Simply insert components and tighten nuts.

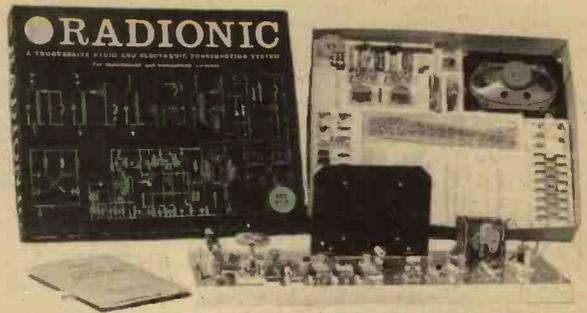
- No. 1 Set £5.18.6. 14 Circuits (Earphone)
 - No. 2 Set £6.19.6. 20 Circuits (Earphone)
 - No. 3 Set £10.19.6. 22 Circuits (7 x 4in. Loudspeaker output)
 - No. 4 Set £14.19.6. 26 Circuits (include 6 Transistor and reflex superhets)
- Prices (Post Free)
- (PLUS: P.T. Surcharge of 1/8d; 1/11d; 3/1d; 4/2d, respectively.)

Full details from:

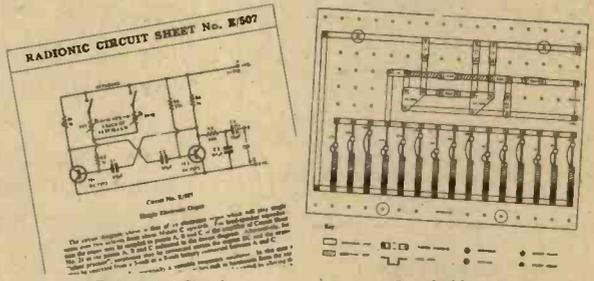
RADIONIC PRODUCTS LIMITED STEPHENSON WAY, THREE BRIDGES CRAWLEY, SUSSEX

Tel.: CRAWLEY 27028

Trade Enquiries Invited



A No. 4 SET and 6-TRANSISTOR SUPERHET



Theoretical Circuit Practical Layout

Our 'E' Series of basic electronic circuits is available separately. Send for details of E/508, our do-it-yourself computer.

COMPARE THESE PRICES

ELECTROLYTIC CONDENSERS

64uf. ..2.5V.	5uf. ..6V.	30uf. ..10V.	750uf. ..18V.
125uf. ..2.5V.	20uf. ..6V.	3uf. ..12V.	2.5uf. ..25V.
640uf. ..2.5V.	25uf. ..6V.	4uf. ..12V.	3uf. ..25V.
0.25uf. ..3V.	30uf. ..6V.	25uf. ..12V.	4uf. ..25V.
2uf. ..3V.	50uf. ..6V.	200uf. ..12V.	10uf. ..25V.
40uf. ..3V.	100uf. ..6V.	2.5uf. ..16V.	25uf. ..25V.
4uf. ..4V.	3.2uf. ..6-4V.	64uf. ..16V.	12.5uf. ..40V.
500uf. ..4V.	40uf. ..6-4V.	200uf. ..16V.	3.2uf. ..64V.

All at 1/- each, 9/- per dozen or mixed packet (our selection) 20 for 10/-, 150uf., 25V.; 400uf., 25V.; 2/6 each, 5,000uf., 12V., 4/- each, 200/100, 275V.; 200/200, 275V.; 125/300/50, 275V.; 5/- each, 3 for 10/-.

PAPER CONDENSERS. SPECIAL CLEARANCE!
0.35uf., 150V.; 0.02uf., 350V.; A.C. 0.25uf., 350V.; 0.5uf., 350V.; 0.5uf., 500 V.; ALL at 15/- per 100.

Mixed packet containing 0.001uf., 200V. to 0.5uf., 500V. Very useful for service work! 50 condensers for 10/-.

RESISTORS

1/2 watt, well assorted values, 10/- per 100, 55/- per 1,000.
1/4 watt to 3 watt, well assorted values, 10/- per 100, 55/- per 1,000.
TO CLEAR: 10 Meg. 1/6th watt resistors—to clear £1 per 1,000.

TRANSISTORS

Untested mixed, 50 for 10/-.
PNP Switching transistors; Min. 200 m/cs. 6 for 10/-.
PNP Switching transistors; Min. 200 m/cs. 6 for 10/-.

DIODES

- Suitable for keying electronic organs, 20 for 10/-.
- 8Y100 type rectifiers, 30/- per dozen.
- ORP12 light cells, 9/- each.
- TRANSISTOR BATTERY ELIMINATOR—same size as PP9, 30/-, PP6, 6/-.
- BATTERY CHARGERS with meter, 4 amp, 6 or 12 V, 55/-.
- LABEL MICROPHONES, crystal or magnetic, 10/- each.
- MINIATURE EARPIECES, complete with plug and lead, 5/- each.
- SIGNAL INJECTOR, parts and circuit to make, 10/- each.
- SIGNAL TRACER, parts and circuit to make, 10/- each.
- MOTOR CAR REV. COUNTER, parts and circuit to make, 10/- each.
- PORTABLE RADIOS, complete with leather case, earpiece, etc., fully guaranteed, 79/6 complete.
- ACOS PICK-UP HEADS, Mono, 10/-, Stereo, 12/6, Diamond, 17/6.
- SAPPHIRE STYLUS, TC8LP; GC2LP; GC8LP; BF40LP; GP67LP; TC8 Stereo LP; Studio OLP; GP37; GP59; ALL AT 3/6 each.
- POTENTIOMETERS—PRE-SET, 100 ohm to 680 K. ohm, 12 tor 10/- (mixed)
- MAGNETIC RECORDING TAPE, BRITISH MADE, FULLY GUARANTEED

STANDARD PLAY

3in., 150 ft., 3/6; 5in., 600 ft., 10/6; 5 1/2in., 900 ft., 13/6; 7in., 1,200 ft., 16/3.

LONG PLAY

3in., 225 ft., 4/-; 5in., 900 ft., 12/9; 5 1/2in., 1,200 ft., 15/9; 7in., 1,800 ft., 21/6.

DOUBLE PLAY

3in., 400 ft., 6/6; 5in., 1,200 ft., 20/-; 5 1/2in., 1,800 ft., 28/-; 7in., 2,400 ft., 34/-; 2 1/2in., 300 ft., 6/9.

TRIPLE PLAY, POLYESTER

- 3in., 600 ft., 12/6; 4in., 900 ft., 16/6.
- WELLER INSTANT HEAT-SOLDERING KIT, 72/6 complete.
- WELLER DUAL-HEAT SOLDERING GUN, only 57/6 complete.
- PISTOL GRIP SOLDERING IRON ONLY, 10/-.
- PHILIPS/STELLA/COSSOR remote control unit, value 3 gns., our price, 10/-.
- RUMBLE AND SCRATCH FILTER, parts and circuit to make, 30/-.
- TRANSISTORS, COMPONENTS AND CIRCUIT to convert 1ma. meter to 0 to 10 Meg. ohmmeter, 10/-.

G. F. MILWARD

17 PEEL CLOSE, DRAYTON BASSETT, NR. TAMWORTH, STAFFS.
TAMWORTH 2321

POST ONLY

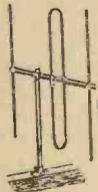
Due to recent heavy increase in parcel rates, please include part postage cost.

NEW RANGE U.H.F. AERIALS FOR BBC 2 (625) line transmissions

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.

Loft Mounting Arrays, 7 element, 35/-, 11 element, 42/6. 14 element, 50/-, 18 element, 57/6. **Wall Mounting with Cranked Arm**, 7 element, 60/-, 11 element, 67/-, 14 element, 75/-, 18 element, 82/6. **Mast Mounting with 2in. clamp**, 7 element, 42/6; 11 element, 55/-; 14 element, 62/-; 18 element, 70/-. **Chimney Mounting Arrays, Complete**, 7 element, 72/6; 11 element, 80/-; 14 element, 87/6; 18 element, 95/-. Complete assembly instructions with every unit. **Low Loss Cable**, 1/8 yd. U.H.F. Pre-amps from 75/-. State clearly channel number required on all orders.

BBC · ITV · F.M. AERIALS



BBC (Band 1), Telescopic loft, 21/-. External S/D, 30/-. "H", £2.10.0.

ITV (Band 3), 3 element loft array, 25/-. 5 element, 35/-. Wall mounting, 3 element, 35/-. 5 element, 45/-.

Combined BBC/ITV, Loft 1+3, 41/3; 1+5, 48/9; Wall mounting 1+3, 56/3; 1+5, 63/9; Chimney 1+3, 63/9; 1+5, 71/3. **VHF** transistor pre-amps from 75/-.

F.M. (Band 2), Loft S/D, 12/6. "H", 30/-. 3 element, 52/6. External units available. Co-ax. cable, 8d. yd. Co-ax. plugs, 1/3. Outlet boxes, 4/6. Diplexer Crossover Boxes, 12/6. C.W.O. or C.O.D. P. & P. 5/-. Send 6d. stamps for illustrated lists. **Quotations for special arrays available on request**

K.V.A. ELECTRONICS (Dept. 2)

27 Central Parade, New Addington
Surrey
LOD 2246

FIRST-CLASS RADIO AND T/V COURSES...

GET A CERTIFICATE!

After brief, intensely interesting study—undertaken at home in your spare time—**YOU** can secure a recognised qualification or extend your knowledge of Radio and T.V. Let us show you how:

FREE GUIDE

The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & C. Telecoms., A.M.I.E.R.E. Guide also gives details of range of diploma courses in Radio/T.V. Servicing Electronics and other branches of engineering, together with particulars of our remarkable Guarantee of

SUCCESS OR NO FEE

Write now for your copy of this invaluable publication. It may well prove to be the turning point in your career.

FOUNDED 1885—OVER 150,000 SUCCESSES

CHAMBERS COLLEGE

(Incorp. National Inst. of Engineering) (Dept. 850F)

148 HOLBORN

LONDON, E.C.1

Basic guides for the enthusiast — a new series in question and answer form:

Q. & A. ON AUDIO

Clement Brown

104 pages.

80 line diagrams.

Q. & A. ON ELECTRONICS

Clement Brown

112 pages.

60 line diagrams.

Q. & A. ON TRANSISTORS

Clement Brown

96 pages.

60 line diagrams.

Q. & A. ON RADIO AND TELEVISION

H. W. Hellyer

128 pages.

70 line diagrams.

each 8s. 6d.

from booksellers or 9s. 6d. by post from **GEORGE NEWNES, Tower House, Southampton Street, W.C.2**



SUPPLIERS OF ELECTRONIC EQUIPMENT TO...

- * UNIVERSITIES
- * COLLEGES OF TECHNOLOGY
- * COLLEGES OF FURTHER EDUCATION & SCHOOLS
- * ALL ENTHUSIASTS

USUAL SUPPLIERS TO MANY EDUCATION AUTHORITIES

Usual Educational Discounts

OUR NEW 1966/67 illustrated catalogue NOW AVAILABLE

(send 1/- in stamps for your copy)

INCLUDES

Valves, Transistors, Transformers, Loudspeakers, Recording Tape, Coils, Resistor, Condensers, Potentiometers, Chassis, Rectifiers, Test meters, Microphones, Tools, Solder, etc.

ALPHA RADIO SUPPLY CO.

103 Leeds Terrace
Wintoun Street, Leeds 7
Telephone 25187

ELECTRONICS GALORE!

IN THE NEW

dca CATALOGUE

THE CONVENIENT WAY TO SHOP FOR ALL YOUR ELECTRONIC NEEDS.

EVERYTHING FROM SINGLE COMPONENTS TO COMPLETE EQUIPMENT ALL AT BEST VALUE PRICES.

SEND 1/6d. NOW FOR YOUR COPY TO:—Dept. PE/3

dca ELECTRONICS LIMITED
28 UXBRIDGE ROAD, EALING, W.5

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 9v; 6v; 41v (single output) 39/6 each. P. & P. 2/9. 9v + 9v; 6v + 6v; or 41v + 41v (two separate outputs) 42/6 each. P. & P. 2/9. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.

R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 11 Oliver Road, London, E.17

HI-FI AMPLIFIERS—TRANSISTOR PACKS

Set of Fairchild Silicon Transistors and Diodes. Complete Circuit 8-10 W Type. AF10 30/-, 20 W Type. AF11 70/-.

HEAT SINKS—4 1/2" X 3" X 1" or 3 1/2" X 3" X 2 Fitted, Alacrom Finish. 1-2 Power Transistors. Undrilled 3/9 each. P.P. 6d.

FAIRCHILD ZENERS 250MW 15%, 6.9, 9.4, 12.7, 17.2, 23.2, 31 volts. 5/6 each.

HIGH STAB. RESISTORS 5% Preferred Values only 1/10, 1/2, 1 W. All 4d. each. P.P. 3d. per doz.

S.A.E. for Details of Silicon Transistors and Diodes.

All our Products have full maker's Guarantee.

VIBRAY MOULDINGS LTD.

3 Kings Road, Slough, Bucks.
Mail Order only

FOOTBALL POOL COMPUTER CIRCUIT and three other analogue circuits, 4/6.

DIGITAL COMPUTER CIRCUIT

A simple digital Adder/Subtractor using switches and lamps only. A fascinating demonstration of Binary arithmetic. Full circuit, wiring diagram and notes on the Binary system, 3/6.

NOUGHTS AND CROSSES MACHINE CIRCUIT. Uses standard miniature switches and lamps only. This machine cannot be beaten. Full circuit, wiring diagram and instructions, 3/6.

1% High Stability Resistors
1/2 watt 1%, 2/- each. Full range 10 ohms to 10 Meg. Stock List available.

1% Wirewound Resistors
1% 1 watt, 1 ohm to 5K, 3/8; to 20K, 4/6; 1/2 watt 3d. Your value would order.
300 Assorted 2 watt Resistors, 1% to 20%, 13/6.

PLANET INSTRUMENT CO.

26 (E) DOMINION AVENUE, LEEDS 7

Six afloat for £35

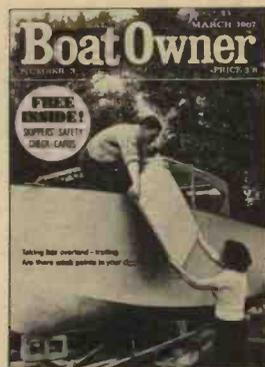


see how to build this boat yourself

She's designed for the utmost simplicity and cheapness . . . and is ideal for the enthusiast to build in time for summer. The March PRACTICAL BOAT OWNER shows how, with full constructional details and step-by-step diagrams.

- Also in the March Issue:*
- How to check the strength of your rigging
 - A practical guide to making masts and booms
 - The right way to tackle that paint job

PRACTICAL Boat Owner



MARCH ISSUE
OUT FEB. 22 - 3/6

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TAI

● Peak output in excess of 1 1/2 watts.

● All standard British components.

● Built on printed circuit panel, size 6 x 3in.

● Generous size Driver and Output Transformers.

● Output transformer tapped for 3 ohm and 15 ohm speakers.

● Transistors (GET 114 or S1 Mullard OC81D and matched pair of OC81 o/p).

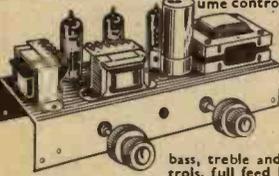
● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/- P. & P. 3/-. Also ready, built and tested, 52/6. P. & P. 3/-. A pair of TAIs are ideal for stereo.



STEREO AMPLIFIER

Incorporating 2 ECL86s and 1 EZ80, heavy duty double wound mains transformer. Output 4 watts per channel into 3 ohm speakers. Full tone and volume controls. Absolutely complete.



ONLY £4.19.6

P. & P. 6/6.

Super Deluxe version with ECL86 valves, sep.

bass, treble and balance controls, full feedback. 4 watts per channel into 3 ohm speakers. 8 gns. P. & P. 6/6.

WELL-KNOWN MAKERS' SURPLUS ONE TRANSISTOR PRE-AMP.

Suitable for use with Medium or High Impedance mikes, guitars, gram pickups, tape decks, etc. For operation from 200/200 volt H.T. rail or 9 volt battery. Gain approx. 14:1. Fully isolated input by Mu-Metal screened transformer. Size 4 1/2" x 1" x 1". Ready built complete with full circuit diagram and instructions. ONLY 15/-. Post free.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PCC84 and PCF80 valves 34-38 Mc/s IF. Biscuits for Channel 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P. & P. 3/9.

GÖRLER F.M. TUNER HEAD

88-100 Mc/s 10.7 Mc/s. I.F., 15/-, plus 2/- P. & P. (ECC85 valve, 8/6 extra).

TAPE DECKS

B.S.R. MONARDECK (Single speed) 3 1/2in. per sec., simple control, uses 5 1/2in. spools, £6/15/-.

LATEST COLLARO MAGNAVOX 363 TAPE DECK DE LUXE. Three speeds, 2 track, takes up to 7 in. spools. 10 gns. Plus 7/6 carr. and ins. on each. (Tapes extra on both.)

QUALITY PORTABLE TAPE RECORDER CASE. Brand new. Beautifully made. Few only at 49/6. P. & P. 5/-.

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, 18/6. P. & P. 1/6.

TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price, 18/6. P. & P. 1/6.

TWIN TELESCOPIC AERIAL. Two 3-section heavily chromed rods. Closed 12-in. each extending to 32 in. Completely adjustable. Universal mounting bracket, coax lead and plug. Ideal for F.M. or T.V. 12/6. P. & P. 2/6.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier was used in a 29 gn. record player, employs heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 2 1/2in. d. x 5 1/2in. h. Ready built and tested. PRICE 69/6. P. & P. 4/9.

ALSO AVAILABLE mounted on board with output transformer and 6in. speaker ready to fit into cabinet below. PRICE 89/6. P. & P. 5/9.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU/12 £39/6. Carr. 5/6.
GARRARD SP25 De Luxe... £10/10/0. Carr. 5/6.
B.S.R. GUT with unit mounted pickup arm. £4/18/8. Carr. 5/6.

AUTO. CHANGERS

Latest B.S.R. UA25 Super slim £6 2 6
GARRARD 1000 with special Hi-Fi cartridge £6 19 6
GARRARD AT60 £9/18. Carr. 6/6 on each.

All the above units are complete with t/o mono head and sapphire styli or can be supplied with compatible stereo head for 12/6 extra.

BRAND-NEW CARTRIDGE BARGAIN!

ACOS GP67-1. Mono complete. List price 21/-. Our price 13/6. P. & P. 1/-.

BRAND NEW. 12" 15w. H/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Offered below list price at 89/6. P. & P. 5/-. Guitar models: 25w. £5.5.0; 35w. £8.8.0.

BRAND NEW 3 OHM LOUDSPEAKERS

5 in., 12/6; 6 1/2 in., 15/-; 8 in., 21/-; 10 in., 25/-; 12 in., 31/-; 15 in., 36/-; 18 in., 42/-.

E.M.I. 8 in. x 5 in. with high flux ceramic magnet 3 ohm 23/6.

E.M.I. 1 1/2 x 8 in. with high flux ceramic magnet, 42/- (15 ohm, 45/-). P. & P. 4" x 5" 2/-, 6 1/2" x 8" 2/6, 10" x 12" 3/6 per speaker.

E.M.I. PLASTIC COMBINED TWEETER.

E.M.I. 3 ohm. Limited number: 12/6 each. P. & P. 1/6.

SPECIAL OFFER!

Limited number of 12 in. 10 watt "R.A." Speakers: 3 ohm 25/-; 15 ohm, 27/6. P. & P. 3/6.

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS

app. 54 in. wide. Usually 35/- yd., our price 13/6 per yd. length (min. 1yd.) P. & P. 2/6. S.A.E. for samples.

7-10 watt OUTPUT TRANSFORMERS

to match pair of ECL 86's in push-pull to 3 ohm output. ONLY 11/-, P. & P. 2/6.

MAINS TRANSFORMER for transistor power supplies. Tapped pri 200-250v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6-3v. at 5 amp for dial lamps etc. Drop thru mounting. Stack size 1 1/2" x 3 1/2" x 3 1/2". P. & P. 4/6.

MATCHED PAIR OF 2 1/2 WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS.

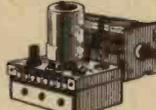
Stack size 1 1/2 x 1 1/2 x 1 in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/- P. & P.

SPECIAL OFFER! FM/AM TUNER HEAD

Beautifully designed and precision engineered by Dormer and Wadsworth Ltd. Supplied ready fitted with twin .0005 tuning condenser for AM connection.

Prefaligned FM section covers 86—102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-. Order quickly!

Limited number also available with precision geared 3:1 reduction drive. 30/- P. & P. 3/-.



3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2in. w. x 4in. d. x 4 1/2in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty double wound mains transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 6/-.

HSL 'FOUR' AMPLIFIER KIT

A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.

★ Heavy duty double-wound mains transformer with electrostatic screen.

★ Separate Bass, Treble and volume controls, giving fully variable boost and cut with minimum insertion loss.

★ Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor.

★ Suitable for use with guitar, microphone or record player.

★ Provision for remote mounting of controls or direct on chassis.

★ Chassis size only 7 1/2 in. wide x 4 in. deep. Overall height 4 1/2 in.

★ All components and valves are brand new.

★ Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success.

★ Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy). PRICE 79/6. P. & P. 6/-.

Comprehensive circuit diagram, practical layout and parts lists 2/6 (free with kit).

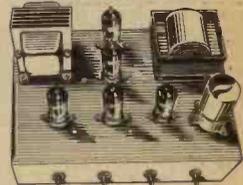
This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good life and cut. Valve line-up 2 EL84s, ECC83, EF86, and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.) All parts sold separately. ONLY £79/6. P. & P. 8/6.

Also available ready built and tested complete with std. input sockets, £93/5/- P. & P. 8/6. Carrying Case for above 28/6. P. & P. 7/6.

MATCHED PAIR AM/FM I.F.'s. Comprising 1st I.F. and 2nd I.F. discriminator. (465 Kc/s/10.7 Mc/s). Size 1" x 1 1/4" x 2 1/4" H. Will match FM/AM Tuner head on left. 11/- pair. P. & P. 2/-.



The most accurate pocket size CALCULATOR in the world

The 66 inch OTIS KING scales give you extra accuracy. Write today for free booklet, or send 75/- for this invaluable spiral slide rule on approval with money back guarantee if not satisfied.

CARBIC LTD. (Dept. PE9)
54 Dundonald Road, London, S.W.19



BUILD YOUR CIRCUITS on VEROBOARD

—the Universal Wiring Board— obtainable from your local Retailer

Relial enquiries to:
NORMAN ROSE (ELECTRICAL) LTD.
8 St. Chad's Place, Gray's Inn Road, London, W.C.1

Technical enquiries to:
VERO ELECTRONICS LTD., Chandler's Ford, Hants



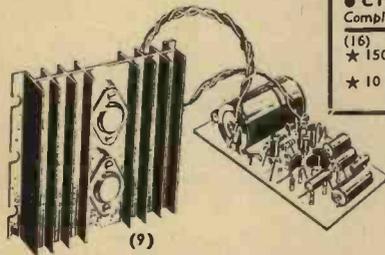
(14)



(12)



(10)



(9)

HENRY'S RADIO LTD.
303 EDGWARE RD., LONDON, W.2
PADDDINGTON 1008/9 (STD: 01-723 1008)
Open Mon. to Sat. 9-6. Thurs. 1 p.m.
Open all day Saturday

12 AND 20 WATT MONO AND STEREO TRANSISTOR AMPLIFIERS

(9) **POWER AMPLIFIERS.** 12 watts RMS output. 100mV input. 30 c/s to 20 kc/s \pm 1dB. 6-Transistor Push-pull. Panel size 4 X 2 1/2 X 1 in. H/S 4 X 4 in. Leaflet on request.
MPA10/3 3-5 ohm spkr. £4.10.0, p.p. 2/6
MPA10/15 8-16 ohm spkr. £5.5.0, p.p. 2/6
(Mains unit 1 or 2 amplifiers, 59/6, p.p. 2/6)

The Finest High Fidelity at Unbeatable Prices

25 WATT AMPLIFIER
8-Transistor design. Push-pull output for 7 1/2 to 16 ohm speaker. 150mV input. 30c/s to 20kc/s \pm 1dB. For use with valve or transistor pre-amplifiers as item (10) above.
PRICE BUILT AND TESTED £7.19.6 P.P. 3/-
(Mains unit 79/6, p.p. 2/6)

(13) **MULTI-METERS SCOPE**
PT34 1kV 59/6 EP30k 30kV £6.10.0
TP10 2kV 75/- EP50k 50kV £8.19.6
ITI-2 20kV 69/6 500 30kV £8.17.6
TP55 20kV £5.19.6 EP100k 100kV £10.10.0
* CT52 Scopes £22.10.0, p.p. 10/-
Complete range of test equipment in stock

(16) **NOMBREX TEST UNITS**
* 150 kc/s—350 mc/s RF Generator £10.10.0. All Transistor.
* 10 c/s—100 kc/s Transistor. £16.19.6 Audio Generator.

(15) **GARRARD BATTERY 2-SPEED TAPE DECK**

Brand New with R/P head, erase/osc. head, tape cassette. Specifications and osc. circuits. 2 speed 2-track 9 volt operated. List Price 13 gns.
PRICE £8.19.6 P. & P. 3/6

COMPONENTS AND EQUIPMENT. The largest range in the country. 8/6 buys 1967 200-page catalogue with discount vouchers.

(10) **PREAMPLIFIERS.** 8 input selector. Treble, bass, volume, filter, controls. 1 1/2 mV to 100mV inputs. Battery operated or from Mains Unit. Output up to 150mV. LEAFLETS ON REQUEST.

MP2 Mono 9 1/2 X 2 1/2 X 2 in. £5.10.0, p.p. 2/6 (grey and gold front panel 8/6).
SP4 Mono/Stereo. 9 X 3 1/2 X 1 1/2 in. £10.19.6, p.p. 3/6 (front panel plate 12/6)
* ALL UNITS BUILT AND TESTED

(12) **MW/LW QUALITY TRANSISTOR RADIO TUNER**

Fully tunable superhet with excellent sensitivity and selectivity. Output up to 1/2 volt peak. Complete with front panel, etc. 9 volt operated. For use with any amplifier or tape recorder.
TOTAL COST TO BUILD £3.19.6 P.P. 2/6

(14) **VHF FM TUNER**

Supplied as 2 Preamplifier Panels, plus metal work Superhet design, 88-108 Mc/s, 9 volt operated. 6 Mullard Transistors
Total cost to assemble £12.17.6, p.p. 2/6

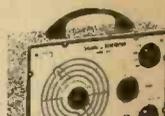
STABILISED POWER SUPPLY

Two outputs. 3.6 volt and 9.6 volt up to 250mA each. Transistorised and Zener stabilised. 110 to 250 volt mains input. In case with leads. PRICE 67/6, p.p. 2/6.

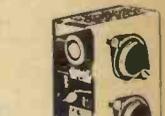
(17) **5 WATT AMPLIFIER**

6-Transistor Push-pull, 3 ohms. 6mV into 1K. 12/18V supply, 2 1/2 X 2 X 1 1/2 in.
BUILT AND TESTED 69/6 P.P. 2/-
(optional mains units 54/-)
1 1/2 watt version 59/6.
Matching Preamplifier, 6 inputs, treble/bass/selector/volume controls. 6-10mV o/p ut. 9-18V supply. 79/6, p.p. 2/-.
For use with any Transistor Amplifier LEAFLET ON REQUEST.

FMT41 FM TUNER. 6-transistor, 3 diode design. Completely built and tested £8.10.0 p.p. 2/-
(19) AMT31. Med. Wave Tuner. Built ready to use. 79/6, p.p. 2/-.



(16)



(17)



(13)



(15)

SEE BACK COVER FOR MORE ITEMS OF INTEREST

WENTWORTH RADIO

GENUINE HIGH QUALITY COMPONENTS
GENUINE LOW PRICES

NKT121	9/-	NKT227	8/6	OC70	5/-	AF115	4/6
NKT122	6/5	NKT228	4/4	OC71	2/6	AF116	4/6
NKT123	5/3	NKT261	3/6	OC72	2/6	AF117	2/6
NKT124	8/5	NKT262	3/6	OC74	6/-	AF118	6/-
NKT129	5/1	NKT263	3/6	OC75	5/-	AC127	6/6
NKT141	6/-	NKT264	3/6	OC77	3/-	AA120	6/-
NKT142	5/1	NKT265	3/6	OC78D	5/3	AC154	6/-
NKT143	5/-	NKT271	3/6	OC78	5/3	AC157	6/-
NKT162	4/11	NKT272	3/6	OC81D	2/6	AC165	6/-
NKT163/25	4/11	NKT273	3/6	OC81	2/6	AC176	6/-
NKT164/25	4/11	NKT274	3/6	OC170	3/-	AD140	10/-
NKT212	4/7	NKT275	3/6	OC171	6/-	AD161	10/-
NKT216	8/6	NKT676	4/4	OC172	4/6	AD162	10/-
NKT217	8/-	NKT713	6/6	OC200	3/6	OC35	10/-
NKT218	4/4	NKT773	5/-	OA91	2/-	OC36	10/-
NKT221	4/11	NKT774	5/-	OC201	10/6	OA70	2/-
OAB1	1/3	OA95	1/-	AF114	4/6	DK14	1/3

FULL RANGE TEXAS AND NEWMARKET TRANSISTORS. LISTS AVAILABLE. 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, 2M, 2.5M.

We welcome enquiries for all types of components. Lists. S.A.E. Terms, cash with order, P.P. add 9d. for orders under £2

1a Wentworth Court, Alston Road, Barnet, Herts

BAR 3087

MAT100 7/9 MAT121 8/6 PXA102 1/6 250mw ZENER
MAT101 8/6 GET573 12/6 XA102 1/6 DIODES
MAT120 7/9 PXA101 1/6 ORP12 9/3 4/- each
1/2 - 1/2V RESISTORS 10 - 22M 2d. 1/2W 10% 10 - 1M 6d.
MAGNETIC EARPIECES WITH LEAD ONLY 1/- each
MINIATURE TRANSISTOR ELECTROLYTICS FULL RANGE 1/2
JACKSON TUNERS 208-176pf with trimmers ONLY 7/6
HI-STABS 1% 1/2W 1/-
CERAMIC CONDENSERS 4d. 30/- per 100
SILVER MICA 10pf-1000pf 6d.
MINIATURE POTS. LIN. 2/-

BARGAIN OF THE MONTH
GENUINE MULLARD
TRANSISTORS
OC44 and OC45
ONLY 1/11 EACH
12 OR MORE POST FREE

YUKAN SO PROFESSIONAL THE YUKAN SELF-SPRAY
Get these AIR DRYING GREY **HAMMER** or BLACK **WRINKLE (CRACKLE)** Finishes

Yukan Aerosol spraykit contains 16 ozs. fine quality durable easy instant spray. No stove baking required. Hammers available in grey, blue, gold, bronze. Modern Eggshell Black Wrinkle (Crackle) all at 14/11 at our counter or 15/11, carriage paid, per push-button self-spray can. Also Durable, heat and water resistant Black Matt finish (12 ozs. self-spray cans only) 13/11 carriage paid.
SPECIAL OFFER: 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11, carriage paid. Choice of 13 self-spray plain colours and primer (Motor car quality) also available.

Please enclose cheque or P.O. for total amount to: YUKAN, Dept. PE/3, 307a Edgware Rd., London W.2. Open all day Saturday. Closed Thursday afternoons.

Other Yukan Air Drying Aerosols include:
Zinc Chromate Primer.
Clear Lacquer.
Anti-Tarnish Gold and Metallic Finishes.



YOU CAN AFFORD! AN INDIVIDUALLY MANUFACTURED

ENGRAVED FACIA PANEL

WE OFFER A COMPLETELY NEW SERVICE TO ELECTRONIC ENTHUSIASTS WHO WISH TO MAKE THEIR APPARATUS INDISTINGUISHABLE FROM THE MOST EXPENSIVE PROFESSIONALLY MADE EQUIPMENT.

FOR FREE QUOTATION AND FURTHER INFORMATION SEND S.A.E. AND WORKING DRAWING OF APERTURES AND WORDING REQUIRED TO:—

GREYMEI LTD., 34 PANCRAS RD., LONDON, N.W.1

VALUABLE NEW HANDBOOK FREE TO AMBITIOUS ENGINEERS

Have you had your copy of "Engineering Opportunities"?

The new edition of "ENGINEERING OPPORTUNITIES" is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new "ENGINEERING OPPORTUNITIES" should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

On 'SATISFACTION OR REFUND OF FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

ELECTRONIC ENG.

Advanced Electronic Eng.—
Gen. Electronic Eng.—
Applied Electronics—
Practical Electronics—
Radar Tech.—
Frequency Modulation—
Transistors.

ELECTRICAL ENG.

Advanced Electrical Eng.—
General Electrical Eng.—
Installations—
Draughtsmanship—
Illuminating Eng.—
Refrigeration—
Elem. Elec. Science—
Elec. Supply—
Mining Elec. Eng.

CIVIL ENG.

Advanced Civil Eng.—
General Civil Eng.—
Municipal Eng.—
Structural Eng.—
Sanitary Eng.—
Road Eng.—
Hydraulics—
Mining—
Water Supply—
Petrol Tech.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORKS STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power?
A.M.I.Mech.E., A.M.S.E., A.M.I.C.E., A.M.I.E.R.E., B.Sc.,
A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.Q.B., A.M.I.Chem.E., A.R.I.C.S.,
M.R.S.H., A.M.I.E.D., A.M.I.Mun.E., CITY & GUILDS, GEN. CERT. OF
EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

316A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE

THIS BOOK TELLS YOU

- ★ HOW to get a better paid, more interesting job.
- ★ HOW to qualify for rapid promotion.
- ★ HOW to put some letters after your name and become a key man . . . quickly and easily.
- ★ HOW to benefit from our free Advisory and Appointments Depts.
- ★ HOW you can take advantage of the chances you are now missing.
- ★ HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.

132 PAGES OF EXPERT
CAREER - GUIDANCE

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, Etc., A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Radio & Television Servicing Practical Electronics Electronics Engineering Automation

INCLUDING TOOLS

The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T.

You are bound to benefit from reading "ENGINEERING OPPORTUNITIES", and if you are earning less than £30 a week you should send for your copy now—FREE and without obligation.



POST NOW!

TO B.I.E.T., 316A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE.

3d. stamp if posted in an unsealed envelope.

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

NAME

ADDRESS

WRITE IF YOU PREFER NOT TO CUT THIS PAGE

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD



1967 CATALOGUE 200 PAGES PLUS!

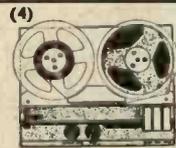
COMPLETELY NEW EDITION — HUNDREDS OF NEW LINES

● Contains the largest and most comprehensive range of components and equipment available. Over 5,000 stock lines with more data more stock lines. Information and illustrations. Hundreds of bargain lines. You cannot afford to be without a copy of this catalogue. Supersedes all previous editions.

● 5 FREE VOUCHERS
Total value 10/- for use on purchases. Pays for catalogue after use.



● Unbeatable value — 200 packed pages — 10/- value discount vouchers ●



MARRIOT TAPE HEADS
1/2 Track R/RP/3 Med z, 7/8. R/RP/1 High z, 8/-, R/RP/1 High z + R/E/1 erase on block, 19/8. 1/2 Track L/RP/8/12 High z, 15/-, L/RP/7 Med z, 19/8. L/ES/9 erase, 12/8. Also HR-RP single track Rec/Play Med z, 6/6

DEAC RECHARGEABLE BATTERY
● 9.6 volt 225mA/H ... 20/-, P.P. 1/6

DEAC CHARGER
To charge 3.6 volt and 9.6 volt packs. Fully mains isolated ... P.P. 45/-
In moulded case

(4) **BUILD A QUALITY 2 OR 4 TRACK TAPE RECORDER**
3-speed version using '363' decks
● **TWO-TRACK.** Deck £10.10.0. Martin Amplifier. £14.19.8. Cabinet and speaker 7 gns. Complete kits with FREE 7in. 1200ft. tape, spare spool. **27 gns.** P.P. 15/-
Today's Value £45.

● **FOUR-TRACK.** Deck £13.10.0. Martin Amplifier £15.19.8. Cabinet and speaker 7 gns. Complete kits with FREE 7in. 1200ft. tape, spare spool. **30 gns.** P.P. 15/-
Today's Value £50.

(6) **GARRARD DECKS — BRAND NEW FULLY GUARANTEED**

1000 mono	£5 19 8	SP25 stereo	£10 19 8	401 less cart./arm	£27 10 0
AT5 mono	£6 9 8	SP25 Deram	£13 19 8	AT6 mono Mk. II	£8 19 8
2000 mono	£8 19 8	AT60 less cart.	£10 19 8	AT6 stereo Mk. II	£9 10 0
2000 stereo	£8 19 8	AT60 mono	£11 10 0	AT6 Deram	£11 19 0
3000 1 in stereo	£7 19 8	AT60 stereo	£11 19 8	Deccadec Mk. II	£17 17 0
SP25 less cart.	£9 19 8	AT60 Deram	£14 19 8	A70 less cart.	£17 17 0
SP25 mono	£10 10 0	LAB80 less cart.	£25 0 0	(P. and P. 5/- any type)	

All other makes of decks and cartridge in stock

(7) **GLOBEMASTER MW/LW/SW PORTABLE RADIO TO BUILD**
Full 3-waveband tuning. Pushbutton wave-change. Superhet printed circuit design. Black-chromed cabinet 11 x 7 1/2 x 3 1/2in. (SW 17-50 metres). Ear/Record sockets. 1 watt Push/Pull output. 6 Mullard Transistors.
TOTAL COST £7.19.6 P.P. 3/6
TO BUILD

(8) **TOURMASTER TRANSISTOR CAR RADIO**
7-Transistor MW/LW Car Radio. 12 volt operated. 3 watt output. Push-button wave-change. RF stage. Supplied built, boxed, ready to use with Speaker and Baffle. Car fixing kit and manufacturer's current guarantee. Special Bargain Offer. Buy Now!
LIST PRICE 15 GNS. £9.90 P.P. 3/6

VALVE AMPLIFIERS AND TUNERS IN CABINETS
● SA100. 5 + 5 watt ● SA200. 7 1/2 + 7 1/2 watt ● AFM 100. AM/FM ● AFM 200. AM/FM Stereo. 300mV Input version. Also Input FM Tuners, PU's, etc. for Mag. Mic. Mag. etc. self-powered mains. **£30** P.P. 7/6
O/P4 to 16ohms. Mains PU's, etc. **£23.10.0** P.P. 5/- (AFM 100 and 200 may be used with any amplifier)

SUPPLIERS OF QUALITY COMPONENTS AND EQUIPMENT FOR MORE THAN 20 YEARS

12 and 25 watt Power Amplifiers and Preamplifiers

Britain's best selling and most reliable equipment. See page 240 for details. Handbook free on request.

TUNNEL DIODES
1mA 22/6; 5mA 15/-; 15mA 12/6. Brand new at fraction of normal price. Free Specs. supplied.

TRANSISTOR CATALOGUE
Completely new 24-page 1967 edition. Hundreds of new types with details. The largest range available with data, information, illustrations, etc. Send 1/- for your copy.

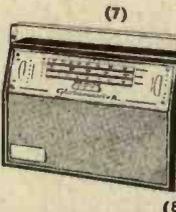
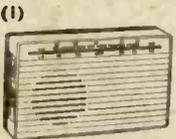
INVERTOR KITS
12 volt input. Output 230 volts, 50 c/a.
● 15 watt ... 67/6, P.P. 3/6
● 40 watt ... 87/6, P.P. 6/6

(1) **REGENT 6 MW/LW POCKET RADIO TO BUILD**
6-Transistor superhet. Geared tuning. Push-pull speaker output. Moulded cabinet 5 x 3 x 1 1/2ins. Phone socket.
TOTAL COST £9.6 P.P. 2/-
TO BUILD Full tuning on both bands

HI-FI EQUIPMENT from stock:
Complete range in stock. Send list of requirements for special price quote. Hi-fi demonstration room open.
ROGERS, TRUVOX, LEAK ETC.

WE CAN SUPPLY FROM STOCK MOST OF THE PARTS SPECIFIED ON CIRCUITS IN THIS MAGAZINE. SEND LIST FOR QUOTATION.
OR BETTER STILL—BUY THE NEW 1967 CATALOGUE. EVERYTHING YOU NEED IS AVAILABLE FROM STOCK.

HENRY'S RADIO LTD.
303 EDGWARE RD., LONDON, W.2
PA Ddington 1008/9 (STD 01-723 1008)
Open Mon. to Sat. 9-6. Thurs. 1 p.m.
Open all day Saturday

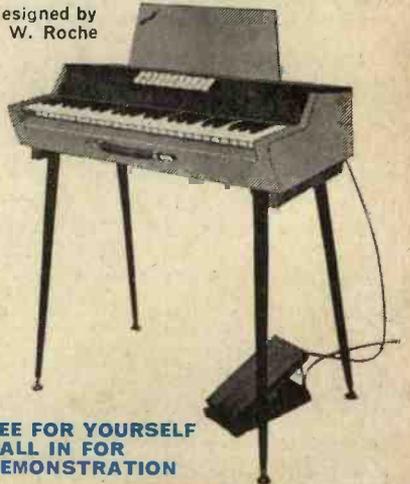


★ MAYFAIR PORTABLE ELECTRONIC ORGAN—ACCLAIMED BY EVERYONE!

Build the World's first All-Transistor Portable Electronic Organ Kit

Designed by L. W. Roche

● Plug-in printed circuits ● 170 transistors and devices ● 10 selected tone colours ● Fully sprung keyboard ● Vibrato ● 6 Octaves of generators ● Simple locked-in tuning ● 110/250 volt mains unit ● Cabinet size 30 1/2" x 15 1/2" x 9" ● Weight 35 lb. Cabinet with detachable legs, music stand and foot swell pedal ● Fully detailed building manual with photos, drawings and full circuits.



START BUILDING FOR AS LITTLE AS £5—BUILD THE MAYFAIR A SECTION AT A TIME

TO BUILD YOURSELF IN EASY STAGES ALL PARTS AVAILABLE SEPARATELY

- ★ COMPLETE KIT 99 GNS. (CARR. 30/-).
- ★ HP FACILITIES AVAILABLE.
- ★ COMPLETE RANGE OF ORGAN COMPONENTS IN STOCK.

Detailed leaflet on request (Handbook separately 20/-)

● SEE FOR YOURSELF CALL IN FOR DEMONSTRATION

SEE PAGE 140 FOR MORE ADVERTS